To:PG&E

From: Andrea Salazar, EMI Consulting

Date:December 30, 2016

RE:2016 PG&E Retail Products Platform (RPP) – Soundbar Laboratory Research Results

Introduction

The Pacific Gas and Electric Company (PG&E) submitted a workpaper for the Retail Products Platform (RPP) Program in December 2015. In its workpaper disposition the California Public Utilities Commission – Energy Division (CPUC-ED) identified the need for further research to support the unit energy savings (UES) values for soundbars.[[1]](#footnote-1),[[2]](#footnote-2) Resultantly, PG&E conducted lab testing of non-ENERGY STAR soundbars to measure modal power draw, default auto power down (APD) timing, and amplifier efficiency and determine if any models meet ENERGY STAR criteria. In this research effort, PG&E has partnered with Intertek, an EPA-certified third-party test lab, to test and meter soundbar models that are not ENERGY STAR certified.

The lab testing is being conducted because commission staff were concerned about the lack of data to support the assumption that non-ENERGY STAR models of products included in the RPP program (such as soundbars, air cleaners, and freezers) do not meet ENERGY STAR specification requirements. Staff stated that there needs to be evidence that non-ENERGY STAR products do, in fact, use more energy than ENERGY STAR products. In other words, a product that is not ENERGY STAR certified does not, by default, consume more energy than an ENERGY STAR product. It may be, for example, that ENERGY STAR certification was too costly for the manufacturer, but that the product meets ENERGY STAR requirements nonetheless.

The RPP program incents a portfolio of ENERGY STAR certified products that are sold by retailers to residential customers. Some of these products have federal energy efficiency regulations in place, and all such models are required to be tested to show compliance with federal standards. However, certain plug load devices such as soundbars and air cleaners are not federally regulated, so test data is only available for ENERGY STAR certified models. With limited data available for non-ENERGY STAR certified models, it is difficult to determine whether those models that have not been tested via the certification process have efficiencies below ENERGY STAR specifications. In the research described here, PG&E identified models of non-ENERGY STAR certified soundbars with high market share and tested them using the applicable ENERGY STAR test protocol. The testing provided key parameters such as power draw and determined whether the selected models meet ENERGY STAR requirements.

Research Questions/Objectives

This purpose of this research was to answer the questions:

* What is the power draw (by mode) of non-ENERGY STAR certified soundbars?
* Is the power draw for non-ENERGY STAR models substantially higher than ENERGY STAR certified models?
* Are there models of soundbars that have not been ENERGY STAR certified, but would meet ENERGY STAR specifications if they were tested?

Summary of Key Findings

* Average idle mode power draw[[3]](#footnote-3) of the non-ENERGY STAR models tested is 8.5 W (ENERGY STAR maximum ranges from 11 – 15 W for the products tested based on functionality and power output).
* Average sleep mode power draw of the non-ENERGY STAR models tested is 1.7 W (ENERGY STAR maximum ranges from 2 – 6 W for the products tested based on functionality).
* Seven of the twenty-three models tested meet all the ENERGY STAR specification requirements. Four models have inconclusive results.

Research Approach

PG&E contracted Intertek, an EPA-certified third-party test lab, to test and meter models selected by PG&E using the methodology discussed below.

Model Selection

At the time when this research began, the RPP program had access to 3 months of program sales data as well as 12 months of historical sales data from participating retailers in PG&E’s service territory. Due to the short life cycle of consumer electronic items such as sound bars (a model from last year may no longer be in stock), we decided to use only the most recent 3 months of program sales data for model selection. We sorted the list of non-ENERGY STAR sound bar models sold between March and May of 2016 by sales volume and selected the 23 top-selling models for those 3 months. 3 of those models were out of stock during the procurement phase of this research, so we instead replaced those with the next 3 top-selling models in the scope. The final list of models tested is shown in Table 1.

