To:PG&E

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Date:December 30, 2016

RE:2016 PG&E Retail Products Platform (RPP) – Air Cleaner Hours of Use 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 room air cleaners.[[1]](#footnote-2) Resultantly, PG&E is currently conducting two distinct but related research efforts on room air cleaners:

1. **Lab testing of non-ENERGY STAR air cleaners to measure power draw and efficiency and to 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 room air cleaner models that are not ENERGY STAR certified.
2. **Surveys to determine hours of use (HOU) and coincident demand factor (CDF) for air cleaners.** For this effort, PG&E and EMI Consulting are conducting a survey of PG&E residential customers to derive more accurate and reliable HOU and CDF estimates.

For the first effort described above, please refer to the separate memo detailing the results of the lab testing. *This memo only summarizes the results of the second effort (HOU and CDF survey results).*

For room air cleaners, the HOU and active mode power draw (which is a function of unit size in terms of the clean air delivery rate (CADR) and unit efficiency) are the two most important parameters affecting the unit energy consumption (UEC) and, in turn, the unit energy savings (UES). In its submitted workpaper, PG&E cited three existing research studies that provide HOU estimates for room air cleaners.[[2]](#footnote-3),[[3]](#footnote-4),[[4]](#footnote-5) Of the three studies, PG&E felt the 2004 Association of Home Appliance Manufacturers’ (AHAM) report was the most robust and substantiated data source and it also provided the most conservative estimate. Therefore, AHAM’s values of 2,921 hours per year in active mode and 5,839 hours per year in idle mode were used in the workpaper for the room air cleaner UEC calculation for both the baseline and the measure-case.

However, the CPUC-ED noted that the 2004 AHAM study, as well as all the other reports, rely on customer self-reported HOU estimates that may or may not apply to California-specific usage. The CPUC-ED questioned the accuracy and reliability of the HOU estimate as well as its applicability to the California market. In response, PG&E agreed to conduct a study with residential customers to derive California-specific estimates of room air cleaner HOU by mode. In addition, this study collected data on usage patterns to estimate a more accurate coincident demand factor (CDF) to use in calculating the demand reduction attributable to room air cleaners.

Research Objectives

From September through October 2016, PG&E and EMI Consulting conducted a survey of PG&E residential customers in order to derive more accurate and reliable HOU and CDF estimates for room air cleaners.The research approach for this study consisted of an online survey with residential customers in the PG&E service territory using PG&E’s internal Customer Insights Panel. Below we detail the research questions and objectives of this study.

Research Questions/Objectives

* Determine how many air cleaners customers have in their homes.
* Assess seasonal use of the air cleaners (e.g., all year or only during some months of the year).
* Compute average daily usage of air cleaners.
* Determine when in the day customers tend to use their air cleaners (to inform CDF).
* Determine typical operating modes of air cleaners (e.g., low, medium, high and/or auto).
* Assess seasonal variability in usage (typical operating mode by season, etc.).
* Determine how often customers unplug their air cleaners

Overall, several improvements over the existing research were targeted through this study, including:

* Developing more current information on customer usage of air cleaners.
* Developing California-specific HOU estimates.
* Developing California-specific CDF estimates.
* Providing a clearer explanation of research methods and final confidence/precision.
* Providing greater clarity on variability both across seasons as well as across users.

Summary of Key Findings

* Across all respondents, we calculated a **mean annual HOU value for air cleaners of** **3,641**.[[5]](#footnote-6) This is higher than the current workpaper assumption of 2,921, which is based on the 2004 AHAM report, and lower than the ENERGY STAR calculator assumption of 5,840.[[6]](#footnote-7)
* Across all respondents, we calculated a **mean annual number of hours that air cleaners are unplugged (off) of 1,332**, which is higher than the current workpaper assumption of 0.
* We calculated a **mean CDF of** **31.9%**, slightly lower than the current workpaper assumption of 33%.
* Nearly two-thirds (65.8%) of respondents only own one air cleaner, in agreement with previous PG&E-sponsored research.[[7]](#footnote-8)
* Three-quarters (75.3%) of respondents reported using their air cleaner(s) every day of the week.
* Just over two-thirds of respondents (67.7%) reported using their air cleaner(s) year-round, slightly lower than indicated by previous PG&E-sponsored research (which indicated that approximately three quarters used air cleaners year round).[[8]](#footnote-9) The most common months of use were May through August, with just over 80% of respondents reporting usage during these months.

