

Workpaper PGECOAPP128

Retail Plug Load Portfolio



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Presentation Overview

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Objective: Seeking TF approval of interim workpaper

- Program Description
 - Program Overview
 - Products Included in the 2015 Portfolio
 - Units, Measure Application and Delivery Type, Eligibility, and Target Markets
- Measure/Program Description
- Cal TF Involvement with RPP
- Market Potential
- Savings Potential
- Key Parameters
 - Net-to-Gross Ratios (NTGRs)
 - Incremental Measure Cost (IMCs)
 - Estimated Useful Life (EULs)
- Workpaper Methodology
- Additional Data Needs
- Questions or Comments

RPP Program Overview

- **Retail Plug-Load Portfolio (RPP) Program Overview**
 - ❑ Plug loads represent a significant and growing portion of residential electricity consumption.
 - ❑ The RPP Program uses retailer incentives and standards advocacy to increase demand for and supply of energy-efficient models of targeted plug load products.
 - ❑ Traditional downstream programs are not cost-effective because the per-unit energy savings—and therefore the associated rebates—are small.
 - ❑ The theory is that, with a combination of incentives and engagement, retailers will assort, stock, and promote more energy efficient models than they would have absent the RPP program.
 - ❑ Changes in retailer practices will generate energy savings as customers become motivated to purchase and install a greater proportion of more efficient products.
 - ❑ The long-term objective is *market transformation*—sustainable changes in the structure and functioning of the market—both through promotion of higher efficiency standards and through self-sustaining increases in supply and demand for increasingly energy-efficient products among both participating and non-participating retailers.

Cal TF Involvement with RPP

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- ✓ RPP Workpaper Development Process: Recap of Meetings-to-Date with the Cal TF
 - ❑ Initial presentation of RPP program design (7/23/2014)
 - ❑ Proposed UEC and modified work paper template to accommodate market transformation objectives (9/25/2014)
 - ❑ Proposed methods for NTGRs, EULs, and IMCs (10/23/2014)
 - ❑ Bass diffusion model for estimating NTGRs (11/21/2014)
 - ❑ Web harvester approach for estimating IMCs (12/4/2014)
 - ❑ Presentation of the interim workpaper (2/26/2015)

Cal TF Involvement with RPP (Cont.)

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- ✓ Recap of key suggestions and issues from Cal TF on RPP methodology and resulting actions taken by PG&E
 - Use DEER UEC and UES values if available
 - Calculation approach revised to use DEER values when present (freezers).
 - UEC/UES methods revised to be consistent with DEER approach (i.e., measure-level).
 - Document all sources of parameter estimates to ensure that there was not a systematic bias in the sources used for the values selected
 - The final workpaper will include a bibliography of all credible sources identified for estimates.
 - Describe decision rules for the selection and updating of parameter estimates
 - To ensure transparency, the final workpaper will include a discussion of decision rules used for the selection of parameter estimates.
 - UEC/UES values to be updated on an annual basis. Other parameters to be updated as data become available.
 - Provide estimates of market potential for each measure in the initial RPP portfolio.
 - The final workpaper will include estimates of market potential, both at the RPP portfolio level and at product-category levels.

Cal TF Involvement with RPP (Cont.)

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- ❑ Suggestions to ensure that the Generalized Bass Diffusion Model is accurately calibrated
 - The workpaper will include a discussion of how the various parameters in the Generalized Bass Diffusion Model will be updated annually using the best available data (e.g., recorded sales and current incremental costs).
- ❑ Examine methodologies used in the recent CPUC Measure Cost Study (MCS) to ensure that the IMC estimates derived from the web harvester methodology will be as comparable as practical given its constraints
 - The workpaper will include a discussion of the methods used in the MCS Study and how those methods, to the extent possible, will be used to estimate the incremental costs of products in the RPP Program.
- ❑ Estimate whether the portfolio of products comprising the 2015 RPP trial, and the portfolio likely to comprise the 2016 program, will be considered High-Impact Measures (HIMs).
 - The workpaper will include a discussion regarding the likelihood of that the portfolio of products in the RPP Program will achieve HIM status in the short-, mid- and long-terms.
- ❑ Given the importance of forecasting future sales of program-qualified units *with* and *without* the program in the estimation of the NTGRs, include a detailed description of these forecasting methods.
 - The workpaper will include a discussion of the methods for estimating and annually updating the NTGRs.

