PACIFICORP CONSERVATION POTENTIAL ASSESSMENT FOR 2019-2038

Volume 1: Executive Summary and Introduction

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Report prepared for:
PACIFICORP

Energy Solutions Delivered.

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INTRODUCTION

In 2018, PacifiCorp commissioned Applied Energy Group (AEG) to conduct this Conservation Potential Assessment (CPA). PacifiCorp commissioned this CPA to inform their biennial Integrated Resource Plan (IRP) planning process, to satisfy other state-specific DSM planning requirements, and to assist PacifiCorp in reviewing designs of existing demand-side management (DSM) programs and in developing new programs. The study's scope encompasses multi-sector assessments of long-term potential for DSM resources in PacifiCorp's Pacific Power (California, Oregon, and Washington) and Rocky Mountain Power (Idaho, Utah, and Wyoming) service territories. [1] This study includes supply curves for the 20-year planning horizon (2019–2038) to inform the development of PacifiCorp's 2019 IRP and assists in satisfying state-specific requirements associated with planning for and pursuing DSM resource acquisition.

Since 1989, PacifiCorp has developed biennial Integrated Resource Plans (IRPs) to identify an optimal mix of resources that balance considerations of cost, risk, uncertainty, supply reliability/deliverability, and long-term public policy goals. The IRP's optimization process accounts for capital, energy, and ongoing operation costs as well as the risk profiles of various resources, including; traditional generation, market purchases, renewable generation, and DSM resources such as energy efficiency, and demand response and direct load control. Since the 2008 IRP, DSM resources have competed directly against supply-side options, allowing the IRP model to select the right mix of resources to meet the needs of PacifiCorp's customers while minimizing cost and risk. Thus, this study does not assess the cost-effectiveness of DSM resources.

This study provides reliable estimates of the magnitude, timing, and costs of DSM resources that are likely available to PacifiCorp over a 20-year planning horizon. The study focuses on resources assumed achievable during the planning horizon, recognizing that known market dynamics may hinder resource acquisition. Study results will be incorporated into PacifiCorp's 2019 IRP and subsequent DSM planning and program development efforts. This study serves as an update to similar studies completed previously for the IRP.[2]

DSM Resource Classes

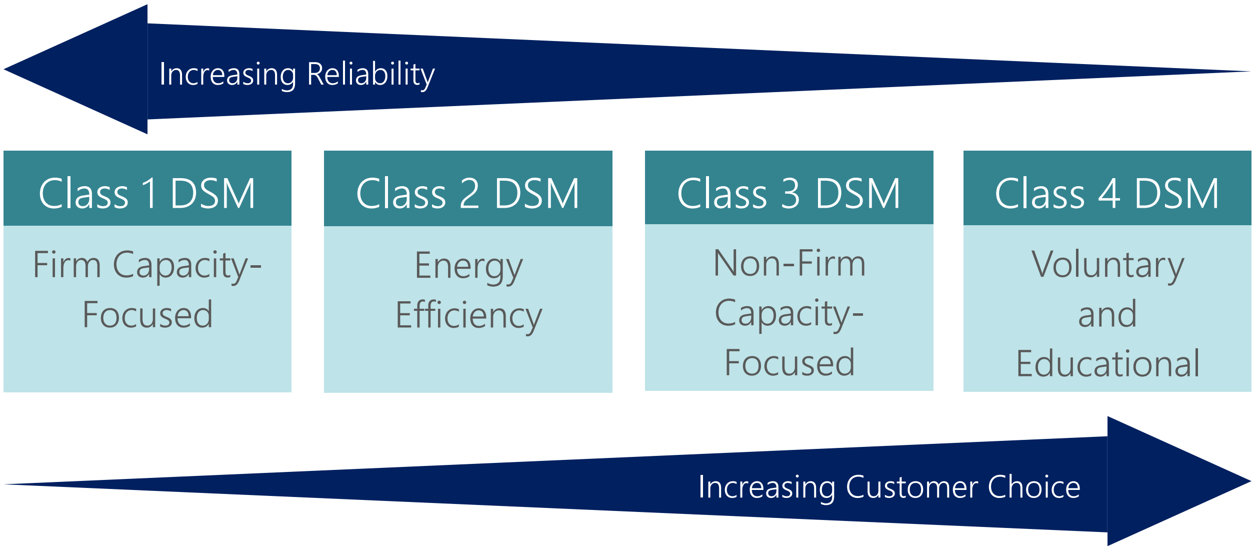
For resource planning purposes, PacifiCorp classifies DSM resources into four categories, differentiated by two primary characteristics: reliability and customer choice (see Figure 1-1). These resources are captured through programmatic efforts that promote efficient electricity use through various intervention strategies, aimed at changing energy use during peak periods (load control), timing (price response and load shifting), intensity (energy efficiency), or behaviors (education and information).