Table 1: Non-ENERGY STAR Soundbars Selected for Testing

|  |  |  |  |
| --- | --- | --- | --- |
| modelA | RPP Retailer non-energy star Market shareB | | |
| NUMBER OF UNITS SOLD | SALES VOLUME RANKC | % OF SALES |
| 1 | 5,651 | 1st | 13.3% |
| 4 | 2,115 | 4th | 5.0% |
| 9 | 2,046 | 5th | 4.8% |
| 2 | 2,036 | 6th | 4.8% |
| 3 | 1,873 | 7th | 4.4% |
| 20 | 1,394 | 9th | 3.3% |
| 11 | 1,218 | 10th | 2.9% |
| 5 | 1,214 | 11th | 2.9% |
| 21 | 852 | 13th | 2.0% |
| 14 | 802 | 15th | 1.9% |
| 23 | 670 | 17th | 1.6% |
| 7 | 598 | 18th | 1.4% |
| 15 | 514 | 21st | 1.2% |
| 22 | 404 | 24th | 0.9% |
| 19 | 328 | 28th | 0.8% |
| 12 | 318 | 30th | 0.7% |
| 17 | 268 | 31st | 0.6% |
| 16 | 262 | 32nd | 0.6% |
| 18 | 230 | 34th | 0.5% |
| 8 | 206 | 37th | 0.5% |
| 10 | 130 | 45th | 0.3% |
| 13 | 101 | 49th | 0.2% |
| 6 | 0 | NA | 0.0% |

A Manufacturer/model information is confidential, but can be provided if requested to the CPUC-ED and/or other utility partners on an as needed basis.

B Market share is based on RPP retailer sales data from January 2015 – November 2016 from the ICF database.

C Out of 202 different non-ENERGY STAR models that are sold by RPP retailers

Using the RPP retailer sales data that has since become available, we determined that this list of models represents roughly 55% of non-ENERGY STAR soundbar market sales.[[4]](#footnote-4) The top five selling models (three of which were tested) represent 37% of non-ENERGY STAR sales. The top ten selling models (seven of which were tested) represent 57% of non-ENERGY STAR sales.

Model Testing

Each model was lab tested in accordance with the test method outlined in the ENERGY STAR Program Requirements Product Specification for Audio/Video Version 3.0.[[5]](#footnote-5)

The following characteristics were collected from manufacturer specifications for each model:

* Manufacturer and model number
* Number of channels
* Connected functionality (Wi-Fi, gigabit Ethernet, Bluetooth, or other networking/control protocols)

The following data were collected through the testing process:

* Auto power down (APD) requirements met? Y/N
* Measured average power before APD
* Measured average power after APD
* Time to APD
* Calculated ENERGY STAR specification maximum sleep mode power (based on each model’s functionality)
* Calculated ENERGY STAR specification maximum idle mode power (based on each model’s functionality and power output)
* Measured input power () at 1/8 maximum undistorted power (MUP)
* Measured output power () at 1/8 MUP
* Measured average power in idle mode ()
* Measured average power in sleep mode ()
* Calculated amplifier efficiency = /()

Research Results

Test results are shown in the table below.

