PACIFICORP CONSERVATION POTENTIAL ASSESSMENT FOR 2019-2038

Volume 5: Class 1 & 3 DSM Analysis Appendix

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Report prepared for:
PACIFICORP

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CLASS 1 AND 3 DSM PARTICIPATION ASSUMPTIONS

This appendix presents detailed documentation for the participation assumptions for Class 1 and 3 DSM options presented in Volume 3 of the report.

In this study, AEG assessed DR potential for the following scenarios:

- Class 1 options, stand alone
- Class 3 options, stand alone
- Class 1 options, integrated

We did not assess potential for an integrated set of Class 3 options nor did we assess technocal potential.

An integrated Class 3 case was not included because AEG and PacfiCorp determined jointly that a case where all Class 3 options were offered to customers simultaneously was unlikely. Therefore it was most useful to assess potential for each option individualy to determine which single options might have the largest impact.

Similarly, technical potential provides little icnremental value for desicision making since it simply represents a case where 100% of eligible participante participate in each option.

Class 1 DSM Participation Assumptions

DLC Program Participation Rates

Table A-1 and Table A-2 present DLC participation assumptions for residential and C&I customers. These participation assumptions are based largely on an analysis of the on FERC 2012 survey of DR programs and actual implementation experience from PacifiCorp.

Table A-1 Residential Class 1 Program Participation

State	Steady Participation for Programs (% of eligible Load)	Value	Basis for Assumptions
All states, except UT	Traditional DLC Options (Central AC, Room AC, DWH)	5% CAC 15% Other	50th percentile value from a dataset of 61 utility programs (with more than 5000 customers enrolled), based on FERC 2012 survey of DR programs. Steady-state participation level is assumed to be lower as compared to Utah, recognizing jurisdictional differences in market conditions, which may lead to difficulties in enrolling customers. (CAC was reduced to 5% from 15% in the previous study by shifting 10% to Smart Thermostats)
UT[1]		16% CAC 23% Other	The UT DLC participation rate assumption begins at 16% to calibrate to the existing program and rises to a 23% steady-state value. The steady-state value is based on the 65th percentile from a dataset of 61 utility programs (with more than 5,000 customers enrolled), based on FERC 2012 survey of DR programs.[2] This is based on existing PacifiCorp market conditions and past implementation experience in Utah to inform the maximum attainable market penetration. (CAC was reduced from 23%, shifting 7% to the Smart Thermostat program)
All states, except UT	Smart Thermostat DLC	25%	Assumed that with the DLC CAC program, the combined marketing and recruitment efforts for both simultaneous cooling programs could achieve a maximum participation of 30%. This represents a level of engagement only seen in mature, leading DR programs. (10% increase to account for migration from DLC Central AC)
UT		14%	Also modeled such that combined with the DLC CAC program that simultaneous cooling programs could achieve a maximum participation of 30%. (7% increase to account for migration from DLC Central AC)
All States	Space Heating DLC	20%	Assumed participation at midpoint between 7th Plan space heating DLC program participation assumption (25%) & PacifiCorp CAC DLC assumption (15%)
All States	Smart Appliances DLC	5%	Based on 015 ISACA IT Risk Reward Barometer - US Consumer Results. October 2015
All States	Electric Vehicle DLC Smart Chargers	25%	Based on TOU participation, which was then throttled / scaled using the equipment saturation for EVs.
All States	Ancillary Services	15%	Assumed to be similar to DLC CAC program
All States	Behavioral DR	20%	Based on PG&E impact evaluation[3]

[1] Eligible customers include those with central air conditioners and heat pumps. For Utah, the eligible market size is further restricted to customers on the Wasatch front, which is covered by the current control network in the Cool Keeper program.

[2] The DR program survey data is downloadable at http://www.ferc.gov/industries/electric/indus-act/demand-response/2012/survey.asp

[3] Review and Validation of 2015 PG&E Home Energy Reports Program Impacts, http://www.calmac.org/publications/DNVGL_PGE_HERs_2015_final_to_calmac.pdf

Table A-2 C&I DLC and Ice Energy Storage Program Participation

State	Program	Steady-state Participation (as % of eligible customers)	Basis for Assumptions
All states, except UT	Central AC DLC	Small and Med. C&I- 3%	50th percentile value from a dataset of 23 utility DLC programs targeting C&I customers (with more than 100 customers enrolled), based on FERC 2012 survey of DR programs.
UT		Small C&I- 1.5%; Med. C&I- 1.5%;	Based on 2013 Non-Residential Cool Keeper program data provided by PacifiCorp, we assume steady-state participation level has been attained in the market with the current level of program implementation efforts. For small C&I customers, current program participation level is at the 50th percentile value from the FERC survey database. For medium C&I customers, current program participation level is higher as compared to the 50th percentile value. Hence, we assume that steady-state participation has already been attained in the Utah market.
All states,	Space Heating DLC	Small and Med. C&I- 3%	Assumed same participation levels as Central AC DLC
All states, except UT	Water Heating DLC	Small and Med. C&I- 3%	Same as Central AC DLC
UT		Small C&I- 2.9%; Med. C&I- 3.9%;	Similar to Central AC DLC
All states, except UT	Ice Energy Storage	Small & Medium C&I - 1.5%	Assumed to be half of Central AC DLC participation since this is an emerging technology
UT		Small & Medium C&I – 0.8%	Assumed to be half of Central AC DLC participation since this is an emerging technology
All States	Ancillary Services	Small & Medium C&I – 7.5%	Assumed to be half of residential DLC CAC program since this is an emerging technology

Irrigation Load Control Program Participation Rates

Table A-3 presents participation assumptions for the Irrigation Load Control option. Compared to DLC for residential and C&I customers, relatively few utilities offer Irrigation Load Control, which makes performance benchmarking using the FERC survey database more difficult. Therefore, substantial data was obtained from PacifiCorp's implementation experience and case studies with which the project team was familiar. Participation here includes the combined effect of eligibility and projected customer willingness. Eligible load for the analysis is defined as loads with at least 25 HP pump size, loads large enough to justify the cost of load control equipment and installation costs.[4]

[4] Note that in PacifiCorp's existing programs, even pump loads this small do not commonly participate. If a pump is less than 50 kW (67 HP), then a $1500 enrollment fee is charged to the customer, resulting in very few small pumps.

Table A-3 Irrigation Load Control Program Participation

State	Participation (as % of irrigation load)	Basis for Assumptions
CA	15%	Based on feedback provided by PacifiCorp staff.
ID	48%	The steady-state participation assumption is informed by the maximum amount of realizable potential in Idaho, based on current program experience and likely future possibilities. This was developed in consultation with PacifiCorp program experts in the area.
OR	15%	Based on feedback provided by PacifiCorp staff
UT	27%	Similar to Idaho, the steady-state participation assumption is informed by the maximum amount of realizable potential in Utah, based on current program experience and likely future possibilities. This was developed in consultation with PacifiCorp program experts in the area.
WA	15%	Based on feedback provided by PacifiCorp staff
WY	15%	Based on feedback provided by PacifiCorp staff

C&I Third Party Contracts Program Participation Rates

Table A-4 presents participation assumptions for the Third Party Contracts option. The basis for arriving at these assumptions is explained below.

Table A-4 C&I Curtailment Program Participation

States	Unit	Value	Basis for Assumptions
All states	Large C&I Customers, Steady-state Participation (as % of eligible customers)	22%	Average of 50th percentile and 75th percentile values from a dataset of 7 utility programs, based on FERC 2012 survey of DR programs. The 50th percentile value is 17%, and the 75th percentile value is 30%. These are considered to be the low and high end of the participation range estimate. We assume the C&I Curtailment participation assumption to be at the midpoint of this range. Please note that these programs, primarily delivered by third parties, are relatively new and much fewer in number than legacy DLC programs. Therefore, the dataset size for these programs is relatively small. This results in a value of 23.5% but is adjusted downward by a factor of 0.94 to 22% because of RICE NESHAP regulations as described below.
All States	Extra-Large C&I Customers, Steady-state Participation (as % of eligible customers)	21%	The data source is the same as Large C&I customers above, resulting in a value of 23.5%. This is adjusted downward by a factor of 0.89 to 21% because of RICE NESHAP regulations as described below.

"RICE NESHAP" Regulations

Program participation rates are further adjusted, taking into account the EPA's Reciprocating Internal Combustion Engines National Emission Standards for Hazardous Air Pollutants "RICE NESAHP" regulations that will constrain the operation of certain back-up generators (BUGs) that contribute to curtailment and demand response efforts. After reviewing data from industry sources, participation rates were adjusted according to the following assumptions:

- Assumed % of customers with BUGs = 30% for extra-large C&I, 15% for large C&I
- Assumed % of curtailment peak demand impacts from BUGs = 50% for Third Party Contracts programs
- Assumed % of BUGs affected by the EPA legislation = 75% (This is an estimate. Newer generators built after 2006 will generally pass regulations as is.)