Proposed Template Modifications

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- The RPP Program involves multiple product categories and parameters that will be updated at least annually.
- Relying on the traditional workpaper process to review and approve these updates would be onerous for all parties
- Given this, we propose the following modifications to the standard workpaper template:
 - The main body of the workpaper would include an overview of the RPP Program and a discussion of methods for estimating key parameters
 - There would be an appendix for each product category that would include all the proposed parameters and sources
- If these modifications to the standard workpaper were implemented, updates to any parameter for any given product category (as well as the addition of new product categories) could be accomplished more easily since the entire workpaper would not have to be re-reviewed.

Program Description (Cont.)

- **Products to be Included in the 2015 RPP Portfolio:**
 - ❑ Freezers
 - ❑ Electric Clothes Dryers
 - ❑ Room Air Cleaners
 - ❑ Home Theaters in a Box (HTiBs)
 - ❑ Sound Bars
- **Units**
 - ❑ Per unit
- **Measure Application and Delivery Type**
 - ❑ Midstream Deemed (ROB/New Construction/Additions)
- **Eligibility**
 - ❑ Climate Zones: All
 - ❑ Building Types: All
- **Target Markets**
 - ❑ Residential home appliance market
 - ❑ Residential consumer electronics market

Measure/Program Description

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Base Case

Conventional (i.e., non-ENERGY STAR) consumer electronics and home appliances

Measure Case

Consumer electronics and home appliances meeting and/or exceeding ENERGY STAR specifications

Market Potential

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Estimated Household Saturation

Product	Household Saturation 2015 (All IOUs)
Electric Clothes Dryers	27%
Air Cleaners	9%
Sound Bars	23%
HTiB	4%
Freezers	15%

Source: Residential Solutions Workbook (Research Into Action, 2014)

Estimated Annual Percentage Increase in Saturation

Product	Estimated Annual Percentage Increase
Electric Clothes Dryers	0.33%
Air Cleaners	0.50%
Sound Bars	2.00%
HTiB	2.00%
Freezers	0.17%

Source: Residential Solutions Workbook (Research Into Action, 2014).

Note: Values were not available for sound bars and HTiBs; assumed 2% increase.

Market Potential (cont.)

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Estimated National Market Share of Participating Retailers

Product	Retailer 1	Retailer 2	Retailer 3	Retailer 4	TOTAL
Electric Clothes Dryers	20.0%	30.0%	0.3%	10.0%	60.3%
Air Cleaners	12.0%	12.0%	0.5%	5.0%	29.5%
Sound Bars	0.0%	5.0%	1.0%	30.0%	36.0%
HTIB	0.0%	5.0%	1.0%	30.0%	36.0%
Freezers	15.0%	35.0%	1.5%	5.0%	56.5%

Source: PG&E internal market characterization research

Market Potential (cont.)

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$$P_t = \left(\frac{S_t \times HH_t \times RS}{EUL} \right)$$

where

P_t = Purchases of product at time t

S_t = Household saturation of product in PG&E households at time t

HH_t = Households in PG&E service territory at time t

RS_t = Retailers' (either participating or nonparticipating) share of the market

EUL = Effective useful life

Long-Term Forecasts of Total Product Sales within the PG&E Service Territory

Year	Air Cleaners		Sound Bars		HTIB		Freezers		Clothes Dryers	
	Participating Retailers	Nonparticipating Retailers	Participating Retailers	Nonparticipating Retailers	Participating Retailers	Nonparticipating Retailers	Participating Retailers	Nonparticipating Retailers	Participating Retailers	Nonparticipating Retailers
2015	20,766	49,627	127,613	226,867	95,031	168,943	42,032	32,361	74,282	48,906
2016	21,904	52,346	134,719	239,500	101,726	180,847	43,019	33,121	76,113	50,111
2017	23,068	55,129	141,992	252,431	108,582	193,035	44,027	33,897	77,984	51,342
2018	24,260	57,978	149,438	265,667	115,603	205,516	45,056	34,689	79,894	52,600
2019	25,480	60,894	157,060	279,217	122,792	218,297	46,108	35,499	81,846	53,885
2020	26,729	63,879	164,862	293,089	130,155	231,386	47,182	36,326	83,839	55,198
2021	28,000	66,914	172,797	307,195	137,652	244,715	48,264	37,159	85,849	56,521
2022	29,297	70,016	180,906	321,610	145,318	258,343	49,365	38,007	87,897	57,869
2023	30,624	73,185	189,191	336,340	153,155	272,275	50,487	38,871	89,983	59,242
2024	31,978	76,423	197,657	351,390	161,166	286,518	51,630	39,750	92,107	60,641
2025	33,363	79,731	206,306	366,766	169,355	301,076	52,793	40,646	94,270	62,065
2026	34,777	83,110	215,141	382,473	177,725	315,956	53,977	41,557	96,474	63,516
2027	36,221	86,562	224,166	398,518	186,279	331,163	55,183	42,486	98,717	64,993
2028	37,696	90,087	233,385	414,907	195,020	346,703	56,410	43,431	101,003	66,498
2029	39,203	93,688	242,800	431,645	203,952	362,582	57,660	44,393	103,330	68,030

