

**DEER2016 Update**  
**Refrigerator and Freezer Appliance Recycling Measures**  
**Updated 20 October, 2015**

The 2010-2012 Appliance Recycling Program (ARP) evaluation study (WO35)<sup>1</sup> expanded on previous evaluations of the program as well as previous DEER analysis. The 2010-2012 evaluation<sup>2</sup> included an investigation of the numerous and varied retention and transfer mechanisms by which refrigerators and freezers removed from service in their current location may, via “transfer paths”, be ultimately relocated to an alternate service home and thus stay connected to the electricity grid as a load. Figure 1 itemizes, for PG&E, the various transfer paths identified by the study and develops a gross savings contribution for each transfer path that can be followed by a collected appliance. The values listed in columns B and E represent the typical unit energy consumption (UEC) values of the collected (baseline) and alternate (measure – installed rather than baseline) units for each path. In the WO35 study, these values represent in situ UEC values that are specific to the accomplishments for the evaluated program period. The WO35 report includes similar tables for SCE and SDG&E.

For the in situ gross savings analysis, the WO35 evaluation utilizes several discreet appliance UECs. One value represents the UEC of the collected appliance. Each alternate UEC represents a particular scenario based on actions of an appliance acquirer due to the program removing the collected appliance from the available choices.

- Acquired nothing (UEC = 0)
- Acquired a similar “Free” used unit
- Purchased a similar used unit
- Unit destroyed, requiring purchase or acquisition of substantially more efficient unit
- Did nothing, kept existing unit that otherwise would have been replaced
- Purchased a new refrigerator

Figure 2 itemizes, for PG&E, for each transfer path identified by the study a savings estimate, along with a designation as to the treatment of the savings in that path as either representing a free-rider or non-free-rider. In this manner the study develops both gross savings and a net-to-gross ratio (NTGR) value. The WO35 report includes similar tables for SCE and SDG&E. It should be noted that only the two “discard anyway” scenarios are considered free riders in Figure 2.

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<sup>1</sup> Appliance Recycling Program Impact Evaluation Volume 1&2: Report and Appendices Work Order 35, California Public Utility Commission, Energy Division, Prepared by KEMA, Inc., October 24, 2014.

<sup>2</sup> Ibid

Figure 1 - Example of Gross Savings Calculation from ARP Evaluation (WO35)<sup>3</sup>

**Table 42: Refrigerator Consumption by Scenario for PG&E**

Counterfactual Action		Statewide Proportions (%)	Program Units Consumption under the Counterfactual			Alternative Unit Consumption under the Counterfactual			Gross Unit Energy Savings, kWh (H=(D-G))			
			Full UEC (B)	Usage (C)	Adj. UEC (D= (B*C))	Full UEC (E)	Usage (F)	Adj. UEC (G= (E*F))				
		(A)	(B)	(C)	(D= (B*C))	(E)	(F)	(G= (E*F))	(H=(D-G))			
Keep in Use by Participant		13.7%	1036	0.91	939	1036	0.00	0	939			
Keep Unused Used by Participant		2.3%	1036	0.00	0	1036	0.00	0	0			
Transferred	Destroyed by Discarder		18.2%	1036	0.98	1017	457	0.98	454	563		
	Peer-to-Peer	Primary Unit	Replaced by similar free unit	1.2%	1036	1.00	1036	791	1.00	791	245	
			Replaced by similar purchased unit	9.9%	1036	1.00	1036	783	1.00	783	253	
			Replaced by new unit	8.4%	1036	1.00	1036	452	1.00	452	584	
		Kept existing Unit	Replacing existing	5.2%	1036	1.00	1036	889	1.00	889	147	
			Add a new unit	1.4%	1036	0.91	939	0	0.91	0	939	
		Secondary Unit	Replaced by similar free unit	0.4%	1036	0.91	939	791	0.91	717	222	
	Replaced by similar purchased unit		2.0%	1036	0.91	939	783	0.91	710	229		
	Replaced by new unit		1.2%	1036	0.91	939	452	0.91	410	530		
	Not replaced		3.6%	1036	0.91	939	0	0.91	0	939		
	Retail	Individual	Primary Unit	Replaced by similar purchased unit	7.4%	1036	1.00	1036	783	1.00	783	253
				Replaced by new unit	5.7%	1036	1.00	1036	452	1.00	452	584
				Kept existing unit	Replacing existing	3.3%	1036	1.00	1036	889	1.00	889
			Add a new unit		0.3%	1036	0.91	939	0	1.00	0	939
			Secondary Unit	Replaced by similar purchased unit	0.9%	1036	0.91	939	783	0.91	710	229
				Replaced by new unit	0.5%	1036	0.91	939	452	0.91	410	530
		Not replaced		0.1%	1036	0.91	939	0	0.91	0	939	
		Primary Unit	Units purchased to install in rental units	1.1%	1036	1.00	1036	783	1.00	783	253	
			Commercial spaces	0.6%	1036	1.00	1036	783	1.00	783	253	
			Other	0.7%	1036	1.00	1036	783	1.00	783	253	
Destroyed by Secondary Market Actors	11.3%		1036	0.98	1017	457	0.98	454	563			
<b>Totals</b>		<b>99.4%</b>	<b>1036</b>	<b>0.94</b>	<b>977</b>	<b>637</b>	<b>0.82</b>	<b>467</b>	<b>510</b>			

<sup>3</sup> Ibid

Figure 2- Example of Net Savings Calculation from ARP Evaluation (WO35)<sup>4</sup>