With these assumptions, we create a participation deflator or discount factor as follows:

- Participation rate deflator for large C&I customers: 100% - (15%*50%*75%) = 94%
- Participation rate deflator for extra-large C&I customers: 100% - (30%*50%*75%) = 89%

Therefore, adjusted steady-state participation rates change from the 23.5% value in Table A-4 to the following:

- 22% for large C&I; 21% for extra-large C&I

Summary of Class 1 DSM Participation Rates

Table A-5 provides a summary of participation assumptions in all Class 1 DSM resources. For existing programs, initial participation levels are calibrated to current projections, with incremental potential beginning in 2019. Where resource types do not already exist, new resources are assumed to be available for IRP selection beginning in 2019 to allow for vendor contracting and regulatory approval. After introduction, program participation increases through marketing and recruitment efforts before reaching a steady state three to five years later depending on the resource type.

Table A-5 Participation Assumptions in Class 1 DSM Options (% of eligible customers)

DSM Class 1 Options	Program Start Year	Year 1	Year 2	Year 3	Year 4	Year 5-20
Res DLC CAC, RAC, Water Heating (All states, except UT)	2021	0.5%	1.5%	3.5%	4.5%	5.0%
Res DLC Central AC (UT)	Existing	16.3%	16.3%	16.3%	16.3%	16.3%
Res DLC Elec Vehicle Charging (All States)	2021	2.5%	7.5%	17.5%	22.5%	25.0%
Res DLC Smart Appliances (All States)	2021	0.5%	1.5%	3.5%	4.5%	5.0%
Res DLC Smart Thermostats (All states, except UT)	2021	2.5%	7.5%	17.5%	22.5%	25.0%
Res DLC Smart Thermostats (UT)	2021	1.4%	4.1%	9.6%	12.3%	13.7%
Res DLC Space Heating (All States, except UT)	2021	2.0%	6.0%	14.0%	18.0%	20.0%
Res Ancillary Services (All States)	2021	1.5%	4.5%	10.5%	13.5%	15.0%
Res Behavioral DR (All States)	2021	5.0%	10.0%	17.0%	20.0%	20.0%
C&I DLC Central AC (All States, except UT)	2021	0.3%	0.9%	2.1%	2.7%	3.0%
C&I DLC Central AC (Small, UT)	2021	0.2%	0.5%	1.1%	1.4%	1.5%
C&I DLC Central AC (Medium UT)	2021	0.2%	0.5%	1.1%	1.4%	1.5%
C&I DLC Space Heating (All States)	2021	0.3%	0.9%	2.1%	2.7%	3.0%

DSM Class 1 Options	Program Start Year	Year 1	Year 2	Year 3	Year 4	Year 5-20
C&I DLC Water Heating (All States except UT)	2021	0.3%	0.9%	2.1%	2.7%	3.0%
C&I DLC Water Heating (Small, UT)	2021	0.7%	1.5%	2.5%	2.9%	2.9%
C&I DLC Water Heating (Medium, UT)	2021	1.0%	2.0%	3.3%	3.9%	3.9%
C&I Ice Energy Storage	2021	0.2%	0.5%	1.1%	1.4%	1.5%
C&I Ancillary Services (All States)	2021	7.5%	7.5%	7.5%	7.5%	7.5%
DLC Irrigation (CA, OR, WY, WA)	2021	1.5%	4.5%	10.5%	13.5%	15.0%
DLC Irrigation (ID)	Existing	48.0%	48.0%	48.0%	48.0%	48.0%
DLC Irrigation (UT)	Existing	27.1%	27.1%	27.1%	27.1%	27.1%

Class 3 DSM Participation Assumptions

Participation Assumptions in Class 3 Pricing Options

Participation assumptions for pricing options are based on The Brattle Group's extensive review of enrollment in full-scale time-varying rates being offered in the U.S. and internationally, as well as findings of recent market research studies. The enrollment estimates are derived from a review of 6 primary market research studies and 31 full-scale deployments, which resulted in a total of 75 enrollment observations.

Specific data sources for deriving enrollment estimates are provided below.

Residential Participation Assumptions

Residential TOU Demand Rate (with and without Electric Vehicle)

- Two of six state jurisdictions analyzed for parsimony and efficiency:
    - OR as dominant consideration in West half of system, with analysis findings applied to CA and WA
    - UT as dominant consideration in East half of system, with analysis findings applied to ID and WY
- Residential TOU Demand Rate

- Steady-state participation = 14% of eligible customers

Figure A-1 presents residential TOU enrollment rate data from various jurisdictions. Key observations from residential TOU offerings are:

- Average enrollment rate = 28%
- Arizona's high TOU participation is attributable to heavy marketing as well as large users' ability to avoid higher priced tiers of the inclining block rate
- Figure A-2 below presents residential dynamic pricing enrollment rate data for both opt-in and opt-out offers.

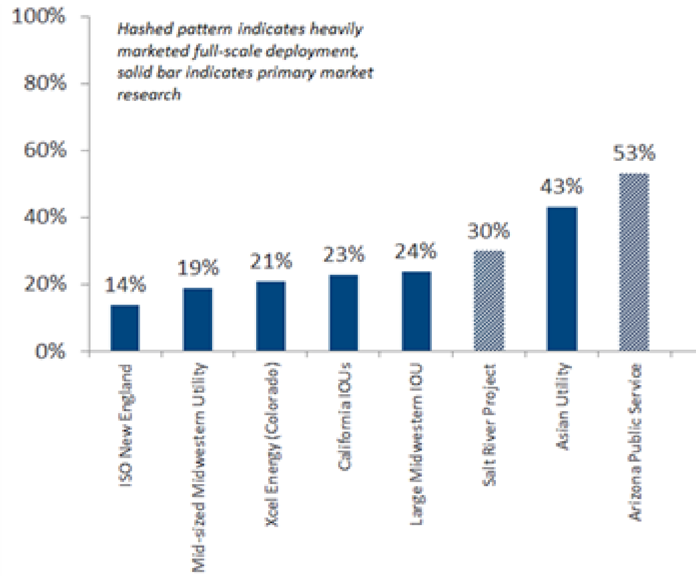

Figure A-1 Residential TOU Enrollment Rate Data

Figure A-2 presents residential dynamic pricing enrollment rate data. Key observations from residential CPP and dynamic pricing offerings are:

- Average enrollment rate = 17%
- Dynamic pricing options considered include CPP, RTP, variable peak pricing (VPP), and peak time rebates (PTR)
- OG&E's VPP rate was rolled out on a full-scale basis in 2012 and has reached its target enrollment rate of 20% a year ahead of schedule
- Availability of Gulf Power's CPP rate is limited

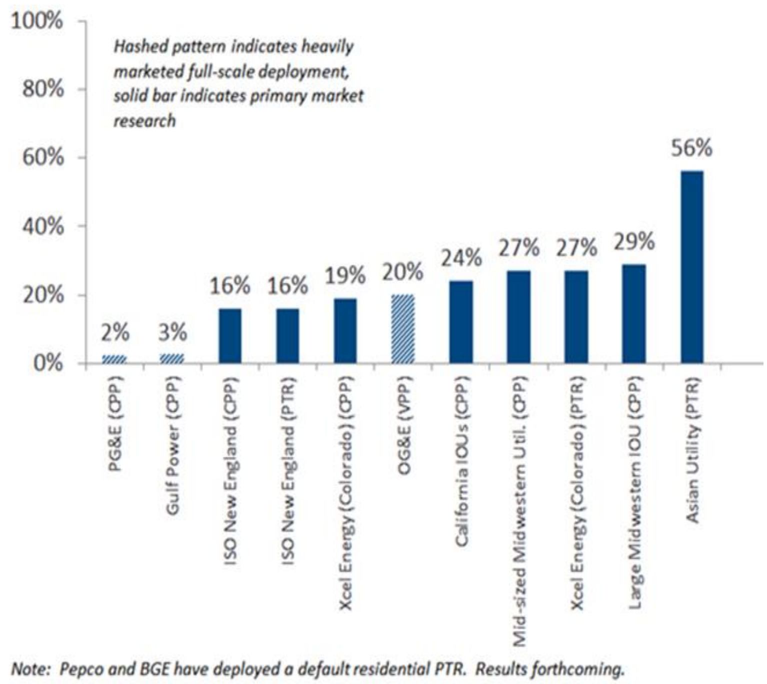

Figure A-2 Residential Dynamic Pricing Enrollment Rate Data

- PG&E's CPP has over 100,000 participants
- Additionally, Pepco, BGE, SCE, and SDG&E have deployed a default residential PTR, but results were not available at the time of this analysis