Research Approach

To answer the research questions for this study, EMI Consulting conducted online surveys with residential customers in the PG&E service territory using PG&E’s internal Customer Insights Panel for recruitment. This online panel consists of a universe of about 10,200 PG&E residential customers with email addresses who have elected to participate in online surveys and discussions without compensation.

The study was designed to attain 90/10 confidence/precision for the final annual HOU estimates in a cost-effective manner. Assuming a coefficient of variation of 1, we estimated the sample size would need to be approximately 270 completed surveys.[[9]](#footnote-10) A soft launch of the survey was conducted from September 23-27, 2016. The main launch was conducted from October 3-10, with a reminder sent on October 6 to boost responses. We provide detailed demographic information in the following section.

Demographics

The PG&E Customer Insight Panel has been designed to be representative of customers in the PG&E territory with a valid email address. To inform the reader of the demographic information on survey respondents, the tables below include detailed information on gender, age, ethnicity, and household income.

A slight majority of respondents (*n* = 401, 57.9%) were male while female respondents comprised just under half of the sample (*n* = 291, 42.1%) (results not shown). **Table 1** presents the age distribution of respondents, showing that two-thirds of respondents (*n* = 461, 66.5%) were between the ages of 35 and 64.

Table 1. Respondent Age

|  |  |  |
| --- | --- | --- |
| Age Range | *n* | Percent |
| Ages 18-34 | 44 | 6.3% |
| Ages 35-49 | 187 | 27.0% |
| Ages 50-64 | 274 | 39.5% |
| Ages 65+ | 188 | 27.2% |
| Total | 693 | 100% |

Respondents’ ethnicity information is reported in **Table 2.**

Table 2. Respondent Ethnicity

|  |  |  |
| --- | --- | --- |
| Ethnicity | *n* | Percent |
| Caucasian | 494 | 71.3% |
| Asian / Pacific Islander | 65 | 9.4% |
| Latino/a | 35 | 5.1% |
| Multi-racial | 27 | 3.9% |
| African American | 16 | 2.3% |
| Other | 4 | 0.5% |
| Prefer not to answer | 52 | 7.5% |
| Total | 693 | 100% |

PG&E service areas were relatively equally represented in the sample. Of the total respondents, 241 (34.8%) were in the Central Coast, 173 (25.0%) in the Bay, 104 (15.0%) in the Central Valley, and 175 (25.3%) in the Northern area.

**Table 3** shows that income levels were also fairly evenly distributed, with the most represented income category being $100,000 to less than $150,000 (*n* = 118; 17.0%).

Table 3. Household Income

|  |  |  |
| --- | --- | --- |
| Income Range | *n* | Percent |
| < $30,000 | 51 | 7.4% |
| $30,000 - < $50,000 | 56 | 8.1% |
| $50,000 - < $75,000 | 85 | 12.3% |
| $75,000 - < $100,000 | 80 | 11.5% |
| $100,000 - < $150,000 | 118 | 17.0% |
| $150,000 - < $200,000 | 67 | 9.7% |
| $200,000 or More | 95 | 13.7% |
| Refused | 141 | 20.3% |
| Total | 693 | 100% |

Results

The following sections detail survey results, including sample characteristics, number of air cleaners owned by respondents, their manners of use, and timer usage. Next we discuss seasonal usage and daily usage patterns. Finally, we provide estimates of HOU and CDF.

Response Summary

**Table 4** presents the final dispositions of all surveys. In all, 4,298 respondents began the survey, of which 3,460 respondents were disqualified because they did not own any air cleaners. Of the 838 respondents who began the survey and were not disqualified, 693 respondents completed the survey in its entirety. Only data from these 693 respondents were used in calculating the results presented in this memo.

Table 4. Survey Dispositions

|  |  |  |
| --- | --- | --- |
| Status | *n* | Percent |
| Invites Sent | 10,195 | 100% |
| Started | 4,298 | 42.1% |
| - Disqualified | 3,460 | 33.9% |
| - Started/Qualified | 838 | 8.2% |
| - Started/Completed | 693 | 6.8% |

Number of Air Cleaners and Operating Mode Usage

**Table 5** shows how many air cleaners customers reported having in their homes. Nearly two-thirds (*n* = 456; 65.8%) of respondents reported owning only one air cleaner, while an additional 23.4% (*n* = 162) indicated two units. Overall, respondents reported owning an average of 1.5 air cleaners (SD = 0.8). However, in this survey, respondents reported on the single air cleaner that they had most recently purchased.