Source: PG&E internal market characterization research

Savings Potential

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Maximum Market-Level Lifecycle and First-Year GWH Potential

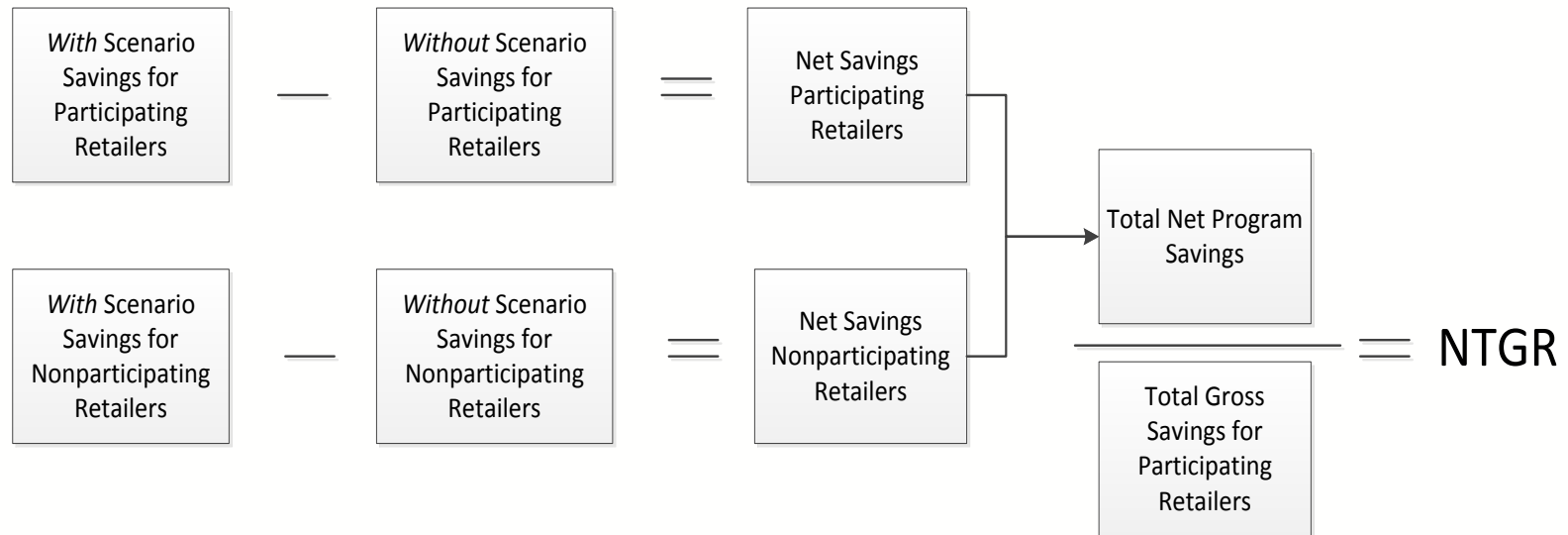
Product Category	Maximum Market-Level Lifecycle Potential (GWH)	Maximum Market-Level First-Year Annual Potential (GWH)
Electric Clothes Dryers	4,214.4	351.2
Air Cleaners	3,070.5	341.2
Sound Bars	3,513.8	502.0
HTiB	771.2	110.2
Freezers	463.0	42.1
TOTAL	12,033.0	1,346.6

- These values represent the sum of the number of units sold each year (both program- and non-program-qualified models) x UES x EUL.
- Revised estimates will be provided as available.

