

Klamath River Basin America's Water Infrastructure Act Affordable Power Measures Report



Bureau of Reclamation Interior Region 10 · California-Great Basin California*, Nevada*, Oregon*

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. (*vi body text*)

RECLANATION Managing Water in the West

Klamath River Basin America's Water Infrastructure Act Affordable Power Measures Report

prepared for

U.S. Department of the Interior Bureau of Reclamation by Kleinschmidt Associates under Contract No. 47QRAA18D005P Task Order 140R2019F0015

AND

Lloyd Reed Consulting

This page intentionally left blank

Table of Contents

	Page
Executive Summary xi	
Purpose and Scope of the Affordable Power Measures Reportxi	
Chapter 1 Purpose and Scope1	
Affordable Power Measures	
Prior Power Cost Reduction Studies for the Klamath Project	
The APM Analysis Team	
Chapter 2 Description of the Klamath Project	
Chapter 3 Historical Power Costs for Irrigation and Drainage in the Upper Klamath River Basin	
Overview and Historical Context	
Current Conditions	
Chapter 4 The Comprehensive Agricultural Power Plan Report11	
Overview11	
CAPP Power Cost Savings Measures	
Chapter 5 APM Report Public/Stakeholder Process13	
Overview13	
Klamath Basin Stakeholder Public Meeting13	
Chapter 6 Identifying the Affordable Power Measures	
Overview15	
Summary of the Affordable Power Measures16	
Chapter 7 APM No. 1 Solar Photovoltaic (Multiple Alternatives)	
Klamath Basin Solar Photovoltaic Generation Potential18	
Description of Solar PV Alternatives in the Upper Klamath Basin19	
Alternative 1 - Individual Customer Facilities20	
Overview/General Description	

Potential Benefits	21
Potential Challenges	21
Siting Considerations	21
Energy Storage Options	21
Anticipated Net Power Cost Savings	.22
Alternative 2 - Shared/Community Facilities	.22
Overview/General Description	.22
Potential Benefits	.22
Potential Challenges	.23
Siting Considerations	.24
Energy Storage Options	.24
Anticipated Net Power Cost Savings	.24
Alternative 3 - Utility/Grid-Scale Facilities	.24
Overview/General Description	.24
Potential Benefits	.25
Potential Challenges	.25
Siting Considerations	.26
Energy Storage Options	.26
Anticipated Net Power Cost Savings	.27
Chapter 8 APM No. 2 – Net Metering (to be used in conjunction w/other Measures)	.29
Overview/General Description	.29
Treatment of Behind-the-Meter Customer-owned Generation	.29
Aggregated Generation Among Multiple End-Use Electricity Users	.30
PacifiCorp Net Metering Programs	30
Potential Benefits	.31

Potential Challenges	32
Anticipated Net Power Cost Savings	
Chapter 9 APM No. 3 – Out-of-Basin Renewable Energy Investment	
Overview/General Information	33
Potential Benefits	33
Potential Challenges	34
Anticipated Net Power Cost Savings	
Chapter 10 APM No. 4 – Equipment/Efficiency Upgrades	
Overview/General Information	
Potential Benefits	
Potential Challenges	37
Anticipated Net Power Cost Savings	
Chapter 11 APM No. 5 – Time-of-Use Power Rates	
Overview/General Information	
Potential Benefits	40
Potential Challenges	41
Anticipated Net Power Cost Savings	41
Chapter 12 APM No. 6 – Irrigation Load Control Programs	43
Overview/General Information	43
Potential Benefits	44
Potential Challenges	45
Anticipated Net Power Cost Savings	45
Chapter 13 APM No. 7 – Small Hydroelectric Generation Plant Development	46
Overview/General Information	46
Potential Benefits	47
Potential Challenges	47

Anticipated Net Power Cost Savings	48
Estimated Costs for New Hydroelectric Generating Plant Development	48
Estimated Value of Power from a New Hydroelectric Generating Plant	49
Net Cost/Benefit Summary for Small Hydroelectric Plants	51
Chapter 14 APM No. 8 Purchases of Federal Power	52
Overview/General Information	52
Potential Benefits	53
Potential Challenges	53
Anticipated Net Power Cost Savings	54
Chapter 15 APM No. 9 – Open-Access Power Purchases	55
Overview/General Information	55
Potential Benefits	55
Potential Challenges	55
Anticipated Net Power Cost Savings	56
Chapter 16 APM No. 10 – PacifiCorp Irrigation Customer Cost-of-Service Evaluation	58
Overview/General Information	58
General Rate Cases	58
General Rate Cases Power Cost Adjustment Cases	58 59
General Rate Cases Power Cost Adjustment Cases Potential Benefits	58 59 59
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges	58 59 59 60
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges Anticipated Net Power Cost Savings	58 59 59 60 61
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges Anticipated Net Power Cost Savings Chapter 17 APM Implementation Summary	58 59 60 61 62
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges Anticipated Net Power Cost Savings Chapter 17 APM Implementation Summary Overview	58 59 60 61 62 62
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges Anticipated Net Power Cost Savings Chapter 17 APM Implementation Summary Overview High Priority Affordable Power Measures	58 59 60 61 62 62 63
General Rate Cases Power Cost Adjustment Cases Potential Benefits Potential Challenges Anticipated Net Power Cost Savings Chapter 17 APM Implementation Summary Overview High Priority Affordable Power Measures Chapter 18 Potential Resources for Implementing the APMs	58 59 60 61 62 62 63 66

Chapter 19 Recommendations/Next Steps	67
Abbreviations and Acronyms	68

List of Tables

Table ES-1. List of Affordable Power Measures	xv
Table ES-2. APM Implementation Summary xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	vii
Table ES-3. High Priority Affordable Power Measures xv	iii
Table 2-1. Project Elements and Characteristics	7
Table 6-1. List of Affordable Power Measures	16
Table 10-1. Energy Trust Energy Efficiency Incentives for OR PacifiCorp Customers	38
Table 11-1. Monthly Power Costs Reductions/Increases During the Prime Summer Season Oregon Pilot Time-of-Use Irrigation Customers	n 42
Table 11-2. Monthly Power Costs Reductions/Increases During the Prime Summer Season California Pilot Time-of-Use Irrigation Customers	n 42
Table 12-1. Irrigation Customer Annual Power Cost Savings Under the Pilot Program4	45
Table 17-1. APM Implementation Summary	62
Table 17-2. High Priority Affordable Power Measures	63

List of Figures

Figure ES-1. Map of the Klamath Project showing primary Project features	xii
Figure 2-1. Klamath Project Area	5
Figure 2-2. Upper Klamath Basin Off-Project Areas	6
Figure 7-1. Photovoltaic Solar Resources of the United States	18

This page intentionally left blank

Executive Summary

Purpose and Scope of the Affordable Power Measures Report

This Affordable Power Measures ("APM") Analysis and Report has been prepared by the United States Bureau of Reclamation ("Reclamation") as the Secretary of the Interior's (Secretary's) response to certain provisions outlined in the America's Water Infrastructure Act of 2018 (Pub. L. 115-270, "AWIA") regarding the reduction of power costs to agricultural water users in the Upper Klamath River Basin. Specifically, Section 4308 of the AWIA amended the Klamath Basin Water Supply Enhancement Act of 2000 (Pub. L. 106-498) to address power and water management in the Klamath Basin, including reduction of power costs (Enhancement Act as amended, Section 4(c)). The Enhancement Act as amended will hereafter be referred to as the "Enhancement Act."

In satisfaction of these requirements, this APM Report is being submitted to the Committee on Energy and Natural Resources of the U.S. Senate and the Committee on Natural Resources of the U.S. House of Representatives (collectively "the Committees"). A separate companion report - referred to as the Power Cost Benchmark ("PCB") Report - is also being submitted to the Committees as directed by the Enhancement Act.

Affordable Power Measures

The set of specific actions that have been developed in response to the criteria referenced in the Enhancement Act are referred to in this report as "Affordable Power Measures" or "APMs". APMs are defined as actions that can be undertaken by stakeholders/water users to reduce power costs for irrigation and drainage use in the Upper Klamath Basin to a level equal to or below the Power Cost Benchmark.¹ The methodologies utilized to identify, evaluate, and select the final set of recommended APMs are described in various chapters of this Report.

Description of the Klamath Project

The Secretary of the Interior authorized development of the Klamath Project on May 15, 1905, under provisions of the Reclamation Act of 1902 (32 Stat. 388). The irrigable lands of the Klamath Project are in south-central Oregon (62 percent) and north-central California (38 percent) and cover lands in Klamath County, Oregon, and Siskiyou and Modoc counties in northern California. The Project provides full-service water and drainage to approximately 210,000 acres of cropland and rangeland located within the Upper Klamath River Basin.

¹ As is described in more detail in the accompanying Power Cost Benchmark Report, the PCB is a per-unit measure (expressed in terms of ϕ /Kilowatt-hour) of the average cost of power for irrigation and drainage use in Reclamation Projects located in the Pacific Northwest Region and that are similarly situated to the Klamath Project.



Figure ES-1. Map of the Klamath Project showing primary Project features

In addition to irrigation customers that are served by the Project, there are a significant number of additional water users irrigating lands that are located within the larger Upper Klamath Basin. These so-called "Off-Project areas" include irrigated lands in Oregon within the watersheds of the Lost, Sprague, Williamson, and Wood rivers. There are water uses located in the Off-Project areas that are considered to be "covered users" under the Enhancement Act (Section 4(a)(1)). Therefore, this APM Analysis evaluates power cost savings measures that have the ability to reduce power costs for covered users located throughout the Upper Klamath Basin.

Additional general information regarding the Klamath Irrigation Project is contained in Chapter 2.0.

Historical Power Costs for Irrigation and Drainage use in the Upper Klamath Basin

At the time of the Klamath Project's development, Reclamation filed for all unappropriated water in the Klamath Basin along with the right to appropriate water for power development at several locations. Reclamation recognized that in order to irrigate the land it was necessary to access inexpensive power for both drainage and pumping purposes. Although Reclamation had the authority and intent to develop and provide power to the Klamath Project irrigators at the time of the Project's development, inadequate funding in the early years of development had prevented it from doing so.

In 1917 the California Oregon Power Company ("COPCO"), now PacifiCorp, approached Reclamation and proposed building a dam on Upper Klamath Lake to provide better water regulation for COPCO's existing and planned hydropower facilities to be developed on the Klamath River. Later that same year Reclamation entered into a 50-year contract with COPCO for the construction and operation of Link River Dam that also included provisions for COPCO to provide power at discounted rates to the Klamath Project beneficiaries. Reclamation's contract with COPCO protected irrigation rights and provided the Klamath Project water users with power rates locked in at 1917 levels; this agreement therefore allowed Reclamation to provide the Klamath Project with affordable power for Basin irrigators as was its original intent.

The original COPCO/Reclamation contract was amended in 1956, featuring essentially the same power rates for an additional 50-year period; this agreement was a condition of PacifiCorp's Klamath Hydroelectric Project FERC operating license becoming effective. Later in 1956, a separate COPCO contract provided Off-Project agricultural power users located in the Upper Klamath Basin with reduced power rates similar to those of the On-Project users.

At the expiration of PacifiCorp's FERC license in 2006, the Oregon and California Public Utility Commissions ("PUCs") allowed PacifiCorp to phase in full tariff power rates to agricultural customers in the Basin over a period of several years. The 1956 contract expiration and the FERC and PUCs rulings ended nearly 90 years of reduced or at-cost power rates for Upper Klamath Basin irrigators.

Current Power Costs for Irrigation and Drainage use in the Upper Klamath Basin

The termination of the 1956 PacifiCorp power supply agreements resulted in an increase in power rates for agricultural water users in the Klamath Basin from 0.3 to 0.75 cents per kilowatt-hour (ϕ /kWh) in 2006 to approximately 9.7 ϕ /kWh in Oregon and 12.9 ϕ /kWh in California in 2016. With these changes, the average water pumping cost on the Klamath Project in 2015 was \$45 per acre as compared to an average power cost of \$2.25 per acre prior to the 1956 power contract's expiration.

It is important to note that the 1956 power contracts in place with PacifiCorp up until 2006 were unique in that low-cost power supplies were made available not only to the Klamath Project itself, but also to irrigation districts for their own pumps, and individual On-Project and Off-Project irrigation customers as well. Therefore, the expiration of these agreements in 2006 and the subsequent phase-in to PacifiCorp's full retail tariff rates had a <u>double (or triple) impact</u> of not only significantly increasing costs at federal pumps delivering water supplies (and drainage) to ultimate On-Project users but also in increasing these same water users' individual at-site water distribution costs, and those of their irrigation districts as well. Off-Project water users also endured significantly higher costs by virtue of having to purchase all of their on-farm power supply needs from PacifiCorp under full retail tariff rates.

Additional historical context regarding power rates for irrigation and drainage use in the Upper Klamath Basin and the impacts of higher power costs in the Basin following the expiration of the PacifiCorp power purchase agreements in 2006 is provided in Chapter 3.0. In addition, Chapter 10.0 of the PCB Report contains updated Calendar Year 2017 – 2018 power cost information for agricultural customers located in the different portions of the Upper Klamath Basin.

APM Analysis Public Stakeholder Process

An important component of the APM Analysis was the opportunity for interested stakeholders to participate in the study process and provide meaningful input into the production of the final APM Report. In particular, many stakeholders have long histories of living and working in the Upper Klamath Basin and their informed insights on the impacts of higher electricity prices on irrigation practices in the Basin were invaluable to the APM Analysis Team.

