To:PG&E

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Date:December 30, 2016

RE:2016 PG&E Retail Products Platform (RPP) – Clothes Dryer Research Results

Introduction

The Pacific Gas and Electric Company (PG&E) submitted a workpaper for the Retail Products Platform (RPP) Program in December of 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 clothes dryers.[[1]](#footnote-2) Resultantly, PG&E launched a research effort to address CPUC-ED concerns, the results of which we summarize in this memo.

In this document, we first review the research questions and objectives, then describe the overall research approach, present key findings, and finally present more detailed results.

Research Questions/Objectives

The research needs related to clothes dryers were outlined as follows in PG&E’s Supplemental Advice Letter dated February 10, 2016 (Advice 3668-G-A/4765-E-A):

**Clothes Dryers Research.** The Disposition requires more research on baseline conditions to augment and support the standard practice baseline for both electric and gas clothes dryers. In response to Energy Division direction on the RPP work paper, PG&E will provide additional information on actual dryer installations to reliably establish typical clothes washer characteristics where RPP qualifying dryers are installed. This research will:

* 1. Determine what fraction of dryers are installed in locations where venting is not possible;
  2. Describe typical characteristics of the washer used where the qualifying dryer is to be installed; and
  3. In instances when a dryer is purchased along with a washer for vented installations, describe characteristics of the typical washer purchased with the qualifying dryer.

The first item above was based on the assumption that there were no ventless dryers available on the market that were not ENERGY STAR-certified. The concern was that PG&E would claim energy savings for high efficiency ventless dryer purchases where the customer had no other purchasing option. It has since been discovered that The Home Depot sells non-ENERGY STAR ventless dryers (see here: <http://www.homedepot.com/p/Ariston-4-cu-ft-Electric-Ventless-Dryer-in-White-TCL73XNA/203729865> for example). Therefore, no further research was needed on this item and it is not further addressed here.

The second and third items are addressed by answering the main research question:[[2]](#footnote-3) *What is the efficiency of washers paired with program-qualified dryers (by type)?* As outlined in the *March 31, 2016 Pacific Gas and Electric Company Retail Product Platform Clothes Dryer Research Plan*, to answer this research question, this study was aimed at determining the frequency with which the two scenarios shown in Table 1 occur when a new, program-qualified dryer is purchased.

Table : Final List of Scenarios to Consider for RPP Program Energy Savings

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Purchase | Scenario # | Before Purchase | | After Purchase | | |
| Washer | Dryer | | Washer | Dryer |
| New Dryer Only | 1 | ConventionalE | ConventionalE | | ConventionalE | Energy EfficientN |
| 3 | Energy EfficientE | ConventionalE | | Energy EfficientE | Energy EfficientN |

The goal was to develop weights for each of the scenarios in the table above to calculate a single, weighted UES value for each dryer type (vented standard electric dryer, ventless compact electric dryer, gas dryer, etc.) that represents all the possible pairing/purchasing scenarios that may occur within the RPP program.[[3]](#footnote-4)

In addition to the main research question, the ED expressed a desire to understand the fraction of dryers that are installed in conditioned versus unconditioned space (in order to be able to appropriately apply interactive effects to only those dryers installed in conditioned space) as well as a desire to understand the types of washers that are paired with compact dryers (in order to affirm or dispute the assumption that compact dryers are typically paired with compact washers). Given these additional requests, the full list of research questions is:

1. What is the efficiency of washers paired with program-qualified dryers (by type)?
2. What fraction of dryers (by type) are installed in conditioned vs. unconditioned space?
3. What types of washers are paired with compact dryers (by type)?

Summary of Key Findings

To summarize our high-level responses to the research questions:

* We estimate that the vast majority of ENERGY STAR-certified clothes dryers are paired with ENERGY STAR-certified clothes washers. While our survey results show there are few ENERGY STAR clothes dryers in the installed base (compared to ENERGY STAR clothes washers), every ENERGY STAR clothes dryer that the research team was able to verify as ENERGY STAR was paired with an ENERGY STAR clothes washer (i.e., 100% of ENERGY STAR clothes dryers were paired with ENERGY STAR clothes washers).
* Across all dryer types, we estimate that in PG&E service territory, roughly two-thirds (66.1%) are installed in conditioned space, while 33.9% are installed in unconditioned space. This value was not substantially different between electric dryers (68.2% installed in conditioned space) and gas dryers (63.6% installed in conditioned space).
* We estimate that just over 70% of compact clothes dryers are paired with compact clothes washers. However, due to the low incidence of compact clothes dryers, this estimate is based on a small number of observations (*n* = 29).