Net-to-Gross Ratios

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- RPP Program will utilize the Generalized Bass Diffusion Model to estimate RPP market share with and without the program
- Market share is defined as the percent of program qualified models in a given year that meet or exceed the RPP Program specification as it was defined in 2015 when the program launched



Net-to-Gross Ratios

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Generalized Bass Diffusion Model

$$N_t = pMP^{-e}A^fB^g + (1 + q - p)N_{t-1} - \left(\frac{q}{MP^{-e}A^fB^g}\right)N_{t-1}^2$$

where:

N_t = Percentage of energy-efficient products sold at time t

P = Coefficient of innovation

Q = Coefficient of imitation

M = Total potential ratio of sales of energy-efficient products to total sales

N_0 = Percentage of energy-efficient products sold at time 0.

P_0 = Ratio of price for energy-efficient product to price for standard product at time 0

E = Coefficient of sensitivity (elasticity) for price term

A_0 = Ratio of advertising expenditure with the program to without the program at time 0

F = Coefficient of sensitivity (elasticity) for advertising

B_0 = Ratio of energy-efficient assortment with the program to without the program at time 0

G = Coefficient of sensitivity (elasticity) for assortment

N_{t-1} = Percentage of energy-efficient products sold in the previous period

Net-to-Gross Ratios

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- Final NTGRs will be based on the results of Monte Carlo simulations
- Goal is to set bounds within which families of possible diffusion curves might exist
- For each product category, the NTGR that best represents the central tendency of the distribution of estimates will be presented in the final workpaper

Product Category	NTGR	Mean	Median	Mode	Standard Deviation
Air Cleaners	TBD	TBD	TBD	TBD	TBD
Sound Bars	TBD	TBD	TBD	TBD	TBD
Home Theaters-in-a-Box	TBD	TBD	TBD	TBD	TBD
Freezers	TBD	TBD	TBD	TBD	TBD
Electric Clothes Dryers	TBD	TBD	TBD	TBD	TBD

Incremental Measure Costs (IMCs)

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- IMC is defined as the fraction of cost difference between qualified and non-qualified models that can be attributed to energy efficiency.
- Since most of the RPP product categories have small individual savings and short shelf lives, they have not been covered in traditional measure cost studies.
- Due to the high cost of calculating IMCs using the traditional approach, and the infrequency of new IMC studies, it is unlikely that future measure cost studies will include the product categories for which the RPP program requires IMCs.

IMCs (Cont.)

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- The alternative IMC estimation approach proposed for the RPP Program is *web harvesting* which involves:
 - Ongoing, automated data collection from retailer web sites
 - Retail pricing, brand, model, and relevant product specifications collected from major online web sites
 - Retail prices collected for hundreds (or possibly thousands) of models within a targeted product category at a given point in time to develop large samples in a cost-effective manner
- Using data collected through the web harvesting, IMCs will be developed using *hedonic price modeling* which is the same methodology that is employed by the CPUC's Measure Cost Study
- Hedonic price modeling identifies key drivers of price to determine the fraction of price that is explained by specific variables.
- Because IMCs may change over time, data will be collected on an ongoing basis, reviewed annually, and adjusted as necessary

Effective Useful Life (EUL)