Interested stakeholders had several different avenues available in which to stay informed of and/or provide input to the APM Analysis throughout the life of the project. Additional information regarding the public stakeholder process and the multiple opportunities for interested parties to provide feedback to the APM Analysis Team is contained in Chapter 5.0.

The Comprehensive Agricultural Power Plan Report

In October 2016, Reclamation publicly released the Comprehensive Agricultural Power Plan ("CAPP") Report for the Klamath Basin. The CAPP was an extensive effort initiated by Reclamation and multiple stakeholders to identify, discuss, and screen multiple different alternatives that might help lower overall power costs for both On-Project and Off-Project covered irrigation water users located in the Oregon and California portions of the Upper Klamath Basin.

The CAPP was also initiated in the context of a broader effort to assess many different facets of water use in the Klamath Basin; this process resulted in the Klamath Basin Restoration Agreement ("KBRA") which was finalized by Reclamation and multiple stakeholders in 2010. The KBRA sought to address short-, medium, and long-term power costs in the Upper Klamath Basin in light of the 2006 of the previously-discussed PacifiCorp power contracts.

After first providing some historical context regarding power costs in the Upper Klamath Basin, the CAPP Report then described in detail a total of eighteen potential power cost savings measures ("Measures") that were identified by the CAPP Analysis Group. Pre-feasibility study-level economic analyses were performed on all of the identified Measures. Once the universe of potential power cost savings Measures were identified and various analyses performed, all of the Measures were screened and ranked using nine different criteria including forecasted reductions in power rates, administrative intensity, access to benefits, and environmental impacts. All of the Measures were then grouped into one of three tiers, with Tier-1 containing those Measures that presented the best opportunities to lower power rates in the Basin while Tier-3 contained Measures that either did not reduce power rates or exhibited substantial uncertainties.

Identifying the Affordable Power Measures

In initially defining the broad parameters for the APM Analysis, the APM Analysis Team agreed that the Analysis should utilize the earlier work originally developed for the CAPP as a starting point in order to re-assess and identify viable APMs for the Upper Klamath Basin pursuant to the directives specified in the Enhancement Act. To this end, the Team first reviewed the results from the CAPP Report and developed a list of power cost savings measures to potentially be considered as part of the APM Analysis. Following this initial screening process, the Team choose 12 power cost savings alternatives from the CAPP to be considered as potential Affordable Power Measures in the APM Analysis.²

Following multiple rounds of open discussion and preliminary evaluations, the Team then identified several additional cost-savings measures for consideration under the APM Analysis that were not previously analyzed as part of the CAPP study. From the overall list of potential APM candidates, the Team then performed a high-level screening process that resulted in a final list of ten Affordable Power Measures to be evaluated in more detail. In developing the final list of ten potential power cost savings measures, the Team placed a focus on Measures that were judged to be: 1) consistent with the requirements established in the Enhancement Act, 2) economically viable given current and forecasted conditions, 3) consistent with the existing regulatory frameworks in place in Oregon and California, 4) have minimal environmental impacts, and 5) are realistically implementable.

The APM Analysis Group recognized that the potential benefits to be derived from some of the identified power cost savings measures might not be equally distributed across all covered water users in the Upper Klamath Basin due to a variety of factors. However, in screening the various candidate Measures, the APM Analysis Team attempted to craft a package of recommended Measures that - when taken as a whole – is expected to create power cost reduction benefits to Reclamation, the irrigation districts located within the Klamath Project, and both On-Project and Off-Project covered water users in the Upper Klamath Basin.

APM No. Affordable Power Measure					
1	Alternative 1 – Development of Individual Customer Solar PV Generation Facilities				
1	Alternative 2 – Development of Shared/Community Solar PV Generation Facilities				
1	Alternative 3 – Development Utility/Grid Scale Solar PV Generation Facilities				
2	Net Metering Programs (Used in conjunction with other APMs)				

Table ES-1	List of Affordable Power Meas	sures
		Suics

² All 12 of the power cost savings alternatives from the CAPP that were selected to be included in the APM Analysis were ranked as either Tier-1 or Tier-2 alternatives under the CAPP's screening process.

3	Out-of-Basin Renewable Energy Investment
4	Equipment/Efficiency Upgrades
5	Time-of-Use Power Rates
6	Irrigation Load-Control Programs
7	Small Hydroelectric Generating Plant Development
8	Purchases of Federal Power
9	Open Access Power Purchases
10	PacifiCorp Irrigation Customer Cost-of-Service Evaluation

Detailed Descriptions of the Affordable Power Measures

Each of the ten APMs - as identified above in Table ES-1 - were evaluated independently utilizing multiple sets of criteria that included technical specifications, environmental attributes, siting considerations, and the overall cost/benefit proposition with regard to lowering power costs for irrigation and drainage customers in the Upper Klamath Basin.

The ten APMs are discussed in detail in Chapters 7.0 - 16.0 of this Report. Information regarding each APM is organized and presented in a standard format that allows for direct comparison of several key attributes between each of the individual Measures. The standard format consists of sub-chapters that: 1) provide an overview/general description, 2) identify potential benefits, 3) identify potential challenges, and 4) evaluate anticipated net power cost savings. In addition, some APM descriptions contain additional informational sub-chapters (for example, siting considerations).

It should be noted that the ten identified APMs are not necessarily mutually exclusive. In other words, two or more APMs can, in many cases, be concurrently implemented in multiple different combinations by either Reclamation, individual irrigation districts or on-farm covered water users in order to maximize a given water user's overall power cost savings.³

APM Implementation Summary

The ten identified APMs cover a broad range of potential mechanisms that can be implemented to help reduce power costs for water users in the Upper Klamath Basin. An important feature of this suite of cost-reduction measures is that many of the APMs can be implemented in a concurrent fashion or in different combinations that best fit the needs of individual water users. While it is true that some of the APMs may not be available and/or provide an equal level of benefits to all covered water users in the Basin, the APM Analysis Team attempted to identify

³ Some combinations of the APMs, however, cannot be implemented on a concurrent basis. For example, PacifiCorp irrigation customers located in Oregon can opt to take service under PacifiCorp's Irrigation Time-of-Use Rate (APM No. 5) or the Irrigation Load Control Rate (APM No. 6), however customers cannot participate in both rate programs at the same time.

and evaluate the APMs so that Reclamation, irrigation districts, and individual covered water users would all have multiple viable power cost alternatives available for consideration.

An important feature of the identified APMs is the question of who can actually implement the measures. For example, some of the APMs would either need to be, or could be, implemented by Reclamation, with the associated power cost reduction benefits flowing to individual On-Project covered users via lower water delivery charges. In other cases, individual On-Project and Off-Project cover users could choose, on their own, to implement one or more APM's with the associated benefits accruing solely to themselves.

Table ES-2 summarizes the ten APMs along with information regarding how the measures could be implemented.

APM No.	Affordable Power Measure	Who Implements the Measure?	How is the Measure Implemented?	Time Horizon For Implementation	Distribution of Benefits
1	Solar PV Development Alternative 1 - (small facilities)	Individual power customer	Individual customer installs solar PV facility	Weeks to months	Individual water user or groups of water users
1	Solar PV Development Alternative 2 – (shared facilities)	Groups of power customers under a central coordinating entity	Individual power customer decision with central entity installing solar PV facility	12 – 24 months	Groups of Off- Project and/or On-Project water users
1	Solar PV Development Alternative 3 – (grid scale facilities0	A central developer and a central benefits administrator	Developer commits to develop solar PV facility	24-36 Months	Developer enters into arrangement with group(s) of water users
2	Net Metering	Individual power customers	Customer signs up with PacifiCorp	1-2 Months	Individual water users who have self- generation
3	Out-of-Basin Renewable Investment	A central developer and a central benefits administrator	Developer commits to invest in a renewable energy project	24-36 Months	Developer enters into arrangement with group(s) water users
4	Equipment/efficiency Upgrades	Individual power customers	Individual power customer purchases/installs equipment	1-6 Months	Individual water user or groups of On-Project water users
5	Time-of-use Power Rates	Individual power customers	Customer signs up with PacifiCorp	TBD based on post-pilot program terms and conditions	Individual water user or groups of On-Project water users
6	Irrigation Load Control Programs	Individual power customers	Customer signs up with PacifiCorp	TBD based on post-pilot program	Individual water users or groups

Table ES-2. APM Implementation Summary

APM No.	Affordable Power Measure	Who Implements the Measure?	How is the Measure Implemented?	Time Horizon For Implementation	Distribution of Benefits
				terms and conditions	of On-Project water users
7	Small Hydro Plant Development	Reclamation or irrigation districts	Developer commits to construct hydro facility	3-5 Years	On-Project water users
8	Purchases of Federal Power	Reclamation	Reclamation develops a new Federal power supply portfolio	2-5 Year	On-Project water users
9	Open-access Power Purchases	Individual power customers	Customer signs up with PacifiCorp and commits to an alternative power supply	Months	Individual water users
10	PacifiCorp Irrigation Cost of Service Evaluation	Individual or group(s) of power customers	Active participation in PacifiCorp rate setting processes in OR and CA	Ongoing with initial action in months	All water users

High Priority Affordable Power Measures

Based on an overall evaluation of each APM, six Measures were identified as exhibiting the best balance between: 1) a reasonable expectation of meaningful power cost reductions, 2) the ability to implement the Measure in a realistic timeframe, and 3) a widespread distribution of benefits across multiple categories of water users in the Basin. These High Priority Measures are listed in Table ES-3.

Table ES-3. High Priority Affordable Power Measures

APM No.	Affordable Power Measure	Interest In Federal Funding?
1	Solar PV Development – Alternative 1 (individual facilities)	Yes
1	Solar PV Development – Alternative 2 (shared/community-scale)	Yes
1	Solar PV Development – Alternative 3 (grid-Scale)	Yes
2	Net Metering (used in conjunction with Solar PV Alternatives 1 & 2)	NA
4	Equipment/Efficiency Upgrades	Yes
5	Time-of-Use Power Rates	Note 1
6	Irrigation Load-Control Programs	Note 1
7	PacifiCorp Irrigation Cost-of-Service Evaluation	No

Note 1: To the extent that implementation of these APMs by Reclamation or irrigation districts causes negative impacts to other water users in the Upper Klamath Basin, Federal Funding might be utilized to either: 1) provide financial offsets to the affected users, or 2) develop additional water system infrastructure to directly reduce negative water delivery/timing impacts.

Recommendations/Next Steps

The Power Cost Benchmark Analysis that accompanies this Report concluded that the average per-unit cost of power for irrigation and drainage use in the Upper Klamath Basin is approximately 97.3% higher than the costs paid by agricultural water users located in five Reclamation Projects in the Pacific Northwest region that were determined to be similarly situated to the Klamath Project.⁴ The Affordable Power Measures that have been evaluated and discussed in this report - and especially those Measures identified as High Priority Measures - were designed to assist water users (including Reclamation, irrigation districts, and individual covered water users) in reducing their respective power costs via a multi-prong approach.

In developing the final list of High Priority APM's, an emphasis was placed on those Measures that could implemented in a reasonably short period of time so as to present water users with viable power savings options that they could consider enacting in the near-future, either on an individual customer basis or, in some cases, as part of a group. In addition, Measures implemented by Reclamation and/or irrigation districts will provide benefits to multiple individual water users.

Given the results presented in this Report, Reclamation recommends that it proceed to conduct feasibility analyses for the set of High Priority APMs listed in Table ES-3.

⁴ PCB Report, Chapter 13.2.

This page intentionally left blank

Chapter 1 Purpose and Scope

This Affordable Power Measures ("APM") Analysis and Report has been prepared by the United States Bureau of Reclamation ("Reclamation") as the Secretary of the Interior's (Secretary's) response to certain provisions outlined in the America's Water Infrastructure Act of 2018 (Pub. L. 115-270, "AWIA") regarding the reduction of power costs to agricultural water users in the Upper Klamath River Basin. Specifically, Section 4308 of the AWIA amended the Klamath Basin Water Supply Enhancement Act of 2000 (Pub. L. 106-498) to address power and water management in the Klamath Basin, including reduction of power costs (Enhancement Act as amended, Section 4(c)). The Enhancement Act as amended will hereafter be referred to as the "Enhancement Act."

The AWIA amended the Enhancement Act by inserting a new Section 4 into the Enhancement Act as follows (portions of the amendment not pertaining to reduction of power costs are omitted for clarity):

SEC. 4. POWER AND WATER MANAGEMENT.

- (a) DEFINITIONS.—In this section:
- (1) COVERED POWER USE.—The term 'covered power use' means a use of power to develop or manage water from any source for irrigation, wildlife purposes, or drainage on land that is—
 - (A) associated with the Klamath Project, including land within a unit of the National Wildlife Refuge System

that receives water due to the operation of Klamath Project facilities; or

- (B) irrigated by the class of users covered by the agreement dated April 30, 1956, between the California
- Oregon Power Company and Klamath Basin Water Users Protective Association and within the Off Project Area (as defined in the Upper Basin Comprehensive Agreement entered into on April 18, 2014), only if each applicable owner and holder of a possessory interest of the land is a party to that agreement (or a successor agreement that the Secretary determines provides a comparable benefit to the United States).
- (3) POWER COST BENCHMARK.—The term 'power cost benchmark' means the average net delivered cost of power for irrigation and drainage at Reclamation projects in the area surrounding the Klamath Project that are similarly situated to the Klamath Project, including Reclamation projects that—
- (A) are located in the Pacific Northwest; and
- (B) receive project-use power.