**Table 47: Gross and Net Savings for PG&E Refrigerators**

Counterfactual Action			Statewide Proportions (%)	Gross Unit Energy Savings	Free-Rider Factor	Net Savings	Gross Unit Savings, weighted by path	Net Unit Savings, weighted by path		
			(A)	(B)	(C)	D= (B*(1-C))	E= (B*A)	F= (D*A)		
Keep in Use by Participant			13.7%	939	1	939	129	129		
Keep Unused Used by Participant			2.3%	0	1	0	0	0		
Destroyed by Discarder			18.2%	563	0	0	102	0		
Transferred	Peer-to-Peer	Primary Unit	Replaced by similar free unit	1.2%	245	1	245	3	3	
			Replaced by similar purchased unit	9.9%	253	1	253	25	25	
			Replaced by new unit	8.4%	584	1	584	49	49	
		Kept existing Unit	Replacing existing	5.2%	147	1	147	8	8	
			Add a new unit	1.4%	939	1	939	13	13	
		Secondary Unit	Replaced by similar free unit	0.4%	222	1	222	1	1	
	Replaced by similar purchased unit		2.0%	229	1	229	5	5		
	Replaced by new unit		1.2%	530	1	530	6	6		
	Not replaced		3.6%	939	1	939	34	34		
	Retail	Individual	Primary Unit	Replaced by similar purchased unit	7.4%	253	1	253	19	19
				Replaced by new unit	5.7%	584	1	584	33	33
			Kept existing unit	Replacing existing	3.3%	147	1	147	5	5
				Add a new unit	0.3%	939	1	939	3	3
		Secondary Unit	Replaced by similar purchased unit	0.9%	229	1	229	2	2	
			Replaced by new unit	0.5%	530	1	530	3	3	
			Not replaced	0.1%	939	1	939	1	1	
Primary Unit		Units purchased to install in rental units	1.1%	253	1	253	3	3		
		Commercial spaces	0.6%	253	1	253	1	1		
	Other	0.7%	253	1	253	2	2			
	Destroyed by Secondary Market Actors	11.3%	563	0	0	64	0			
<b>Weighted Program Average</b>							<b>510</b>	<b>344</b>		
<b>NTGR</b>								<b>67%</b>		

The DEER team review of the WO35 data and analysis methodology identified issues as well as limitations with the approach and therefore performed further development in order to apply the results in a forward looking manner to future program activities. For this reason the DEER team utilized the same data and an expanded version of the methodology to develop more appropriate gross and net savings for application to future refrigerator and freezer ARP activities. The DEER expanded approach, following CPUC policy, develops a “standard practice” baseline for refrigerator and freezer recycling

<sup>4</sup> Ibid

using the research data developed under the WO35 study<sup>5</sup>. Additionally, the DEER approach treats discreet age ranges of used units as having distinctly different levels of viability in the used appliance market; in other words, used appliances of different ages have different probabilities of being able to be transferred to new service locations when retired from service at their current location. The DEER expanded approach was developed by analyzing the data and results from the WO35 research including the below items.

- Characteristics of units in the claims data set for the 2010-2012 program years including:
  - Unit type (refrigerator or freezer)
  - Configuration such as side-by-side, top or bottom freezer, chest or upright freezer
  - Age
  - Size
- Surveys of participant and non-participant acquirers and discarders used by WO35 to identify alternative decisions that could have occurred in place of the decision to utilize the ARP service. The DEER team utilized these survey data to establish a standard practice baseline for the program within each IOU service territory.
- The nameplate UEC of each collected appliance was used to develop baseline and alternative case UEC values. A portion of the claims records did not include enough unit information for the WO35 team to determine the nameplate UEC. For these units, the WO35 team developed and implemented an approach to impute the UEC.
- WO35 expanded the existing data set, developed under previous ARP evaluation studies, of laboratory tested appliances. The DEER team utilized these lab test results to develop degradation adjustment factors to apply to the nameplate UEC of refrigerators and freezers to account for the increased energy use over the nameplate values as observed in used appliances.

### **Gross Unit Energy Savings**

The WO35 results as well as previous versions of DEER have assumed that the baseline is average nameplate UEC, adjusted based on either short-term in-situ metering or building modeling, of collected appliances from the most recent program evaluation. The DEER team has three concerns with this approach. First, this baseline assumption is utilizing a pre-existing equipment baseline assumption for all equipment when this baseline assumption is only allowed in the case of program induced early retirement<sup>6</sup>. Second, the previous approach to establishing baseline assumes that all collected appliances have equal full viability in the secondary market and are able to be successfully transferred

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<sup>5</sup> D.12-05-015, at 351: In the cases when there is no regulation, code, or standard that applies, which would normally set the baseline equipment requirements, the baseline must be established using a “standard practice” choice. For purposes of establishing a baseline for energy savings, we interpret the standard practice case as a choice that represents the typical equipment or commonly-used practice, not necessarily predominantly used practice.

<sup>6</sup> D.12-05-015, at 346: Specifically, D.11-07-030 notes that it is necessary to establish, by a preponderance of evidence, that the program has induced the replacement rather than merely caused an increase in efficiency in a replacement that would have occurred without the program.

for continued use. Third, the use of nameplate UEC does not consider the likelihood that the efficiency of appliances degrades with time. Each of these concerns is further described below.

### **Viability in Secondary Market and the Standard Practice Baseline**

The DEER team agrees with using the pre-existing equipment (collected unit) baseline for the fraction of the units the participant discarder identified they would have kept in service at their home had the program not induced them to remove the unit. This is the first disposition pathway line in Figure 1 and Figure 2 above. However, the other lines in these tables require further examination of their baseline assumptions.