C&I Participation Assumptions

Figure A-1 presents C&I TOU enrollment rate data. Key observations from C&I TOU offers are:

- Average enrollment rate = 13%
- Estimates are reported separately for Small, Medium, and Large C&I customers (as designated by the utility) where possible
- Full-scale deployment estimates were derived from FERC data, with a focus on the highest enrolled programs
- TOU rates are often offered on a mandatory basis to Large C&I customers; these are excluded from our assessment

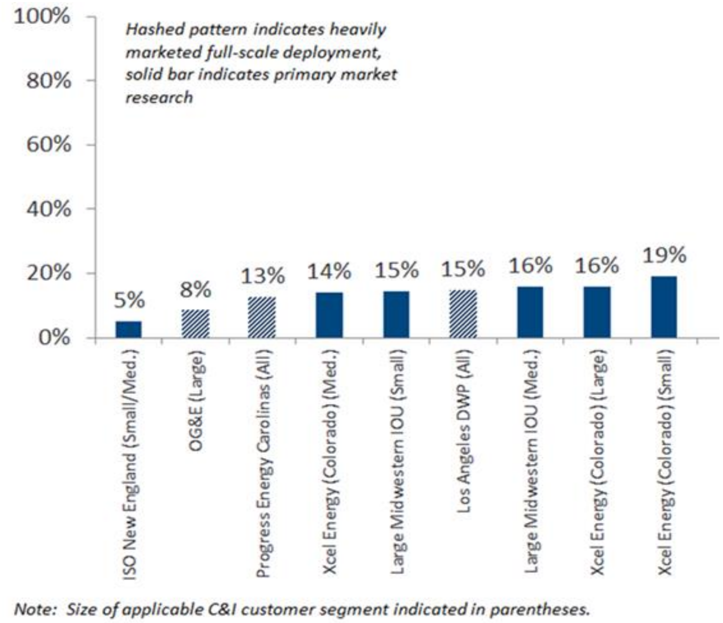

Figure A-1 C&I TOU Pricing Enrollment Rate Data

Figure A-2 and Figure A-3 present C&I enrollment rate data for CPP and RTP, respectively. Key observations from C&I CPP offers are:

- There is limited full-scale CPP deployment experience for C&I customers.
- Average enrollment rate = 18%
- C&I preferences for CPP rates tend to be slightly higher than for TOU rates – the opposite of the relationship observed among residential customers
- The California IOU default CPP offering began in 2011 and has experienced significant opt-outs - it may not have been effectively marketed. The rate is being deployed to smaller customers, but results from this deployment were not available at the time of this analysis.

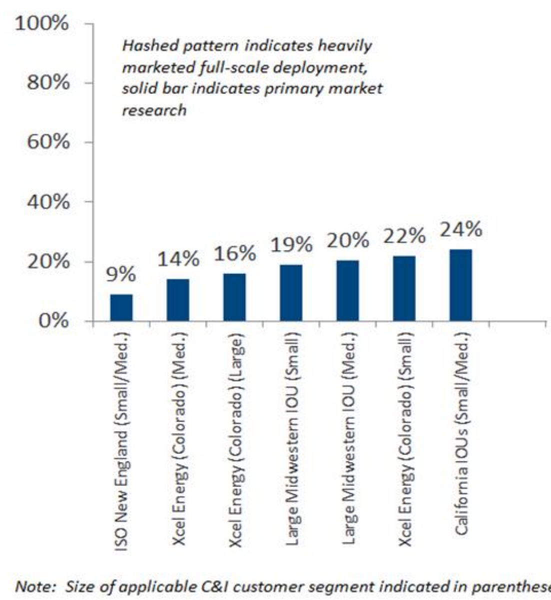

Figure A-2 C&I CPP Pricing Enrollment Rate Data

Key observations from C&I RTP offers are:

- Large C&I RTP deployments vary widely and enrollment is heavily dependent on the nature of the rate offering

- Average enrollment rate = 31%[5]
- All observations are based on full-scale deployments
- Participation estimates are derived from a 2005 LBNL survey
- There are many different RTP design/hedging options and these significantly affect enrollment
- Local market conditions also play a key role in determining RTP enrollment
- The LBNL study finds that most Large C&I RTP programs are not heavily marketed and provide limited assistance to help participants manage price volatility

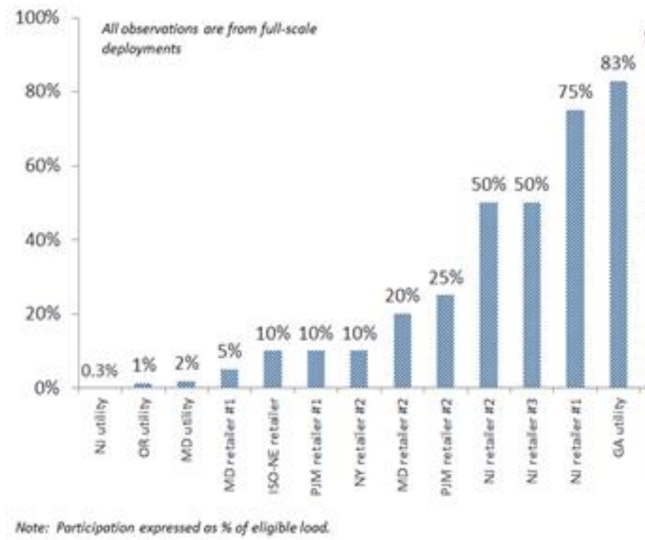

Figure A-3 C&I RTP Pricing Enrollment Rate Data

Summary of Average Enrollment Rates in Pricing Options

Table A-1 provides the average enrollment rates in pricing options, based on the observations presented earlier. These represent averages across 6 market research studies and 31 full scale deployments. These enrollment estimates are for rates that are offered in isolation, with only the existing rate as an alternative choice.

[5] We adjust the opt-in enrollment rate downward for purposes of this analysis – see Table below – since we anticipate that opt-ins will be less prevalent than opt-outs within the same service territory. We also anticipate a lower general level of interest in RTP than other available rates.

Table A-1 Average Enrollment Rates in Pricing Options offered in Isolation

Customer Class	Option	Enrollment Rate for Standalone Programs
Residential	TOU	28%
	TOU w/ EV	28%
	TOU Demand Rate	14%
	TOU Demand Rate w/ EV	14%
	CPP	17%
C&I	TOU	13%
	CPP	18%
	RTP (Large)	3%
	RTP (Extra-large)	5%

Irrigation Customer Participation Assumptions

Expectations around participation in irrigation pricing options have not changed significantly relative to the 2017 PacifiCorp DSM potential study. Therefore, we continued to use the participation rates developed in that prior study.

Summary of Class 3 DSM Participation Rates

This section presents summary tables for pricing participation assumptions by customer class. For existing resources, initial modeled participation is calibrated to current participation. Any new or incremental Class 3 resources are assumed to be available for IRP selection after the establishment of Advanced Metering Infrastructure (AMI) is assumed to be available. PacifiCorp does not currently have comprehensive AMI in any of its service territories. This study assumes that PacifiCorp makes a staggered deployment of AMI in Oregon in 2020, Idaho in 2021, and all other territories in 2025. After introduction, program participation increases through marketing and recruitment efforts before reaching a steady state three to five years later depending on the resource type.

Table A-2 Participation Assumptions for Residential Customers in Time-Varying Rates (with Opt-in Dynamic Pricing Offer)

Option by State	Program Start Year	Year 1	Year 2	Year 3	Year 4	Year 5-20
TOU[6](w/ and w/o EV)						
CA, UT, WA, WY	2025	2.8%	8.4%	19.6%	25.2%	28.0%
OR	2020	2.8%	8.4%	19.6%	25.2%	28.0%
TOU Demand Rate						
CA, UT, WA, WY	2025	1.4%	4.2%	9.8%	12.6%	14.0%
ID	2021	1.4%	4.2%	9.8%	12.6%	14.0%
OR	2020	1.4%	4.2%	9.8%	12.6%	14.0%
TOU Demand Rate w/ EV						
CA, UT, WA, WY	2025	1.4%	4.2%	9.8%	12.6%	14.0%
ID	2021	1.4%	4.2%	9.8%	12.6%	14.0%
OR	2020	1.4%	4.2%	9.8%	12.6%	14.0%
Critical Peak Pricing						
CA, UT, WA, WY	2025	1.7%	5.1%	11.9%	15.3%	17.0%
ID	2021	1.7%	5.1%	11.9%	15.3%	17.0%
OR	2020	1.7%	5.1%	11.9%	15.3%	17.0%

[6] Participation for Idaho TOU not applicable because it is already an existing rate offering. Zeroed out to avoid negative impacts in modeling.