(c) REDUCING POWER COSTS.—

(1) IN GENERAL.—Not later than 180 days after the date of enactment of America's Water Infrastructure Act of 2018, the Secretary, in consultation with interested irrigation interests that are eligible for covered power use and organizations representative of those interests, shall submit to the Committee on Energy and Natural Resources of the Senate and the Committee on Natural Resources of the House of Representatives

a report that-

- (A) identifies the power cost benchmark; and
- (B) recommends actions (other than direct payments to persons making covered power uses or to other entities for the purposes of subsidizing power rates) that, in the judgment of the Secretary, are necessary and appropriate to ensure that the net delivered power cost for covered power use is equal to or less than the power cost benchmark, including a description of—

(i) actions-

- (I) to immediately reduce power costs; and
- (II) to ensure that the net delivered power cost for covered power use is equal to, or less than, the power cost benchmark in the near term, while longer-term actions are being implemented;
- (ii) actions that prioritize-
- (I) water and power conservation and efficiency measures that could assist in achieving the power cost benchmark;
- (II) to the extent actions involving the development or acquisition of power generation are included, renewable energy technologies (including hydropower); and
- (III) regional economic development;
- (iii) the potential costs and timeline for the actions recommended under this subparagraph;
- (iv) provisions for modifying the actions and timeline to adapt to new information or circumstances;

and

- (v) a description of public input regarding the proposed actions, including-
- (I) input from water users that have covered power use; and
- (II) the degree to which those water users concur with the recommendations.

In satisfaction of these requirements, this APM Report is being submitted to the Committee on Energy and Natural Resources of the U.S. Senate and the Committee on Natural Resources of the U.S. House of Representatives (collectively "the Committees"). A separate companion report - referred to as the Power Cost Benchmark ("PCB") Report - is also being submitted to the Committees as directed by the Enhancement Act.

Affordable Power Measures

The set of specific actions that have been developed in response to the criteria referenced in Chapter 1.2 are referred to in this report as "Affordable Power Measures" or "APMs". APMs are defined as actions that can be undertaken by stakeholders/water users to reduce power costs for irrigation and drainage use in the Upper Klamath Basin to a level equal to or below the Power Cost Benchmark. ⁵The methodologies utilized to identify, evaluate, and select the final set of recommended APMs are described in various chapters of this Report.

Prior Power Cost Reduction Studies for the Klamath Project

Prior to the passage of the AWIA, Reclamation conducted an analysis of power costs in the Upper Klamath Basin which was released as part of the Klamath Comprehensive Agricultural Power Plan ("CAPP") in February 2016. The CAPP Report presented a set of alternatives that might be implemented in order to reduce power costs to agricultural water users located in the Basin. This APM Report updates, and in several areas significantly expands upon, this earlier analysis with the goal of identifying a set of APMs to help reduce the net delivered cost of power⁶ for covered power use⁷ in the Upper Klamath Basin.

The APM Analysis Team

The completion of the APM Analysis and the accompanying Report was a group effort that involved multiple individuals from several organizations including Reclamation's Klamath Falls regional office, the Klamath Water Users Association ("KWUA") through its power committee in which other Upper Klamath Basin irrigation interests were invited to participate, and Kleinschmidt Associates.⁸ Collectively, this group is referred to throughout this Report as the "APM Analysis Team" or "the Team." Appendix A contains a list of the individuals who were part of the APM Analysis Team and the organizations with which they are affiliated.

⁵ As is described in more detail in the accompanying Power Cost Benchmark Report, the PCB is a per-unit measure (expressed in terms of ϕ /Kilowatt-hour) of the cost of power for irrigation and drainage use in Reclamation Projects located in the Pacific Northwest Region and that are similarly situated to the Klamath Project.

⁶ The term "net delivered cost of power" is used in Section 4(a)(3) of the AWIA when defining the Power Cost Benchmark.

⁷ The term "covered power use" for the Klamath Basin is defined in Section 4(a)(1) of the AWIA.

⁸ Reclamation retained Kleinschmidt Associates to provide consulting services for the APM and PCB analyses pursuant to Contract #140R2019F0015 AWIA Klamath Power Studies

Chapter 2 Description of the Klamath Project

Overview

The Secretary of the Interior authorized development of the Klamath Project on May 15, 1905, under provisions of the Reclamation Act of 1902 (32 Stat. 388). The irrigable lands of the Klamath Project are in south-central Oregon (62 percent) and north-central California (38 percent) and cover lands in Klamath County, Oregon, and Siskiyou and Modoc counties in northern California. The Project provides full-service water to approximately 210,000 acres of cropland and rangeland located within the Upper Klamath River Basin.

The Upper Klamath River Basin has extensive land and water resources which are not fully developed. The terrain varies from rugged, heavily timbered mountain slopes to rolling sagebrush bench lands and broad, flat valleys. The Project plan includes construction of facilities to divert and distribute water for irrigation of basin lands, including reclamation of Tule and Lower Klamath Lakes, and control of floods in the area.

The two main sources of water for the Project are: 1) Upper Klamath Lake and the Klamath River; and 2) Clear Lake Reservoir, Gerber Reservoir, and Lost River, which are located in a closed basin. The total drainage area, including the Lost River and the Klamath River watershed above Keno, Oregon, is approximately 5,700 square miles. Principal irrigated crops within the Project are include alfalfa hay and grass hay, irrigated pasture, grains, potatoes, and onions, with smaller acreage in mint and horseradish.



Figure 2-1. Klamath Project Area

In addition to irrigation customers that are served by the Project, there are a significant number of additional water users irrigating lands that are located within the larger Upper Klamath Basin. These so-called "Off-Project areas" include irrigated lands in Oregon within the watersheds of the Lost, Sprague, Williamson, and Wood rivers. Figure 2-2 below shows the boundaries of the Off-Project areas located within the Upper Klamath Basin (outlined in red) and how these areas relate to the Project's boundaries.



Figure 2-2. Upper Klamath Basin Off-Project Areas

For the purposes of the APM Report (and the accompanying PCB Report as well), there are water uses located in the Off-Project areas that are considered to be "covered users" under the AWIA.⁹ Therefore, this APM analysis incorporates power cost information for irrigation and/or drainage customers that are located both within the Klamath Project's boundaries and the covered users that are located in the Upper Klamath Basin Off-Project areas.

Several of the key elements and characteristics of the Klamath Project are summarized in Table 2-1 below.

⁹ See AWIA Section 4308, Sec 4(a)(1).

Project Elements	Data
Irrigated acres	191,592 – 230,769 acres*
Average annual precipitation	13.8 in
Mean temperature	49 F
Growing season	120 days
Elevation of irrigable areas	4,093 ft
Project authorization	1905
Storage Dams	3
Diversion Dams	4
Canals	185 mi ¹⁰
Laterals	532 mi
Pumping Plants	28
Drains	728.2 mi
Tunnels	1.9 mi

Table 2-1. Project Elements and Characteristics

Source: Reclamation website <u>https://www.usbr.gov/projects/index.php?id=470</u> *191,592 figure is from Reclamation project website; 230,769 from GIS data.

What is not reflected in Figure 2-2, however, is the complexity of the system's actual operation which includes a network of gravity fed canals, along with significant electrical loads associated with numerous pumps in the system that must lift water where elevation changes must be overcome or where drainage must occur. In particular, the Klamath Project is unique in that very little pumping is required to initially deliver water into the upstream portions of the Project, however significant amounts of pumping are required to lift water out of the downstream portions of the Project (which are located in a closed basin) in order to provide return flows back into the Klamath River. The system is often noted as one of the more complex "plumbing" efforts for irrigated lands served by Reclamation water.

¹⁰ The figures shown for canals, laterals, pumping plants and drains excludes facilities located within the Project area that are owned by non-Federal entities.

Chapter 3 Historical Power Costs for Irrigation and Drainage in the Upper Klamath River Basin

Overview and Historical Context

At the time of the Klamath Project's development, Reclamation filed for all unappropriated water in the Klamath Basin along with the right to appropriate water for power development at several locations, the largest of which was the Keno Canal. Reclamation recognized that in order to irrigate the land it was necessary to access inexpensive power for both drainage and pumping purposes. Although Reclamation had the authority and intent to develop and provide power to the Klamath Project irrigators at the time of the Project's development, inadequate funding in the early years of development had prevented it from doing so.

In 1917 the California Oregon Power Company ("COPCO"), now PacifiCorp, approached Reclamation and proposed building a dam on Upper Klamath Lake to provide better water regulation for COPCO's existing and planned hydropower facilities to be developed on the Klamath River. Later that same year Reclamation entered into a 50-year contract with COPCO for the construction and operation of Link River Dam that also included provisions for COPCO to provide power at discounted rates to the Klamath Project beneficiaries. Reclamation's contract with COPCO protected irrigation rights and provided the Klamath Project water users with power rates locked in at 1917 levels; this agreement therefore allowed Reclamation to provide the Klamath Project with affordable power for Basin irrigators as was its original intent.

The original COPCO/Reclamation contract was amended in 1956, featuring essentially the same power rates for an additional 50-year period; this agreement was a condition of PacifiCorp's Klamath Hydroelectric Project FERC operating license becoming effective. Later in 1956, a separate COPCO contract provided Off-Project agricultural power users located in the Upper Klamath Basin with reduced power rates similar to those of the On-Project users.

At the expiration of PacifiCorp's FERC license in 2006, Reclamation and the Upper Klamath Basin irrigation community appealed to FERC and the Oregon and California Public Utility Commissions (PUCs) to preserve the reduced power rate agreements provided for in the 1956 FERC license, initially in connection with the automatic one-year renewals of the license. Despite these appeals, FERC and the PUCs ultimately did not compel PacifiCorp to continue to provide power at reduced costs, and allowed PacifiCorp to phase in full tariff rates over a period of several years. The 1956 contract expiration and FERC and the PUCs ruling ended nearly 90 years of reduced or at-cost power rates for Upper Klamath Basin irrigators.

Current Conditions

The termination of the 1956 PacifiCorp power supply agreements resulted in an increase in power rates for agricultural water users in the Klamath Basin from 0.3 to 0.75 cents per kilowatt-hour (ϕ /kWh) in 2006 to approximately 9.7 ϕ /kWh in Oregon and 12.9 ϕ /kWh in California in 2016.

With these changes, the average water pumping cost on the Klamath Project in 2015 was \$45 per acre as compared to an average power cost of \$2.25 per acre prior to the 1956 power contract's expiration.

It is important to note that the 1956 power contracts in place with PacifiCorp up until 2006 were unique in that low-cost power supplies were made available not only to the Klamath Project itself,¹¹ but also to districts for their own pumps, and individual On-Project and Off-Project irrigation customers as well. Therefore, the expiration of these agreements in 2006 and the subsequent phase-in to PacifiCorp's full retail tariff rates had a <u>double (or triple) impact</u> of not only significantly increasing costs at federal pumps delivering water supplies (and drainage) to ultimate On-Project users but also in increasing these same water users' individual at-site water distribution costs, and those of their irrigation districts as well. Off-Project water users also endured significantly higher costs by virtue of having to purchase all of their on-farm power supply needs from PacifiCorp under full retail tariff rates.

¹¹ In this regard, the 1917 and 1956 power contracts between Reclamation and PacifiCorp were akin to Federal Project-use Power arrangements that were historically established at multiple Reclamation irrigation projects located throughout the Pacific Northwest Region (and that remain in place today).

This page intentionally left blank

Chapter 4 The Comprehensive Agricultural Power Plan Report

Overview

In October 2016, Reclamation publicly released the Comprehensive Agricultural Power Plan ("CAPP") Report for the Klamath Basin. The CAPP was an extensive effort initiated by Reclamation and multiple stakeholders to identify, discuss, and screen multiple different alternatives that might help lower overall power costs for both On-Project and Off-Project covered irrigation water users located in the Oregon and California portions of the Upper Klamath Basin.

The CAPP was also initiated in the context of a broader effort to assess many different facets of water use in the Klamath Basin; this process resulted in the Klamath Basin Restoration Agreement ("KBRA") which was finalized by Reclamation and multiple stakeholders in 2010. The KBRA sought to address short-, medium, and long-term power costs in the Upper Klamath Basin in light of the 2006 of the previously-discussed PacifiCorp power contracts. As part of the development of the CAPP, Reclamation worked with PacifiCorp to assemble historical power usage information for the Upper Klamath Basin On-Project and Off-Project water users; some of this information was utilized by the APM and PCB Analyses Teams in deriving the usage-weighted average power cost in the Basin during calendar years 2017 and 2018. ¹²A complete copy of the 2016 CAPP Report is available via the web-site link listed in Appendix E of the Report.

CAPP Power Cost Savings Measures

The CAPP Report began with several sections that provided background and context on irrigation water use in the Upper Klamath Basin and the history associated with the original 1917 and the subsequent 1956 PacifiCorp power supply contracts that were in place with Reclamation and KWUA on behalf of other water users in the Upper Klamath Basin. The Report then described in detail a total of eighteen potential power cost savings measures ("Measures") that were identified by the CAPP Analysis Group. Pre-feasibility study-level economic analyses were performed on all of the identified Measures.

Once the universe of potential power cost savings Measures were identified and various analyses performed, all of the Measures were screened and ranked using nine different criteria including forecasted reductions in power rates, administrative intensity, access to benefits, and environmental impacts.¹³ Rankings in each area were on a four step scale with "Excellent/Yes" being the highest ranking and "Poor/No" being the lowest ranking. Overall scores for each

¹² These computations are discussed in more detail in Chapter 10.0 of the accompanying PCB Report.