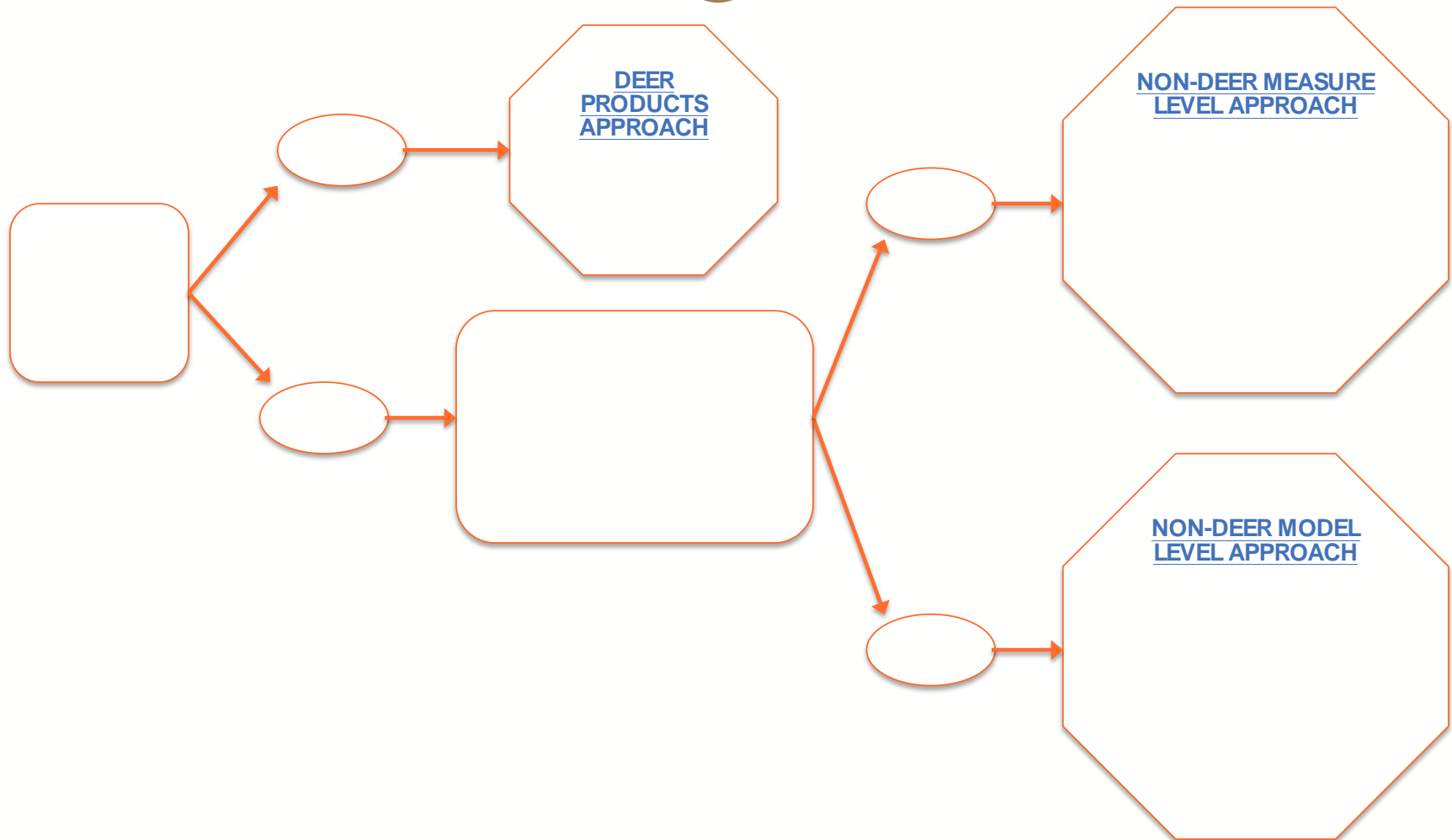
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EUL by Product Category

Product	EUL	Source(s)
Electric Clothes Dryers	12 years	Appliance Magazine
Air Cleaners	9 years	U.S. EPA Appliance Calculator (relies on Appliance Magazine, Portrait of the U.S. Appliance Industry, 1998)
Sound Bars	4 years	2008 Ecos report: video and compact audio 4.4 years; DOE's Energy Conservation Standards Rulemaking – Battery Chargers and External Power Supplies Market Assessment and Product Price Determination Workbook: 4 – 6 years. No additional EUL data for sound bars was found.
HTiB	7 years	U.S. EPA
Freezers	11 years	DEER

Workpaper Methodology: Baseline and Measure

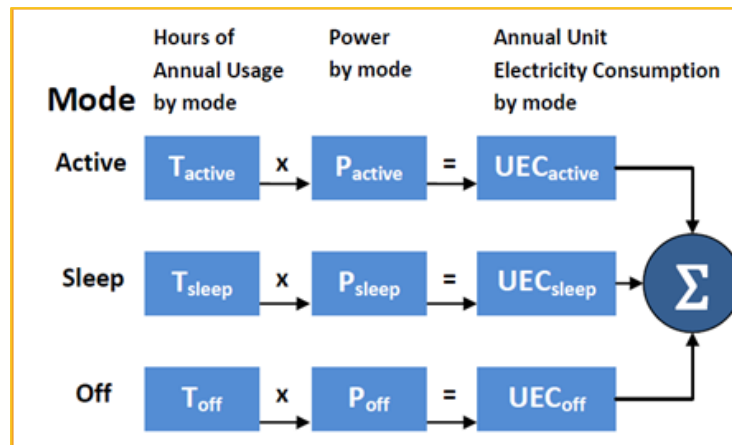
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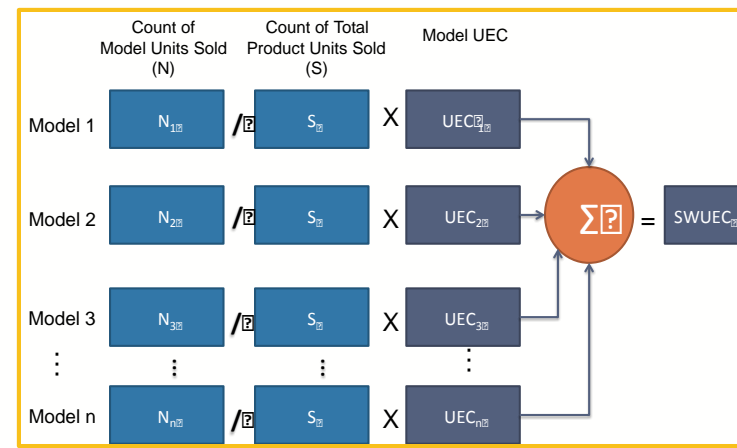
Workpaper Methodology