From a system-planning perspective, Class 1 (dispatchable or scheduled firm) and Class 2 (energy efficiency) DSM resources (particularly Class 1 direct load control programs) are considered the most reliable, as once a customer elects to participate in a Class 1 DSM program, the resource is controllable by the utility and can be dispatched as needed. Similarly, when a customer invests in a home or business efficiency improvement, the savings are expected to be continuous as a result of the installation and will occur during normal operation of the equipment. In contrast, savings resulting from energy education and awareness actions included in Class 4 (voluntary and educational) DSM, tend to be the least reliable,

[2] The previous potential studies can be found at: http://www.pacificorp.com/es/dsm.html

as savings will vary due to greater customer control and the need for customers to take specific and consistent actions to lower their usage during peak periods. Impacts from Class 4 DSM are not considered within this analysis.

Figure 1-1 Characteristics of DSM Resource Classes



This study excludes an assessment of Oregon's Class 2 DSM potential, as this potential has been captured in assessment work conducted by the Energy Trust of Oregon, which estimates Oregon energy-efficiency potential to PacifiCorp for resource planning purposes. Additionally, this study does not include assessments of Class 4 DSM resources. Unless otherwise noted, all results presented in this report represent savings at generation; that is, savings at the customer meter have been grossed up to account for line losses using values consistent with other PacifiCorp DSM planning projects.

Interactions among Resources

This assessment includes multiple resources, actions, and interventions that would interact with each other if implemented in parallel. As explained in more detail later in this report, we take specific actions to account for these interactions to avoid double-counting the available potential. The interactive effects that we have analyzed occur within the major analysis sections; meaning that the interactions of energy efficiency resources are considered across all Class 2 DSM resources. Likewise, the analysis of capacity-focused Class 1 and Class 3 DSM resources explicitly considers interactions. It should be noted, however, that this study does not attempt to quantify potential interactions between energy-focused and capacity-focused resources due to uncertainties regarding resources likely to be found economic and pursued.

Abbreviations and Acronyms

Table 1-1 shows the abbreviation or acronym, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
ACEEE	American Council for an Energy-Efficient Economy
ACS	American Community Survey
AEO	Annual Energy Outlook
AMI	Advanced Metering Infrastructure
ASHP	Air-Source Heat Pump
BEST	AEG's Building Energy Simulation Tool
BDR	Behavioral Demand Response
BPA	Bonneville Power Administration
C&I	Commercial and Industrial
CEE	Consortium for Energy Efficiency
CAC	Central Air Conditioning
COMMEND	EPRI's "Commercial End-Use" model
CPP	Critical Peak Pricing
CPUC	California Public Utilities Commission
The Council	Northwest Power and Conservation Council (NWPCC)
CBSA	Commercial Building Stock Assessment
CPA	Conservation Potential Assessment
CPP	Critical Peak Pricing
DHW	Domestic Hot Water
DEER	California's Database for Energy Efficient Resources
DEEM	AEG's Database of Energy Efficiency Measures
DSM	Demand-Side Management
DLC	Direct Load Control
E3T	Energy Efficient Emerging Technologies database
EE	Energy Efficiency
EIA	Energy Information Administration
EISA	Energy Independence and Security Act of 2007
EPA	Environmental Protection Agency
ETO	Energy Trust of Oregon
EUL	Effective Useful Life
EUI	Energy Utilization Index

Acronym	Explanation
FTE	Full-Time Employee
GWh (GW)	Gigawatt-Hours (Gigawatt)
HER	Home Energy Reports
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IBR	Inclining Block Rate
IECC	International Energy Conservation Code
IFSA	Industrial Facilities Site Assessment
IRP	Integrated Resource Plan
kWh (kW)	Kilowatt-Hour (Kilowatt)
LCOE	Levelized Cost of Energy
LED	Light-emitting diode
lm	lumens
LSE	Load-Serving Entity
MWh (MW)	Megawatt-Hour (Megawatt)
NAPEE	National Action Plan for Energy-Efficiency
NEEA	Northwest Energy Efficiency Alliance
NEEP	Northeast Energy Efficiency Partnerships
NEMA	National Electrical Manufacturer's Association
NEMS	National Energy Modeling System
NPV	Net Present Value
O&M	Operations and Maintenance
PMSMs	Permanent Magnetic Synchronous Motors
RBSA	Residential Building Stock Assessment
REEPS	EPRI's Residential End-Use Energy Policy System
RTP	Real-Time Pricing
RTF	Regional Technical Forum
SEEM	Simple Energy Enthalpy Model
SIC	Standard Industrial Classification
Sq. Ft.	Square Foot
TRC	Total Resource Cost
TMY3	Typical Meteorological Year 3
TOU	Time-of-Use Rate
UCT	Utility Cost Test, also known as the Program Administrator Cost Test (PACT)

Acronym	Explanation
UEC	Unit Energy Consumption
UES	Unit Energy Savings
UNIDO	United Nations Industrial Development Organization
WHP & RT	Waste-Heat-to-Power and Regenerative Technologies
WSEC	Washington State Energy Code 2015

Report Organization

This report is presented in five volumes as outlined below. This document is Volume 1, Executive Summary and Introduction.