**Table 5. Number of Air Cleaners**

|  |  |  |
| --- | --- | --- |
| Number | *n* | Percent |
| 1 Air cleaner | 456 | 65.8% |
| 2 Air cleaners | 162 | 23.4% |
| 3 Air cleaners | 55 | 7.9% |
| 4 Air cleaners | 15 | 2.2% |
| 5 Air cleaners | 4 | 0.6% |
| 6 Air cleaners | 1 | 0.1% |
| Total | 693 | 100% |

**Table 6** presents the results of operating mode usage. The majority of those who completed the survey (*n* = 429, 61.9%) indicated that they manually turn their air cleaners on and off. About one-fifth (*n* = 143, 20.6%) reported that they never turn their air cleaner off.

**Table 6. Air Cleaner Operating Mode Usage**

|  |  |  |
| --- | --- | --- |
| Operating Mode Usage | *n* | Percent |
| Manually turn on and off | 429 | 61.9% |
| Never turn it off | 143 | 20.6% |
| Set to auto mode | 76 | 11.0% |
| Manually turn on, then set timer to turn off | 45 | 6.5% |
| Total | 693 | 100% |

**Figure 1** plots air cleaner time duration by percentage of sample. Almost half of the 45 respondents who reported using their air cleaners’ timers (*n* = 21, 46.7%) indicated they use the timer for 1 to 2 hours. Average timer duration was 4.3 hours (SD = 3.8).

Figure 1. Air Cleaner Timer Duration



Nearly three-quarters of survey respondents (*n* = 426, 61.5%) indicated that they always leave their air cleaner plugged in (**Table 7**).

Table 7. Annual Hours for Which Air Cleaner Unit is Unplugged

|  |  |  |  |
| --- | --- | --- | --- |
| Response | Frequency | Percent | Cumulative Percent |
| I always leave it plugged in. | 426 | 61.5% | 61.5% |
| I leave it plugged in most of the time. | 77 | 11.1% | 72.6% |
| I leave it plugged in sometimes, but sometimes I unplug it. | 46 | 6.6% | 79.2% |
| I unplug it most of the time. | 57 | 8.2% | 87.4% |
| I always unplug it. | 87 | 12.6% | 100.0% |
| **TOTAL** | **693** | **100.0%** |  |

To compute an average value for the number of annual hours that respondents unplug their units, we assumed the following percentages related to their answer of how often they unplugged their air cleaners: “I leave it plugged in all the time” (0% of the time), “I leave it plugged in most of the time” (25% of the time), “I sometimes unplug it and sometimes leave it plugged in” (50% of the time), “I unplug it most of the time” (75% of the time), and “I always unplug it” (100% of the time). Then for each respondent, we multiplied this percentage by the number of annual hours they are *not* operating their unit. The resulting mean value for all respondents was 1,332 hours, which reflects the average number of annual hours that air cleaner units were *unplugged*.

Seasonal Usage of Air Cleaners

**Table 8** shows the reported seasonal air cleaner usage.[[10]](#footnote-11) The majority of respondents (*n* = 469, 67.7%) indicated that they use their air cleaners year-round. This value is close to the value of 71.0% reported in the AHAM study.

Table 8. Comparison to AHAM Reported Seasonal Air Cleaner Usage

|  |  |  |  |
| --- | --- | --- | --- |
|  | AHAM Data | Current Study Data | |
| Seasonal Usage | Percent | n | Percent |
| Year-Round | 71.0% | 469 | 67.7% |
| Seasonal Use Only | 29.0% | 224 | 32.3% |
| **TOTAL** | **100.0%** | **693** | **100.0%** |

**Figure 2** shows that the most frequently reported months of use were June (*n* = 561, 81.0%), August (*n* = 557, 80.4%), May (*n* = 556, 80.2%), and July (*n* = 555, 80.1%). However, these differences were not statistically significant.[[11]](#footnote-12)

Figure 2. Air Cleaner Monthly Use Patterns (All Respondents)



Table 9 shows the percentage of respondents who reported running their air cleaner at each operating mode. We use these results to estimate the frequency at which the “low”, “medium”, and “high” fan speeds are used. It is reasonable to assume that respond if “auto” or “don’t know” likely have air cleaners that run on “medium” speed. We attribute the “auto” and “don’t know” responses to “medium” and estimate the following weighting factors for typical operating speeds: 30% on “low”, 50% on “medium”, and 20% on “high”.