Table A-3 Participation Assumptions for C&I Customers in Time-Varying Rates (with Opt-in Dynamic Pricing Offer)

Option by State	Program Start Year	Year 1	Year 2	Year 3	Year 4	Year 5-20
TOU – Small, Medium, Large C&I						
CA, UT, WA, WY	2025	1.3%	3.9%	9.1%	11.7%	13.0%
ID	2021	1.3%	3.9%	9.1%	11.7%	13.0%
OR	2020	1.3%	3.9%	9.1%	11.7%	13.0%
TOU – Large C&I						
All States	2019	1.3%	3.9%	9.1%	11.7%	13.0%
TOU – Extra Large C&I						
ID Only[7]	2019	1.3%	3.9%	9.1%	11.7%	13.0%
Critical Peak Pricing – Small & Medium C&I						
CA, UT, WA, WY	2025	1.8%	5.4%	12.6%	16.2%	18.0%
ID	2021	1.8%	5.4%	12.6%	16.2%	18.0%
OR	2020	1.8%	5.4%	12.6%	16.2%	18.0%
Critical Peak Pricing- Large and Extra C&I						
All States	2019	1.8%	5.4%	12.6%	16.2%	18.0%
Real Time Pricing – Large C&I						
All States	2019	0.3%	0.9%	2.1%	2.7%	3.0%
Real Time Pricing – Extra Large C&I						
All States	2019	0.5%	1.5%	3.5%	4.5%	5.0%

[7] All Extra-Large C&I customers already on mandatory TOU rates except ID, so these are removed from the analysis of incremental resources.

Table A-4 Participation Assumptions for Irrigation Customers in Time-Varying Rates (with Opt-in Dynamic Pricing Offer)

Option by State	Program Start Year	Year 1	Year 2	Year 3	Year 4	Year 5-20
TOU - Irrigation						
CA, UT, WA, WY	2025	1.3%	3.9%	9.1%	11.7%	13.0%
ID	2021	1.3%	3.9%	9.1%	11.7%	13.0%
OR	2020	1.3%	3.9%	9.1%	11.7%	13.0%
Critical Peak Pricing – Irrigation						
CA, UT, WA, WY	2025	1.8%	5.4%	12.6%	16.2%	18.0%
ID	2021	1.8%	5.4%	12.6%	16.2%	18.0%
OR	2020	1.8%	5.4%	12.6%	16.2%	18.0%

B

CLASS 1 AND 3 DSM IMPACT ASSUMPTIONS

This appendix presents detailed impact assumptions for Class 1 and 3 DSM resources included in our analysis.

Class 1 DSM Impact Assumptions

Residential DLC Impact Assumptions

Table B-1 presents unit load reduction assumptions for residential DLC

Table B-1 Residential DLC Unit Load Reductions[8]

State	Unit	Value	Basis for Assumption
CA	kW reduction per participant for Cooling	0.66	For Utah, 0.97 kW is the weighted average impact for residential SF and MF home participants, based on Cool Keeper program data provided by PacifiCorp.[9] Idaho assumption is based on FERC 2012 survey results for Idaho power, and weather adjusted to account for the weather differences across the service territories for PacifiCorp and Idaho Power For the other states, impact assumptions are interpolated using UT and ID impacts, and the ratio of cooling degree days in each state.
ID		0.46	
OR		0.43	
UT		0.97	
WA		0.53	
WY		0.53	
All states	kW reduction per participant for DWH	0.58	7th Plan from Cadmus Group, Comprehensive Assessment of Demand-Side Resource Potentials (2014-2033), page 75, 2013.
CA	kW-Reduction per participant for Space Heating	1.11	Developed using the average of the 7th plan and the PSE 2010 DLC Pilot (WA), multiplied by ratio of HDD
ID		1.75	
OR		1.20	
UT		1.38	
WA		1.47	
WY		1.78	

[8] The unit impact assumptions are at site.

[9] Recent Cool Keeper program data provided by PacifiCorp indicates that impact per unit in SF homes is 1.1 kW and impact per unit in MF homes is 0.36 kW. SF homes are estimated to have 1.08 units on an average, and MF homes are estimated to have one unit on average. The total number of units enrolled in the Cool Keeper program is estimated at 100,000 (75,000 from SF homes and 25,000 units in MF homes). The weighted average impact per participant is calculated using these data.

Table B-1 continued

State	Unit	Value	Basis for Assumption
CA	kW-Reduction per participant for Room AC	0.23	Developed using the DLC CAC impact, multiplied by ratio of the UEC for Room AC/CAC in EE Market Profile for each state
ID		0.21	
OR		0.14	
UT		0.23	
WA		0.17	
WY		0.30	
CA	kW reduction per participant for Smart T-Stat (Summer)	0.66	Same as Residential DLC Cooling
ID		0.46	
OR		0.43	
UT		0.97	
WA		0.53	
WY		0.53	
CA	kW-Reduction per participant for Smart T-stat (Winter)	0.53	Developed using the Space Heating impacts multiplied by the ratio of electric heat to electric cooling saturations.
ID		0.54	
OR		0.54	
UT		0.21	
WA		1.01	
WY		0.39	
All States	kW reduction per participant for Smart Appliances	0.139	Ghatikar, Rish. Demand Response Automation in Appliance and Equipment. Lawrence Berkley National Laboratory, 2015 Same for Summer and Winter Peak Seasons
All States	kW Reduction per participant for Electric Charger	0.28	Avg coincident per vehicle kW Xcel Energy "Electric Vehicle Charging Station. Pilot Evaluation Report" May 2015, pg. 18
All States	kW Reduction per participant for Ancillary Services	0.11	Mathieu, Dyson, Callaway. Using Residential Electric Loads for Fast Demand Response: The Potential Resource and Revenues, the Costs, and Policy Recommendations
All States	kW Reduction per participant for Behavioral DR (Summer)	0.04	Based on OPower documentation
All States	kW Reduction per participant for Behavioral DR (Winter)	0.02	Assumed winter impacts are half of those in summer, to account for the absence of electric heat in some residential homes.

C&I DLC and Ice Energy Impact Assumptions

Table B-2 presents unit load reduction assumptions for non-residential DLC.

Table B-2 C&I DLC Unit Load Reductions[10]

State	Program	Customer Class	Unit	Value	Basis for Assumption
CA	DLC CAC	Small C&I	kW reduction per participant for cooling	1.08	The Utah impact is based on 2013 Cool Keeper program data for non-residential customers. Other state impacts are based on Utah impacts, using the method described above for Residential DLC analysis.
ID	DLC CAC	Small C&I	kW reduction per participant for cooling	1.16	
OR	DLC CAC	Small C&I	kW reduction per participant for cooling	1.08	
UT	DLC CAC	Small C&I	kW reduction per participant for cooling	1.16	
WA	DLC CAC	Small C&I	kW reduction per participant for cooling	1.34	
WY	DLC CAC	Small C&I	kW reduction per participant for cooling	1.34	
CA	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
ID	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
OR	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
UT	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
WA	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
WY	DLC CAC	Medium C&I	kW reduction per participant for cooling	15.2	
CA	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	0.95	Based on ratio of DLC central AC peak-load reductions sizes between residential and small C&I facilities.
ID	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	1.46	
OR	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	1.46	
UT	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	0.69	
WA	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	1.47	
WY	DLC Water Heating	Small & Medium C&I	kW reduction per participant for DHW	1.47	
CA	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	1.82	Based on ratio of DLC space heating peak-load reductions sizes between residential and small C&I facilities.
ID	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	4.41	
OR	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	3.02	
UT	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	1.65	
WA	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	3.72	
WY	DLC Space Heating	Small C&I & Medium C&I	kW reduction per participant for Space Heating	4.51	
All States	Ice Energy Storage	Small C&I	kW reduction per participant	1.68	Ice Bear technical specifications
All States	Ice Energy Storage	Small C&I	kW reduction per participant	8.40	AEG engineering research, vendor interviews, technical brief on Thermal Energy Storage

[10] The unit impact assumptions are on site at the meter.

Irrigation Load Control Impacts

For Irrigation Load Control, we assume that a customer will completely turn off their participating pumps and equipment during an event. The portion of load that is completely curtailed is embedded in the class-average participation assumptions covered in Appendix A.

Third Party Contracts Program Impacts

Table B-3 presents load reduction assumptions for the Third Party Contracts option.

Table B-3 Third Party Contracts and Ice Energy Storage Unit Impact

State	Unit	Value	Basis for Assumption
All states	% of enrolled load in Curtail Agreements	21%	Weighted average impact estimates from aggregator DR programs administered by California utilities (Ref: 2012 Statewide Load Impact Evaluation of California Aggregator Demand Response Programs Volume 1: Ex post and Ex ante Load Impacts; Christensen Associates Energy Consulting; April 1, 2013.). This is combined with data from the 2012 FERC National Survey database of DR programs. Impact assumed the same for both Summer and Winter.