Table 2: Non-ENERGY STAR Soundbar Lab Testing Results

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Time to ADP (min) | ADP Req Met? | PIdle (W) | Max PIdle (W) | PSLEEP (W) | Max PSLEEP (W) | Amp Eff | Amp Eff Req | All Spec Reqs Met? |
| 1 | Not enabled | No | 3.2 | 11.0 | 0.3 | 1.0 | 0.098 | NA | No |
| 2 | 41.3 | Yes | 2.8 | 11.0 | 0.2 | 3.0 | 0.271 | NA | Yes |
| 3 | 10.7 | Yes | 11.1 | 11.0 | 0.4 | 3.0 | 0.244 | NA | No |
| 4 | 9.7 | Yes | 3.3 | 11.0 | 0.3 | 1.0 | 0.415 | NA | Yes |
| 5 | 9.9 | Yes | 7.6 | 11.0 | 0.4 | 3.0 | 0.008 | NA | Yes |
| 6 | Not enabled | No | 3.1 | 11.0 | 0.2 | 1.0 | 0.369 | NA | No |
| 7 | 9.9 | Yes | 2.5 | 11.0 | 0.4 | 3.0 | 0.248 | NA | Yes |
| 8 | 4.7 | Yes | 7.0 | 11.0 | 2.6 | 2.0 | 0.219 | NA | No |
| 9 | 19.9 | Yes | 5.4 | 11.0 | 0.4 | 3.0 | 0.33 | NA | Yes |
| 10 | 14.9 | Yes | 19.8 | 11.0 | 6.2 | 3.0 | 0.292 | 0.44 | No |
| 11 | 19.4 | Yes | 6.0 | 11.0 | 0.3 | 3.0 | 0.488 | NA | Yes |
| 12 | 4.9 | Yes | 6.7 | 11.0 | 5.5 | 1.0 | 0.393 | 0.44 | No |
| 13 | 20.7 | Yes | 23.5 | 13.0 | 0.3 | 6.0 | 0.088 | 0.44 | No |
| 14 | 20.5 | Yes | 18.1 | 13.0 | 1.6 | 6.0 | 0.038 | 0.55 | No |
| 15 | 20.4 | Yes | 13.2 | 13.0 | 5.4 | 6.0 | 0.362 | 0.44 | No |
| 16 | 19.9 | Yes | 9.9 | 11.0 | 4.9 | 4.0 | 0.323 | NA | No |
| 17 | 4.7 | Yes | 5.3 | 11.0 | 0.2 | 3.0 | 0.154 | NA | Yes |
| 18 | 14.9 | Yes | 5.2 | 11.0 | 2.6 | 2.0 | 0.059 | NA | No |
| 19 | 20.0 | Yes | 10.2 | 11.0 | 5.1 | 4.0 | 0.398 | NA | No |
| 20 | 19.8 | Yes | 7.9 | 11.0 | 0.4 | 3.0 | Unknown\* | Unknown\* | Unknown\* |
| 21 | 9.7 | Yes | 4.8 | 12.0 | 0.2 | 1.0 | Unknown\* | Unknown\* | Unknown\* |
| 22 | 17.6 | Yes | 6.4 | 11.0 | 0.3 | 2.0 | Unknown\* | Unknown\* | Unknown\* |
| 23 | 20.6 | Yes | 11.8 | 13.0 | 1.6 | 6.0 | Unknown\* | Unknown\* | Unknown\* |

\* The audio amplification tests for these units were indeterminate due to inconsistent test results or a malfunctioning unit. Rough estimates of input power for these units indicate that most of these units likely have an input power draw that falls below the threshold that requires amplifier testing.

As can be seen above 7 of the 23 models tested meet all applicable ENERGY STAR criteria. Of the 12 units that do not meet the ENERGY STAR criteria, 2 fail to meet the ADP requirement, 6 fail to meet the sleep mode power draw requirement, 5 fail to meet the idle mode power draw requirement, and 5 fail to meet the amplifier efficiency requirement. 4 models meet the ADP, idle mode power, and sleep mode power requirements, but it is inconclusive whether the amplifier efficiency requirement is met.

As shown in Figure 1 below, all the models that had ADP enabled meet the ENERGY STAR time to ADP requirement of less than or equal to 2 hours. The average time to ADP was approximately 16 minutes with a range of approximately 5 minutes to just over 41 minutes.

Figure 1. Time to ADP by Model Tested



Figure 2 shows that the models tested have idle mode power draws ranging from 2.5 to 23.5 W and an average idle mode power draw of 8.5 W. The ENERGY STAR maximum idle mode power draw ranges from 11 to 13 W for the models tested depending on the functionality of the unit.