Table 9 shows there are no statistically significant differences in choice of operating mode between respondents who reported using their air cleaner year-round and those who only used it during certain months or seasons.[[12]](#footnote-13)

Table 9. Typical Operating Mode by Use (Seasonal vs. Year-Round)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Typical Operating Mode | Seasonal Use | | | |
| *Seasonal Only* | | *Year-Round* | |
| Count | Column n % | Count | Column n % |
| Low | 61 | 27.2% | 138 | 29.4% |
| Medium | 90 | 40.2% | 167 | 35.6% |
| High | 44 | 19.6% | 87 | 18.6% |
| Auto | 21 | 9.4% | 67 | 14.3% |
| Don't know | 8 | 3.6% | 10 | 2.1% |

Daily Usage of Air Cleaners

**Table 10** shows that the pattern of daily usage of air cleaners (in terms of number of hours) reported by respondents in the current study closely mirrors the pattern of use found in the 2004 AHAM study.[[13]](#footnote-14)

Table 10. Estimated Air Cleaner Daily Usage [[14]](#footnote-15)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| AHAM Data | | Current Study Data | | | |
| *Weekdays* | | *Weekends* | |
| Hours Per Day | Percent | *n* | Percent | *n* | Percent |
| 1-4a | 25.0% | 157 | 27.7% | 152 | 26.2% |
| 5-8 | 25.0% | 144 | 25.4% | 143 | 24.7% |
| 9-23 | 20.4% | 88 | 15.5% | 102 | 17.6% |
| 24 | 29.0% | 178 | 31.4% | 183 | 31.6% |
| **TOTAL** | **99.40%** | **567** | **100%** | **580** | **100%** |

a The AHAM report used the bracket “1-4” which we assumed was meant to include users who used their air cleaner for less than one hour per day.

**Table 11** shows air cleaner usage for year-round users. Among those respondents who use their air cleaner(s) year-round, the vast majority (*n* = 414, 92.8%) use it every day. This value is higher than the value of 67.0% in the 2004 AHAM report.

Table 11. Air Cleaner Usage for Year-Round Users [[15]](#footnote-16)

|  |  |  |  |
| --- | --- | --- | --- |
|  | AHAM Data | Current Study Data | |
| Days Per Week | Percent | n | Percent |
| < 1 | 7.0% | - | - |
| 1-2 | 4.7% | 17 | 3.8% |
| 3-4 | 11.2% | 9 | 2.0% |
| 5-7 | 8.7% | 6 | 1.3% |
| Every Day | 67.0% | 414 | 92.8% |
| **TOTAL** | **98.6%** | 446 | **100%** |

**Table 12** shows air cleaner usage for customers that reported using the devices seasonally. Among those respondents who only use their air cleaner in certain months, almost two-thirds (64.9%) reported using their air cleaner every day (higher than the 29.0% value in the 2004 AHAM report).

Table 12. Air Cleaner Usage for Seasonal Users

|  |  |  |  |
| --- | --- | --- | --- |
|  | AHAM Data | Current Study Data | |
| Days Per Week | Percent | n | Percent |
| < 1 | 29.8% | - | - |
| 1-2 | 8.3% | 29 | 17.3% |
| 3-4 | 17.0% | 23 | 13.7% |
| 5-7 | 15.9% | 7 | 4.2% |
| Every Day | 29.0% | 109 | 64.9% |
| **TOTAL** | **100%** | 168 | **100%** |

**Figure 3** plots the daily usage pattern of air cleaners indicating little variability across days.[[16]](#footnote-17) Across all types of respondents, most respondents (*n* = 522, 75.3%) indicated that they use their air cleaners every day of the week. The days with the greatest reported usage are Saturdays (*n* = 581, 83.8%), Sundays (*n* = 575, 83.0%), and Mondays (*n* = 575, 83.0%).

Figure 3. Air Cleaner Daily Use Patterns



HOU Estimation

Average annual HOU was computed by taking the product of reported hours per day (separately for weekdays and weekends), days/week used, months used, and the average number of weeks in a month: HOU = (Hours per Day Used x Total Days Used per Week x 4.33 Weeks per Month x Total Months Used). This was performed for each respondent individually. We then took the average of these individual HOU values to produce our overall HOU estimate. An example computation sequence is shown in **Table 13**.