Class 3 DSM Impact Assumptions

Unit Impact Assumptions for Pricing Options

Table B-4 below shows the customer segments and rates for which per-participant peak demand impacts were estimated.

Table B-4 Applicable Customer Segments for Development of Class 3 Impacts

Customer Class	TOU	TOU w/ EV	CPP	RTP	TOU Demand Rate	TOU Demand Rate w/ EV
Residential	X	X	X		X	X
Small C&I	X		X			
Medium C&I	X		X			
Large C&I	X		X	X		
Extra Large C&I	X		X	X		
Irrigation	X		X			

Steps for Unit Impact Estimates for Pricing Options

The following steps describe the process followed for arriving at impact estimates for pricing options:

- Establish a reasonable peak-to-off-peak price ratio for each rate option
    - The peak-to-off-peak price ratio is the key driver of peak demand reduction among participants in time-varying rates.
    - A higher price ratio means a stronger price signal and greater bill savings opportunities for participants – on average, participants provide larger peak demand reductions as a result.

- We surveyed the range of price ratios that have been offered in time-varying rates over the past decade to establish reasonable assumptions for PacifiCorp.
- We chose a modest 2:1 TOU price ratio in recognition of lower-than-average energy prices in PacifiCorp's operating regions.
- The assumed CPP price ratio of 6:1 is also lower than the national average.

- Simulate impacts of time-varying rates based on a comprehensive review of recent pilot results
  - Due to limited experience with dynamic pricing in PacifiCorp's service territories, we could not rely on its existing tariffs/programs to estimate per-customer peak reductions
  - Instead, for residential customers, we rely on results from more than 200 pricing tests that have been conducted in the U.S. and internationally
  - Small and Medium C&I impacts are based on results of a dynamic pricing pilot in California
  - Large C&I impacts are based on experience with full-scale programs in the Northeastern U.S.
- Brattle's "Arc of Price Responsiveness" was used to simulate TOU and CPP impacts for residential customers. These are illustrated below in Figure B-1 and Figure B-2.

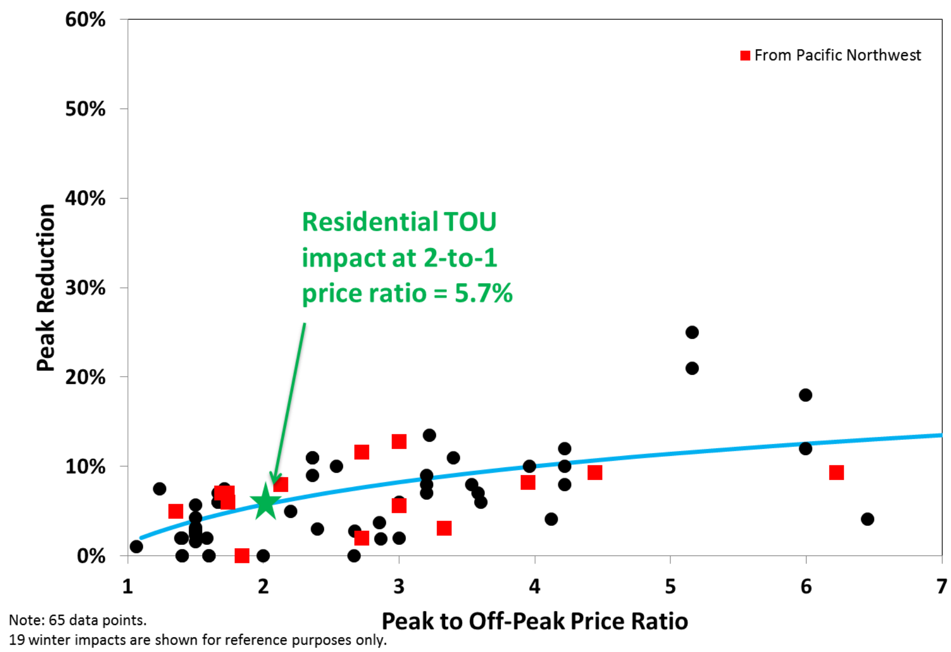

Figure B-1 Results of Residential TOU Pricing Tests with Arc

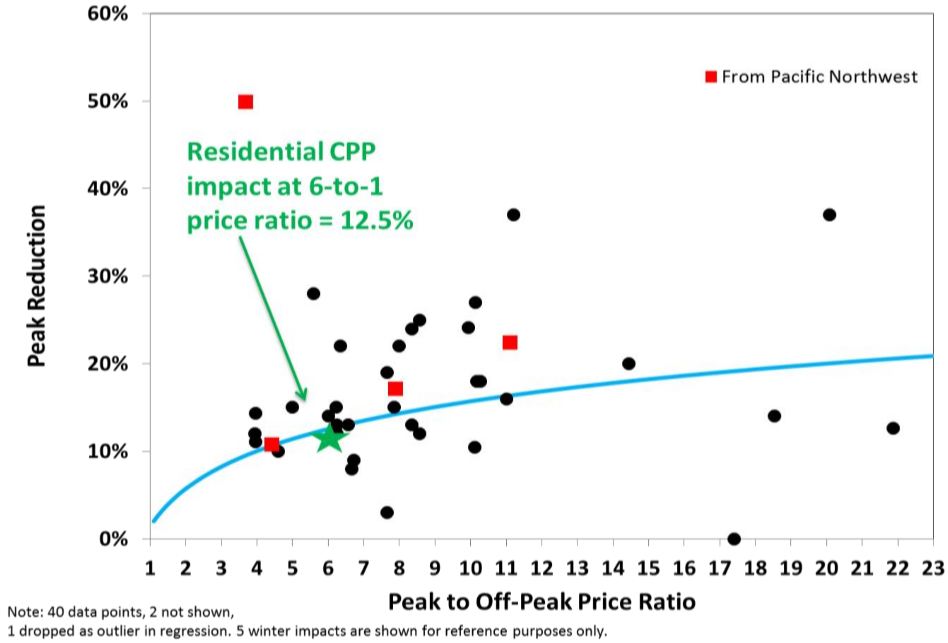

Figure B-2 Results of Residential CPP Pricing Tests with Arc

- C&I impacts were estimated using a similar approach, but fewer pilots have been conducted for these customers. Figure B-3 shows the peak reduction with varying peak to off-peak price ratio, for participants without and with enabling technology.

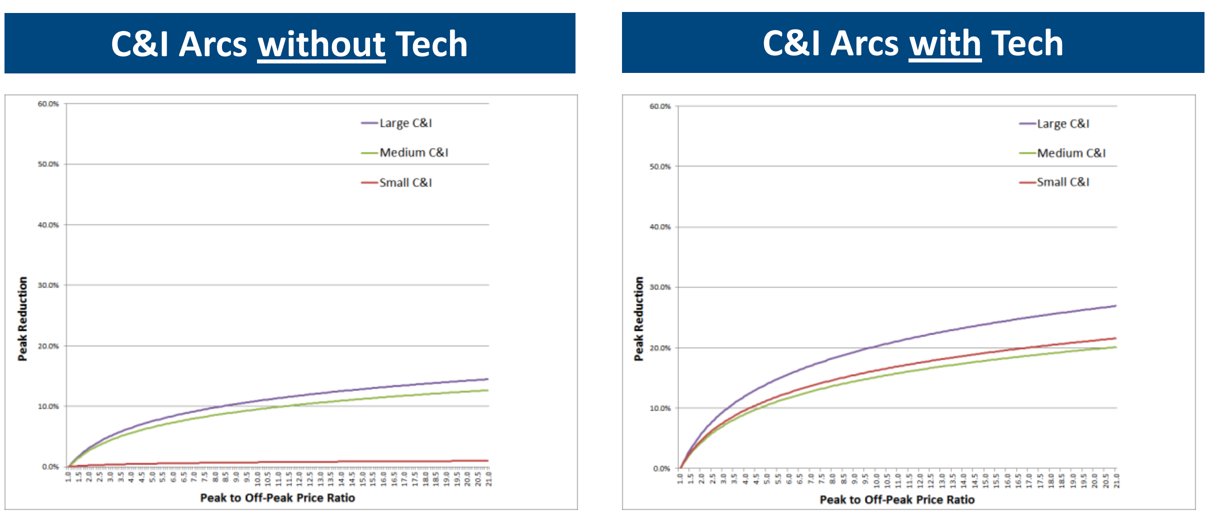

Figure B-3 C&I Impacts with and without Enabling Technology

- Simulated impacts for irrigation customers:
  - A 2001/2002 irrigation TOU pilot in Idaho found that customers produced, on average, a 9% reduction in peak demand for a TOU with a 3.5-to-1 price ratio.
  - We used the Arc of Price Responsiveness to scale these impacts to the TOU and CPP price ratios assumed in this study.

  - The resulting peak demand reduction estimates are 4.7% for a TOU rate with a 2:1 price ratio and 13.1% for a CPP rate with a 6:1 price ratio.