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Generalized Unit Energy Consumption (UEC) Estimation Methodology



Sales-Weighted Unit Energy Consumption (SWUEC)



Unit Energy Savings (UES)

$$UES_{p,t} = UEC_{Base-Case_{p,t}} - UEC_{Program-Qualified_{p,t}}$$

where:

p = product category or subcategory

t = time period

Additional Data Needs

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- Information to be collected during interim approval
 - NTGRs (all products)
 - IMCs (all products)
 - UESs (air cleaners)
 - Peak demand savings (kw) (all products)
- Data to be collected during implementation for use by program staff and/or evaluators
 - Product sales (at the model level)
 - Market share data
 - UECs
 - UESs
 - EULs
 - IMCs
 - Other metrics, including baselines, as dictated by logic model

Questions or Comments?

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Appendix

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- UES and UEC Values for 2015 RPP Program Product Categories

UES and UES Values: Clothes Dryers

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$$UEC = \frac{\text{cycles} * C}{CEF}$$

where:

UEC = unit energy consumption in kWh

cycles = 283 cycles per year according the DOE test procedure

C = pounds of laundry dried per cycle, 8.45 lbs. for standard dryers and 3 lbs. for compact dryers per ENERGY STAR

CEF = combined energy factor

Electric Clothes Dryers UEC and UES Values

Product Type	Size	Voltage (V)	Base-Case		Program Qualified		UES (kWh/yr)
			CEF	UEC (kWh/yr)	CEF	UEC (kWh/yr)	
Ventless or Vented	Standard*	Any	3.11	769	3.93	608	160
Ventless or Vented	Compact**	120	3.01	405	3.80	223	181
Vented	Compact**	240	2.58	329	3.45	246	83
Ventless	Compact**	240	2.34	363	2.68	317	47

* Standard is 4.4 cu-ft or greater

** Compact is less than 4.4 cu-ft

UEC and UES Values: Air Cleaners

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$$UEC = \frac{P_A * T_A + P_I * T_I}{1000 \text{ Wh/kWh}} \quad \text{and} \quad P_A = \frac{Cap}{Eff}$$

Where:

UEC = unit energy consumption in kWh

P_A = power draw in active mode in watts

T_A = number of hours per year spent in active mode

P_I = power draw in idle mode in watts

T_I = number of hours per year spent in idle mode

Cap = capacity of air cleaner in CADR

Eff = efficiency of air cleaner in CADR/W

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

Air Cleaner Hours of Use Assumptions

Active	Idle
5,840	2,920

Air Cleaner Power Consumption and Efficiency Assumptions

Product Type	Idle Power Consumption (W)	Efficiency (CADR/W)	UEC (kWh/yr)
ENERGY STAR certified Air Cleaner	0.6	3	$(P_A * 5,840) + (1.0 * 2,920) / 1,000$
Conventional Air Cleaner	1	1	$(P_A * 5,840) + (0.6 * 2,920) / 1,000$

The UECs for room air cleaners are calculated at the model level since they depend on the capacity of each unit sold. UESs are then calculated as the difference between the SWUECs for base-case and program-qualified models.