- Volume 1, Executive Summary and Introduction
- Volume 2, Class 2 DSM Analysis
- Volume 3, Class 1 and 3 DSM Analysis
- Volume 4, Class 2 DSM Analysis APPENDIX
- Volume 5, Class 1 and 3 DSM Analysis APPENDIX

2

SUMMARY OF RESULTS

This chapter presents a summary of the identified cumulative potential in 2038 from energy-focused Class 2 (energy efficiency) DSM resources as well as capacity-focused Class 1 (dispatchable or scheduled firm) and Class 3 (price responsive) DSM resources. These savings draw upon forecasts of future consumption, absent projected future PacifiCorp DSM program intervention. While the baseline projection accounts for past PacifiCorp Class 2 DSM resource acquisition, the identified estimated potential is inclusive of (not in addition to) future planned programs.

Class 2 (Energy Efficiency) DSM Resources

Table 2-1 summarizes the 2038 cumulative achievable technical potential for Class 2 DSM resources by state and sector, both in megawatt-hour (MWh) and as a percentage of projected 2038 baseline sector loads. At the system level,[3] the identified technical achievable potential by 2038 is nearly ten terawatt-hours, or approximately 20 percent of projected baseline loads. Technical achievable potential represents potential which can reasonably be acquired through all future potential mechanisms, regardless of how conservation is achieved (including both utility and non-utility interventions) and ignoring cost-effectiveness considerations. The cost-effectiveness of the identified potential is assessed within PacifiCorp's IRP model through direct comparison with supply-side resource alternatives.

The commercial sector accounts for the largest portion of the technical achievable potential, followed by residential then industrial. Irrigation and street lighting, with much smaller baseline loads, contribute a smaller amount of potential relative to the larger sectors. Savings as a percentage of the baseline is largely influenced by the presence of various end uses in each sector. Class 2 DSM methodology, data sources, assumptions, technical potential, and detailed results are provided in Volume 2 of this report.

Table 2-1 Cumulative Class 2 DSM Achievable Technical Potential by 2038 (MWh @ generator)

Sector	California	Idaho	Utah	Washington	Wyoming	All States	
						Technical Achievable Potential	% of Baseline
Residential	126,785	206,534	1,660,103	455,686	225,090	2,674,197	19.7%
Commercial	63,347	196,402	3,287,308	482,221	504,808	4,534,085	27.4%
Industrial	10,127	43,536	1,039,868	150,422	1,000,703	2,244,656	12.9%
Irrigation	10,464	69,311	22,893	17,561	2,546	122,775	9.7%
Street Lighting	772	1,366	30,759	4,738	5,855	43,491	41.4%
Total	**211,495**	**517,148**	**6,040,931**	**1,110,628**	**1,739,002**	**9,619,204**	**19.7%**

Key findings by market sector are described below:

[3] Class 2 DSM analysis for Oregon is excluded from this report because it is assessed statewide by the Energy Trust of Oregon.

Class 2 Residential Sector Key Findings

The 20-year residential technical achievable potential is 2.7 million MWh or 19.7% of the 2038 baseline. Savings as a percent of baseline are very consistent across states. California is slightly higher due to a relatively higher share of electric space heating and water heating. Key findings include:

- Nearly half of the technical achievable potential (47%) comes from HVAC systems through the application of equipment upgrades and building shell measures.
    - The space heating end use provides the largest share of potential, at 28% of total residential technical achievable potential, particularly driven by Washington, Idaho, and California where electric resistance heating is common.
    - The cooling end use comprises 19% of total residential technical achievable potential, driven by large air-conditioning loads in Utah.
- Water heating savings comprise 20% of the total technical achievable potential through the installation of efficient heat pump water heater systems and upgrades to water-consuming equipment (low flow showerheads, clothes washers, etc.). Heat pump water heaters are assigned to the "LO1Slow" ramp rate, assumed to exhibit slow achievable adoption in early years of the study, but escalating to 85% of technical potential in the later years. This is consistent The Council's Seventh Power Plan[4] methodology.
- The lighting end use accounts for 13% of the residential technical achievable potential, primarily due to LED lamps, which are modeled with lumen-per-watt performance substantially increasing over the lifetime of the study.
- The appliances, electronics, and miscellaneous end uses represent the remaining 20% of the potential.