The WO35 research included surveys of acquirers and non-participant discarders of used appliances. Acquirers were asked to provide the approximate age of the refrigerator or freezer they acquired. These results provide an indication of the market preferences for used refrigerators and freezers in terms of age. Non-participant discarders were asked how they discarded their appliances. A portion of discarders disposed of units in a way that would have resulted in the unit being destroyed, such as taking it to a landfill or an appliance recycler. However, others reported that they successfully sold or gave (for free) the unit to another person. These results provide an indication of the likelihood that appliances have any viability, in terms of age, in the used appliance market. In other words, the survey results indicate the likelihood that an appliance within a particular age range could be successfully transferred to a new owner and keep in service. Table 1 includes the results of these two survey questions as well as the distribution of collected units by age from the 2010-2012 program cycle. Table 2 contains some details of the acquirer sample. Figure 3 and Figure 4 show the same information graphically. It can be seen that used units older than 9 years in age have a rapidly decreasing attractiveness in the used market place. A similar trend can be observed in similar survey data from the 2006-2008 ARP evaluation<sup>7</sup> thus cannot be attributed to the recent ARP activities, but rather is a reality of the used appliance market place. Thus, despite a discarder's likely intention to sell or give away the unit, the probability of a successful transfer will be greatly decreased with increasing unit age.

It should also be noted that if collected units are placed into the used market rather than being recycled there is no indication that the used market would grow in size substantially due to a unmet demand of used units. However, it can be reasonably assumed that if added units are placed into the market that are attractive to purchasers, they will displace older less attractive units in the market such that those other units will have a lower probability of being acquired. So, introducing a substantial number of units into the used market that are 10-14 years old will likely reduce the ability of currently available units older than that in the market place from being successfully sold or otherwise transferred. For this reason, combined with acquirer preference data, the DEER process applies rapidly decreasing probability, as the age of collected unit increases, if they were allowed to be re-introduced into the used appliance market.

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<sup>7</sup> Residential Retrofit High Impact Measure Evaluation Report and Appendices, prepared for the California Public Utilities Commission Energy Division, The Cadmus Group, Inc., February 8, 2010.

The data discussed above provide strong evidence that the older age ranges of used appliances collected, notwithstanding an owner's stated desire to transfer the unit, would have rapidly decreasing value in the secondary market with age and therefore would have a greatly reduced ability to be successfully transferred. Instead, these units would be destroyed or taken out of service permanently with or without the ARP program.

**Table 1 - Age Distribution of Collected, Transferred and Acquired Appliances**

Age Cohort	Refrigerators Collected by ARP Program (2010-2012)				Survey Data		
	SDGE	SCE	PGE	All	Collected Percent by Age	Transferred to New Owners	Acquired from Secondary Market
More than 30 years old	904	0	9,838	10,742	3.8%	2.3%	1.5%
20-29 years old	6,404	68,697	21,707	96,808	34.7%	6.9%	1.7%
15-19 years old	9,591	73,488	11,609	94,688	33.9%	8.0%	3.6%
10-14 years old	16,330	40,110	8,488	64,928	23.3%	21.8%	14.6%
5-9 years old	6,884	0	3,761	10,645	3.8%	39.1%	27.9%
Less than 5 years old	1,022	0	311	1,333	0.5%	21.8%	50.7%
<b>Total</b>	<b>41,135</b>	<b>182,295</b>	<b>55,714</b>	<b>279,144</b>			

Age Cohort	Freezers Collected by ARP Program (2010-2012)				Survey Data		
	SDGE	SCE	PGE	All	Collected Percent by Age	Transferred to New Owners	Acquired from Secondary Market
More than 30 years old	367	0	2,646	3,013	11.0%	0.0%	2.0%
20-29 years old	1,084	9,071	2,910	13,065	47.8%	11.4%	2.0%
15-19 years old	1,015	4,163	859	6,037	22.1%	11.4%	4.1%
10-14 years old	1,445	2,478	498	4,421	16.2%	20.0%	14.3%
5-9 years old	489	0	215	704	2.6%	45.7%	30.6%
Less than 5 years old	87	0	16	103	0.4%	11.4%	46.9%
<b>Total</b>	<b>4,487</b>	<b>15,712</b>	<b>7,144</b>	<b>27,343</b>			

**Table 2 - Sample Statistics for Age Distribution Acquired Refrigerators**

Survey of Recent Successful Used Refrigerator Acquirers				
Age Range	N	% of Acquirers	Standard Error	90% Confidence Interval (=/- %)
30 and up years old*	6	1.46%	0.59%	0.97%
20-29 years old*	7	1.70%	0.64%	1.05%
20 and up years old	13	3.16%	0.86%	1.42%
15-19 years old	15	3.64%	0.92%	1.52%
10-14 years old	60	14.56%	1.74%	2.86%
5-9 years old	115	27.91%	2.21%	3.64%
Less than 5 years old	209	50.73%	2.46%	4.05%

\*Small response numbers in these two categories makes 90% CI calculation unreliable