¹³ The complete list of the power cost savings measures screening criteria and the associated results are described in Section 5 of the CAPP Report.

Measure were then derived (across all nine of the individual scoring criteria) and the overall results were then arranged into the following three tiers:

- Tier-1 Measures that present the best opportunities to lower power rates.
- Tier-2 Measure that have promise to lower power rates but that may contain implementation obstacles or provide a lower potential for reducing power rates than Tier-1 Measures.
- Tier-3 Measures that do not reduce power rates or contain substantial uncertainties.

It should be noted that the CAPP Study and the accompanying report were completed prior to the enactment of the AWIA. However, the twelve Tier-1 and Tier-2 power cost savings Measures that were originally identified in the CAPP and that were selected for further consideration as part of the APM Analysis are all consistent with the AWIA's provisions regarding the Upper Klamath Basin.¹⁴

¹⁴ Additional details regarding the complete universe of potential power cost savings measures that were considered as part of the APM analysis are contained in Chapter 6.

Chapter 5 APM Report Public/Stakeholder Process

Overview

An important component of the APM analysis was the opportunity for interested stakeholders to participate in the study process and provide meaningful input into the production of the final APM Report. In particular, many stakeholders have long histories of living and working in the Upper Klamath Basin and their informed insights on the impacts of higher electricity prices on irrigation practices in the Basin were invaluable to the APM Analysis Team.

Interested stakeholders had several different avenues available in which to stay informed of and/or provide input to the APM analysis throughout the life of the project, including the following:

- Regular bi-weekly APM project status conference calls with Reclamation and the APM Analysis Team.
- A project kickoff meeting with Reclamation and the APM Analysis Team on March 19, 2019.
- A focused progress review session with Reclamation and the APM Analysis Team on June 11, 2019.
- A public meeting held in Klamath Falls on September 10, 2019.
- An opportunity to review and provide written comments on the Draft APM Report that was made available to the general public on November 1, 2019. Interested parties were provided a 14-day period of time to review the Draft APM Report and submit comments to Reclamation.

Klamath Basin Stakeholder Public Meeting

On September 10, 2019, the APM Analysis Team jointly hosted a public meeting in Klamath Falls, Oregon to present general information regarding the APM (and PCB) topics and to provide and discuss some of the preliminary findings. Approximately 65 persons attended the meeting and many of those present were actively engaged in asking questions of the APM Analysis Team and providing constructive feedback. In addition, several local organizations that assist consumers in lowering and/or more efficiently managing their energy costs attended the meeting and made short presentations regarding the services they can provide to agricultural water users in the Upper Klamath Basin.

A more detailed synopsis of the September 10 public stakeholder meeting is contained in Appendix B.

This page intentionally left blank

Chapter 6 Identifying the Affordable Power Measures

Overview

As was previously described in Chapter 4.2, the 2016 CAPP Report contained a significant amount of detail on 18 potential alternatives for reducing power costs to the Klamath Project and to individual on-farm covered water users located in the Upper Klamath Basin. These alternatives were subjected to a rigorous screening process and then ranked into three separate tiers based upon a combination of factors including economics, environmental impacts, potential regulatory issues, and consistency with the KBRA.

In initially defining the broad parameters for the APM Analysis, the APM Analysis Team agreed that the Analysis should utilize the earlier work originally developed for the CAPP as a starting point in order to re-assess and identify viable APMs for the Upper Klamath Basin pursuant to the directives specified in the Enhancement Act. To this end, the Team first reviewed the results from the CAPP Report and developed a list of power cost savings measures to potentially be considered as part of the APM Analysis. Following this initial screening process, the Team choose 12 power cost savings alternatives from the CAPP to be considered as potential affordable power measures in the APM Analysis.¹⁵

Following multiple rounds of open discussion and preliminary evaluations, the Team then identified several additional cost-savings measures for consideration under the APM Analysis that were not previously analyzed as part of the CAPP study. From the overall list of potential APM candidates, the Team then performed a high-level screening process that resulted in a final list of 10 Affordable Power Measures to be evaluated in more detail. In developing the final list of 10 potential power cost savings measures, the Team placed a focus on Measures that were judged to be: 1) consistent with the requirements established in the Enhancement Act,¹⁶ 2) economically viable given current and forecasted conditions, 3) consistent with the existing regulatory frameworks in place in Oregon and California, 4) have minimal environmental impacts, and 5) are realistically implementable.

The APM Analysis Group recognized that the potential benefits to be derived from some of the identified power cost savings measures might not be equally distributed across all covered water users in the Upper Klamath Basin due to a variety of factors including different state utility rate commissions, differences in state regulatory and environmental processes, differences between

¹⁵ All 12 of the power cost savings alternatives from the CAPP that were selected to be included in the APM Analysis were ranked as either Tier-1 or Tier-2 alternatives under the CAPP's screening process.

¹⁶ For example, the potential development of new generating plants to help reduce power costs in the Upper Klamath Basin was limited to renewable resources (such as hydro, wind and solar) as specified in the AWIA. This requirement resulted in several CAPP Study Tier-1 and Tier-1 power cost reduction alternatives (including the development of new natural-gas fired generating facilities and/or the conversion of electric pumps to natural-gas) being dropped from consideration as potential Affordable Power Measures in the APM Analysis.

On-Project and Off-Project covered water users, and the unique characteristics of the Measures themselves. However, in screening the various candidate Measures, the APM Analysis Team attempted to craft a package of recommended Measures that - when taken as a whole – is expected to create power cost reduction benefits to Reclamation, the irrigation districts located within the Klamath Project, and both On-Project and Off-Project covered water users in the Upper Klamath Basin.

Summary of the Affordable Power Measures

As was previously mentioned in Chapter 6.1, the final list of 10 power cost savings measures was chosen by the APM Analysis Team from a combination of: 1) Measures previously identified in the CAPP Report as being the most promising alternatives, and 2) additional Measures as identified by the Team. Table 6-1 below summarizes the 10 Affordable Power Measures for the Upper Klamath Basin.

APM No.	Affordable Power Measure	
1	Alternative 1 – Development of Individual Customer Solar PV Generation Facilities	
1	Alternative 2 – Development of Shared/Community Solar PV Generation Facilities	
1	Alternative 3 – Development Utility/Grid Scale Solar PV Generation Facilities	
2	Net Metering Programs (Used in conjunction with other APMs)	
3	Out-of-Basin Renewable Energy Investment	
4	Equipment/Efficiency Upgrades	
5	Time-of-Use Power Rates	
6	Irrigation Load-Control Programs	
7	Small Hydroelectric Generating Plant Development	
8	Purchases of Federal Power	
9	Open Access Power Purchases	
10	PacifiCorp Irrigation Customer Cost-of-Service Evaluation	

Table 6-1. List of Affordable Power Measures

Each of the individual APMs shown in Table 6-1 is discussed in detail in Chapters 7.0 through 16.0 of this Report.

It should be noted that the APM's listed in Table 6-1 are not necessarily mutually exclusive. In other words, two or more APMs can, in many cases, be concurrently implemented in multiple
different combinations by either Reclamation, individual irrigation districts or on-farm covered water users in order to maximize a given water user's overall power cost savings.¹⁷

¹⁷ Some combinations of the APMs, however, cannot be implemented on a concurrent basis. For example, PacifiCorp irrigation customers located in Oregon can opt to take service under PacifiCorp's Irrigation Time-of-Use Rate (APM No. 5) or the Irrigation Load Control Rate (APM No. 6), however customers cannot participate in both rate programs at the same time.

Chapter 7 APM No. 1 Solar Photovoltaic (Multiple Alternatives)

Klamath Basin Solar Photovoltaic Generation Potential

In 2012, the National Renewable Energy Laboratory (NREL) for the United States (U.S.) Department of Energy released a map of photovoltaic (PV) solar resources in the U.S. based on data from 1998 to 2009, as shown in Figure 7-1.



Figure 7-1. Photovoltaic Solar Resources of the United States

This above map indicates that solar irradiance in the Upper Klamath Basin is conducive for solar PV generation development, with solar intensities ranging from 5.0 to 6.0 kWh per square meter

per day¹⁸. In general, the most conducive sites for solar PV development should meet the following criteria:

Proximity to loads

Can the solar PV generation be used by loads close to the PV array?

Proximity to Transmission/Distribution Infrastructure

If a larger, utility scale project is proposed, is the site close to power transmission and/or distribution lines?

Site location

Is the site open to the south or southwest without tree cover?

Site geography

Is the site relatively flat or does it slope slightly to the south or southwest?

Local microclimate

Is the site prone to fog or flooding that would limit solar irradiance or flood electrical components?

As will be discussed in more detail in chapters that follow, the desired and/or optimal site characteristics for solar PV facilities are a function of both size and the intended use of the facility.

Description of Solar PV Alternatives in the Upper Klamath Basin

While solar PV technology has been commercially available in the United States for several decades, capital development costs for solar installations have declined significantly over the past few years, and further significant cost reductions are anticipated. At the same time, the conversion efficiency of the solar panels has also significantly improved over time. The combination of higher efficiencies and lower installation costs means that potential applications of this technology that in the past were not economical compared to other power supply alternatives may now be a preferred alternative.

One important benefit of solar PV technology is that while individual solar PV panels are relatively small, they are modular in design and the panels and associated equipment (such as panel racks and DC/AC invertors) can easily be scaled to form generating facilities that vary from small, individual home or farm installations (in the range of 3-5 kW of installed capacity) up to very large, utility grid-scale facilities (that can exceed 200 MW of installed capacity).

¹⁸ The solar intensities shown in Figure 7-1 range from a low of < 3.0 kWh/m2 to a high of > 6.5 kWh/m2.

Another key benefit is portability; unlike many other power generation technologies that have very specific siting requirements, solar PV panels can be installed at a wide range of locations.

The overall size and location of a given solar PV generating facility is driven by several different design criteria. Therefore, in evaluating this APM, the APM Analysis Team recognized that "one size does not fit all" potential applications in the Upper Klamath Basin, but rather different size facilities, and their locations, would likely be tailored to meet different sets of needs. Subsequently the Team defined three different alternatives - representing three specific size ranges of solar PV generating facilities - to be evaluated under this one APM. These three alternatives are:

Alternative 1 - Individual customer solar PV facilities

Alternative 2 - Shared/Community solar PV facilities

Alternative 3 - Utility/Grid scale solar PV facilities

Each of the three solar PV generating alternatives are discussed separately in Chapters 7.3-7.5. While there are definitely common characteristics present across all three alternatives, discussing and evaluating each alternative separately provides for a better understanding of how this APM can be targeted to specific needs and circumstances in order to create power cost savings benefits across a wide variety of power users in the Upper Klamath Basin.

As solar PV generating facilities are becoming more commonplace at various scales in the power industry, so too are these generating facilities being "paired up" with energy storage devices such as batteries. In particular, recent cost reductions in large-scale battery storage technologies are allowing combined solar PV/storage facilities to provide energy and capacity to the grid at prices competitive with new natural gas fired generating plants without the limitations traditionally ascribed to solar PV facilities, namely their inability to serve loads when the sun is not shining. Battery storage technology can even be applied at the single-user level via commercially available equipment that allows customers to actively monitor and manage their own power usage patterns. The potential to pair energy storage technology with solar PV generating facilities in the Upper Klamath Basin is discussed for each of the three solar PV alternatives.

Alternative 1 - Individual Customer Facilities

Overview/General Description

Small-scale solar PV systems with installed capacities of approximately 2-100 kW could be privately owned by individual residences, businesses, and agricultural water users. The common attribute of these systems is that they would be "behind the meter" installations that are designed partially (or potentially fully) offset an individual customer's electrical load at a specific location. These small PV installations typically have relatively small footprints, could be roof-

mounted or ground-mounted, and could utilize either fixed-axis tracking or variable-axis tracking systems.¹⁹

Several small-scale solar PV facilities designed to provide power to individual loads have been installed in the Basin, for example a 10 kW system that was installed by the Klamath Irrigation District at its main office building in Klamath Falls.

Potential Benefits

The power produced by small-sized solar PV systems directly offsets the power supplied by the local utility, therefore reducing the individual customer's energy and capacity (i.e. demand) costs. Also, under some situations, the electricity produced by the solar PV facility may exceed the individual customer's overall electrical load on either a short-term (i.e. hour-to-hour) or long-term (monthly to annual) basis. In these cases, the customer is essentially supplying energy in excess to his or her needs to the local utility (in this case, PacifiCorp). This concept - referred to as "net metering" – is discussed in more detail in Chapter 8.0 (APM No. 2).

Potential Challenges

Small-scale solar PV systems have relatively few constraints since the modular nature of the technology, combined with its portability, results in many potential siting opportunities. However, typical solar PV systems for agricultural pumping purposes are ground-mounted; depending on the system size, some amount of farmland may be required for the installation. For example, a 100-kW system would require approximately one acre for the PV array and power collection system. Also, customers would be responsible for performing regular maintenance functions on their own solar PV equipment (or contracting out for these services).

This option provides benefits only to individual loads attached directly to the small-scale solar PV facility; individual installations have no capability to generate benefits to the covered power users as a group.

Siting Considerations

The primary siting consideration for small-scale solar PV facilities is having available land/space with a generally open southern exposure that is relatively close to the pumping load and the associated electric meter. The physical electrical interconnection process is fairly simple since the raw output from the PV system is low voltage and is wired downstream of the meter.