Class 2 Commercial Sector Key Findings

The 20-year commercial technical achievable potential is 4.5 million MWh or 27.4% of the 2038 baseline. Savings as a percent of baseline are very consistent across states. Washington potential is slightly lower due to more stringent building codes and greater reach of past energy efficiency efforts. Utah's potential as a percent of the baseline projection is slightly higher, largely due to a greater presence of cooling loads and their associated potential. Key findings and observations include:

- Lighting opportunities represent approximately 52% of the identified commercial technical achievable potential, largely attributable to LED lighting. Based on the best projections available at the time of the analysis, these lamps are expected to become significantly more available and efficient over the study time period and be widely applicable for linear fluorescent, high bay, and screw-in applications. The Council's Seventh Power Plan's enhanced fixture control packages also represent a sizeable portion of 20-year savings and are modeled as a lost opportunity to be acquired at the time of fixture replacement.
- There is significant technical achievable potential (35%) from HVAC systems through the application of equipment upgrades and building shell measures within the cooling, heating, and ventilation end uses. The largest of these three is cooling, driven by large air conditioning loads in Utah.

[4] Seventh Northwest Conservation and Electric Power Plan (2016). https://www.nwcouncil.org/energy/powerplan/7/plan/

- Refrigeration makes up 8% of the total commercial potential, primarily from grocery stores throughout PacifiCorp's territory in the five states analyzed and the controlled atmosphere segment in Washington.
- The water heating, food preparation, office equipment, and miscellaneous end uses make up the remaining 5% of potential.

Class 2 Industrial Sector Key Findings

The 20-year industrial technical achievable potential is 2.2 million MWh or 12.9% of the 2038 baseline. Savings as a percent of baseline are relatively consistent across states. After observing a marked increase in recent-year conservation in PacifiCorp's industrial Wyoming programs, AEG removed the market ramp rate, which was previously applied on top of all measure ramp rates in this sector, from the CPA, increasing Class 2 conservation potential in the earlier years of the study. Key findings and observations include:

- Motor and process loads represent the largest share of end use consumption in the industrial sector (77% of savings) and, correspondingly, have the largest identified technical achievable potential.
  - Motor savings comprise 72% of the total sector potential, while process savings account for an additional 5%.[5] Potential savings for motor equipment change-outs have been essentially eliminated by the National Electrical Manufacturer's Association (NEMA) standards, which now make premium efficiency motors the baseline efficiency level for many motors. As a result, the savings opportunities in this end use come from controls, system optimization, and variable frequency drives, which improve system efficiencies where motors are utilized.
  - This study identified significant pump motor potential in the mining and extraction industry group[6] within PacifiCorp's Wyoming territory, including potential from pump energy management and submersible pump measures.
- Like the residential and commercial sectors, the projected improvements in performance and applicability of LED lighting technologies provides a large potential opportunity in the industrial sector, leading to lighting representing 16% of the identified technical achievable potential.
- Potential for the heating, cooling, ventilation, and miscellaneous end uses represent the remaining 7% of potential, mainly realized within the non-industrial portions of the space (e.g., warehouse and office spaces).

Class 2 Irrigation Sector Key Findings

The 20-year irrigation technical achievable potential is 122,775 MWh or 9.7% of the 2038 baseline. Potential does not vary much by state as a percent of baseline, but the majority of potential is in Idaho due to size of its irrigation base load. Key findings and observations include:

- Similar to the industrial sector, potential savings for motor equipment change-outs have been essentially eliminated by the National Electrical Manufacturer's Association (NEMA) standards, which now make premium efficiency motors the baseline efficiency level. As a result, the savings opportunities for irrigation pumps come from discretionary, or non-equipment measures, such as

[5] It is often difficult to distinguish between motors used for industrial process and non-process purposes, so in many ways, these two end-use categories can be viewed as a group.

[6] For the purposes of this study, a mining and extraction group was compiled from Standard Industrial Classification (SIC) codes 10XX through 14XX with the addition of several extraction and pipeline-related customers in SIC codes 46XX through 49XX, since many of the end uses are tied to moving fluids or materials as part of the extraction process.

controls, pressure regulation, and variable speed drives, which improve system efficiencies where motors are utilized.

- Energy consumption varies by state based on presence of surface water, type of crop, and size of the irrigation market sector. In Pacific Power service territories, surface water and specialty crops are more prevalent, leading to smaller pump sizes. In Rocky Mountain Power territories, larger row crop fields and deeper water reservoirs require larger pumps.

Class 2 Street Lighting Sector Key Findings

The 20-year street lighting technical achievable potential is 43,491 MWh or 41.4% of the 2038 baseline.