Figure 3 - Age Distribution of Collected, Transferred and Acquired Refrigerators

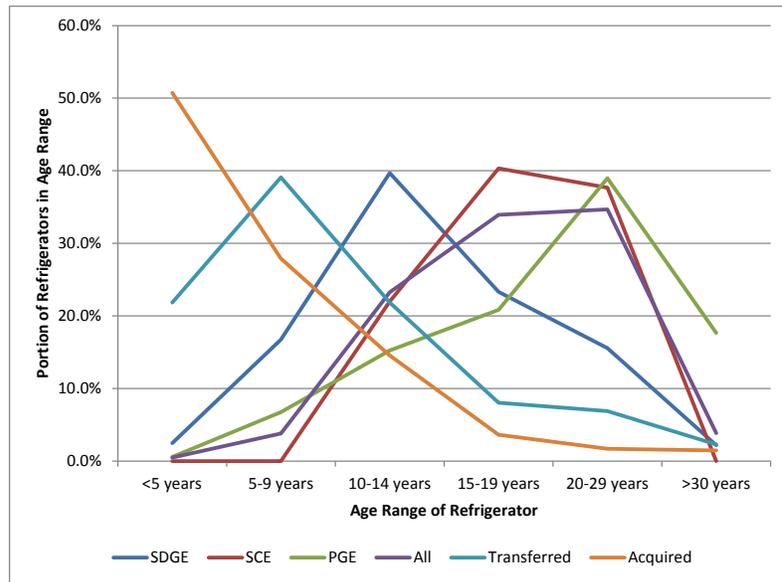
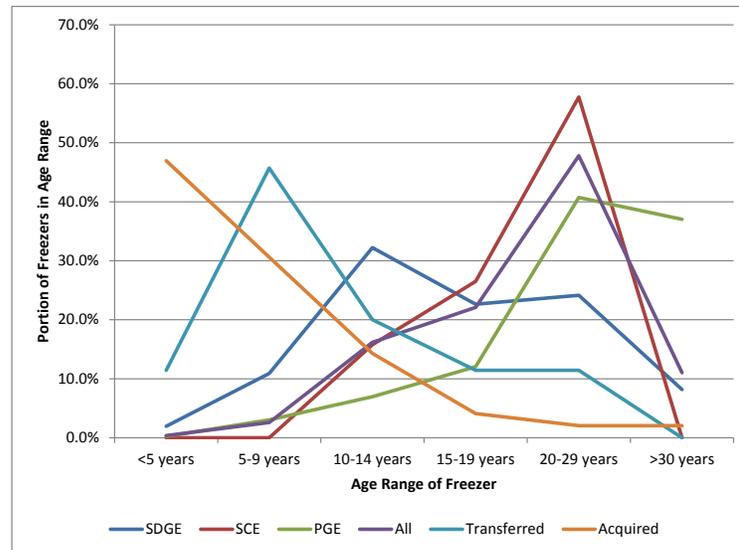


Figure 4 - Age Distribution of Collected, Transferred and Acquired Freezers



To account for this, the DEER team calculated two baselines, one representing the non-viable units and one representing viable units. The DEER team accomplished this by applying adjustment factors based on age to the entire set of claimed appliances from the 2010-2012 program cycle. This enabled the calculation of viable versus non-viable UEC by IOU service territory. Then the percentages of each alternative disposition path as shown in Figure 1 above were adjusted to reflect the fraction of non-viable units within each IOU service territory. Table 3 lists the market viability factors developed by the DEER team. The table includes the values originally proposed in June, 2015, to be used for the DEER 2016 update. As noted above, the viability factor in the for the initial DEER 2016 proposal decreases rapidly with increasing age since introducing younger units into the market causes both existing market older units and newly introduced older units to be less viable. Table 3

also includes the values for viability factors to be included in the final adopted DEER 2016 revision as directed by the Commission in response to the DEER team proposal. The UEC of viable units is determined by multiplying the UEC of each claimed appliance by the factor, then weight averaging all units together. The UEC of the non-viable units is determined by multiplying the UEC of each claimed appliance by one minus the factor, then weight averaging all units together. Table 4 shows the results of applying the market viability factors along with the percentage of collected appliances within each IOU service territory that have negligible market viability.

**Table 3 - Estimated Market Viability of Collected Appliances**

Age Cohort	Secondary Market Viability Factor	
	DEER 2016 Proposed	DEER 2016 Final
More than 30 years old	0.05	0.25
20-29 years old	0.05	0.25
15-19 years old	0.15	0.50
10-14 years old	0.50	1.00
5-9 years old	1.00	1.00
Less than 5 years old	1.00	1.00

**Table 4 - Recalculated Non-Viable and Viable UECs**

Refrigerators				
IOU	Collected UEC	% Not Viable	Recalculated UEC	
			Not Viable	Viable
SDGE	747	25.0%	888	700
SCE	836	48.4%	898	778
PGE	915	52.9%	999	821
Freezers				
IOU	Collected UEC	% Not Viable	Recalculated UEC	
			Not Viable	Viable
SDGE	695	35.6%	774	651
SCE	748	56.5%	775	714
PGE	855	64.3%	887	799

For the proposed DEER revisions published in June, 2015, the DEER team adjusted the dispositions paths for each IOU to reflect the fraction of non-viable units as determined from the units collected during 2010-2012 program years. For the final adopted DEER values, CPUC staff was directed to further examine the WO35 analysis for determining disposition paths to ensure that the adjustments were reasonable and did not double count paths with zero savings. As a result of this review the DEER team identified the following needed corrections:

1. The portions of primary and secondary refrigerators within the peer-to-peer channel did not sum to 100%. The DEER team renormalized these values so that they summed to 100%.
2. The fraction of units destroyed by retail market actors appears to have had some portion reallocated back in to peer-to-peer transfers. This appears to be an attempt, out of an abundance of caution, to account for the possibility that, while peer-to-peer market actors may state that they would have transferred the unit to a new owner, there are likely some refrigerators that would not be successfully transferred, regardless of the discarders' intentions. The DEER team has used the viability factors to account for these attempted, but unsuccessful, transfers, assuming those should be counted in the standard practice baseline. Therefore, the DEER team removed this adjustment made in the WO35 development of disposition paths, and left the fraction destroyed by retail market actors only in the retail transfer group. The result is a slight increase in the percentages of paths that result in part and full savings with corresponding small increases in gross savings.
3. Two disposition paths for freezers were incorrectly identified. The DEER team identified two freezer disposition paths as "Keep Existing" when they should have been "Not Replaced". "Keep Existing" results in a savings of zero while "Not Replaced" results in full savings. The correction to these disposition paths resulted in a gross savings increase for freezers of 60%-100% depending on the IOU.