Table 13. Example HOU Estimate for a Single Respondent

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Weekdays | | | Weekends | | | Total Hours/  Week | Mean # Weeks/  Month | Months Used Per Year | HOU Estimate |
| **Hours/**  **Day** | **Days/**  **Week** | **Total # Hours** | **Hours/**  **Day** | **Days/**  **Weekend** | **Total # Hours** |
| **[A]** | **[B]** | **[C = A\*B]** | **[D]** | **[E]** | **[F = D\*E]** | **[G = C+F]** | **[H]** | **[I]** | **[J = G\*H\*I]** |
| 9 | 5 | 45 | 9 | 2 | 18 | 63 | 4.33 | 6 | 1,636.74 |

As shown in **Table 14**, the average HOU (across all respondents) for weekdays was 2,565. For weekends, the average HOU was 1,072. The overall HOU was 3,641 (*n* = 596, SD = 3,348). At a 90% level of confidence, the relative precision of this overall estimate is +/- 6.2%.

**Table 14. Average Hours of Use for All Respondents a**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *n* | *Mean* | *SD* | *Median* | *Min* | *Max* |
| HOU - Weekdays | 597 | 2,565 | 2,406 | 1,819 | 0 | 6,235 |
| HOU - Weekends | 597 | 1,072 | 954 | 831 | 0 | 2,494 |
| HOU - Overall | 596 | 3,641 | 3,348 | 2,546 | 2 | 8,729 |

a Note that as described above, the overall HOU value is not computed as a sum of the weekday and weekend values.

As shown in **Figure 4**, the distribution of HOU values is somewhat bimodal, with respondents tending to either use their air cleaners relatively infrequently or nearly all the time.

Figure 4. Histogram of Overall HOU Values by Respondent



Here we note the difference in computation approaches between the current study and the 2004 AHAM report (which yielded an HOU estimate of 2,921). Had we used the same approach used in that earlier study, we would have yielded a slightly higher HOU estimate of 3,876. We chose to not use that same approach as we believe our approach to be more precise, given that it does not rely on using ranges of values (as was used in the 2004 AHAM report). A comparison of these two approaches is included in the next section.

CDF Estimation

Coincident demand factor (CDF) was assessed by asking respondents: “During the hottest months of the year (July through September), on weekdays between 2:00pm and 5:00pm, what percentage of the time would you estimate the air cleaner is typically in use in your home?”[[17]](#footnote-18) The average coincident demand factor reported by respondents was **31.9%** (*n* = 654, SD = 42.0%). At a 90% level of confidence, the relative precision of this estimate is +/- 4.9%.

Comparison of HOU Calculations Between 2004 AHAM Study and Current Study

To provide additional context around the calculations presented in this memo for HOU, in this section we reproduce the calculations used to estimate HOU from the 2004 AHAM study. Using this same approach, we then substitute in data from the current study to directly compare the two resulting HOU values (using the AHAM computation approach). Finally, we explain why we believe that the HOU value presented in this memo is more accurate than the 2004 AHAM value.

AHAM Approach Using AHAM Data

Although the 2004 AHAM study did not provide exact details on how they computed HOU, the research team for the current study attempted to recreate these calculations. The first step was to determine the mean number of days that air cleaners were used by two groups: (1) those who use their air cleaner year-round, and (2) those who only use it seasonally. To do this, the midpoints of the ranges shown in the leftmost column in **Table 15** were multiplied by the percent of respondents in each of those ranges. This was performed separately for year-round users and seasonal users. The end result (for each group) is a mean number of days/week for air cleaner usage (5.71 days and 3.85 days, respectively).

Table 15. Using AHAM Approach to Estimate Mean Days of Use for Year-Round and Seasonal Users

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Year-Round Users | | Seasonal Users | |
| Days Per Week | Midpoint of Range | Percent of Respondents | Weighted  Contribution  (days/week) | Percent of Respondents | Weighted Contribution  (days/week) |
| < 1 | 0.5 | 7.0% | 0.035 | 29.8% | 0.149 |
| 1-2 | 1.5 | 4.7% | 0.0705 | 8.3% | 0.1245 |
| 3-4 | 3.5 | 11.2% | 0.392 | 17.0% | 0.595 |
| 5-7 | 6 | 8.7% | 0.522 | 15.9% | 0.954 |
| Every Day | 7 | 67.0% | 4.69 | 29.0% | 2.03 |
| **OVERALL:** | | **98.6%a** | **5.71** | **100%** | **3.85** |

a Note the level of detail provided in the AHAM report does not provide any insight into why the values shown in the table do not sum to 100%.