- The primary mode of achieving savings in the street lighting sector is through LED equipment replacements and retrofits. As mentioned for other sectors, the improving performance and cost trends of LED lighting technologies provides a large potential opportunity in street lighting applications.
- The study also considers a smart dimming controller as a non-equipment or discretionary measure that is applicable to the street lighting sector. This measure, which can selectively dim or shut down individual bulbs on a multi-head fixture utilizing a motion sensor or timer, was considered applicable in areas such as parking lots and low-traffic roadways. This measure represents 16% of the identified technical achievable potential.

Class 1 and Class 3 (Capacity-Focused) DSM Resources

This section presents high-level potential analysis results for Class 1 and 3 DSM options based on the assumptions and methodologies outlined in Chapter 2 of Volume 3 of this report. The results are provided on a standalone basis, meaning that the results shown in this section have not been adjusted for the inherent interactions that exist between Class 1 and 3 DSM resources, and thus, the results are not additive across resource classes. For results of the integrated analysis that considers interactive effects between the two resource classes, see Section G in Volume 5 of this report.

Like the previous assessment, this study also includes an assessment of resources targeted at the winter peak. We focus our present discussion of findings on summer impacts since this is still PacifiCorp's primary planning objective along with controlling system constraints (please refer to Volume 3 for more detail on winter impacts).

Within the Class 1 resources, some customers are eligible for multiple competing Class 1 options (e.g., direct load control (DLC) Cooling and DLC Smart Thermostats). This is also true for the Class 3 options. To account for this, our analysis made assumptions within each resource class about the choices that eligible customers would make if competing options were offered in parallel, based on observed customer preference in such pilots and full-scale deployments.

Class 1 DSM Market Potential

Table 2-2 shows total Class 1 DSM potential results in 2038 by option for each state. This combines the effects of existing Class 1 DSM resources with new options that have incremental potential in future years (incremental potential above current program impacts are presented in Volume 3 of this report). Note, the market potentials indicate the magnitude of the opportunity, but do not consider the economics of program delivery, local need for capacity management, or portability of resources (transmission constraints). PacifiCorp's IRP determines whether to pursue Class 1 DSM resources as the least cost, least risk resource. Key findings and observations include:

- Total Class 1 DSM market potential more than doubles in the 20-year period from 2019-2038. Savings potential from Class 1 DSM resources are estimated to grow from 279 MW in 2019 to 930 MW in 2038, translating into 8.1% of projected system peak demand in 2038. Savings from existing programs account for about one third of the total potential from Class 1 DSM options in 2038.
- In 2019, potential is derived only from PacifiCorp's existing Class 1 DSM programs; residential and small commercial and industrial (C&I) air conditioning load control programs in Utah, as well as irrigation load control programs in Idaho and Utah.[7] Incremental potential for these existing programs, above current impacts, is assumed to begin in 2021 to allow time for additional participant recruitment if selected by the 2019 IRP. For planning purposes, this study assumes that if the IRP identifies a need for new Class 1 DSM resources, new programs could begin to be implemented within 18-24 months. The 18-24 month planning assumption is necessary to allow time for vendor selection, contracting and regulatory approvals. Following a new program's implementation, its savings potential is expected to be fully realized within three to five years, depending on the program. As a result of these assumptions, savings potential identified in this study begins to grow substantially starting in 2020.
- Control of residential, and small and medium C&I cooling end uses using either DLC or smart thermostats provides the highest total potential of the Class 1 products. There is a total of 156 MW of reduction from DLC and 153 MW of reduction from smart thermostats for a total of 309 MW in 2038. It should be noted that about 65% of the total DLC related savings is from PacifiCorp's existing Cool Keeper program in Utah. An additional 54 MW of potential in 2038 is associated with a modest expansion of the Utah program, and new DLC programs launching in the PacifiCorp's remaining five states.
- Irrigation Load Control has the highest total potential of any single Class 1 DSM product. However, the high impacts are driven by the large existing base of controllable irrigation load in Idaho and Utah. More than 86% of the 2038 savings potential for Irrigation Load Control is derived from these two states. Additional savings potential is primarily associated with new program deployments in the remaining four states.
- Third Party Contracts has the highest remaining market potential of all Class 1 DSM options; 168 MW of market potential in 2038. This CPA analysis includes an estimate of winter peak demand reduction potential. Total winter potential reaches 486 MW in 2038, which is substantially lower than summer savings potential. The largest contributors to winter potential are the DLC Space Heating and DLC Smart Thermostats programs, with potential reaching 157 MW and 100 MW in 2038, respectively.

[7] In May of 2016, PacifiCorp received regulatory approval to operate an irrigation load control pilot in its Oregon service territory. As the pilot program is small, time-bound, and the potential analysis was already materially complete at this point, the impacts of this pilot are not considered "existing" in this study.