The adjusted proportions for each disposition path are shown in Table 5 and Table 6 for refrigerators and freezers, respectively.

Table 5 - DEER vs. WO35 Alternative Disposition Paths for Refrigerators

Disposition Path				Proportion of Program Units in Disposition Path				
				(A)		Recalculated for Nonviable Units		
				WO35	SDGE	SCE	PGE	
Keep in Use by Participant				13.7%	13.7%	13.7%	13.7%	
Keep Unused Used by Participant				2.3%	4.2%	5.9%	6.2%	
Destroyed by Discarder (non-viable units)					14.6%	28.3%	30.9%	
Destroyed by Discarder				18.2%	18.2%	18.2%	18.2%	
Transfers	Peer to Peer	Primary Unit	Replaced by similar free unit	1.4%	1.1%	0.7%	0.7%	
			Replaced by similar purchased unit	12.2%	9.1%	6.3%	5.7%	
			Replaced by new unit	10.3%	7.8%	5.3%	4.9%	
			Kept existing Unit	Replaced existing	6.4%	4.8%	3.3%	3.0%
				Add a new unit	1.7%	1.3%	0.9%	0.8%
		Secondary Unit	Replaced by similar free unit	0.5%	0.4%	0.3%	0.3%	
			Replaced by similar purchased unit	2.5%	1.8%	1.3%	1.2%	
			Replaced by new unit	1.5%	1.1%	0.8%	0.7%	
			Not replaced		4.5%	3.3%	2.3%	2.1%
	Retail	Individual	Primary Unit	Replaced by similar purchased unit	5.8%	4.3%	3.0%	2.7%
				Replaced by new unit	4.4%	3.3%	2.3%	2.1%
			Kept existing unit	Replaced existing	2.6%	1.9%	1.3%	1.2%
				Add a new unit	0.2%	0.2%	0.1%	0.1%
			Secondary Unit	Replaced by similar purchased unit	0.7%	0.5%	0.4%	0.3%
		Replaced by new unit		0.4%	0.3%	0.2%	0.2%	
		Not replaced		0.1%	0.1%	0.0%	0.0%	
		Primary Unit	Units purchased to install in rental units	0.9%	0.6%	0.4%	0.4%	
			Commercial spaces	0.4%	0.3%	0.2%	0.2%	
			Other	0.5%	0.4%	0.3%	0.2%	
Destroyed by Secondary Market Actors				8.8%	6.6%	4.6%	4.2%	
				100.0%				

<< Added Path has no Gross Savings  
<< Path has full Gross Savings

<< Path has no Gross Savings

Table 6 - DEER vs. WO35 Alternative Disposition Paths for Freezers

Disposition Path		Proportion of Program Units in Disposition Path					
		(A)	Recalculated for Nonviable Units				
			WO35	SDGE	SCE	PGE	
Keep in Use by Participant		14.2%	14.2%	14.2%	14.2%		
Keep Unused Used by Participant		1.8%	5.0%	6.8%	7.5%		
Destroyed by Discarder (non-viable units)			22.2%	35.3%	40.2%		
Destroyed by Discarder		12.6%	12.6%	12.6%	12.6%		
Transfers	Peer to Peer	Replaced by similar free unit	0.0%	0.0%	0.0%	0.0%	
		Replaced by similar purchased unit	5.6%	3.6%	2.4%	2.0%	
		Replaced by new unit	4.5%	2.9%	2.0%	1.6%	
		Kept existing Unit	24.0%	15.5%	10.4%	8.6%	
	Retail	Individuals	Replaced by similar purchased unit	5.2%	3.4%	2.3%	1.9%
			Replaced by new unit	3.6%	2.3%	1.6%	1.3%
			Kept existing unit	12.5%	8.1%	5.4%	4.5%
		Units purchased to install in rental units	1.3%	0.8%	0.6%	0.5%	
		Commercial spaces	0.7%	0.5%	0.3%	0.2%	
		Other	0.8%	0.5%	0.3%	0.3%	
		Destroyed by Secondary Market	13.2%	8.5%	5.7%	4.7%	
				100.0%			

<< Added Path has no Gross Savings  
 << Path has full Gross Savings  
 << Path has no Gross Savings

One of the principle differences between the recommended DEER approach and the WO35 approach is that the DEER team has assumed that non-viable units, as well as those units destroyed by secondary market actors represent the policy directed standard practice baseline and therefore have no gross savings. The effect of these assumptions is that gross savings decrease by a substantial amount compared to DEER2014 and WO35 results.