Energy Storage Options

Small-scale lithium-ion battery storage systems are currently commercially available that could be installed in combination with an individual customer-sized solar PV facility, however such small-scale systems are currently relatively expensive. In addition, under the net metering programs currently in effect in Oregon and California, there is little incentive for individual customers to install small-scale battery storage devices since the net metering accounting process essentially allows a customer to store power 'on paper' with PacifiCorp on a 1:1 basis. However,

¹⁹ Variable-axis tracking systems – which can utilize either single-axis or dual-axis configurations - continuously adjust the orientation of the solar panels as the sun moves across the sky in order to increase electrical energy production during the early morning and late afternoon periods.

if the Oregon and California net metering programs were to be revised in the future, small scale battery storage facilities may become more economically attractive, especially if battery costs continue to drop along with further technological advances.

Anticipated Net Power Cost Savings

The primary benefit of individual small-scale solar PV facilities is that they are interconnected behind the customer's electric meter such that generation produced directly offsets the customer's electrical load without incurring any transmission or distribution costs on PacifiCorp's system. Therefore, power cost savings to the customer are maximized and the amount of self-generation produced reduces the customer's power purchases from PacifiCorp on a kWh-for-kWh basis.

The installation costs of individual customer-sized solar PV facilities in the 5 - 20 kW range are currently estimated to be approximately \$3,000 per installed kW (at the 5 kW size) down to approximately \$2,500 per installed kW (at the 20 kW size). For a 100 kW system that might be utilized for larger single pumping loads, the per-unit costs are estimated to be approximately \$2,100 per installed kW.

Customer can receive additional financial benefits associated with small-scale solar PV facilities through the use of PacifiCorp's net metering programs that are in effect in both Oregon and California that allows customers to either sell self-generation in excess of the customer's load to PacifiCorp and/or to "bank" excess generation in one period to be counted towards the customer's electrical usage in a future period.²⁰

[cost/benefit analysis results are under development]

Alternative 2 - Shared/Community Facilities

Overview/General Description

Mid-scale solar PV systems - in the range of roughly 1 MW up to approximately 5 MW can be developed to serve a group of customers or even a small community. Often referred to as "Shared Solar", "Community Solar", or "Solar Gardens", these installations can provide several benefits over small-scale, individual customer-based solar PV facilities. A primary feature of these intermediate-sized solar PV facilities is that multiple electric customers of the same electric utility can each receive a portion of the power produced from a single, centralized project, with the associated benefits being reflected on each customer's individual power bill.

Potential Benefits

The primary benefit of shared/community sized solar PV facilities is one of economies of scale; that is the per-unit installation costs in moving from small-size to mid-sized solar PV facilities tends to decrease (fairly rapidly) as the total installed capacity of the facility increases. These economies of scale, when combined with the sharing aspect of such centralized plants, allows

²⁰ Details of PacifiCorp's net metering programs in effect in Oregon and California are discussed in more detail in Chapter 8.0 (APM No. 2).

individual customers to essentially acquire a source of "self-generation" at an overall lower cost than they could likely achieve by developing their own customer-specific facilities.

Other key benefit of shared/community solar PV facilities is that there is no need for individual customers to site the panels on their own property (and potentially take some farm land out of production). In addition, the initial development of the facility and ongoing O&M functions (such as washing the panels and conducting regular equipment maintenance) are handled by centralized personnel rather than individual customers.

Potential Challenges

There are several challenges to be dealt with as the size of solar PV facilities are increased from the individual customer level to the shared/community level including site availability, more complicated electrical interconnect requirements, additional local permitting and public processes, potential visual impacts, and security.

In particular, shared/community solar PV installations would interconnect to the electric grid at higher voltages (likely at least at 13.2 KV) than individual behind-the-meter type installations. This would require each proposed community solar facility to submit a formal interconnection request to PacifiCorp. After receiving such a request, PacifiCorp would then perform a transmission/distribution system impacts study to determine: 1) if the proposed solar PV project could feasibly be interconnected to the grid at the specific location specified in the Request, 2) the estimated costs of the at-site interconnection facilities including any new transmission or distribution lines, and 3) if the proposed new project would require any upgrades or reinforcements downstream of the plant's interconnection point on PacifiCorp's transmission/distribution system in order to maintain overall system reliability.

The above referenced interconnection request/study involves a formal multi-step process that can easily stretch over a twelve-month period or longer. In addition, the costs associated with PacifiCorp performing the required studies need to be funded by the entity who submitted the interconnection request. Finally, PacifiCorp's interconnection request process operates on a non-discriminatory "first-come/first-served" basis; therefore, it processes the requests and performs the associated studies in the order that it received the interconnection requests. This "queuing" process can result in further delays to a proposed timeline for a new generating project depending upon the number of new interconnection requests that a transmission operator is processing at a given time.²¹

An important design constraint for proposed shared/community solar PV facilities to be developed in Oregon or California are the net metering size limits that have been implemented by the two states. While the net-metering topic is discussed in more detail in Chapter 8.0, it suffices to say that these policies essentially act to restrict the size of shared/community solar PV to a maximum of 1,000 kW in California and 2,000 kW in Oregon even though larger shared facilities might feasibly be developed in the Upper Klamath Basin that could generate power at a lower overall cost (i.e. again through economies of scale). Therefore, the size range of solar PV

²¹ It is not uncommon for transmission operators in the Pacific Northwest (such as PacifiCorp) to have dozens to hundreds of new requests in their generation interconnection queues at any given time.

facilities being evaluated under this APM alternative has been dictated more by state regulatory policies rather than by technical considerations.

Finally, the price at which generation from a shared solar PV facility is sold back to PacifiCorp is lower than the price received for such excess energy sales from individual customer-sized installations.

Siting Considerations

The two main siting constraints as solar PV generating facilities are scaled up from individual customer/load size to the shared/community size are: 1) the need for additional land/space, and 2) locations that minimize electrical interconnection costs with the existing distribution and transmission infrastructure. In particular, large tracts of open land that are otherwise suitable for the placement of solar PV panels (i.e. good southern exposure, no overhanging trees, etc.) may be located in remote areas and located long distances away from existing transmission or distribution lines.

Energy Storage Options

Energy storage using either lithium-ion or other types of batteries can be installed in tandem with mid-sized share/community solar PV facilities in order to perform short-term generation firming and extending the facility's daily generation profile across a longer time period. Like solar PV panels, battery storage technology is very scalable in that the individual battery cells are relatively compact and modular; to create larger energy storage capabilities individual cells are simply interconnected through a shared invertor and other common control equipment.

Anticipated Net Power Cost Savings

The primary benefit of shared/community solar PV facilities is that they offer many of the same benefits as smaller sized individual installations, but at a lower dollar-per-kW installation cost. The estimated installation cost of a shared solar PV facility in the 1,000 kW – 2,000 kW range is approximately 2,100/kW (for the 1,000 kW size) dropping to approximately 1,800/kW (for the 2,000 kW size), not including the cost of land acquisition, permitting, or interconnection costs to the local transmission/distribution system.

Individual customers who participate in the shared/community solar PV facility also receive financial benefits through the use of PacifiCorp's net metering programs that are in effect in both Oregon and California that allows "the community" to either sell self-generation in excess of the customer's load to PacifiCorp and/or to "bank" excess generation in one period to be counted towards the community's pooled electrical usage in a future. However, as was previously mentioned, the price at which excess power is sold back to PacifiCorp is lower than the price received from individual customer-sized solar PV facilities.

[Cost/benefit analysis results under development]

Alternative 3 - Utility/Grid-Scale Facilities

Overview/General Description

For the purpose of this APM Report, utility-scale solar PV installations are considered to be those facilities with total installed capacity greater than 2,000 kW in Oregon and 1,000 kW in

California. Electricity generated at utility-scale solar PV facilities would not - with one possible exception - be associated with serving any particular customer (or group of customers') end-use loads in the Upper Klamath Basin; rather the power output from such facilities could be sold at wholesale to either PacifiCorp, or potentially to other Pacific Northwest electric utilities. Sales would be made under a long-term purchased power agreement, pursuant to either: 1) the Public Utility Regulatory Policy Act ("PURPA"), or 2) an individual agreement to be negotiated between the seller and purchaser(s).

The one possible exception referenced above is that it may be possible for Reclamation to develop one or more utility-scale solar PV generating plants in the Upper Klamath Basin to be part of a new Federal Project-use Power supply portfolio dedicated to providing low-cost power to Reclamation's Klamath Project pumping and drainage loads. In this case, the power output from the Project's large solar PV plant(s) would be wheeled across PacifiCorp's transmission and distribution systems to one or more specific Reclamation loads.²² This concept is discussed further in Chapter 14.0 (APM No. 8).

Potential Benefits

Due to a combination of lower capital investment costs, improved panel efficiencies, and government tax incentives, Solar PV can be competitive with other forms of electric generating technologies such as wind and natural gas fired combustion turbines. However, as many states in the Pacific Northwest are enacting Green-house Gas reduction programs and/or increasing their renewable portfolio standards, wind and solar are emerging as the primary candidates for new resource development in order to comply with these mandates.

Development of utility-scale solar PV facilities in the Upper Klamath Basin would have several benefits. First of all, the Basin's location in south-central Oregon is conducive to solar PV developments due to favorable solar radiation levels and less cloudy conditions than potential sites located on the west side of the Cascade Mountain range. Second, there are multiple existing transmission lines that traverse the through the Basin and/or in areas near the Basin. And finally, large-scale solar PV facilities could help replace a portion of - or perhaps all of - the approximately 180 MW of capacity and associated energy that PacifiCorp will lose when it retires and removes four hydroelectric dams located on the Klamath River.²³

Potential Challenges

A 200 MW size facility would likely need to interconnect at a transmission-level voltage of 115 KV or higher. In particular, large tracts of open land that are otherwise suitable for the placement of solar PV panels (i.e. good southern exposure, no overhanging trees, etc.) may be located in remote areas and located long distances away from existing transmission or

²² This is not a novel concept; some of the Reclamation pumping loads in the Minidoka Project are served by Federal Project-use Power (generated at multiple Federally-owned dams located in southern Idaho) that is wheeled across transmission/distribution facilities owned by Idaho Power.

²³ The four Klamath River hydroelectric facilities that PacifiCorp will be removing are: 1) COPCO 1 (28,000 kW),
2) COPCO 2 (34,000 kW), Iron Gate (18,800 kW) and J.C. Boyle (98,000 kW).

distribution lines. Facilities of this size would be subject to multiple permitting processes which can add both costs and risk to the project.

The primary challenge to a grid scale solar PV facility to be located in the Upper Klamath Basin is the need for the project's developer(s) to secure a long-term (i.e. at least ten years in length and preferably 20 year) power sales agreement with one or more purchasers, likely to be regional electric utilities. In order to secure financing for a project of this magnitude, lenders will general require that the developer demonstrate the project has a long-term, known revenue stream that will be used to pay off the capital investment in the project. Securing one or more long-term power sales agreements - with one or more regional utilities - for a project of this magnitude could be a potentially time-consuming (and complex) process.

Siting Considerations

The two main siting constraints as solar PV generating facilities are scaled up from the shared/community size to utility/grid size are again: 1) the need for additional land/space, and 2) locations that minimize both local electrical interconnection costs and the need for other potential transmission system upgrades. A 200 MW solar PV facility in the Upper Klamath Basin would require approximately 2,400 acres of land. Also, as the installed capacity of proposed new generating facilities increase in size, the number of suitable sites from a transmission perspective tends to decrease which further constrains potential development locations. A generating facility of this size would also require an increased need for site security as such a facility would be considered to be part of the critical infrastructure of the regional bulk power system.

Energy Storage Options

The primary energy storage alternative for grid-scale solar PV facilities would likely, again, utilize battery technology, at least for on-site storage options. A present, there are only a few battery storage facilities in the western U.S. that are at grid-scale although the Los Angeles Department of Water and Power and 8minute Solar Energy recently announced plans to develop a 200 MW solar PV project to be coupled with a 200 MW battery storage facility. It is also possible for new grid-scale solar PV plants to be coupled with hydroelectric pumped storage projects as the energy storage medium although hydro pumped storage plants have much more specific siting requirements than batteries storage facilities.²⁴

Coupling energy storage with solar PV facilities at grid-scale provides opportunities for utilities and grid operators to not only firm up the output of the solar PV generation but to also actively utilize the combined output of the solar/battery facility as a source of short-term dispatchable capacity. In addition, the ability to use the battery storage to extend and/or reshape the predictable and very steep generation ramps that occur at solar PV facilities as the sun rises and sets is a valuable attribute for the electric utilities as they attempt to integrate more intermittent renewable resources onto the grid while maintaining a high level of system reliability.

²⁴ One hydroelectric pumped storage facility (the Swan Lake project) that is proposed for future development in the Pacific Northwest region is located near to the Upper Klamath Basin.

The value of adding battery storage to a grid scale solar PV facility is not a function of the net metering programs in place in Oregon or California (plants of this size do not qualify for these programs), but rather is derived through the market value of a class of power products in the regional wholesale power markets that are typically referred to as "ancillary services". Ancillary services are a set of discrete power products that provide short-term operating flexibility and/or reliability to the bulk power grid. A generating facility that is capable of providing such services can earn additional revenues in the wholesale power markets above and beyond the price it receives for energy production alone.

Anticipated Net Power Cost Savings

The potential benefits to be derived from utility-scale solar PV development in the Basin are a functions of two primary drivers: 1) the cost of constructing and maintaining the facility, and 2) the value derived from the generation output and how that value is monetized and distributed to covered water users in the form of either direct, or indirect benefits. These different cost/benefit components are discussed separately below:

Capital Costs

The per-kW installation costs of large-sized solar PV facilities benefits greatly from economies of scale as compared to the shared/community class of facilities. The estimated installation cost for a 200 MW solar PV facility is in the range of \$750/kW - \$850/kW, not including land acquisition costs, permitting, or the cost of the transmission/distribution interconnection.