In conducting this research, we also note the following observations:

* The market saturation (installed base) of residential ENERGY STAR-certified clothes dryers is low (in the range of 3%-8%). In comparison, we estimate the saturation (installed base) of ENERGY STAR-certified clothes *washers* to be much higher (in the range of 60%). This is not surprising, given that the ENERGY STAR specification for clothes washers has been in place since 1997, while the specification for clothes dryers has only been in place since 2015.
* Across all dryer types, survey results show that two-thirds (67.4%) of clothes dryers were purchased at the same time as the clothes washers with which they were paired. This is generally in line with other sources, which suggest washers and dryers are frequently purchased together.[[4]](#footnote-5)

Research Approach

As shown in Table 2, the approach to answering the research questions outlined above was a combination of secondary and primary research. Below we briefly describe each of the research activities, what we aimed to determine from each activity, and the challenges associated with them.

Table : Research Activities by Research Question

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Research Question | Research Activities | | | |
| Secondary Research | | | Primary Research |
| Review of CLASSa | Review of NEEA Field Studyb | Review of ENERGY STAR Datac | Customer Survey |
| 1. What is the efficiency of washers paired with program-qualified dryers (by type)? | X | X | X | X |
| 2. What fraction of dryers (by type) are installed in conditioned vs. unconditioned space? |  | X |  | X |
| 3. What types of washers are paired with compact dryers (by type)? |  |  |  | X |

a KEMA, Inc. (2012). *WO21: Residential On-site Study: California Lighting and Appliance Saturation Study.* Available: <http://www.calmac.org/publications/2014.11_24_WO21_CLASS_Final_Report_Clean.pdf>

b Ecotope Inc. (2014). *Dryer Field Study Report #E14-287*. Northwest Energy Efficiency Alliance. Available: <https://www.neea.org/docs/default-source/reports/neea-clothes-dryer-field-study.pdf>

c ENERGY STAR Unit Shipment Data. Available: <https://www.energystar.gov/index.cfm?c=partners.unit_shipment_data>

### Approach: Secondary Research

Our review of secondary research included the sources shown in the table above and some additional studies that we found in our literature review from Oak Ridge National Laboratory[[5]](#footnote-6) and the California Urban Water Conservation Council.[[6]](#footnote-7)

### Approach: Primary Research

For Research Questions 1 and 2, primary data was collected to supplement the existing secondary data. For Research Question 3 (“What types of washers are paired with compact dryers (by type)?”), we relied solely on primary data collected from customers.

To collect primary data in a cost-effective manner, the research team conducted a web survey with a random sample of customers in the PG&E service territory. We utilized an online panel approach for our survey, specifically PG&E’s Customer Voice Online Panel. This online panel consists of a sample universe of about 10,200 PG&E residential customers with email addresses who have elected to participate in online surveys and discussions without compensation.

Original Sample Design

There were three dryer-type dimensions that we considered as part of the original sample design:

* Fuel source (gas vs. electric)
* Venting (ventless vs. vented)
* Size (compact vs. standard)

In our research plan, we anticipated the need to use a stratified sample design, as shown below in Table 3. Because the resulting metric of interest is proportional (i.e., the proportion of ENERGY STAR dryers paired with ENERGY STAR vs. non-ENERGY STAR washers for each type of dryer), the required sample sizes (*n*) were based on a standard sample size calculation for proportional data collection with a slight oversample in each category to allow for the possibility that some data might be invalid.[[7]](#footnote-8)

Table . Original Proposed Sample Stratification by Dryer Type

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ENERGY STAR? | Fuel Source | Venting | Size | Stratum ID | Target Sample Size (n) |
| Y | Electric | Vented | Standard | 1 | 100 |
| Compact | 2 | 100 |
| Ventless | Standard | 3 | 100 |
| Compact | 4 | 100 |
| Gas | Vented | n/a | 5 | 100 |

Because we were only interested in customers who had an ENERGY STAR clothes dryer, we included a screening question asking respondents in which year they purchased their clothes dryer.[[8]](#footnote-9) We also asked if respondents believe their dryer and/or washer are ENERGY STAR-certified. However, based on early findings, the study design needed to be revised.