### Age Degradation and Appliance UEC

A review of the laboratory testing results performed as part of the WO35 research as well as previous evaluation studies indicates that even relatively new refrigerators and freezers experience significant deviation in efficiency as compared to the DOE rating value when placed into service in a home. Table 7 and Table 8 provide a compilation of the lab-tested UEC compared to nameplate UEC by age for refrigerators and freezers. Lab results appear to show that tested appliance efficiency is higher for all ages of appliances, even relatively new units. There is a general trend toward greater deviation with age. It is not known if this deviation represents a degradation of performance that occurs after a unit has been in service for a relatively short period or if this represents a typical difference between the rating method result compared with the performance of units delivered into service. To develop a typical UEC for the various baseline and alternative path dispositions, the DEER team has adjusted the nameplate UEC values by age factors from the Table 7 and Table 8.

Table 7 - Comparison of Laboratory and Nameplate UECs for Refrigerators

Age	Average Results for Refrigerators					
	Count	Size	Age	Nameplate UEC	Lab Tested UEC	Ratio
<5 years	2	19.7	3.0	801	876	1.09
<=5 years	5	19.9	4.2	740	1,027	1.39
<6 years	5	19.9	4.2	740	1,027	1.39
<=6 years	7	19.7	4.7	651	905	1.39
<7 years	8	19.7	5.0	607	831	1.37
<=7 years	9	19.4	5.2	594	795	1.34
<8 years	10	19.3	5.4	580	771	1.33
<=8 years	16	18.2	6.4	562	733	1.30
<9 years	17	18.4	6.5	556	736	1.32
<=9 years	21	18.6	7.0	528	720	1.36
<10 years	21	18.6	7.0	528	720	1.36
<=10 years	29	18.9	7.8	571	860	1.51
6-10 years	19	18.5	7.4	500	703	1.41
11-15 years	35	19.9	12.0	687	1,040	1.51
16-20 years	160	20.4	17.2	1,044	1,530	1.47
21-25 years	65	19.6	21.5	1,102	1,901	1.72
26-30 years	49	19.7	26.7	1,312	1,989	1.52
<=25 years	291	20.0	17.0	991	1,521	1.53
>30 years	26	17.3	34.5	1,283	2,025	1.58
<b>All</b>	<b>356</b>	<b>19.8</b>	<b>19.4</b>	<b>1,043</b>	<b>1,601</b>	<b>1.53</b>

Table 8 - Comparison of Laboratory and Nameplate UECs for Freezers

Age	Average Results for Freezers					
	Count	Size	Age	Nameplate UEC	Lab Tested UEC	Ratio
<= 15 years	0	- n/a -	- n/a -	- n/a -	- n/a -	- n/a -
16-20 years	4	19.2	18.3	798	1,045	1.31
21-25 years	8	17.6	22.6	979	1,466	1.50
26-30 years	4	16.3	28.0	929	1,918	2.06
<=25 years	12	18.1	21.2	919	1,325	1.44
>30 years	6	15.5	35.7	929	1,752	1.89
<b>All</b>	<b>22</b>	<b>17.0</b>	<b>26.4</b>	<b>923</b>	<b>1,550</b>	<b>1.68</b>

### UEC of a Newly Purchased Appliance

Several transfer pathways result in a new unit being placed in service as the alternative to the recycled unit being placed into service post transfer. For this case the WO35 approach developed the UEC of the new appliance based on the total sales volume of refrigerators published by the Association of Home Appliance Manufacturers (AHAM). The AHAM data is reasonable for all newly purchased refrigerators and freezers. However, respondents to the survey were asked if they would acquire a similar unit to the one they discarded. The overall AHAM reported value is not representative of the units for the transfer pathways of the ARP activity based on what the survey respondents indicate would happen. Therefore, the DEER team recalculated the UEC for each

collected appliance from 2010-2012 claims using the currently applicable code requirements. These values were then averaged to determine equivalent UECs by IOU for new refrigerators and freezers.

### **Determination of Gross Savings**

All issues and expanded methods discussed above have been used to develop the gross savings recommended by the DEER team are incorporated into the workbook available on the DEER website (DEER2015\_ARPUpdate\_2015-06-02.xlsx). Table 11 provides the gross savings components for refrigerators along with their baseline and alternative path UEC bases, similar to Figure 1 above from the WO35 report. The differences between the DEER analysis and the WO35 analysis are:

1. The DEER approach includes a disposition pathway for non-viable units. This portion of collected the units are determined to have no transfer potential into the secondary market and will be destroyed in the standard practice baseline case, and thus are assigned a gross savings of zero.
2. WO35 assigned gross savings but no net savings for the “destroyed by discarder” pathway. The DEER team expects that a portion of the units following this pathway should also be included into the standard practice baseline, however has not determined the fraction of units following this path which should be included into the standard practice baseline. If the destroyed units have market value, then there may be gross savings associated with the program removing them, even if the discarders would have destroyed them without the program. In either case, the net savings would be unchanged and only a difference in the gross savings would result. At this time, pending additional research, the final DEER values retain the WO35 proposed disposition on this pathway. Retaining the WO35 and assigning a non-zero value for gross savings causes the net-to-gross ratio to be less than one.
3. WO35 assigned gross savings but no net savings for the “destroyed by secondary market actors” path. The DEER team has assigned this path to the standard practice baseline and thus a zero gross savings since they are likely non-viable units. Secondary market actors would have removed and destroyed these units from inventory since they would have no value in used retail channel.

For refrigerators these changes result in some differences in the disposition pathway percentages and also the resultant standard error and 90% confidence intervals on those percentages. A summary of the percentages, standard errors and 90% confidence intervals provided by for the W00-35 results and DEER team alterations is found in Table 9. A similar summary for freezers is found in Table 10.