Figure 2. Idle Mode Power Draw by Model Tested

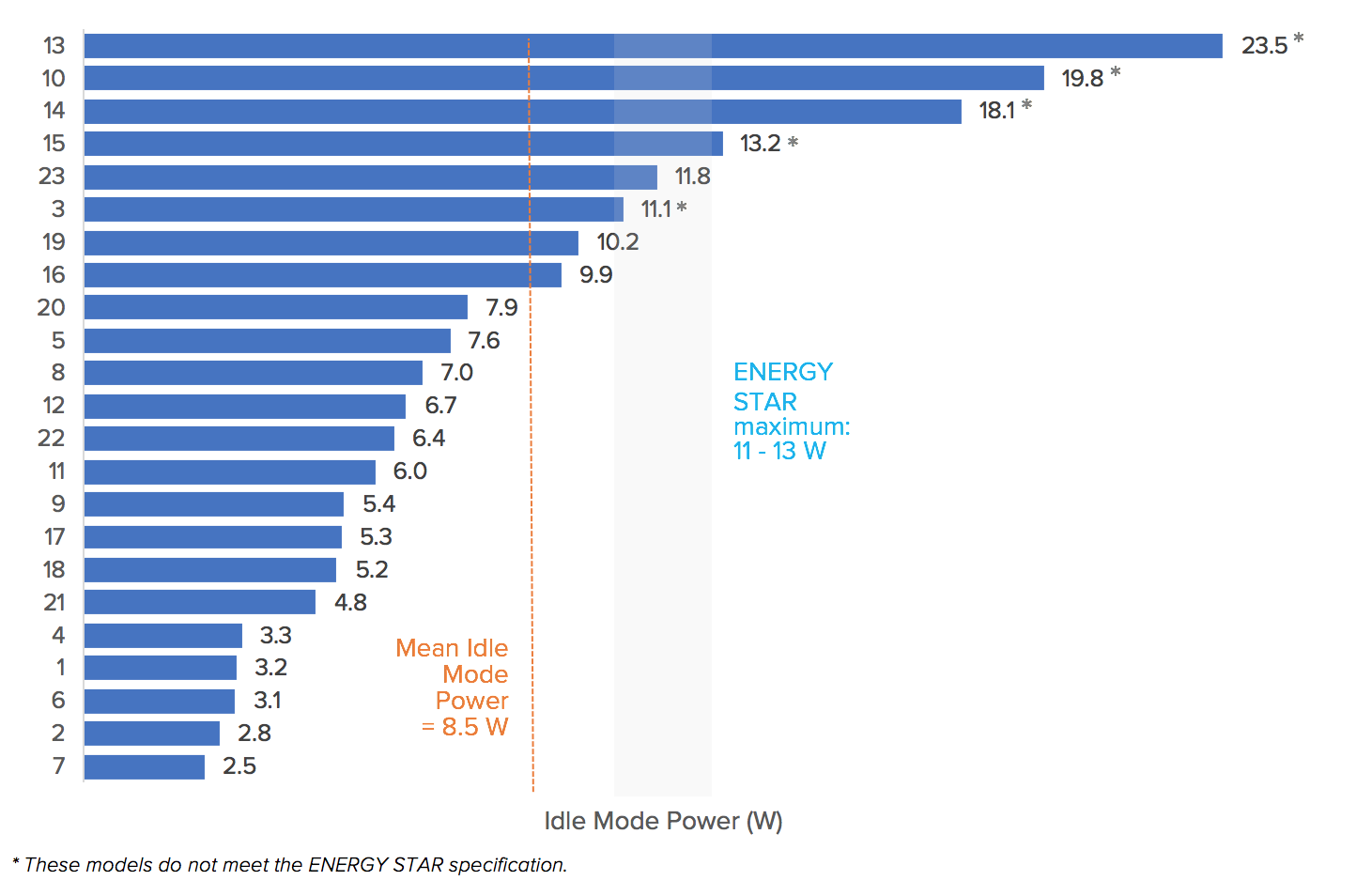
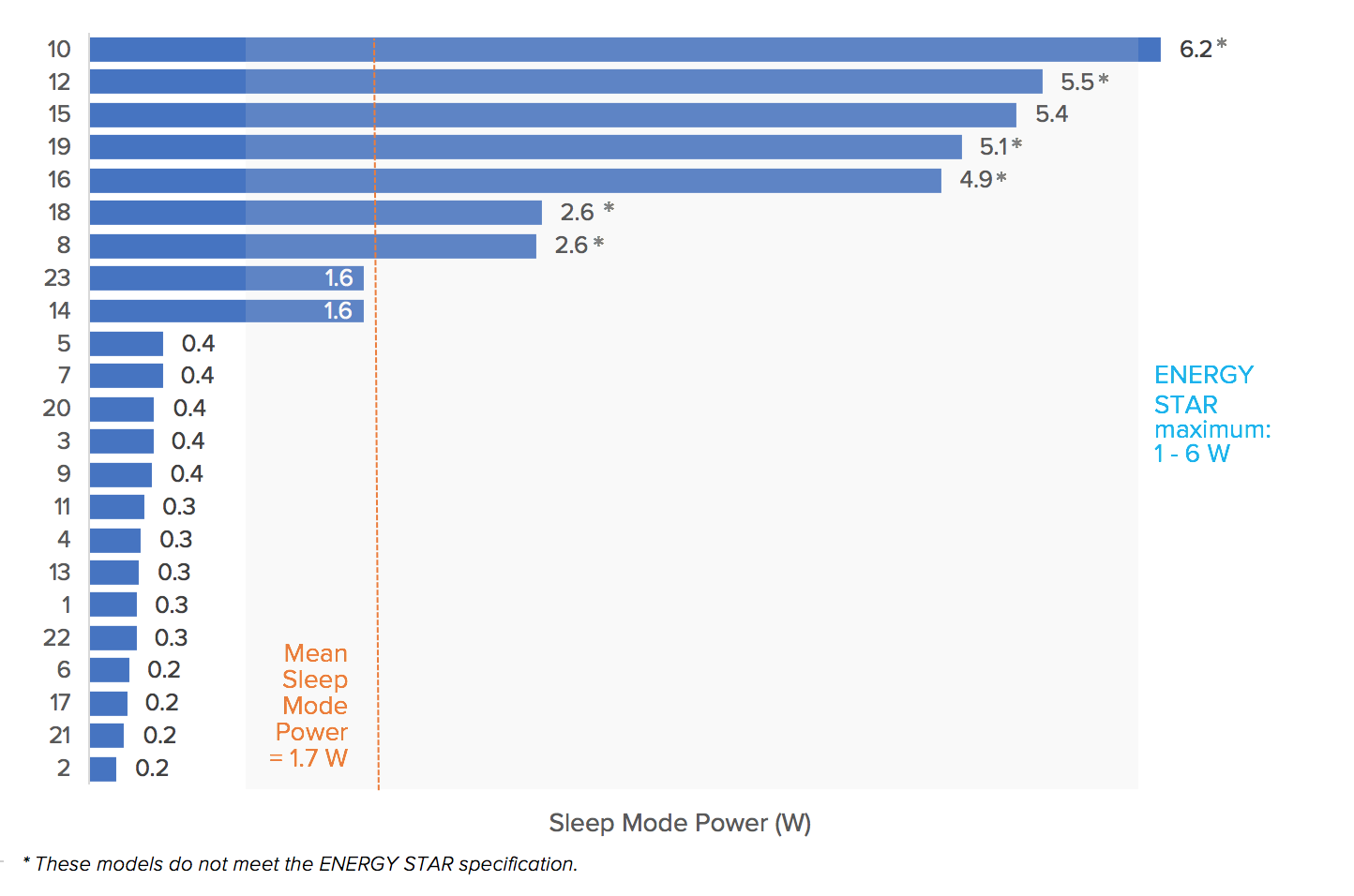


Figure 3 shows that the models tested have sleep mode power draw ranging from 0.2 to 6.2 W, and an average sleep mode power draw of 1.7 W. The ENERGY STAR maximum sleep mode power draw ranges from 1 to 6 W for the models tested depending on the functionality of the unit.