Revised Sample Design

Based on data from three soft launches of the online survey, we determined that the incidence rates for several of the strata in Table 3 were too low to achieve the target sample sizes. Specifically, we found that most clothes dryers (97%) were either electric vented standard or gas vented units. The remaining 3% were electric ventless standard units. Data from these soft launches also indicated that approximately 5% of respondents in the PG&E territory had ENERGY STAR dryers. This finding was supported by calculations using 2015 ENERGY STAR shipment data, in which we estimated that the current national market penetration (installed base) of ENERGY STAR clothes dryers to be similarly low – around 3%.[[9]](#footnote-10) This is not unexpected given the fact that the first version of the clothes dryer ENERGY STAR criteria was released in January of 2015, and supports our finding that the incidence of ENERGY STAR dryers across the California population is quite low. Given the low national market penetration of ENERGY STAR dryers and the low incidence of ENERGY STAR dryers encountered in the soft launch, we estimated that we would need to survey hundreds of thousands (or even millions of people) to fill all the strata in Table 3. As this approach would not be cost effective, we modified the sample design accordingly:

* Instead of attempting to achieve a high degree of confidence and precision for the ENERGY STAR version of each dryer type as shown in Table 3, we recognized that a necessary first step in this research was to better understand the relative proportions for all dryers (ENERGY STAR and conventional) in the California population as a whole.
* As such, we modified the survey instrument to accept responses from all respondents who have a dryer, not just those with ENERGY STAR dryers, and decreased the number of strata in the sample design to two (instead of the five strata in the original sample design). This allowed us to retain a reasonable degree of confidence and precision across electric and gas dryer types without setting overly-specific quotas for substrata.

These changes to the research approach meant that we were able to collect data on all dryers, and could better understand how ENERGY STAR clothes dryers are situated within the larger population of clothes dryers. Our final sample design is the same as that shown in Table 3 above, except that we include both ENERGY STAR and non-ENERGY STAR dryers. The final sample design is shown in Table 4.

Table . Revised Sample Design

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ENERGY STAR? | Fuel Source | Venting | Size | Stratum ID | Target Sample Size (n) |
| Both | Electric | Vented | Standard | 1 | 100 |
| Compact |
| Ventless | Standard |
| Compact |
| Gas | Vented | n/a | 2 | 100 |

Research Results

In this section we first discuss the results of our review of secondary research and then present the findings from our survey.

### Results: Secondary Research

Our secondary research did not directly answer any of the research questions, but provided us with valuable information to check our primary research results and workpaper assumptions against. Key findings include:

* The literature review indicates that the current market penetration (across all dryer types) of ENERGY STAR clothes washers in California is somewhere around 60%.
* The literature reviewed shows that 89% of the sites surveyed in a study done in the Pacific Northwest had laundry equipment in conditioned space.

We provide more details on these findings below.

The CLASS data and ENERGY STAR shipment data provided some useful information with respect to Research Question 1: *What is the efficiency of washers paired with program-qualified dryers (by type)?* The CLASS study[[10]](#footnote-11) reports that 41% of the clothes washers sampled exceeded the ENERGY STAR minimum requirement in effect in 2012. An ENERGY STAR Clothes Washer Product Snapshot[[11]](#footnote-12) indicates a sales penetration of ENERGY STAR-certified clothes washers in California of around 50% in 2006.[[12]](#footnote-13) At the national level, the EPA’s 2015 Unit Shipment and Market Penetration Report[[13]](#footnote-14) estimates that the sales penetration of ENERGY STAR clothes washers is 56% -- though we expect California’s sales penetration to be higher than this given that California is one of the most active ENERGY STAR markets in the country.[[14]](#footnote-15)

We used these findings to check the validity of our survey research findings. Given that the annual sales penetration of ENERGY STAR clothes washers increased from 50% in 2006 to 56% in 2015, we compute an average sales penetration of 53% for that period. If we assume that roughly 10% of clothes washers are replaced each year on average,[[15]](#footnote-16) we can estimate the current market penetration as 41% (market saturation in 2012 + 9% (replaced per year) x 53% (percentage of replacements that are ENERGY STAR) x 4 years ≈ 60%).