The estimated annual capacity factor for a grid-scale solar PV facility located in the Upper Klamath Basin would be in the range of approximately 26.7% to 30.3%, depending upon the specific type of tracking system utilized. For a 200 MW facility, the annual total energy production would be approximately 468,000 MWh to 530,000 MWh. In comparison, the total annual load for all irrigation and drainage use in the Upper Klamath Basin is approximately 118,000 MWh.

Direct Benefits

Direct benefits could be provided to covered users through a special arrangement with PacifiCorp whereby a portion of the power generated at one or more new solar PV facilities to be located in the Basin would be dedicated to serving a portion of each users' electrical load.²⁵ Benefits could be conveyed to covered users via a billing credit on their monthly power bills from PacifiCorp. Depending on the size of the solar PV facilities to be developed, the portion of the power output not expressly dedicated to serving covered users loads could be retained by PacifiCorp for its own benefit (thereby providing PacifiCorp's out-of-Basin customers with a new carbon-free source of generation).

This arrangement might also incorporate some form of "short distance" PacifiCorp transmission and distribution charges that recognize the fact that the new solar PV generating facilities will likely be located in relatively close proximity to covered users' end-use loads. In addition,

²⁵ Such an arrangement would likely be subject to approval by either the Oregon or California rate commissions.

locating new utility-scale solar PV generation in the Basin might also provide locational benefits to PacifiCorp by helping to replace the hydroelectric generation that will be lost when PacifiCorp removes its four dams on the Klamath River.

Indirect Benefits

Indirect benefits could be provided to covered users through a series of long-term payments to be made based on the revenue streams earned from one or more utility-scale solar PV facilities to be developed in the Basin. In this case, the power output from the new solar PV facilities would not be dedicated to serving any particular customers' electric loads in the Basin, but rather the facilities' generation would be sold to one or more utilities in the region with a portion of the net revenues earned to be distributed among covered users.²⁶ The sales price received would be a market-based/negotiated price with one or more purchasers with the price incorporating the full value of the environmental attributes associated with carbon-free renewable resources.

[Cost/benefit analysis results under development]

²⁶ This alternative is very similar to APM No. 3 (Out of Basin Investment) with the primary difference being that the solar PV facilities to be developed would be located within the Basin.

Chapter 8 APM No. 2 – Net Metering (to be used in conjunction w/other Measures)

Overview/General Description

Net metering programs have been established and implemented by many utilities in the Pacific Northwest region as an accounting mechanism whereby end-use electric customers can combine self-generated power with power purchases from their local utility provider and, in doing so, may lower their overall power purchase costs. In particular, significant recent reductions in the installation costs of solar PV panels has led to the situation where many residential and commercial power users have installed panels on their homes or office buildings and effectively become "self-generators" whereby they provide some, or perhaps most, of the electricity that they consume.

There are two key concepts that are typically incorporated into the net metering programs: 1) how a local utility treats customer-produced electricity that is located "behind-the-meter", and 2) potential load/generation aggregation among multiple end-use retail power customers. These concepts are discussed separately in the following two chapters.

Treatment of Behind-the-Meter Customer-owned Generation

All electric utility customers are familiar with the concept of the electric meter that is installed at their home, farm, commercial establishment, or factory. The utility industry has long relied upon a "pay for what you use" financial model in that one's monthly power bill is largely a function of the amount of electricity that you consumed during that month. Use more power during a month and your total power costs goes up. Use less power and your costs goes down.

However, what happens when an end-use customer actually creates electricity via their own generating facility? Where does that power go? Is the customer essentially "selling" the power to themselves or are they selling it to the local utility? If so, at what price does the customer sell power to the utility? And, does the utility have to buy the electricity that a customer produces that is in excess of their own on-site load? These are just some of the questions that customers, utilities, stakeholders, and regulators take into consideration when defining net metering programs.

In general, net metering programs allow end-use customers that self-generate to use that generation to directly offset their power purchases from the local utility. In essence, by interconnecting the generating source on the *customer's side* of the electric meter, less power flows thru the meter and the customer's receipt of power from the utility decreases. As long as the customer's load is greater than his or her self-generation amount at any given point in time, the customer is still a net purchaser of power from the utility. However, if the customer's self-generation amount is greater than his or her electric load, power flows backward thru the meter and the customer is actually delivering power to the utility.

In this last case, a key provision of the net metering program is when the meter runs backwards, at what price does the utility "purchase" that power at from the customer? This amount is often referred to as the "net metering credit". There are various ways to establish net metering credits; however, all of these methodologies generally entail some tradeoffs between the interests of the customer (who favors a higher price for the credits), the local utility (who favors a lower price) and stakeholders/regulators who are attempting to implement and balance multiple different public policies. Another important issue is the time period across which the net billing credits are computed since both the customer's load and the amount of their self-generation are likely not constant values but rather are likely quite variable.²⁷

Aggregated Generation Among Multiple End-Use Electricity Users

Utility regulators in both Oregon and California have approved programs whereby multiple individual power customers can purchase a portion of the generation produced at a single, centralized solar PV generating facility. As previously mentioned in Chapter 7.4, these types of facilities are commonly referred to as shared or community solar facilities. Net metering shared solar PV facilities provide a double benefit to participating power customers in that: 1) a portion of the plant's generation output is dedicated to replacing the customer's power purchases from PacifiCorp, and 2) the installation costs of the shared facility can be significantly lower than what the customer could achieve their own (by developing a single-customer sized solar PV facility).

PacifiCorp Net Metering Programs

The Oregon and California rate commissions have established net billing programs in their respective states that apply to the utilities that serve end-use retails loads in that state. Since PacifiCorp serves retail customers in both states, all water users located in the Upper Klamath Basin potentially have the ability to leverage these programs (in conjunction with other APMs) to help reduce their power costs. While the net metering programs in the two states are similar in concept, there are several important differences:

Billing Credit for Excess Energy Delivered to PacifiCorp

There is a significant difference in the billing credit that self-generating customers receive for excess energy delivered to PacifiCorp between the Orgon and California programs. ²⁸ In California, the amounts paid by the local utility to the Customer for Excess Energy is based upon the wholesale market value of power at the time that the Excess Energy is delivered to the

²⁷ For example, a power customer with a solar PV installation could be delivering power to the local utility during the daylight hours but then be receiving power during the night time hours.

²⁸ Excess Energy is defined as the amount by which the customer's self-generation exceeds their electric load. These amounts represent the volumes of energy "sold" by the customers to the utility via the billing credit mechanism.

utility.²⁹ In Oregon there are no payments for Excess Energy deliveries made by the customer to the utility.

However, in Oregon the Excess Energy amount is computed on an aggregated basis across a 12month period; this feature effectively allows customers to shift the Excess Energy they produce in Month A to offset their load in Month B (if both months are in the same 12-month accounting period). This is an important concept for irrigation customers whose power usage tends to be very seasonal in nature; essentially, self-generation that these customers produce during the offirrigation season can be utilized to offset their power purchases from PacifiCorp during the summer irrigation season.

Maximum Size Threshold for Shared Solar PV Facilities

As was previously highlighted in Chapter 7.4.3, there is a difference in Oregon and California regarding the maximum size solar PV generating facility that qualifies to be a shared/community generating facility and therefore receive the favored treatment of aggregating generation across a pool of multiple participating power customers. In California, the maximum size limit is 1,000 kW while in Oregon the current limit is 2,000 kW.

Potential Benefits

The primary benefit of PacifiCorp's net metering programs that are in effect in both Oregon and California is that the programs allow customers to reduce their overall power costs by self-generating a portion of, or even all, of their own power need by displacing power formally purchased from PacifiCorp. A key feature of the programs is that self-generation in excess of the customer's load at any given time can be "banked" (through an accounting mechanism) and used to off-set the customer's purchases from PacifiCorp during a future period. In addition, for customers located in California, self-generation that is in excess of the customer's overall power usage across the 12-month accounting period can be sold back to PacifiCorp.

In general, the price that local utilities pay under net metering programs for self-generation in excess of a customer's load can vary significantly. In the case of investor-owned utilities like PacifiCorp, the self-generation credit price(s) are generally established by state-level utility rate commissions. Small-scale solar PV systems can be net metered under PacifiCorp's Schedule 135 in Oregon and Schedule NEM-35 in California; these programs provide individual customers with a self-generation credit equal to the energy rates specified in their respective service tariffs. For PacifiCorp irrigation customers located in Oregon and taking service under Schedule 41 the self-generation credit is currently 9.285 ¢/kWh. For PacifiCorp irrigation customers located in California and taking service under Schedule PA-20 the self-generation credit is 11.988 ¢/kWh.

²⁹ The California Independent System Operator's DLAP (Default Load Aggregation Point) price(s) are used to derive the annual Excess Energy payments to customers.

In addition, for customers located in California, PacifiCorp provides compensation for any net excess energy provided by the customer's solar PV facility across a 12-month accounting period. For customer located in Oregon, there is no annual excess energy true-up payment.

Potential Challenges

Increasingly, as more and more end-use customers begin to self-generate a portion of their own power needs, electric utilities have begun to modify their retail electricity rate tariffs to reduce the amount of revenue customers receive from per-unit usage charges and at the same time increase revenue from either fixed charges (such as a monthly "customer charge") and/or establishing so-called "demand" or "capacity" charges that are based on a customer's maximum electricity usage during the billing period.

Therefore, when evaluating the potential benefits of utilizing net billing programs with PacifiCorp as an APM (likely in conjunction with APM No. 1) it is important to recognize that utility rate tariffs and associated regulatory policies are not constant thru time but rather are subject to change for a multitude of reasons. While it should be noted that PacifiCorp cannot, own its own, make such retail tariff changes without the approval of the Oregon and California state rate commissions, power users in the Upper Klamath Basin should recognize that there is some level of regulatory risk involved when attempting to utilize PacifiCorp's net metering programs as part of a long-term power cost reduction plan since: 1) the terms and conditions of the programs are subject to change, and 2) PacifiCorp's retail irrigation rate tariffs are also subject to change.³⁰

As was discussed in Chapter 7.4, the size limitations for shared solar PV facilities that are currently incorporated into PacifiCorp's net billing programs in place in both Oregon and California will likely act to limit the power cost saving that can be achieved for water users in the Upper Klamath Basin since these size figures likely do not reflect the optimal size of such facilities from an economics standpoint.

Anticipated Net Power Cost Savings

[Cost/benefit analysis results under development]

³⁰ It should be noted that *any end-use customer* that purchases power from an electric utility is always subject to *some level* of regulatory risk since utility rate tariffs are subject to revision across time.

Chapter 9 APM No. 3 – Out-of-Basin Renewable Energy Investment

Overview/General Information

The majority of the Affordable Power Measures discussed in this report are designed to directly reduce Upper Klamath Basin water users' power costs. However, this APM would reduce power costs in the Upper Klamath Basin in an indirect fashion by creating one or more investment vehicles that would be utilized to produce revenue streams that would, in turn, be passed along to covered power users in the Upper Klamath Basin.

While the AWIA does not specify any particular type of generating resource that might be developed either inside of, or outside of, the Upper Klamath Basin in order to reduce power costs in the Basin, the legislation does state a preference for renewable resources. ³¹ Investment in renewable energy outside of the Upper Klamath Basin can be done in several ways, including a partnership with a developer of renewable generating resources or investments in renewable energy mutual funds, exchange traded funds, or yieldcos. The goal of such commercial arrangements would be to provide a long-term, known revenue stream to the sponsoring (likely non-profit) entity who, in turn, would pass thru the associated dollar benefits to individual covered-users to help offset these customers' power purchase costs from PacifiCorp.

Potential Benefits

The states of Washington, Oregon and California have all enacted various legislation and policies that will require the development of a considerable amount of new renewable energy resources across the next several decades. For example, in May 2019, Washington enacted legislation that will require electric utilities that serve end-use retail loads in the state to: 1) cease acquiring power supplies from coal-fired power plants by the end of 2025, and 2) have power generation portfolios that are 80% carbon free by 2030. Oregon also has in place renewable portfolio standards that will require electric utilities – including PacifiCorp – to meet 50% of their end-use retail loads with renewable resources by 2030. In addition, PacifiCorp recently announced that it will be retiring several more of its coal-fired power plants and that it intends to replace this lost generation with approximately 800 MW of new renewable resources.

There are several potential benefits of investments in renewable energy that are not necessarily tied to projects that would be located in the Upper Klamath Basin. These include:

• The ability for water users located in the Upper Klamath Basin to sponsor and/or invest in one or more entities that develop new renewable generating resources significantly

³¹ The AWIA does not expressly define what is considered to be a renewable energy generating resource. However, resource types that are commonly considered to be renewable in the Pacific Northwest region include, but are not necessarily limited to, hydroelectric, wind, solar, tidal, biomass and geothermal.

expands the universe of potential renewable energy opportunities by considering locations outside of the Basin.