Once the weighted contributions from each of the ranges were computed, these numbers were used to calculate an overall number of days/year for air cleaner usage. This was again performed separately for the year-round users and the seasonal users. As shown in **Table 16**, the two groups’ contributions to days/year were combined to obtain 235 days per year.

Table 16. Using AHAM Approach to Estimate HOU Using AHAM Data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Group Percent of Total | Mean Days/Week | Seasonal Correction Factor (percentage of year) | Weeks/Year | Relative Group Contribution  (days) |
| Year-Round | 71.0% | 5.71 | 100% | 52 | 211 |
| Seasonal | 29.0% | 3.85 | 42% | 52 | 24 |
|  |  |  |  | **OVERALL:** | **235** |

The final step involved translating this value of 235 days/year into an HOU value. This was done by multiplying the value by the mean number of hours per day (also called a daily loading factor). For the AHAM data, this value was reported as 12.43 hours. Thus, the annual HOU estimation became: 235 days \* 12.43 hours/day = 2,923 hours. The actual value reported by the AHAM study was 2,921 hours, which is slightly lower than the value obtained here, but may simply be a result of rounding error.

AHAM Approach Using Data from Current Study

To enable a more direct comparison between data from the 2004 AHAM report and data from the current study, below we reproduce the 2004 AHAM calculations using data *from the current study*, as shown below in **Table 17** and **Table 18**.

Table 17. Using AHAM Approach to Estimate Mean Days of Use for Year-Round and Seasonal Users with Data from Current Study

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | Year-Round Users | | Seasonal Users | |
| Days Per Week | Midpoint of Range | Percent of Respondents | Weighted  Contribution  (days/week) | Percent of Respondents | Weighted Contribution  (days/week) |
| < 1 | 0.5 | - | - | - | - |
| 1-2 | 1.5 | 3.8% | 0.057 | 17.3% | 0.2595 |
| 3-4 | 3.5 | 2.0% | 0.07 | 13.7% | 0.4795 |
| 5-7 | 6 | 1.3% | 0.078 | 4.2% | 0.252 |
| Every Day | 7 | 92.8% | 6.496 | 64.9% | 4.543 |
| **OVERALL:** | | **100%** | **6.701** | **100%** | **5.53** |

Table 18. Using AHAM Approach to Estimate HOU Using Data from Current Study

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group | Group Percent of Total | Mean Days/Week | Seasonal Correction Factor (percentage of year) | Weeks/Year | Relative Group Contribution  (days) |
| Year-Round | 67.7% | 6.70 | 100% | 52 | 236 |
| Seasonal | 32.3% | 5.53 | 81% | 52 | 76 |
|  |  |  |  | **OVERALL:** | **312** |

As shown in **Table 18**, using data from the current study resulted in a higher overall number of days of air cleaner usage (312 days for the current study versus 235 for the AHAM study). However, here it is worth noting that the AHAM study relied on data representing the West Coast Region, and a slightly larger days of air cleaner usage for a California-specific sample makes sense given the climate differences between California and Washington and Oregon. The mean number of hours used per day was also slightly higher for the current study than for the AHAM study (12.44 hours for the current study versus 12.43 hours for the AHAM study). Using this approach, the corresponding HOU estimate using data from the current study was 3,876 (computed as 312 days \* 12.44 hours/day). Using this approach yields a higher HOU value than the approach used in the body of this memo (3,641).

*The research team believes that the AHAM method is less precise than the method presented earlier in the current memo, as the AHAM method relies on using midpoint values from ranges of number of days the air cleaner is used per week (as detailed in Table 15 and Table 17). This is in contrast to the method presented in this study, which computes a separate HOU value for each individual respondent and then averages the results. Also, because the data from the current study represents a California-specific sample, our estimates should be more applicable to the State.*

Impact of Results on RPP Workpaper

In the RPP workpaper’s unit energy savings calculation for room air cleaners, runtime for room air cleaners was assumed to be 2,921 hours per year with the remaining hours of the year assumed to be spent in idle mode (0 hours off). Based on the results of this research, we believe the assumption for runtime should be increased to 3,641 and the assumption for hours the unit is off should be increased from 0 to 1332 (thus decreasing the number of hours the unit is in idle mode).