Figure 3. Sleep Mode Power Draw by Model Tested



Impact of Results on RPP Workpaper

In the RPP workpaper, the unit energy consumption of soundbars is calculated using Equation 1.

Equation 1

Where

UEC = unit energy consumption in kWh

PA = power draw in active mode in watts

TA = number of hours per year spent in active mode

PI = power draw in standby mode in watts

TI = number of hours per year spent in standby mode

PS = power draw in sleep mode in watts

TS = number of hours per year spent in sleep mode

1000 = conversion factor to change from watt-hours to kilowatt-hours.

Idle mode power draw was assumed to be 12 W for base-case models, 9.2 W for basic tier (ENERGY STAR + 15%) program-qualified models, and 5.5 W for advanced tier (ENERGY STAR + 50%) program-qualified models. Sleep mode power draw was assumed to be 4 W for base-case models, 1.5 W for basic tier (ENERGY STAR + 15%) program-qualified models, and 1.0 W for advanced tier (ENERGY STAR + 50%) program-qualified models.

Based on the results of this research, we believe the assumption for the base-case power draw assumptions should be changed from 12 W and 4 W to 8.5 W and 1.7 W for idle and sleep modes respectively (the averages of all the non-ENERGY STAR models tested).

1. In its disposition letter, the CPUC-ED also requested additional research on clothes dryers, room air cleaners, and research into product-specific market barriers preventing increased adoption of RPP measures. This memo only covers soundbar lab-based research. [↑](#footnote-ref-1)
2. In the disposition, the Ex Ante Review team also noted “that the hours of use for soundbars does not seem to take into account the previous results for HDTV hours of use and the fact that soundbars are most likely installed with the highest use HDTV in the home (“Understanding Television Set Usage: An investigation into average TV- set usage patterns in California,” prepared by Nielsen for PG&E, May 16, 2012.).” The Nielson study found a daily average of 5.1 hours of use (HOU) per TV across all TVs and 7.7 hours for the most watched TV in the household. This translates to an annual usage of 1,862 hours across all TVs and 2,811 hours for the most watched TV. The workpaper currently estimates 1,580 hours in active mode for sound bars, based on a Consumer Electronics Association (CEA) survey conducted for home theatre in a box systems (Roth, K. W., & McKenney, K. (2007, December). *Energy Consumption by Consumer Electronics in U.S. Residences.* Retrieved December 27, 2016, from Consumer Electronics Association: <http://s3.amazonaws.com/zanran_storage/www.ce.org/ContentPages/25159083.pdf>). PG&E agreed to revise the active mode HOU from 1,862 to 2,811 hours per year since the large volume of metered data from the Nielson study is likely more representative of actual consumer usage than consumer responses from the CEA survey. [↑](#footnote-ref-2)
3. Note that the idle mode power draw requirements in the ENERGY STAR specification do not apply to soundbars with default auto-power down (APD) settings of 30 minutes or less that cannot be disabled or increased beyond 30 minutes. [↑](#footnote-ref-3)
4. The models tested represent 55% of non-ENERGY STAR qualified sound bars from January 2015 to November 2016. From March 2016 to May 2016, these same models represent roughly 69% of RPP retailer sales. [↑](#footnote-ref-4)
5. <https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/audio_video/Final_Version_3_AV_Program_Requirements.pdf?143e-0e06> [↑](#footnote-ref-5)