Table 2-2 Class 1 DSM Total Market Potential by Option and State in 2038 (Summer Peak MW)

Program	CA	ID	OR	UT	WA	WY	Total
Residential DLC Central AC	0.3	0.8	4.9	147.2	1.9	1.3	**156.4**
Residential DLC Space Heating	-	-	-	-	-	-	**-**
Residential DLC Water Heating	0.7	1.2	11.0	15.2	4.2	1.3	**33.6**
Residential DLC Smart Thermostats	3.8	5.8	36.5	87.2	9.3	10.5	**153.2**
Residential DLC Smart Appliances	0.3	0.6	4.2	8.1	0.9	1.0	**15.0**
Residential DLC Room AC	0.2	0.4	1.5	3.0	0.7	0.8	**6.5**
Residential DLC EV Charging	0.1	0.2	1.3	4.8	0.3	0.1	**6.7**
Residential Ancillary Services	0.0	0.0	0.3	1.1	0.1	0.0	**1.6**
C&I DLC Central AC	0.5	0.9	6.7	5.9	1.8	2.3	**18.2**
C&I DLC Space Heating	-	-	-	-	-	-	**-**
C&I DLC Water Heating	0.1	0.4	2.1	1.4	0.4	0.7	**5.2**
C&I DLC Smart Thermostats	2.1	3.0	25.7	51.1	7.5	9.4	**98.8**
C&I Third Party Contracts	1.1	1.9	37.7	76.7	10.9	40.1	**168.3**
C&I Ancillary Services	0.5	0.7	7.9	15.9	1.9	3.2	**30.0**
C&I Ice Energy Storage	0.2	0.5	2.9	2.4	0.7	1.0	**7.6**
DLC Irrigation	4.6	177.3	13.9	23.0	8.3	1.8	**228.9**
Total	**14.5**	**193.8**	**156.6**	**443.0**	**48.8**	**73.5**	**930.2**

Class 3 DSM Market Potential

For Class 3 DSM resources, potential results associated with pricing options represent a voluntary, "opt-in" type of offering for dynamic pricing programs. For comparison purposes only, pricing potential associated with an "opt-out" type of offering is presented in Volume 5 of this report. The pricing options are assumed to be offered only after Advanced Metering Infrastructure (AMI) has been deployed. PacifiCorp does not currently have comprehensive AMI in any of its service territories, so in order to assess the potential for dynamic pricing options, this study assumes that PacifiCorp makes a staggered deployment of AMI in Oregon in 2020, Idaho in 2021, and all other territories in 2025.

Table 2-3 shows the total potential from Class 3 DSM resources by state and option, as they would be configured in 2038. Key findings and observations include:

- Total savings potential at the end of the study horizon is 353 MW, or 3.1% of the projected summer system peak.
- In Utah, residential critical peak pricing (CPP) has the highest contribution to potential. The three C&I pricing options combined have roughly equal potential to residential CPP.
- Oregon has the second highest potential, after Utah. Residential pricing (time of use (TOU), TOU Demand Rate w/EV, and CPP) constitute more than half of the potential in Oregon.
- Wyoming ranks third in terms of potential contribution from pricing options. Most of the potential is derived from C&I customers, particularly large sized industrial customers.

- In Idaho, roughly half of the savings opportunities from pricing options are in the irrigation sector.
- In Washington and California, the residential sector constitutes nearly half the total savings potential from pricing options.
- Similar trends continue in the winter peak season, with Oregon and Washington contributing the most potential due to the residential rate programs and C&I CPP.

Table 2-3 Class 3 DSM Total Market Potential by Option and State in 2038 (MW)

Program	CA	ID	OR	UT	WA	WY	Total
Residential TOU Demand Rate	0.3	0.9	4.8	26.9	1.9	2.4	**37.3**
Residential TOU Demand Rate with EV	0.1	0.2	1.5	5.6	0.3	0.1	**7.9**
Residential TOU	0.9	0.0	16.7	38.4	6.6	3.5	**66.1**
Residential TOU with EV	0.2	0.0	3.0	11.3	0.6	0.2	**15.4**
Residential CPP	1.2	1.8	22.3	51.1	8.8	4.6	**89.8**
Residential Behavioral DR	0.3	0.7	4.8	9.2	1.0	1.1	**17.1**
C&I TOU	0.1	0.3	2.5	5.6	1.1	1.0	**10.5**
C&I CPP	0.6	1.0	17.4	36.1	6.1	15.7	**76.8**
C&I RTP	0.1	0.1	3.0	6.0	0.8	3.6	**13.7**
Irrigation TOU	0.2	2.0	0.6	0.5	0.3	0.1	**3.7**
Irrigation CPP	0.7	7.9	2.2	1.8	1.3	0.3	**14.3**
Total	**4.5**	**15.1**	**78.9**	**192.5**	**28.9**	**32.6**	**352.5**