- Final summary of results for time-varying rates:

Table B-5 and Table B-6 shows the summary of per-customer impacts from time varying rates, note that impact assumptions in kW vs. percent are italicized.

Table B-5 Residential Per-Customer Impacts from Pricing Options[11]

Customer Class	State	Option	Per Customer Summer Peak Demand Reduction (%)	Per Customer Winter Peak Demand Reduction (%)
Residential	All	Time-Of-Use	5.7%	2.9%
Residential	All	Time-Of-Use with EVs	*0.59 kW*	*0.29 kW*
Residential	All	Critical Peak Pricing	12.5%	6.3%[12]
Residential	OR, WA, CA	TOU Demand Rate	3.3%	1.7%
Residential	UT, ID, WY	TOU Demand Rate	8.0%	0.0%*
Residential	All	TOU Demand with EVs	*0.59 kW*	*0.29 kW*

Table B-6 C&I Per-Customer Impacts from Pricing Options

Customer Class	Option	Per Customer Summer Peak Demand Reduction (%)	Per Customer Winter Peak Demand Reduction (%)
Small C&I	Time-Of-Use	0.2%	0.1%
Small C&I	Critical Peak Pricing	0.6%	0.3%
Medium C&I	Time-Of-Use	2.6%	1.3%
Medium C&I	Critical Peak Pricing	7.3%	3.7%
Large C&I	Time-Of-Use	3.1%	1.6%
Large C&I	Critical Peak Pricing	8.4%	4.2%
Large C&I	Real Time Pricing	8.4%	4.2%
Extra Large C&I	Time-Of-Use	3.1%	1.6%
Extra Large C&I	Critical Peak Pricing	8.4%	4.2%
Extra Large C&I	Real Time Pricing	8.4%	4.2%
Irrigation	Time-Of-Use	4.7%	0.0%
Irrigation	Critical Peak Pricing	13.1%	0.0%

[11] Brattle developed per customer peak reductions in percentages. Households with electric vehicles were assumed to have peak loads of 6kW, so the percentage-impact assumptions are multiplied by 6kW to obtain the kW impact reduction for these Class 3 resources.

[12] Our estimate here does not differentiate peak demand reduction in the summer and winter months. In practice, summer demand is generally reduced by a greater percentage than winter demand.

Notes:

- TOU impacts assume 2:1 peak to off-peak price ratio
- CPP impacts assume 6:1 peak to off-peak price ratio

C

CLASS 1 AND 3 DSM PROGRAM COST ASSUMPTIONS

This appendix presents itemized cost assumptions for the Class 1 and 3 DSM resources included in our analysis.

Class 1 DSM Program Cost Assumptions

Table C-1 presents itemized cost assumptions for residential DLC.

Table C-1 Residential DLC Program Cost Assumptions

Cost Item	Unit	Value	Basis for Assumption
Annual Program Administration Cost	$/year	$300,000 – CAC & Space Heating each $75,000 – Smart programs & EV charging each	Assumed 2 FTEs are required to run the DLC program system wide (targeting residential and commercial customers with eligible cooling equipment), @$150,000 per FTE. The overall cost is allocated across customer classes by state, based on their shares in the 2038 potential for CAC and Space Heating. RAC and WH programs share costs with CAC and Space heating. And additional $75,000 (1/2 FTE) for each smart thermostat and smart appliances.
Annual Marketing and Recruitment Costs	$/new participant	$50-60	Assumed $50 per-participant marketing and recruitment cost for Utah. For other states, costs are assumed to be 20% higher at $60, to reflect additional marketing/recruitment efforts that may be necessary.
Equipment capital and installation cost for HVAC switch	$/participant	CAC, RAC, Space Heating – $215 each	Assumed $115 cost for switch, plus $100 installation cost. Based on Cool Keeper program data, number of units per participant is 1.06 (weighted for single family and multifamily home participants). Therefore, the total cost per unit is multiplied by the average number of units per participant, in order to arrive at the total capital and installation cost per participant. Cost is assumed to be uniform across all states.
Equipment capital and installation cost for WH switch	$/participant	$315	Assumed $115 cost for water heater switch (same as cooling switch cost), plus $200 installation cost. Water heater switch installation cost is assumed to be double that of cooling switch installation cost (reflecting scheduling time for going inside house, extra time required for installation).

Table C-1 Continued

Cost Item	Unit	Value	Basis for Assumption
Equipment capital and installation cost Smart Programs and EV Charging	$/participant	Smart t-stat – Bring-your-own Smart Appliances – $300 EV Charging – $1,200	Smart thermostat- assume no incremental equipment cost to the program due to "bring your own" model where customer offers devices they've already procured. Smart appliances- Google research revealed devices range anywhere between $150 -400. The home needs Wi-Fi hub to connect devices EV charging- AEG research of pilot and active utility programs indicates this is approximate cost of installing level 2 charging equipment.
Annual O&M cost	$/participant	$11 – DLC CAC, RAC, Space Heat $44 – Smart t-stat	Assumed to be 5% of capital and installation costs for HVAC switches. Assumed higher for more complex smart thermostat devices at $44.
Per participant annual incentive (AC & Space Heating, Smart tstat)	$/participant/ year	$21	Incentive level assumed to be $20 per unit, which translates into $21.2 per participant, assuming 1.06 units[13] per participant. $20 incentive is based on Cool Keeper program incentive level.

[13] Average no. of units per participant in residential DLC is 1.06, weighted by SF and MF participants. This is based on Cool Keeper program data.

Table C-2 presents itemized cost assumptions for C&I DLC.

Table C-2 C&I DLC Program Cost Assumptions

Cost Item	Unit	Value	Basis for Assumption
Annual Program Administration Cost	$/year		Assumed to be covered and included under residential program
Annual Marketing and Recruitment Costs	$/new participant	$62-$75 for small C&I;	Assumed to be 25% higher than residential costs.
		$75-90 for medium C&I;	Assumed to be 50% higher than residential costs.
Equipment capital and installation cost for AC switch	$/participant	$387 for small C&I	Per switch capital and installation cost is assumed to be $200, which is same as residential. However, small C&I customers, on average, are estimated to have 1.8 AC units.[14] Medium C&I customers, on an average, are estimated to have 5.6 units.[15] So per participant costs are scaled up accordingly for small and medium C&I DLC participants.
		$1,200 for medium C&I	
Equipment capital and installation cost for WH switch	$/participant	$315	Same assumption as residential
Annual O&M cost	$/participant	$19 for small C&I; $60 for medium C&I	Assumed to be approx. equal to 5% of capital and installation costs for AC switches.
Per participant annual incentive (AC & Space Heat)	$/participant/ year	$38 for small C&I, $128 for medium C&I	The per participant incentive levels are based on average incentive amounts based on 2013 Cool Keeper data for non-residential customers. C&I participants are offered two incentive levels, based on the size of the AC unit. Units less than 5.4 tons have a $20 annual bill credit, while larger size units have an annual incentive of $40. 2013 non-residential Cool Keeper program data provided the number of units that received $20 and $40 incentive amounts. This was used to calculate the average incentive provided on a per participant basis.
Per participant annual incentive (WH)	$/participant/ year	$24	Same as Residential

[14] The estimation of the number of units per participant is based on Cool Keeper program data for non-residential customers, provided by PacifiCorp.

[15] *Ibid.*

Table C-3 present cost assumptions for the Irrigation Load Control.

Table C-3 Irrigation Load Control Program Cost Assumptions[16]

Cost Item	Unit	Value	Basis for Assumption
Program Delivery Cost (administered by third party)	$/kW-year.	$52 for ID and UT; $68 for remaining states;	Based on third-party program implementation experience, irrigation load control delivery cost is expected to be in the range of $45-50/kW. This applies to states such as Idaho and Utah, with relatively favorable markets for realizing irrigation load reductions. The delivery cost for Idaho and Utah is assumed at the midpoint of the $45-50/kW estimate. For the other states, delivery costs are assumed to be 30% higher, based on implementation experience. The higher costs reflect a combination of higher value crop types (due to which incentive costs are likely to increase) and possibly higher marketing and recruitment costs in these states. We assume delivery cost to be an "all inclusive" item covering costs associated with equipment purchase and installation, maintenance costs, network communications costs, sales and marketing costs, and payments to the customer. An additional 10% cost, over the third-party delivery cost, is assumed to account for separate utility expenses related to program management, regulatory filings, internal book keeping, etc.

Table C-4 and Table C-5 presents itemized cost assumptions for Ice Energy Storage and Curtailment Agreement program options.