UEC and UES Values: Sound Bars

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$$UEC = \frac{P_A * T_A + P_I * T_I + P_S * T_S}{1000} \text{ Wh/kWh}$$

Where:

UEC = unit energy consumption in kWh

P_A = power draw in active mode in watts

T_A = number of hours per year spent in active mode

P_I = power draw in idle mode in watts

T_I = number of hours per year spent in idle mode

P_S = power draw in sleep mode in watts

T_S = number of hours per year spent in sleep mode

1000 = conversion factor to change from watt-hours

Sound Bar Hours of Use Assumptions

Active	Idle	Sleep
1,580	730	6,450

Sound Bar UEC and UES Values

Product Type	Power Consumption (w)			UEC (kWh/yr)	UES
	Active	Idle	Sleep		
ENERGY STAR	20.2	3.5	0.5	37.5	44.5
Base-Case	30.0	12.0	4.0	82.0	

UEC and UES Values: HTiBs

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$$UEC = \frac{P_{A,HTiB} * T_{A,HTiB} + P_{I,HTiB} * T_{I,HTiB} + P_{S,HTiB} * T_{S,HTiB}}{1000 \text{ Wh/kWh}} + \frac{P_{A,DVD/Blu} * T_{A,DVD/Blu} + P_{I,DVD/Blu} * T_{I,DVD/Blu} + P_{S,DVD/Blu} * T_{S,DVD/Blu}}{1000 \text{ Wh/kWh}}$$

where

UEC = unit energy consumption in kWh

$P_{A,HTiB}$ = HTiB power draw in active mode in watts

$T_{A,HTiB}$ = HTiB number of hours per year spent in active mode

$P_{I,HTiB}$ = HTiB power draw in idle mode in watts

$T_{I,HTiB}$ = HTiB number of hours per year spent in idle mode

$P_{S,HTiB}$ = HTiB power draw in sleep mode in watts

$T_{S,HTiB}$ = HTiB number of hours per year spent in sleep mode

$P_{A,DVD/Blu}$ = DVD player/Blu-Ray player power draw in active mode in watts

$T_{A,DVD/Blu}$ = DVD player/Blu-Ray player number of hours per year spent in active mode

$P_{I,DVD/Blu}$ = DVD player/Blu-Ray player power draw in idle mode in watts

$T_{I,DVD/Blu}$ = DVD player/Blu-Ray player number of hours per year spent in idle mode

$P_{S,DVD/Blu}$ = DVD player/Blu-Ray player power draw in sleep mode in watts

$T_{S,DVD/Blu}$ = DVD player/Blu-Ray player number of hours per year spent in sleep mode

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

HTiB UEC and UES Values

HTiB Hours of Use Assumptions

Active	Idle	Sleep
1,580	730	6,450

Product Type	Base-Case UEC (kWh/yr)	ENERGY STAR (kWh/yr)	UES (kWh/yr)
HTiB	90.9	53.0	37.9
HTiB w/DVD	107.1	63.3	43.8
HTiB w/Blu-Ray	108.4	65.7	42.7

UES and UES Values: Freezers

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UEC and UES Values for Freezers (DEER)

Product Type	DEER Size Category	DEER – Baseline UEC (kWh/yr.)	DEER ENERGY STAR (Tier 1) UEC (kWh/yr.)	UES		
				kWh/ yr	kW/yr	Therm s/yr
Upright freezer with manual defrost	Small (<13 cu. ft.)	255.0	229.5	22.1	0.00398	-0.65
	Medium (13-16 cu. ft.)	274.0	246.6	23.8	0.00428	-0.699
	Large (>16 cu. ft.)	294.0	264.6	25.5	0.00459	-0.75
Upright freezer with automatic defrost	Small (<13 cu. ft.)	323.0	290.7	28.0	0.00505	-0.824
	Medium (13-16 cu. ft.)	353.0	317.7	30.6	0.00552	-0.9
	Large (>16 cu. ft.)	383.0	344.7	33.2	0.00598	-0.977
Chest freezer with manual defrost	Small (<13 cu. ft.)	188.0	169.2	16.3	0.00294	-0.48
	Medium (13-16 cu. ft.)	214.0	192.6	18.6	0.00334	-0.546
	Large (>16 cu. ft.)	239.0	215.1	20.7	0.00373	-0.61
Chest freezer with automatic defrost	Small (<13 cu. ft.)	261.0	234.9	22.6	0.00408	-0.666
	Medium (13-16 cu. ft.)	297.0	267.3	25.8	0.00464	-0.758
	Large (>16 cu. ft.)	332.0	298.8	28.8	0.00519	-0.847