- An investment in an out-of-Basin renewable energy resource would not require the direct delivery of the facility's generation output to covered water-users (which could potentially be expensive and/or not feasible under current regulatory restrictions). Instead, the power output of the facility would be sold to one or more third-parties (likely regional electric utilities) with the financial proceeds from the sale(s) being distributed among covered water users in the Basin.
- The revenue stream(s) from the out-of-Basin renewable investments can be distributed among covered water-users through various means. Most notably, both On-Project and Off-Project covered water users could receive financial benefits under these arrangements.
- There could be an opportunity for interests in the Basin to work collaboratively with PacifiCorp to develop new renewable resources that would help PacifiCorp meet its newly expanded renewable resource acquisition goals while also providing associated financial benefits to covered water users in the Basin.

Potential Challenges

The three main constraints associated with renewable energy investments outside the Upper Klamath Basin are: 1) risk, 2) equitable distribution of benefits to covered water users, and 3) and public perception. Any investment would require close evaluation of the finances, the partnership, and its future durability. Also, public perception of investment outside the Basin may be viewed unfavorably and could experience opposition from the Klamath Basin community for not reinvesting in Basin jobs.³²

In addition to the above referenced constraints, the development of any new power generating facilities is always subject to multiple regulatory permitting processes, the outcome of which is always subject to some level of uncertainty and/or potential unexpected costs. Also, the electric utility transmission interconnection process for new generating facilities (of any type) can be very involved and time consuming as well.

Anticipated Net Power Cost Savings

As previously discussed, investment in out-of-Basin renewable energy opportunities would not directly reduce a covered-user's monthly power bill, but instead would provide a source of revenue to the user that would, in effect, offset a portion of their power costs. The effective amount of reductions in customers' power costs is therefore difficult to assess at present since the savings

³² To the extent that the Enhancement Act places a priority on projects which promote regional Klamath Basin economic development, an out-of-basin investment might be considered to be incompatible as an APM. However, by creating more optimal and readily implementable power cost reduction opportunities, such investments serve to keep more Klamath Basin dollars at home, thereby promoting local economic development.

would be primarily tied to: 1) the total net revenues earned from the out-of-Basin investment, and 2) the individual customer's allocated portion of the benefits.

The expected returns on an out-of-Basin investment in renewable energy are subject to a number of uncertainties including, but not necessarily limited to: 1) the specific structure of the investment vehicle, 2) long-term capital financing rates, 3) future Federal, State and Local tax policies, 4) future Federal, State and Local environmental policies including programs to reduce Green House Gas emissions, 5) Pacific Northwest regional electric utility load growth rates, and 6) future state-level renewable portfolio standards.³³

Of particular note is that the renewable energy industry in the Pacific Northwest is very competitive with many established companies already having developed multiple projects throughout the region. Overall, the financial margins to be earned off the development of new out-of-Basin renewable energy resources will be determined largely by market forces. However, the current regulatory and environmental climates in Washington and Oregon is to not only encourage the development of new renewable resources – primarily wind and solar – but to also discourage (or outright prohibit) the development of new thermal-based generating plants including natural gas plants.

[Cost/benefit analysis results under development]

³³ The 2016 CAPP Report projected that an out-of-basin renewable energy investment would provide an annual return of four percent on the capital investment.

Chapter 10 APM No. 4 – Equipment/Efficiency Upgrades

Overview/General Information

As was highlighted in Chapter 2.1, the water delivery and return systems that were developed by Reclamation and irrigation districts in the Klamath Project were specifically designed around low-cost supplies of power. This is due primarily to local geography and especially since the Project has a relatively large amount of drainage related pumping load as compared to other similarly situated Reclamation projects located in the Pacific Northwest region. In addition, Off-Project covered water users located in the Upper Klamath Basin, and some On-Project users as well, rely upon deep well pumping in order to irrigate their crops, which is also an energy intensive operation.

Given the large amount of irrigation pumping loads in the Klamath Basin and the associated onfarm water delivery equipment (such as irrigation pivot sprinklers), opportunities exist in the Basin to upgrade and/or replace existing water delivery components to utilize more energy efficient equipment and thereby reduce overall irrigation electricity consumption. In addition, energy efficiency and equipment improvements are specifically referenced in the AWIA as a potential mechanism to reduce power costs in the Basin.³⁴

Potential Benefits

In 2014, Reclamation conducted pump efficiency and energy consumption testing on several of the Reserved and Transferred Works ("R&T Works") facilities and private pumps to assess general equipment conditions and to undertake specific efficiency testing. The testing found that annual energy consumption could be reduced at many R&T Works facilities and private pumps through pump and motor upgrades and reoperation. In addition, improvements to existing equipment could leverage funds available through current PacifiCorp and Energy Trust of Oregon ("Energy Trust") energy efficiency programs in Oregon.

General benefits to water users in the Upper Klamath Basin of implementing irrigation system energy efficiency improvements in the On-Project and Off-Project portions of the Basin include the following:

- Irrigation districts and individual on-farm water users can voluntarily choose to reduce their power costs by making cost-effective investments in more energy-efficient equipment (which results in directly reducing overall electricity usage).
- Expected power cost savings and the associated payback period can reasonably be determined at the time of the energy efficiency investment.

³⁴ <u>https://www.congress.gov/115/bills/s3021/BILLS-115s3021enr.pdf</u>

Several organizations, including Reclamation, have existing programs to assist agricultural water users: 1) identify equipment to potentially be upgraded/replaced, 2) perform cost/benefit analyses, and in some cases 3) provide financial assistance/grants to help defray some of the customer's up-front investment costs. Several of the organizations that provide these types of services to agricultural water users are listed in Appendix C.

Potential Challenges

The main constraint associated with efficiency and equipment improvements on the irrigation systems located in the Upper Klamath Basin is funding. Replacing or upgrading older, inefficient irrigation-related equipment usually requires a significant up-front investment with the associated benefits accruing back to the investor over a fairly long period of time. In addition, it is likely that some covered water users in the Basin have more opportunities available (for various reasons) to make cost-effective investments in energy efficiency than other users. Also, some funding programs that are available to assist water users in reducing their up-front energy efficiency investment costs have been established on the state level; therefore, some of the potential funding sources available to covered users located in the Oregon portion of the Basin are not available to users located in California.

Anticipated Net Power Cost Savings

Potential gross cost savings for power use associated with energy efficiency upgrades are primarily a function of: 1) the efficiency differential between the new equipment and the old equipment to be replaced, 2) how often the equipment is expected to be operated, and 3) the estimated future cost of electricity. In general, efficiency improvements provide an excellent opportunity to reduce power costs if the currently installed equipment is of an older vintage.

In the Upper Klamath Basin, strategic equipment replacements could be undertaken to assist in maximizing energy savings at private pumps and select R&T Works facilities. The field testing performed by Reclamation in 2014 found that annual energy consumption could be reduced by 9 to 30 percent at R&T Works facilities and 12 to 30 percent at private pumping facilities through pump upgrades and reoperation (e.g., operating a more efficient pump more frequently than a less efficient pump).

[Cost/benefit analysis results under development]

Funding, in the form of incentives provided through the Energy Trust of Oregon, could be leveraged to help reduce the up-front expenses associated with implementing energy efficiency improvements in the Oregon portion of the Klamath Basin. Currently, Energy Trust offers PacifiCorp customers in Oregon rebates on irrigation equipment and incentives for pump and irrigation system upgrades, as shown in Table 10-1 below.

Table 10-1. Energy Trust Energy Efficiency Incentives for OR PacifiCorp Customers

Туре	Incentive ¹		
Cash incentives for	Linear and pivot improvement: \$5 per low-pressure regulator \$4 per rotating-type sprinkler that replaces an impact sprinkler \$2.75 per sprinkler for new multiple configuration nozzles Wheel and hand-line improvement: \$10 per section of cut and pipe press repair of leaking pipes \$3.75 per flow controlling type nozzle for impact sprinklers \$2.00 per new gasket, including mainline valve gaskets and mainline section gaskets		
<u>.</u>	Up to 40 percent savings for drip irrigation system conversion		
Custom cash incentives	Up to 50 percent energy savings for existing pump or linear/pivot system conversions		
Scientific irrigation scheduling	\$3.22 per irrigated acre, up to 100 percent of the cost of the service and/or equipment for as many as three years.2		
1 Values listed in this table are subject to change throughout the year. Visit the Energy Trust website3 (<u>https://www.energytrust.org/solutions/agriculture-irrigation-improvements/)</u> for the full list of the most up-to-date offers.			

2 Incentive is paid at the end of the growing season.

Chapter 11 APM No. 5 – Time-of-Use Power Rates

Overview/General Information

Currently in the Pacific Northwest region, the majority of retail electricity customers – including most of the irrigation loads located in the Upper Klamath Basin – receive service under utility rate tariffs whereby the customer pays a constant rate for the electricity they consume no matter when they use the power during a monthly billing cycle. However, some utilities (including PacifiCorp on a limited pilot program basis) offer alternative rate tariffs whereby customers have the opportunity to reduce their overall power purchase costs by proactively modifying their electricity usage patterns.

Time-of-Use power rates are one such class of electric utility rate tariffs whereby end-use retail customers can self-manage a portion of their overall power costs by shifting their electricity usage patterns off of the utility's highest peak load periods (when the value of wholesale power is generally highest) and into periods when the utility's loads are lower such as during the night (when the value of wholesale power is generally lowest). The concept behind Time-of-Use rates is that by providing retail customers with "price signals" regarding the real-time value of electricity in the regional wholesale markets, customers can voluntarily choose to adjust their electricity usage patterns to the benefit of both the utility and the customer.³⁵

PacifiCorp has implemented Pilot Time-of-Use Service programs that are available to a limited group of its irrigation customers located both in Oregon and California.³⁶ In Oregon the Time-of-Use rate tariff is referred to as Schedule 215 and in California the Time-of-Use tariff is Schedule PA-115. Currently, participation in both pilot programs has been limited by PacifiCorp to a small number of irrigation customers (100 in Oregon and 25 in California), however PacifiCorp has expressed a willingness to make both the Oregon and California time-of-use programs more widely available in the future.³⁷

PacifiCorp's Oregon and California Pilot Time-of-Service rate tariffs are very similar, with the primary difference being the specific rate surcharges and discounts relative to the base energy rates specified in PacifiCorp's standard irrigation tariffs (which are Schedule 41 in Oregon and

³⁵ High wholesale power prices tend to occur during power system "stress events" such as a summer heat wave or a major transmission outage, both of which could lead to shortage conditions and potential load curtailments. ³⁶ "Pilot" rate programs are typically newly developed rate tariffs where a utility desires to gather additional information before implementing the tariff on a long-term basis. Many pilot programs are also developed in conjunction with customer groups and other stakeholders. It is also common for the utility to limit participation in pilot rate programs to gain actual experience with a small group of customers before making the program more widely available.

³⁷ Any expansions of the PacifiCorp Pilot Time-of-Use programs that are currently in effect will be subject to the approval of the Oregon and California rate commissions.

Schedule PA-20 in California). Key characteristics of the Pilot Time-of-Service programs are as follows:

- Both the Oregon and California programs are in effect during the "Prime Summer Season", which is defined as the period running from June 1 through August 31. During the Prime Summer Season, energy charge adjustments are applied to the base energy charges specified in Schedule 41 (Oregon) and PA-20 (California). No energy charge adjustments are applied outside of the Prime Season.
- On-Peak Periods are defined under both programs to be Monday through Friday 2:00 PM to 6:00 PM. Off-Peak Periods are all other days and hours including Independence Day.
- During the Prime Summer Season, the following price adjustments are applied to the Schedule 41 (Oregon) and Schedule PA-20 (California) base energy charges:

Oregon

On-Peak Period Energy Charge Adjustment = +22.313 cents/kWh

Off-Peak Period Energy Charge Adjustment = (3.161) cents/kWh

<u>California</u>

On-Peak Period Energy Charge Adjustment = +30.022 cents/kWh

Off-Peak Period Energy Charge Adjustment = (4.254) cents/kWh

- There are no price adjustments applied to the base Schedule 41 or Schedule PA-20 energy rates outside of the Prime Summer Season.
- During the first Prime Summer Season that a customer participates in either Pilot, if the customer's overall total cost across that Prime Summer Season exceeds 10% of what the customer's total power costs would have been under the base Schedule 41 or Schedule PA-20 rates, PacifiCorp will credit the difference back to the customer.
- Participation in either Pilot is voluntary. However, once a customer commits to participate in the Pilot, they are required to participate through the end of the next Prime Summer Season.

Potential Benefits

PacifiCorp's Pilot Time-of-Use rate tariffs provide individual irrigation customers located in both Oregon and California the opportunity to reduce their power costs during the three-month Prime Summer Season by shifting some, or perhaps all, of their electricity consumption off of the designated On-Peak Hours. One key benefit of these Pilot programs is that PacifiCorp has pre-determined the exact days and hours that are designated as On-Peak Hours; this feature allows customers to plan their individual pumping schedules and associated power usage well in advance. In addition, the exact price impacts of a customer shifting their power usage off of the On-Peak Hours are known in advance as well since the Pilot Programs' price adjustments are predetermined, fixed values. This feature allows customers to perform their own cost/benefit analyses and make proactive decisions regarding their electricity usage based upon real-time weather and crop conditions.

Potential Challenges

While PacifiCorp's Pilot Time-of-Use tariffs provide an opportunity for irrigation customers to reduce their power costs, <u>such reductions are not guaranteed</u>. In fact, customer's monthly power bills during the three-month Prime Summer Season can actually *be higher* than what they would have been had the customer taken service under PacifiCorp's standard Schedule 41 (in Oregon) and Schedule PA-20 (in California) rate tariffs. For customers to be able to reduce their power costs under the Pilot programs, they must be able to modify their irrigation/water use practices in order to successfully shift a portion of their electricity usage from the designated On-Peak Hours to Off-Peak Hours.