The NEEA 2014 Dryer Field study looked at the location of laundry equipment within the house, which is related to Research Question 2. The study found that 89% of the sites surveyed had laundry equipment in the house or a conditioned basement. This serves as a point of comparison for our findings from the survey.

### Results: Primary Research

The web survey was sent to 6,039 panelists during the month of September 2016. Table 4 shows the final dispositions of the survey invites. Out of these 6,039 invites, 1,827 respondents began the survey and 647 respondents completed the survey, resulting in a 10% completion rate. Not included in the 647 respondents were 97 respondents who were screened out because they indicated they had neither a washer nor dryer and 2 respondents who only had a clothes washer.

Table . Online Survey Dispositions

|  |  |
| --- | --- |
| Invites Sent | 6,039 |
| Started | 1,827 |
| Did Not Complete | 1,178 |
| Completed + Screened Out | 746 |
| Completed + Had Dryer | 647 |
| Completion Rate | 10.7% |
| Median Length | 13.5 minutes |

Of the 1,178 respondents who started but did not complete the survey, many did not make it past the first two questions while a number of others made it nearly to the end of the survey, but dropped out prior to a question asking them to submit photos of their washer and dryer:

* Roughly 35% dropped out prior to answering the screening question.
* 16% dropped out at various points during the main question sequence. The remainder (49%) dropped out during the question sequence asking them to upload photos of their washer or dryer. A preliminary assessment showed that including these incompletes would not change the interpretation of the final results. Since we would be unable to verify these respondents’ model numbers, we thus chose not to include them in the final analysis.

The prevalence of ENERGY STAR washers across all 647 respondents who completed the survey (regardless of dryer type) is 71%. This estimate is close to that of our market saturation estimate, based on CLASS data and ENERGY STAR unit shipment data, of 60%.

Compared to clothes washers, the prevalence of ENERGY STAR clothes dryers is low. As shown in Table 5, of the 647 respondents with a clothes dryer, 112 respondents (17.3%) believed they had an ENERGY STAR clothes dryer. However, after manually reviewing these models, the research team determined that in fact only 46 (7.1%) of the dryers were ENERGY STAR-certified.

Table . Reported vs. Confirmed Prevalence of ENERGY STAR-Certified Clothes Dryers

|  |  |  |
| --- | --- | --- |
|  | N | Percentage |
| All Dryers | 647 | 100% |
| Dryer Purchased Prior to 2014 | 535 | 83.7% |
| Dryer Purchased 2014 or Latera | 112b | 17.3% |
| Dryer Confirmed as ENERGY STAR | 46 | 7.1% |

a Analysis of the EPA Qualified Product List indicated that several certified clothes dryer models were available on the market beginning in 2014, although the specification did not take effect until 2015.

b The research team performed manual model matching on all 112 dryers purchased in 2014 or later to confirm whether or not they were in fact on the ENERGY STAR QPL. Models with a purchase date of “Don’t know” were also manually verified, none of which turned out to be ENERGY STAR.

Overall frequencies for all dryers from the online survey are shown below in Table 6.

Table . Survey Frequencies by Dryer Types

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Fuel Source | Type | Size | N | Percentage |
| Electric | Vented | Compact | 20 | 3.1% |
| Standard | 316 | 48.9% |
| Unknown | 3 | 0.5% |
| Ventless | Compact | 4 | 0.6% |
| Standard | 1 | 0.2% |
| Unknown | 0 | - |
| Gas | Vented | Compact | 5 | 0.8% |
| Standard | 290 | 44.9% |
| Unknown | 7 | 1.1% |
| **Total** | | | ***646a*** | ***100%*** |

a One dryer was unable to be categorized into any of these categories and was thus excluded from this table.

To answer Research Question #1­ (“What is the efficiency of washers paired with program-qualified dryers, by type?”), we first broke out the 46 ENERGY STAR clothes dryers by fuel source, vent type (vented vs. ventless), and size. Then, within each of these groups, we computed the percentage of ENERGY STAR dryers that are paired with ENERGY STAR washers (vs. conventional washers). As shown in Table 7, among the dryers that we confirmed to be ENERGY STAR-certified, 100% of these units were paired with ENERGY STAR washers -- in no instance was an ENERGY STAR clothes dryer paired with a conventional clothes washer (although we were unable to verify the ENERGY STAR status of two washers).