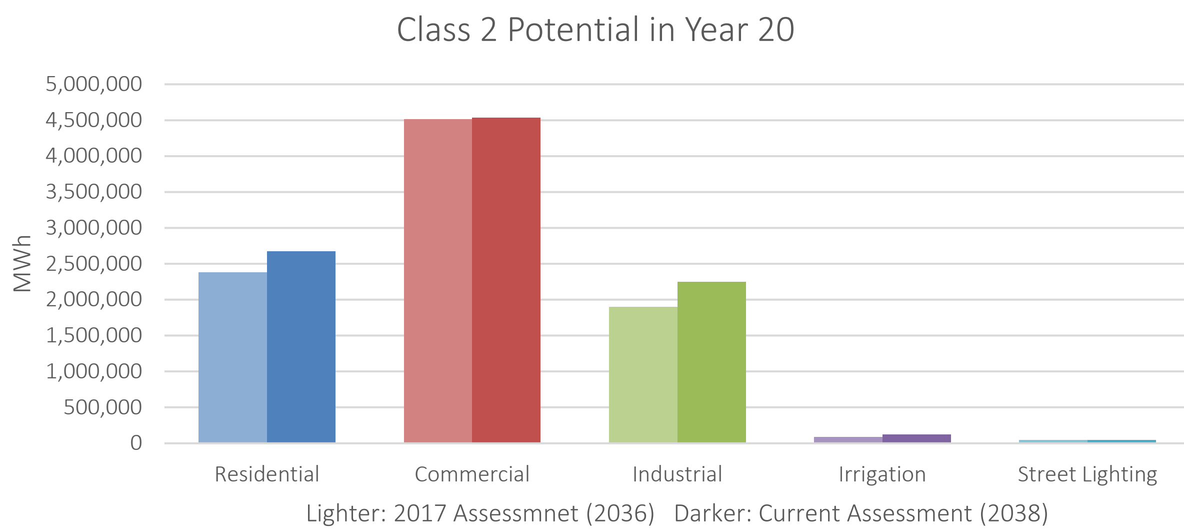
Comparison to 2017 Assessment

As noted, this assessment builds upon previous studies. This section reviews key updates leading to differences between the current study findings and those presented in the 2017 study.

Class 2 DSM Resources

Figure 2-1 compares 20-year annual energy savings estimates for the Class 2 analysis with the prior assessment.

Figure 2-1 Comparison of 20-Year Technical Achievable Class 2 Potential with Prior CPA (MWh)



For the Class 2 DSM analysis, the following aspects of the current analysis served as key drivers of change:

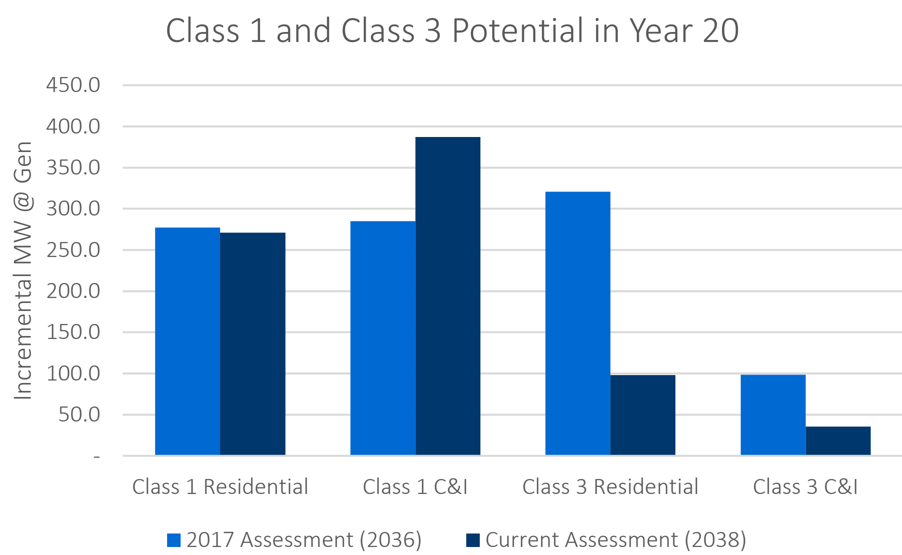
- State energy codes and equipment efficiency standards enacted as of April 2018, even if they have not yet taken effect.
- Feedback provided during the IRP Public Meeting process, including a reduction in maximum incentive cost from 70% of incremental cost to 50% for nonresidential lighting programs in Utah.
- PacifiCorp's actual and projected DSM program accomplishments through 2017.
- Adjustments to measure savings, based on recent evaluation results, data available from the Regional Technical Forum (RTF), and other updated secondary sources available before April 2018.
- 2016 customer and sales information to determine segmentation; and updated sales and customer forecasts.
- A sizeable suite of new emerging technology measures.
- Updated heat pump water heater analysis using the latest RTF and NEEA-tier data, increasing efficiency. Market conditions and guidance from the RTF indicate that more efficient NEEA Tier 3 units should be considered over the Tier 1 and Tier 2 units projected in the prior study.
- New emerging technologies and updated assumptions around applicability, cost, and efficacy of LED lighting.
- Addition and re-assessment of Waste Heat to Power and Regenerative Technology measures (these were previously considered outside the CPA).
- Variation of administrative costs by state.
- Use of the Utility Cost Test in Idaho.
- Removal of market ramp rate from the Wyoming industrial market, which increases opportunity in this state and segment.