Table 9 - WO035 and DEER2016 Refrigerator Recycling Disposition Paths

Disposition Path				Disposition Path Statistics						
				WO35 Values			EAR Team Recalc			
				%	SE (%)	CI (+/- %)	%	SE (%)	CI (+/- %)	
Keep in Use by Participant				13.7%	2.8	4.6	13.7%	1.1	1.8	
Keep Unused Used by Participant				2.3%	2.8	4.6	2.3%	0.5	0.8	
Destroyed by Discarder (non-viable units)										
Destroyed by Discarder				18.2%	2.1	3.5	18.2%	2.1	3.5	
Transfers	Peer to Peer	Primary Unit	Replaced by similar free unit	1.2%	0.7	1.2	1.4%	0.5	0.8	
			Replaced by similar purchased unit	9.9%	5.1	8.5	12.2%	1.8	3.0	
			Replaced by new unit	8.4%	4.4	7.3	10.3%	1.6	2.7	
			Kept existing Unit	Replacing existing	5.2%	2.7	4.5	6.4%	1.2	1.9
				Add a new unit	1.4%	0.8	1.4	1.7%	0.5	0.9
		Secondary Unit	Replaced by similar free unit	0.4%	0.3	0.5	0.5%	0.3	0.5	
			Replaced by similar purchased unit	2.0%	1.1	1.8	2.5%	0.7	1.1	
			Replaced by new unit	1.2%	0.7	1.2	1.5%	0.5	0.8	
			Not replaced	3.6%	1.9	3.2	4.5%	0.9	1.5	
		Retail	Individual	Primary Unit	Replaced by similar	7.4%	5.9	9.7	5.8%	3.5
	Replaced by new unit				5.7%	4.5	7.5	4.4%	2.7	4.5
	Kept existing unit			Replacing existing	3.3%	2.7	4.4	2.6%	1.6	2.7
				Add a new unit	0.3%	0.3	0.5	0.2%	0.2	0.4
	Secondary Unit			Replaced by similar	0.9%	0.8	1.3	0.7%	0.5	0.9
			Replaced by new unit	0.5%	0.5	0.8	0.4%	0.3	0.5	
			Not replaced	0.1%	0.2	0.3	0.1%	0.1	0.2	
	Primary Unit		Units purchased to install in rental	1.1%	0.9	1.4	0.9%	0.4	0.7	
			Commercial spaces	0.6%	0.4	0.7	0.4%	0.2	0.4	
			Other	0.7%	0.5	0.9	0.5%	0.2	0.3	
	Destroyed by Secondary Market Actors				11.3%	8.9	14.7	8.8%	2.8	4.7
<i>Weighted Average</i>				<i>99.4%</i>			<i>100.0%</i>			

Table 10 - WO035 and DEER2016 Freezer Recycling Disposition Paths

Disposition Path				Disposition Path Statistics					
				WO35 Values			EAR Team Recalc		
				%	SE (%)	CI (+/- %)	%	SE (%)	CI (+/- %)
Keep in Use by Participant				14.2%	3.4	5.7	No differences with WO035 values		
Keep Unused Used by Participant				1.8%	1.5	2.4			
Destroyed by Discarder (non-viable units)									
Destroyed by Discarder				12.6%	3.5	5.8			
Transfers	Peer to Peer	Replaced by similar free unit	0.0%	0.0	0.0				
		Replaced by similar purchased unit	5.6%	2.4	3.9				
		Replaced by new unit	4.5%	2.4	4.0				
		Not Replaced	24.0%	4.5	7.5				
	Retail	Individuals	Replaced by similar purchased unit	5.2%	1.3	2.2			
			Replaced by new unit	3.6%	1.1	1.8			
			Not Replaced	12.5%	2.0	3.3			
		Units purchased to install in rental units	1.3%	0.2	0.3				
		Commercial spaces	0.7%	0.1	0.2				
		Other	0.8%	0.1	0.2				
Destroyed by Secondary Market				13.2%	1.9	3.1			
<i>Weighted Average</i>				<i>100.0%</i>					

Table 11 - 2015 DEER Refrigerator Recycling Disposition Paths

Disposition Path				Base UEC Description	Alternative Path UEC Description	Gross Savings?	
Keep in Use by Participant				Average of all collected units	None	Yes	
Keep Unused Used by Participant				None	None	No	
Destroyed by Discarder (non-viable units)				Non-viable collected units	None	No	
Destroyed by Discarder					Average of other paths (same as WO35)	Yes	
Transfers	Peer to Peer	Primary Unit	Replaced by similar free unit		Viable collected units	Viable collected	No
			Replaced by similar purchased unit			Peer-to-peer purchased	Yes
			Replaced by new unit			New	Yes
			Kept existing Unit	Replacing existing Add a new unit		Viable collected	No
						New	Yes
		Secondary Unit	Replaced by similar free unit			Peer-to-peer free	Yes
			Replaced by similar purchased unit			Peer-to-peer purchased	Yes
			Replaced by new unit			New	Yes
			Not replaced			None	Yes
						Retail	Yes
	Retail	Individual	Primary Unit	Replaced by similar purchased unit		New	Yes
				Replaced by new unit		Viable collected	No
				Kept existing unit	Replacing existing Add a new unit	New	Yes
			Replaced by similar purchased unit			Peer-to-peer purchased	Yes
			Secondary Unit	Replaced by new unit		New	Yes
		Not replaced		None	Yes		
				Retail	Yes		
		Primary Unit	Units purchased to install in rental units		Retail	Yes	
			Commercial spaces		Retail	Yes	
			Other		Retail	Yes	
Destroyed by Secondary Market Actors				Non-viable collected units	None	No	