Table . Breakdown of ENERGY STAR Clothes Dryers Paired with ENERGY STAR Washers

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ES Dryer? | Fuel Source | Type | Size | Na | Percentage |
| Y | Electric | Vented | Compact | - | - |
| Standard | 27 | 58.7% |
| Unknown | 2 | 4.3% |
| Ventless | Compact | 2 | 4.3% |
| Standard | - | - |
| Unknown | - | - |
| Gas | Vented | Compact | - | - |
| Standard | 15 | 32.6% |
| Unknown | - | - |
| **Total** | | | | ***46*** | ***100%*** |

a The research team verified that 44 of the 46 washers that respondents claimed were ENERGY STAR were in fact ENERGY STAR washers. Two models contained incomplete or inaccurate model numbers and could not be verified.

To answer Research Question #2­ (“What fraction of dryers, by type, are installed in conditioned vs. unconditioned space?”), we broke out the ENERGY STAR clothes dryers by fuel source and examined the number in conditioned vs. unconditioned space. As shown in Table 8, when looking at all dryers, there appears to be minimal differences between electric and gas clothes dryers being placed in conditioned space (68.2% of electric dryers and 63.6% of gas dryers). Overall, 66.1% of dryers were installed in conditioned space.[[16]](#footnote-17)

Table . Breakdown of All Clothes Dryers in Conditioned vs. Unconditioned Space by Type

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Fuel Source | Type | Size | Conditioned | | Unconditioned | | Unknown | Total |
| **N** | **Percentage** | **N** | **Percentage** | **N** | **N** |
| Electric | Vented | Compact | 17 | 85.0% | 3 | 15.0% | - | 20 |
| Standard | 208 | 67.3% | 101 | 32.7% | 7 | 316 |
| Unknown | 2 | 66.7% | 1 | 33.3% | - | 3 |
| Ventless | Compact | 2 | 50.0% | 2 | 50.0% | - | 4 |
| Standard | 1 | 100% | - | 0% | - | 1 |
| Unknown | - |  | - |  | - | 0 |
| Gas | Vented | Compact | 4 |  | - |  | 1 | 5 |
| Standard | 181 | 63.1% | 106 | 36.9% | 3 | 290 |
| Unknown | 4 | 66.7% | 2 | 33.3% | 1 | 7 |
| **Total** | | | **419** | 66.1% | **215** | 33.9% | **12** | **646** |

When looking only at ENERGY STAR dryers (Table 9), we see that a slightly higher percentage of electric dryers are installed in conditioned spaces (72.4%) compared to gas dryers (53.3%).

Table . Breakdown of ENERGY STAR Clothes Dryers in Conditioned vs. Unconditioned Space by Type

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ES Dryer? | Fuel Source | Conditioned | | Unconditioned | | Unknown | Total |
| **N** | **Percentage** | **N** | **Percentage** | **N** | **N** |
| Yes | Electric | 21 | 72.4% | 8 | 27.6% | 2 | 31 |
| Gas | 8 | 53.3% | 7 | 46.7% | - | 15 |
| Don’t know | - | - | - | - | - | - |
| **Total** | **29** | **-** | **15** | **-** | **2** | **46** |

To answer Research Questions #3 (“What types of washers are paired with compact dryers, by type?”), we looked at the size of clothes washers (compact vs. standard) paired with compact clothes dryers. As shown in Table 10, overall 72.4% of compact clothes dryers are paired with compact clothes washers. We do not provide this table for ENERGY STAR dryers because the sample sizes are too small to draw meaningful conclusions.

Table . Pairing of Compact Clothes Dryers with Compact vs. Standard Clothes Washers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Fuel Source | Type | Size | Compact Washer | | Standard Washer | | Total |
| **N** | **Percentage** | **N** | **Percentage** | **N** |
| Electric | Vented | Compact | 14 | 70.0% | 6 | 30.0% | 20 |
| Ventless | Compact | 2 | 50.0% | 2 | 50.0% | 4 |
| Gas | Vented | Compact | 5 | 100.0% | 0 | - | 5 |
| **Total** | | | **21** | **72.4%** | **8** | **27.6%** | **29** |

We also examined the extent to which clothes dryers and clothes washers are purchased together. As shown in Table 11, across all dryer types, two-thirds (67%) of clothes dryers were purchased at the same time as the clothes washers with which they were paired.