The total, system-wide, 20-year, Class 2 DSM achievable technical potential increased from 8,930,775 MWh to 9,619,204 MWh between the two studies. This is primarily driven by new measures assessed in this CPA, the inclusion of Waste Heat to Power and Regenerative Technologies potential within the CPA, changes in the baseline forecast, and updates to measure assumptions. A detailed comparison of the identified potential in the two studies, along with explanations of large changes, is provided in Volume 2 of this report.

Class 1 and 3 DSM Resources

Figure 2-2 compares 20-year summer peak results for the Class 1 and Class 3 analysis with the prior assessment.

Figure 2-2 Comparison of 20-Year Class 1 and Class 3 Incremental Potential with Prior CPA (Summer Peak MW)



For the Class 1 and Class 3 DSM analysis, the following aspects of the current analysis served as key drivers of changes:

- There have been baseline customer changes relative the prior study. For example, peak load forecasts show higher growth in all states except Utah, Wyoming and to a lesser degree California. Projected Wyoming load growth in the oil & gas industry has flattened given the economic outlook for the sector.
- Compared to the prior study, a significant portion of the residential DLC Central AC opportunity was shifted to the Smart Thermostat option.
- As part of this study the calculation of the levelized costs was adjusted to conform to the California Public Utility Commission's (CPUC) cost-benefit analysis protocols[8] for all Pacific Power states including California, Oregon, Washington, and Wyoming. Utah and Idaho use traditional methods cost-benefit analysis methodology.

[8] More information on the protocols can be found here: http://www.cpuc.ca.gov/general.aspx?id=7023

  - Given that we know that incentives likely exceed the true cost to the customer we have discounted the benefit of the incentive to the customer by 25% and counts only 75% of the incentive payment as a cost in the levelized cost calculation.
  - For more information on this update, please see Section 1 in Volume 3 of this report.

The 20-year incremental potential for Class 1 DSM in the current study is 659 MW, which is roughly 17% larger than the 20-year Class 1 DSM potential estimate in the 2017 assessment of 562 MW.

- Newly included program options drive a large portion of this increase: DLC Smart Thermostats and Ancillary Services in the C&I sector.
- Conversely, there was a decrease in DLC programs for electric vehicles (EVs) and thermal storage given new information about program implementation, customer growth assumptions, saturation of applicable equipment, and estimated participation rates. For more details, please see the comparison with the previous assessment in Section 3, Volume 3 of this report.
- Potential for DLC Irrigation and Third-Party Contracts is similar between the two studies.

The Class 3 DSM potential estimate in the current study is lower than the 2017 study, due largely to the revisions to the participation assumptions for TOU Demand Rates. The current study estimates 342 MW of incremental Class 3 DSM potential in 2038 compared to 438 MW in 2036 from the previous study.

- Residential pricing potential in the current study is estimated at 233 MW in 2038, versus 321 MW in the previous assessment. This difference is driven by the lower participation of the TOU Demand Rate and TOU Demand Rate with EV programs. Additionally, the previous study assumed a pullback or decrease in traditional TOU participation in the middle of the study in favor of higher adoption of other rate options such as CPP. The current study assumed more straightforward program ramping instead of predicting such an inflection point, so the current CPP potential is slightly lower than the previous study while the TOU potential is slightly higher.
- The C&I pricing potential in the current study of 90.8 MW in 2038 is close to the corresponding value of 98.6 MW from the previous study. Many of the assumptions around impacts and participation rates remained consistent between the two studies so changes in potential were relatively minor.

Across Class 1 and Class 3 programs, the current study shows slightly lower potential than the previous study with a total incremental potential of 1,325 MW in this study versus a total incremental potential of 1,419 MW in the previous study. This is primarily due to updated assumptions based on larger scale pilots for some Class 3 programs. These include lower participation in the TOU Demand Rate program to reflect more realistic customer adoption rate, and lower participation and impacts in EV programs to reflect saturation of EVs in the region. A detailed comparison of the identified potential in the two studies, along with explanations of large changes, is provided in Volume 3 of this report.

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