The final step in determining the gross savings is to adjust the gross nameplate UES values based on the space type, conditioned or unconditioned, where the appliances will likely be operated. These adjustments vary by space type (conditioned or unconditioned), building type (single family, multi-family or manufactured home), climate zone and building vintage and were most recently revised as part of the 2014 DEER update process. In general, whole building UEC values of appliances (and therefore energy savings of more efficient appliances) are lower than the nameplate ratings. This is due to ambient temperatures seen by appliances in homes are lower than the ambient temperatures the appliances are exposed to in testing procedures used to determine the rated UEC values. The typical refrigerator and freezer use, including alternative internal temperature settings and door openings, do not impose large enough added loads on the unit in most climates to outweigh the environmental temperature differences between the rating test and in-situ use. The weighting values for building type, climate zone and vintage have not changed since DEER 2014. Fractions of conditioned and unconditioned space have been revised based on survey results from WO35 using the criteria described below. Table 12 lists the fractions of appliances installed in conditioned versus unconditioned space.

Refrigerators: Acquirers of refrigerators were asked if the acquired appliance was to be the primary or spare unit. The DEER approach assumes that primary refrigerators are located in conditioned space while secondary refrigerators are located in unconditioned space or outdoors.

Freezers: Participant discarders were asked whether the discarded appliance was operated in conditioned or unconditioned space. The DEER approach assumes that placement of freezers is similar for discarders and acquirers.

Table 12 - Fraction of Appliances Installed in Conditioned and Unconditioned Space

Conditioned Space Fractions		
Appliance/Space Type	DEER2014	DEER2016
Refrigerator-Conditioned	0.855	0.820
Refrigerator-Unconditioned	0.145	0.180
Freezer-Conditioned	0.855	0.204
Freezer-Unconditioned	0.145	0.796

Table 13 shows the proposed savings values compared to the WO35 results and DEER 2014.

Table 13 - Comparison of ARP Savings Values

UES Case	IOU	Refrigerators			Freezers		
		Gross UES	Net UES	NTG	Gross UES	Net UES	NTG
DEER 2016 Adopted Values	SDG&E	260	216	0.83	351	289	0.82
	SCE	318	251	0.79	344	269	0.78
	PG&E	298	231	0.77	329	252	0.77
DEER 2016 Proposed Values	SDG&E	196	165	0.84	128	123	0.96
	SCE	224	177	0.79	140	131	0.94
	PG&E	203	163	0.80	139	132	0.95
WO35 Results	SDG&E	385	272	0.71	771	577	0.75
	SCE	519	352	0.68			
	PG&E	510	344	0.67			
DEER 2014	SDG&E	640	339	0.53	804	563	0.70
	SCE	670	355		844	591	
	PG&E	696	369		726	508	

### Net-to-Gross Ratio

WO35 assigned “free rider” status to the alternative disposition paths of “destroyed by discarder” and “destroyed by secondary market actors.” As discussed above, the DEER team has assigned units destroyed by secondary market actors to the standard practice baseline and thus a gross savings of zero, therefore eliminating that path from the NTG calculation. At this time, the final NTG values assume that the disposition path “Destroyed by Discarder” receives full credit in the gross savings calculation and no credit in the net savings calculation. The DEER team considers this disposition path to represent standard practice and thus should have a gross savings of zero. However developing an accurate conclusion in this regard from available data is not possible, so this pathway was left in as a component of gross savings. This disposition path should be a specific research area in future evaluation efforts to establish whether or not this is a standard practice as the DEER team believes may be true.

The final statewide NTG values<sup>8, 9</sup> are a weighted average of the calculated values shown in Table 13 and the relative quantities of collected appliances from each IOU during the 2010-2012 program years. The final DEER 2016 NTG values are included in Table 14.

Table 14 - Final DEER 2016 Net-To-Gross Values

Weighted Average NTG Value Calculations					
Appliance Type	Value	SDG&E	SCE	PG&E	Total Units
					Weighted NTG
Refrigerators	Units	41,135	182,295	55,714	279,144
	NTG	0.83	0.79	0.77	<b>0.79</b>
Freezers	Units	4,487	15,712	7,144	27,343
	NTG	0.82	0.78	0.77	<b>0.78</b>

### Measure Cost Consideration

As shown in Table 5 and Table 6 several of the alternative path dispositions include the purchase of a new appliance rather than a used appliance. The percentages range from about 1 percent for PG&E freezers to about 8 percent for SDG&E refrigerators. The incremental cost associated with the purchase of a new appliance versus acquiring a used appliance has never been considered in the participant cost portion for the measure cost calculations used in determining the TRC. In future workpapers, IOUs must add this cost, based on the typical cost of new units with similar features as collected appliances, as a participant cost so that the TRC costs include this participant cost in addition to the program contractor, customer incentive and program administrator costs.

<sup>8</sup> D.12-05-015 at 54: We agree that similar measures delivered by similar activities should have single statewide values unless recent evaluations show a significant variation between utilities and that difference is supported by a historical trend of evaluation results. While it would be inappropriate to adopt planning values based on anomalous results we do not believe the 2006-2008 evaluation Net-to-Gross results overall are anomalous. We therefore accept Staff's recommendation to use those results. We direct Commission Staff to strive for uniform statewide Net-to-Gross planning values that represent typical expected results in the DEER update for the next planning cycle for measures in which the variation between utilities is not significant.

<sup>9</sup> D.12-05-015 OP 6: Commission Staff shall strive for uniform statewide Net-To-Gross planning values that represent typical expected results in the Database of Energy Efficient Resources update for the next planning cycle for measures in which the variation between utilities is not significant.