Additionally, the workpaper assumed a coincident demand factor of 0.33 in the peak demand reduction calculation. Based on the results of this research, we believe the assumption for the coincident demand factor should be decreased slightly to 0.319.

This research also has data to inform how often air cleaners are used at different operating modes. We estimate that on average, 30% of air cleaners are run at low speed, 50% at medium speed, and 20% at high speed.

1. In its disposition letter, the CPUC-ED also requested additional research on clothes dryers, soundbars, and research into product-specific market barriers preventing increased adoption of RPP measures. This memo only covers air cleaner research. [↑](#footnote-ref-2)
2. Davis Energy Group and Energy Solutions. (2004). *Draft Analysis of Standards Options For*

   *Portable Room Air Cleaners.* Retrieved May 5, 2015, from California Energy Commission:

   [http://www.energy.ca.gov/appliances/2003rulemaking/documents/case\_studies/CASE\_Port\_Ro](http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Port_Ro om_Air_Cleaner.pdf)

   [om\_Air\_Cleaner.pdf](http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Port_Ro om_Air_Cleaner.pdf)<http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Port_Room_Air_Cleaner.pdf> [↑](#footnote-ref-3)
3. Morris, W. (2004). Report to California Energy Commission: Analysis of Energy Efficiency of

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   <http://www.energy.ca.gov/appliances/2003rulemaking/documents/public_comments/2004-8-13_AHAM.PDF> [↑](#footnote-ref-4)
4. Bensch, I.,Pigg, S., Koski, K., & Belshe, R. (2010). *Electricity Savings Opportunities for Home*

   *Electronics and Other Plug-In Devices in Minnesota Homes.* Retrieved from Energy Center of

   Wisconsin: <http://www.ecw.org/resource_detail.php?resultid=430> [↑](#footnote-ref-5)
5. We relied on a different, more precise approach to computing HOU than did the 2004 AHAM report. If we had followed the same approach used in that earlier study, the data in this current study would have yielded a slightly higher HOU value of 3,876.3. [↑](#footnote-ref-6)
6. Available here: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiUqdumjp_QAhVB0WMKHS_GB8QQFggdMAA&url=https%3A%2F%2Fwww.energystar.gov%2Fsites%2Fdefault%2Ffiles%2Fasset%2Fdocument%2Fappliance_calculator.xlsx&usg=AFQjCNFAy5-mu5GR3BjLp4MR1LqrOHegCA&sig2=Jo5zpqOmtzEgwd_Q5iESIA> [↑](#footnote-ref-7)
7. <http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Port_Room_Air_Cleaner.pdf> [↑](#footnote-ref-8)
8. <http://www.energy.ca.gov/appliances/2003rulemaking/documents/case_studies/CASE_Port_Room_Air_Cleaner.pdf> [↑](#footnote-ref-9)
9. As detailed below, we obtained 693 completed survey responses, thus exceeding the 90/10 confidence/precision target. [↑](#footnote-ref-10)
10. The research team did not find any statistically significant differences in HOU or CDF based on California climate zone using a Kruskal-Wallis test. [↑](#footnote-ref-11)
11. Differences between months were not significant using a one-sample chi-square test, p > .05. [↑](#footnote-ref-12)
12. Differences were not significant between groups using a Pearson’s chi-square test, p > .05. [↑](#footnote-ref-13)
13. The AHAM report only reported percentages and did not report n-values. [↑](#footnote-ref-14)
14. Note the level of detail provided in the AHAM report does not provide any insight into why the values shown in the table do not sum to 100%. The AHAM report did not report daily usage by weekday vs. weekend. [↑](#footnote-ref-15)
15. Ibid. [↑](#footnote-ref-16)
16. Differences between days were not significant using a one-sample chi-square test, p > .05. [↑](#footnote-ref-17)
17. This question was only asked of the 579 respondents who reported using their air cleaner during July, August, and/or September. Of these 579 respondents, only 39 indicated they did not know the answer. The 114 respondents who did not report using their air cleaners at all during the months of July-September were assigned a CDF of zero. This resulted in a total valid sample of 654 respondents. [↑](#footnote-ref-18)