Table C-4 C&I Ice Energy Storage Program Cost Assumptions

Cost Item	Unit	Value	Basis for Assumption
Annual Program Development cost	$/year	$75,000	System wide costs for Rate - Allocated across states and customer classes for 1.2 FTE. (1 FTE is $150,000). New program that needs budget allocated for development.
Annual Program Administration Cost	$/year	$75,000	System wide costs for Rate - Allocated across states and customer classes for 1.2 FTE. (1 FTE is $150,000)
Annual Marketing and Recruitment Costs	$/new participant	$100 for All states	Assumed to be same as DLC CAC.
Equipment capital and installation cost for storage unit	$/participant	$8,400	AEG research indicates a typical small commercial storage unit size if 5 KW and that an average cost is approximately $2,000/kW system.
Per participant annual incentive (WH)	$/participant/ year	$0	No incentive. Program purchases & installs unit.

[16] These cost assumptions are on site at the meter.

Table C-5 Third Party Contracts Program Cost Assumptions

Cost Item	Unit	Value	Basis for Assumption
Program Delivery Cost (administered by third party)	$/kW-year	$70 for all states	Based on third-party program implementation experience, delivery cost is expected to be in the range of $60-80/kW. We assume delivery cost to be the average value in this range. This is inclusive of all costs to run the program including equipment purchase and installation costs, maintenance costs, network communications costs, sales and marketing costs, and payments to the customer. In addition to the third-party delivery cost, we assume additional utility administrative costs to account for items such as program management, regulatory filings, internal book keeping, etc. The administrative costs are estimated to be equivalent to a full FTE cost for implies a 1% adder to the per kW capacity delivery costs.
Incentive payment for energy delivery	$/kWh	$0.11 for all states	Based on third-party program implementation experience, energy dispatch prices typically fall in the $75-150/MWh range. We assume an average price at the midpoint of this range for all states.

Class 3 DSM Program Cost Assumptions

Table C-6 presents itemized cost assumptions associated with implementation of time varying rate options (TOU, CPP, and RTP).

Table C-6 Cost Assumptions for Time Varying Rates

Cost Item	Unit	Value	Basis for Assumption
Development Cost	$/program	$150,000 (1 full-time employee equivalent, or FTE) for TOU & CPP each; $75,000 (0.5 FTE) for TOU Demand Rate, TOU Demand Rate w/ EV, RTP each;	Assumed 1 FTE (@$150,000 per FTE) is required to design and set up each of the TOU and CPP rates. For RTP, it is assumed that costs are lower, since RTP is applicable only to extra-large customer classes. Therefore, we assume that 0.5 FTE is required for setting up the RTP option. The one-time development cost is allocated across states and eligible customer classes by their share of 2034 potential.
Annual Program Administration Cost	$/year	$75,000 (0.5 FTE) for each pricing program	Assumed 0.5 FTE is required for system wide administration of TOU and RTP each, and 1 FTE is required for system wide administration of CPP. This cost is allocated across states and eligible customer classes by their share of 2034 potential.
Annual Marketing and Recruitment Costs	$/new participant	All sectors $10 for TOU; Residential $20 for TOU Demand Rate & TOU Demand Rate w/ EV; Residential, Small and Medium C&I, Irrig- $50 for CPP; Large C&I- $200; Extra-large C&I- $400	Source: AEG implementation experience; Costs increase with customer size, with increasing need for one-on-one marketing approaches, development of customized load reduction strategies, etc. For large C&I customers, costs are assumed to be four times the cost for small and medium C&I participants; for extra-large customers, costs are assumed to be double the costs for large C&I participants.

D

INTEGRATED ASSESSMENT OF CLASS

Integrated Analysis Framework with Class 1 DSM Interactions

In the main body of the report in Volume 3, we presented Class 1 DSM analysis results on a standalone basis, without taking into consideration interactions between the different Class 1 DSM resources. This presents the resources in a way that best represents them before selections are made in the IRP. However, if two resource classes are combined, whether in part or in whole, there will be some interactions due to some Class 1 resources often targeting the same customer classes and peak loads. For example, Smart Thermostats and DLC Central AC both target residential customers with CAC. Customers enrolled in the Smart Thermostat program will not have load available for reduction during DLC Central AC events because their AC unit is already being curtailed by a smart thermostat. Therefore, the total amount of load reduction that may be possible from Smart Thermostat and DLC Central AC combined would be significantly less than the sum of the potential from these two options considered on a standalone basis.

The integrated analysis results presented in this section attempts to address these interactions between the Class 1 DSM resources and provide an assessment of the potential.

The first step in conducting an integrated assessment of Class 1 DSM resources is to define a hierarchy of options, according to which eligibility criteria are established. This is necessary to account for the interactive effects between Class 1 DSM resources, and to avoid double counting of impacts. Program eligibility criteria were defined to ensure that customers cannot participate in multiple programs. For example, residential customers cannot participate in both an air conditioning DLC program and a Smart Thermostat program, both of which could target the same load for curtailment on the same days.

Table D-1 shows the participation hierarchy by customer class for applicable Class 1 DSM options. The ordering of the options is based primarily on the firmness of the resource with secondary consideration given to levelized costs and maturity of program offerings.

Table D-1 Participation Hierarchy in Class 1 and 3 DSM Options by Customer Class

	Program Option	Resource Class	Residential	Small C&I	Medium C&I	Large C&I	Extra Large C&I	Irrigation
Loaded First	DLC Smart Thermostats	Class 1	x	x	x			
	DLC Central AC	Class 1	x	x	x			
	DLC Water Heating	Class 1	x	x	x			
	DLC Space Heating	Class 1	x	x	x			
	DLC Room AC	Class 1	x					
	DLC Smart Appliances	Class 1	x					
	DLC Irrigation	Class 1						x
	Ice Energy Storage	Class 1		x	x			
	DLC Elec Vehicle Charging	Class 1	x					
Loaded Last	Ancillary Services	Class 1	x	x	x	x	x	

Class 1 DSM Integrated Analysis Results with Opt-in Offer for Pricing Options

This section presents integrated potential analysis results for Class 1 DSM options.

Integrated analysis results are presented at the following levels:

- Overall total and incremental potential results Class 1 DSM options in 2038 for the summer and winter peak seasons
- Incremental potential results by state for Class 1 DSM options in 2038
- Levelized costs by option over the period of 2017-2038

Overall Integrated Potential Results

Table D-2 presents overall integrated potential results for Class 1 DSM in 2038.

Key observations from analysis results are:

- Overall achievable potential for Class 1 DSM reaches 896 MW in 2038, representing 7.8% of forecasted system peak.
- Compared to standalone analysis results, total Class 1 DSM potential is lower by 3.7% because of the stacking and interactive effects
- Top contributors to the total potential (existing and incremental) are irrigation load control, Third Party Contracts, and Residential Smart Thermostats.

Table D-2 Class 1 DSM Total Potential with Interactive Effects in 2038 (Summer MW @ Generator)

DSM Options	Total Potential in 2038
System Peak Forecast (Summer MW)	**11,513.0**
Class 1 DSM Potential	
Residential DLC Central AC	143.9
Residential DLC Space Heating	-
Residential DLC Water Heating	33.6
Residential DLC Smart Thermostats	153.2
Residential DLC Smart Appliances	15.0
Residential DLC Room AC	5.4
Residential DLC EV Chargers	6.7
Residential Ancillary Services	1.6
C&I DLC Central AC	16.2
C&I DLC Space Heating	-
C&I DLC Water Heating	5.2
C&I Smart Thermostats	98.8
DLC Irrigation	210.9
Ice Energy Storage	6.8
Third Party Contracts	168.3
C&I Ancillary Services	30.0
Total Class 1 DSM (MW)	**895.6**
Potential (% of PacifiCorp 2038 summer peak)	
Class 1 DSM	**7.8%**

Table D-3 Class 1 DSM Total Potential with Interactive Effects in 2038 (Winter MW @ Generator)

DSM Options	Total Potential in 2038
System Peak Forecast (Winter MW)	**9,298.0**
Class 1 DSM Potential	
Residential DLC Central AC	-
Residential DLC Space Heating	130.6
Residential DLC Water Heating	33.6
Residential DLC Smart Thermostats	100.1
Residential DLC Smart Appliances	15.0
Residential DLC Room AC	-
Residential DLC EV Chargers	6.7
Residential Ancillary Services	-
C&I DLC Central AC	-
C&I DLC Space Heating	7.4
C&I DLC Water Heating	5.2
C&I Smart Thermostats	26.5
DLC Irrigation	-
Ice Energy Storage	-
Third Party Contracts	133.9
C&I Ancillary Services	-
Total Class 1 DSM (MW)	**459.1**
Potential (% of PacifiCorp 2038 winter peak)	
Class 1 DSM	**4.9%**

Incremental Potential by State in 2038

Next, we consider the incremental impacts from new programs and rate offerings included in our analysis. We do this by identifying the load reductions from existing programs and rates being offered by PacifiCorp and subtracting that amount from the total potential. Table D-4 presents load reductions being realized from current Class 1 DSM programs. Table D-5 through Table D-6 then present incremental potential results in 2038 by state and peak season.