Table . Clothes Dryers Purchased as Pair with Clothes Washers by Dryer Type

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Fuel Source | Type | Size | Purchased as Pair | | Not Purchased as Pair | | Unknown Purchase Status | Total |
| **N** | **Percentage** | **N** | **Percentage** | **N** | **N** |
| Electric | Vented | Compact | 17 | 89.5% | 2 | 10.5% | 1 | 20 |
| Standard | 212 | 68.8% | 96 | 31.2% | 8 | 316 |
| Don’t Know | 1 | 50.0% | 1 | 50.0% | 1 | 3 |
| Ventless | Compact | 1 | 25.0% | 3 | 75.0% | 0 | 4 |
| Standard | 1 | 100.0% | 0 | 0.0% | 0 | 1 |
| Gas | Vented | Compact | 4 | 100.0% | 0 | 0.0% | 1 | 5 |
| Standard | 182 | 64.8% | 99 | 35.2% | 8 | 289 |
| Don’t Know | 2 | 40.0% | 3 | 60.0% | 1 | 6 |
| **Total** | | | **421** | **67.4%** | **204** | **32.6%** | **20** | 32.6% |

a Two respondents had clothes dryers only and were not included in this table.

### Impact of Results on RPP Workpaper

At a high level, this effort has the following impacts on the workpaper:

* The workpaper assumption that all dryers are paired with ENERGY STAR washers is reasonable given the finding that 100% of ENERGY STAR dryers were paired with ENERGY STAR washers and 71% of all dryers were paired with ENERGY STAR washers. This is also confirmed by the finding that 67% of clothes dryers were purchased at the same time as the clothes washers with which they were paired (i.e. new ENERGY STAR dryers are likely to be purchased along with ENERGY STAR washers).
* To determine the appropriate remaining moisture content (RMC) at the beginning of the drying cycle, the workpaper currently assumes that all dryers, including compact dryers, are paired with standard-sized ENERGY STAR washers. The finding that 72% of compact dryers are paired with compact washers should be used to develop a weighted UES for compact dryers.
* We recommend that the finding that 66% of dryers are in conditioned space be used to refine the application of interactive effects.

These impacts are discussed more in depth below.

Currently, the RPP workpaper assumes all dryers are paired with ENERGY STAR washers (both baseline and measure-case). This has an effect on the UES because ENERGY STAR washers are designed to extract more water from laundered clothes than less efficient models. Consequently, dryers paired with ENERGY STAR washers expend less energy drying clothes than dryers paired with less efficient models. This is currently accounted for in the workpaper by applying a factor to the UES that reflects the fact that clothes entering the dryer after being washed in ENERGY STAR washers have a lower remaining moisture content (RMC) than clothes washed in less efficient washers. The results of this survey indicate that across all dryer types, 71% of dryers are paired with ENERGY STAR washers and 100% of ENERGY STAR dryers were paired with ENERGY STAR washers. In addition, 67% of clothes dryers were purchased at the same time as the clothes washers with which they were paired, meaning that new ENERGY STAR dryers are likely to be purchased along with new ENERGY STAR washers. That said, **the workpaper assumption that all dryers are paired with ENERGY STAR washers is a reasonable approach.**

In the current RPP workpaper, both standard-sized and compact dryers are assumed to be paired with standard-sized washers. The initial remaining moisture content used in the calculations is for standard-sized washers. Given the survey finding that 72.4% of compact clothes dryers are paired with compact washers, **it would be more accurate to develop a weighted UES for compact dryers where an initial RMC of 45% (for compact ENERGY STAR washers, taken from the 2012 DOE Technical Support Document) is applied to 72.4% of the value and an initial RMC of 35% (for standard-sized ENERGY STAR washers, taken from the 2012 DOE Technical Support Document) is applied to the remaining 27.6%**

The workpaper currently applies interactive effects to 100% of the energy used by ventless dryers and 20%[[17]](#footnote-18) of the energy used by vented dryers. Given the survey finding that 66.1% of dryers are in conditioned space, **it would be more accurate to develop weighted UESs for each dryer type where interactive effects are applied to 66.1% of the value and no interactive effects are applied to the remaining 33.9%.**