Table D-4 Impacts from Existing Class 1 DSM Options by State (MW @ Generator)

Option	CA	ID	OR	UT	WA	WY	Total
Residential DLC	-	-	-	102	-	-	**102**
C&I DLC	-	-	-	10	-	-	**10**
Irrigation DLC	-	168	-	21	-	-	**189**

Table D-5 Class 1 DSM Incremental Potential by State with Interactive Effects in 2038 (Summer MW @ Generator)

Program	CA	ID	OR	UT	WA	WY	Total
Residential DLC Central AC	0.30	0.67	4.24	33.93	1.62	1.15	**41.90**
Residential DLC Space Heating	-	-	-	-	-	-	**-**
Residential DLC Water Heating	0.66	1.15	11.03	15.25	4.16	1.34	**33.58**
Residential DLC Smart Thermostats	3.79	5.85	36.46	87.19	9.34	10.53	**153.17**
Residential DLC Smart Appliances	0.28	0.63	4.18	8.09	0.87	0.98	**15.03**
Residential DLC Room AC	0.16	0.38	1.23	2.38	0.55	0.71	**5.40**
Residential DLC EV Chargers	0.07	0.19	1.29	4.79	0.27	0.10	**6.72**
Residential Ancillary Services	0.02	0.04	0.30	1.13	0.06	0.02	**1.58**
C&I DLC Central AC	0.45	0.83	5.98	5.26	1.62	2.05	**16.19**
C&I DLC Space Heating	-	-	-	-	-	-	**-**
C&I DLC Water Heating	0.12	0.39	2.14	1.43	0.45	0.69	**5.23**
C&I DLC Smart Thermostats	2.08	3.03	25.69	51.13	7.45	9.39	**98.77**
C&I Third Party Contracts	1.07	1.89	37.69	76.71	10.91	40.08	**168.34**
C&I Ancillary Services	0.45	0.74	7.87	15.90	1.93	3.15	**30.03**
Irrigation DLC	4.64	24.39	13.91	3.45	8.27	1.82	**56.47**
Ice Energy Storage	0.22	0.42	2.60	2.09	0.62	0.85	**6.81**
Total	**14.31**	**40.59**	**154.63**	**308.71**	**48.12**	**72.86**	**639.22**

Table D-6 Class 1 DSM Incremental Potential by State with Interactive Effects in 2038 (Winter MW @ Generator)

Program	CA	ID	OR	UT	WA	WY	Total
Residential DLC Central AC	-	-	-	-	-	-	**-**
Residential DLC Space Heating	3.60	8.36	54.67	33.50	20.63	9.88	**130.63**
Residential DLC Water Heating	0.66	1.15	11.03	15.25	4.16	1.34	**33.58**
Residential DLC Smart Thermostats	3.04	6.90	46.04	18.47	17.77	7.84	**100.06**
Residential DLC Smart Appliances	0.28	0.63	4.18	8.09	0.87	0.98	**15.03**
Residential DLC Room AC	-	-	-	-	-	-	**-**
Residential DLC EV Chargers	0.07	0.19	1.29	4.79	0.27	0.10	**6.72**
Residential Ancillary Services	-	-	-	-	-	-	**-**
C&I DLC Central AC	-	-	-	-	-	-	**-**
C&I DLC Space Heating	0.16	0.55	2.68	1.98	0.73	1.26	**7.36**
C&I DLC Water Heating	0.12	0.39	2.14	1.43	0.45	0.69	**5.23**
C&I DLC Smart Thermostats	0.77	1.97	11.89	3.52	5.22	3.17	**26.54**
C&I Third Party Contracts	0.66	1.36	32.84	51.31	10.23	37.53	**133.94**
C&I Ancillary Services	-	-	-	-	-	-	**-**
Irrigation DLC	-	-	-	-	-	-	**-**
Ice Energy Storage	-	-	-	-	-	-	**-**
Total	**9.37**	**21.49**	**166.77**	**138.34**	**60.32**	**62.79**	**459.08**

Key observations are:

- Class 1 DSM potential with interactive effects reaches 639 MW in 2038, which is lower by about 34 MW when compared to the standalone potential presented in the Volume 3 of the report. The decrease in potential is in part due to the interaction between the DLC CAC program and the DLC Smart Thermostat program, which compete for the same residential customer base. On the commercial side, the DLC CAC program competes with the newly added Ice Energy Storage program for the same customer base. The DLC smart thermostat program was prioritized over the DLC CAC and ice energy storage programs, therefore leaving less available customer load for those programs.
- After taking all interactive effects into consideration, the 2038 incremental Class 1 DSM potential is estimated to reach 217 MW in Pacific Power's service territory and 422 MW in Rocky Mountain Power's service territory.
    - The top five contributors to incremental potential in 2038 are the following:
    - Utah Residential Smart Thermostats – 87 MW
    - Utah Third Party Contracts – 77 MW
    - Utah C&I Smart Thermostats – 51 MW
    - Wyoming Third Party Contracts – 40 MW
    - Oregon Third Party Contracts – 38 MW

Levelized Costs by State and Option

Table D-7 and Table D-8 present the incremental potential for Class 1 DSM options, after subtracting the potential from existing Class 1 DSM programs for the summer and winter peak seasons. These serve as inputs to the IRP. Note that the assessment of levelized cost per summer peak kW is conducted independently of the assessment of cost per winter peak kW. In other words, there is no allocation of costs between seasons and each figure in this report represents the full program cost applied to the seasonal peak impact.

Table D-7 Class 1 DSM Levelized Costs and Incremental Potential in 2038 (Summer Peak)

Option	CA	ID	OR	UT	WA	WY	System Wtd Avg Levelized $/kW (2017-2038)	Total Potential MW in Year 20
Res DLC Central AC	$115	$155	$161	$132	$137	$139	**$137**	**141.67**
Res DLC Space Heating								**-**
Res DLC Water Heating	$83	$84	$85	$86	$85	$86	**$85**	**33.37**
Res DLC Smart Thermostats	$96	$138	$150	$66	$122	$122	**$98**	**151.84**
Res DLC Smart Appliances	$244	$242	$249	$250	$249	$243	**$249**	**14.91**
Res DLC Room AC	$234	$247	$392	$226	$316	$178	**$271**	**5.46**
Res DLC EV Chargers	$812	$733	$800	$724	$798	$879	**$746**	**6.24**
Res Ancillary Services	$642	$480	$606	$451	$602	$743	**$500**	**1.47**
C&I DLC Central AC[17]	$80	$87	$74	$73	$68	$74	**$74**	**16.08**
C&I DLC Space Heating								**-**
C&I DLC Water Heating	$51	$34	$34	$73	$34	$34	**$45**	**5.19**
C&I DLC Smart Thermostats	$29	$32	$24	$19	$20	$23	**$22**	**97.98**
C&I Ancillary Services	$67	$54	$55	$34	$53	$34	**$43**	**29.79**
DLC Irrigation	$81	$59	$83	$61	$83	$84	**$62**	**209.56**
Ice Energy Storage	$172	$181	$176	$184	$175	$179	**$179**	**6.77**
Third Party Contracts	$97	$98	$99	$101	$102	$102	**$101**	**166.89**

[17] Note that C&I direct load control costs assume economies of scale from aligning with residential program and leveraging shareable resources.

Table D-8 Class 1 DSM Levelized Costs and Incremental Potential in 2038 (Winter Peak)

Option	CA	ID	OR	UT	WA	WY	System Wtd Avg Levelized $/kW (2017-2038)	Total Potential MW in Year 20
Res DLC Central AC								**-**
Res DLC Space Heating	$55	$43	$49	$44	$41	$48	**$46**	**130.06**
Res DLC Water Heating	$83	$84	$85	$86	$85	$86	**$85**	**33.37**
Res DLC Smart Thermostats	$120	$117	$119	$312	$64	$164	**$145**	**99.57**
Res DLC Smart Appliances	$244	$242	$249	$250	$249	$243	**$249**	**14.91**
Res DLC Room AC								**-**
Res DLC EV Chargers	$812	$733	$800	$724	$798	$879	**$746**	**6.24**
Res Ancillary Services								**-**
C&I DLC Central AC								**-**
C&I DLC Space Heating	$65	$30	$45	$83	$39	$31	**$51**	**7.31**
C&I DLC Water Heating	$51	$34	$34	$73	$34	$34	**$45**	**5.19**
C&I DLC Smart Thermostats	$78	$49	$51	$280	$28	$69	**$78**	**26.41**
C&I Ancillary Services								**-**
DLC Irrigation								**-**
Ice Energy Storage								**-**
Third Party Contracts	$156	$137	$113	$155	$110	$110	**$127**	**132.85**

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