1. In its disposition letter, the CPUC-ED also requested additional research on air cleaners, soundbars, and research into product-specific market barriers preventing increased adoption of RPP measures. This memo only covers the clothes dryer research. [↑](#footnote-ref-2)
2. Note that research questions are different from survey questions. Survey questions were developed with the goal of obtaining the desired information from respondents given their understanding (or lack thereof), perceptions, attitudes, and awareness of the products and programs in question. [↑](#footnote-ref-3)
3. The reduction from ALL twelve possible pairing/purchasing scenarios to the two noted in the table above that are relevant to the RPP program is outlined in the *March 31, 2016 Pacific Gas and Electric Company Retail Product Platform Clothes Dryer Research Plan*. [↑](#footnote-ref-4)
4. For instance: Evergreen Economics, Inc. (2016). *Characterization of the Super-Efficient Dryer Market.* Available: <https://neea.org/docs/default-source/reports/characterization-of-the-super-efficient-dryer-market.pdf?sfvrsn=6> [↑](#footnote-ref-5)
5. Tomlinson, J., & Rizy, T. (1998). *Measured impacts of high efficiency domestic clothes washers in a community* (No. ORNL/CP--98781; CONF-980815--). Oak Ridge National Lab., Energy Div., TN (United States). Available: <http://aceee.org/files/proceedings/1998/data/papers/1007.PDF> [↑](#footnote-ref-6)
6. Western Policy Research (2014). BMP Cost and Savings Study Update. California Urban Water Conservation Council. Available: [http://cuwcc.org/Portals/0/Document Library/Resources/Publications/Cost and Savings Studies/BMP Cost and Savings Report Update 2014 - Phase 1.pdf?timestamp=1427997149163](http://cuwcc.org/Portals/0/Document%20Library/Resources/Publications/Cost%20and%20Savings%20Studies/BMP%20Cost%20and%20Savings%20Report%20Update%202014%20-%20%20Phase%201.pdf?timestamp=1427997149163) [↑](#footnote-ref-7)
7. This might include respondents who mistakenly thought their dryer was a certain type (e.g., electric vented) but was actually a different type (e.g., electric ventless) or missing data. [↑](#footnote-ref-8)
8. Note that the first ENERGY STAR specification for clothes dryers went into effect January 1, 2015, so owners of ENERGY STAR clothes dryers will have purchased them relatively recently. [↑](#footnote-ref-9)
9. 2015 ENERGY STAR shipment data estimated sales penetration to be 15%-17% for qualified clothes dryers. Assuming that 10% of the residential clothes dryer stock turns over each year, and given that ENERGY STAR dryers have only been available since 2015, this corresponds to: roughly 2 years since introduction of ENERGY STAR dryers \* 10%/year \* 16% (mean sales penetration) ≈ 3% market saturation in the residential installed base. [↑](#footnote-ref-10)
10. KEMA, Inc. (2012). *WO21: Residential On-site Study: California Lighting and Appliance Saturation Study.* Available: <http://www.calmac.org/publications/2014.11_24_WO21_CLASS_Final_Report_Clean.pdf> [↑](#footnote-ref-11)
11. D&R International (2008). ENERGY STAR Clothes Washer Product Snapshot. Available: <https://www.energystar.gov/ia/partners/reps/pt_reps_res_retail/files/CW_ProductSnapshot_May08.pdf> [↑](#footnote-ref-12)
12. The research team was unable to find any other, more recent data on the California market. [↑](#footnote-ref-13)
13. ENERGYSTAR.GOV (2016). ENERGY STAR® Unit Shipment and Market Penetration Report Calendar Year 2015 Summary. Available: <https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2015_USD_Summary_Report.pdf?5f2b-363b> [↑](#footnote-ref-14)
14. For more information, see: <http://aceee.org/files/proceedings/2008/data/papers/6_262.pdf> [↑](#footnote-ref-15)
15. The 9% per year figure is generally consistent with the DEER effective useful life (EUL) assumption of 11 years for clothes washers used in single-family homes. [↑](#footnote-ref-16)
16. In this survey, we found that 66.1% of all dryers are in conditioned space. This is lower than the value of 89% from the NEEA study from the Pacific Northwest discussed previously. However, this may not be surprising given the difference in weather patterns between California (generally warmer and sunnier) and the Pacific Northwest (generally colder and wetter). [↑](#footnote-ref-17)
17. The 20% factor is taken from the DEER values for the internal gain fractions for residential appliances. [↑](#footnote-ref-18)