For customers who successfully shift a portion of their electricity usage off of the On-Peak Hours for the majority of the days in a month, those savings can quickly be "undone" if they fail to shift consumption on only a couple of other days within that same month. In other words, there is a relatively large dollar penalty for power usage during the designated "On-Peak" Hours on any given On-Peak Day (i.e. Monday – Friday). In addition, under the Pilot programs, customers are required to remain participants in the program through the end of their first Prime Summer Season (although PacifiCorp does cap the amount of the customer's power cost increase at 10%).

It is important to recognize that water users or districts located in the lower parts of the Klamath Project could be negatively impacted by the shifting of pumping operations occurring in the upper parts of the Project. Large-scale Time-of-Use programs have the potential to disrupt water deliveries in the Klamath Irrigation District and the Tulelake Irrigation District to an unknown degree, and to result in increased operational spills that increase the need for pumping (primarily at D Plant) and attendant power costs.

Anticipated Net Power Cost Savings

The power cost savings that can be achieved under PacifiCorp's Oregon and California Pilot Time-of-Use irrigation tariffs are solely a function of how much electricity consumption individual participating customers can successfully shift off of the designated On-Peak Hours during the Prime Summer Season. However, as was previously described in Chapter 11.3, customers' power costs could actually increase (relative to the base Schedule 41 and Schedule PA-20 costs) if the customer fails to shift enough of their consumption off of the On-Peak Hours.

Table 11-1 summarizes the overall monthly power cost reductions and increases for an Oregon irrigation customer who shifts differing amounts of their electricity consumption off of the On-Peak Hours during the three-month Prime Summer Season.

Table 11-1. Monthly Power Costs Reductions/Increases During the Prime Summer Season Oregon Pilot Time-of-Use Irrigation Customers

Amount of Customer's On-Peak Hour Energy Usage Shift (Percent)	Increase/(Reduction) in Customer's PacifiCorp Energy Charges (Percent)
0	+14.8
20	+4.9
40	(5.1)
60	(15.1)
80	(25.1)
100	(35.1)

Note: The figures shown in Table 11-1 represent the percentage increase or reduction in the total monthly energy charges accessed by PacifiCorp to a participating Oregon irrigation customer.

Table 11-2 summarizes the overall monthly power cost reductions and increases for a California irrigation customer who shifts differing amounts of their electricity consumption off of the On-Peak Hours during the three-month Prime Summer Season.

Table 11-2. Monthly Power Costs Reductions/Increases During the Prime Summer Season California Pilot Time-of-Use Irrigation Customers

	Amount of Customer's On-Peak Hour Energy Usage Shift (Percent)	Increase/(Reduction) in Customer's PacifiCorp Energy Charges (Percent)
0		+14.2
20		+4.7
40		(4.9)
60		(14.5)
80		(24.0)
100		(33.6)

Note: The figures shown in Table 11-2 represent the percentage increase or reduction in the total monthly energy charges accessed by PacifiCorp to a participating California irrigation customer.

Chapter 12 APM No. 6 – Irrigation Load Control Programs

Overview/General Information

The majority of the power that is provided to customers by electric utilities in the Pacific Northwest region is delivered on a so-called "firm" basis; that is the customer determines when and how much electricity they want to consume and the utility strives to deliver that amount. However, under some system conditions - for example when overall customer demand for power is at its peak level - it may be more cost-efficient for the utility to reduce its deliveries of electricity to end-use customers rather than attempt to acquire additional power supplies (either by purchasing power in the short-term wholesale markets or potentially constructing new generating plants in the long-term).

One form of rate tariff that allows utilities to reduce their electric loads during time of system stress are referred to as "Demand Response" or "Load Control" programs.³⁸ As the names suggest, Load Control programs allow utilities to keep their total load and total resources in balance by adjusting the load side – as opposed to the generation side - of the equation. Since Load Control programs are primarily designed to help utilities meet their peak load demand, implementing such programs on a large-scale may negate the need for utilities to construct expensive new generating plants that may only need to be operated for a limited number of hours each year.

PacifiCorp has implemented an Irrigation Pilot Load Control Program that is available to its irrigation customers located in Oregon under Rate Schedule 105. In July, 2019, PacifiCorp announced that it was extending and expanding this Pilot Program to, among other things, offer the Program to a broader set of customers including customers located outside of the Upper Klamath Basin. PacifiCorp also announced that it was modifying the Pilot to incorporate higher potential incentive payments to customers and its intent to automate portions of the Program for larger loads.³⁹

PacifiCorp's Load Control Pilot Program differs from its Pilot Time-of-Use Programs (which were previously described in Chapter 11.0) in that the days and times that customers may be asked to reduce their electricity consumption are not pre-determined, but rather PacifiCorp will make load reduction requests to its participating customers on either a day-ahead or hour-ahead basis. So, while the overall goal of both Pilot Programs is similar - to reduce electricity demand during periods of electric system stress – the two Pilots attempt to achieve this through different means. In particular, the Load Control Pilot attempts to leverage situations where irrigation water

³⁸ Another rate program that allows utilities to curtail electricity deliveries to certain classes of customers are referred to as "Interruptible Tariffs".

³⁹ See Advice No. 19-008, <u>Irrigation Load Control Program Pilot Expansion</u>, PacifiCorp filing with the Public Utility Commission of Oregon dated July 22, 2019.

users have real-time flexibility to modify their pumping operations, with the power-related benefits of this flexibility being shared between the customer and PacifiCorp.

Key characteristics of the PacifiCorp's Oregon Pilot Load Control Program are as follows:

- The period of time that the Pilot Program is in effect runs from the week including June 1 through the week including August 15. There is also a "Voluntary Period" that runs from August 15 to September 30.
- The Program hours are defined as all Weekdays, 12:00 PM to 8:00 PM Pacific Time.
- Incentive payments for load curtailments made by PacifiCorp on a day-ahead basis are \$18/kW per year.⁴⁰ Incentive payments for load curtailments made by PacifiCorp on an hour-ahead basis are \$30/kW per year.
- PacifiCorp can request load curtailments on a maximum of 52 hours per year. PacifiCorp is also limited to requesting a maximum of 20 curtailment events per year, with each event being no longer than 4 hours in duration.
- Participants in the Pilot may opt-out of curtailment requests issued by PacifiCorp; however, opting out will lower the participants' incentive payments on a proportional basis.

Potential Benefits

Individual irrigation customers' overall net power costs can be moderately reduced under the Pilot Program by allowing PacifiCorp to curtail their electricity usage on short notice in exchange for receiving incentive payments from PacifiCorp. Key benefits of this Pilot Program are:

- There is no penalty to the customer if the customer is unable to comply with a curtailment request from PacifiCorp. The customer receives incentive payments from PacifiCorp based upon the actual amount of power usage curtailment that it is able to provide.
- The greater the customer's ability to accept power curtailment notices from PacifiCorp, the higher the dollar payments that it receives.
- Customers that can curtail electricity usage on an hour-ahead (as opposed to a day-ahead basis) receive additional incentive payments from PacifiCorp.
- A customer's participation in the Pilot Program is voluntary.
- Customers can opt out of the Pilot Program (subject to notice requirements).

⁴⁰ For customers that participated in the Pilot Program in 2018 and for new participants in 2019 that participated prior to the Oregon Commission approving PacifiCorp's July 22, 2019 Pilot Expansion Proposal, the day-ahead incentive payment was \$23/kW per year.

Potential Challenges

In order for irrigation customers to reduce their power costs under PacifiCorp's Pilot Load Control Program, customers must have a moderate to significant amount of short-term flexibility regarding their pumping operations. For some customers, this may entail having some level of water storage available, or alternatively, the ability to "make up" pumping (or sprinkler) operations in the hours following a load curtailment event.

A key provision of the Pilot Program is that the exact days and hours that PacifiCorp can call for a load reduction is not pre-determined; rather PacifiCorp will make this determination based upon a variety of factors that are outside of the customer's control. To benefit from the Pilot, and especially to receive the higher hour-ahead curtailment incentive payments, customers may incur costs associated with having personnel available on short notice to shut down/restart water delivery equipment. It is also possible that customers could endure crop-related losses if curtailments occur during particularly sensitive time periods (although customers do have the ability to opt-out of the curtailment events).

As was the case under PacifiCorp's Pilot Time-of-Use program (APM No. 5), water users located in the lower parts of the Klamath Project could be negatively impacted by the shifting of pumping operations occurring in the upper parts of the Project. Large-scale load curtailments have the potential to disrupt water deliveries in the Klamath Irrigation District and the Tulelake Irrigation District to an unknown degree.

Anticipated Net Power Cost Savings

Power cost savings available to customers who choose to take service under PacifiCorp's Irrigation Pilot Load Control Program, as compared to taking service under the standard Schedule 41 rates, are primarily a function of four key factors: 1) the size of the associated pumping equipment, 2) how often PacifiCorp issues load curtailment requests, 2) how often the customer opts out of load curtailment requests, and 3) whether or not the customer can respond to load curtailment requests on an hour-ahead as opposed to a day-ahead basis.

Table 12-1 illustrates the maximum power cost savings that an irrigation customer could receive – in the form of a one-time annual incentive payment received from PacifiCorp - under the Pilot Program given several different assumptions.

Table 12-1. Irrigation Customer Annual Power Cost Savings Under the Pilot Program

Example Load	Day-Ahead Curtailment Maximum Annual Incentive Payment (\$)	Hour-Ahead Curtailment Maximum Annual Incentive Payment (\$)
10 HP Pump	135	225
50 HP Pump	675	1,125
100 HP Pump	1,350	2,250

Chapter 13 APM No. 7 – Small Hydroelectric Generation Plant Development

Overview/General Information

The incorporation of hydroelectric generation into Reclamation irrigation projects located in the Pacific Northwest region is not a new or novel idea. In fact, in the Power Cost Benchmark analysis that accompanies this APM Report, all five of the Reclamation projects that were identified as being "Similar Projects" to the Klamath Project currently receive, and have for many years received, power produced at Federally-owned hydro plants that were developed as part of these projects' irrigation water delivery infrastructure.⁴¹ However, largely due to the long-term power purchase agreements that were in place between Reclamation/Basin covered users and PacifiCorp between 1917 and 2006, Reclamation never developed any hydro generating facilities on the Klamath Project.

Smaller/low-head hydro generating plants can often be installed on existing water features including small dams, canals, irrigation drops, and even run-of-river from small diversions. Several potential sites for low-head hydro plants have been identified in the Oregon portion of the Upper Klamath Basin including PacifiCorp's Keno Dam, the Eastside and Westside Powerhouses, and several irrigation canals and conduits.

The CAPP Report identified and evaluated the potential installation of small hydro generation at six sites located on the Klamath Project, ranging in size from 300 kW to 3.8 MW. Of the six sites, the CAPP concluded that the installation of a 3.8 MW hydropower facility at Keno Dam appeared to be the most economically feasible alternative, in part due to the year-round flows available at this particular site. The CAPP Report did not identify any low-head hydro plant development sites in the California area of the Klamath Basin.⁴²

In reviewing potential small hydro plant development in the Upper Klamath Basin, the APM Analysis Team noted that several companies are currently in various stages of developing new technologies for small hydro facilities (i.e. roughly in the 100 kW to 5,000 kW range) that may result in lower overall construction and life-cycle costs than traditional technologies that typically involve significant civil construction works. Some of these technologies are designed specifically to be installed at diversion structures in existing water canals with minimal footprints. For example, facilities utilizing a siphon design can be installed at existing check structures essentially in-line with the existing canal. An example of an early prototype facility

⁴¹ In addition, irrigation districts in some of the five Similar Projects have also constructed hydro generating plants that utilize the irrigation water delivery infrastructure that was originally developed by Reclamation.

⁴² It should be noted that hydro generating facilities that incorporate newer "in-line" technical designs may be capable of feasibly producing power at low-head sites where conventionally-designed hydro plants cannot. Therefore, it is possible that some small scale (sub-MW), on-farm hydro power generation capability may exist for sites located in the California portion of the Basin where adequate flow and head conditions prevail, preferably year-around to reduce the payback period.

that is currently in operation is Emrgy's hydrokinetic turbine plant, a series of ten each 10 kW machines located on a water supply canal operated by Denver Water near Golden, Colorado. The system generates enough electricity to supply approximately 7 homes a year.

Potential Benefits

The ability to generate power regardless of the time of day makes hydropower especially beneficial to power users and electric utilities. Notably, the seven months of the year when water is typically available in most Klamath Project irrigation canals and conduits encompasses the summer irrigation season which coincides with higher overall power demand in the Basin due to agricultural pumping operations. In the Lower Klamath region, winter season gravity diversion occurs; winter / early spring drainage pumping can be significant in that and other areas.

As part of the APM Analysis, the Team reviewed, evaluated, and updated several aspects of the work previously performed under the CAPP regarding potential small hydro development sites on the Klamath Project. The Team concluded that the Keno Dam site remains the preferred alternative for On-Project hydro generation development, due largely to the year-round flows available at the particular site which result in an annual generation capacity factor of approximately 82.5%. This is in comparison to capacity factors ranging from 20% to 85% for the other alternatives considered in the CAPP. The Team therefore selected hydropower generation development at Keno Dam to be the preferred alternative under this APM although other sites may be cost-effective as well.

There are multiple alternatives regarding the potential disposition of the energy and capacity to be generated by a new small hydro facility at Keno Dam and/or at other sites located on the Project. In addition, there are also several mechanisms by which water users receive the associated benefits. This topic is discussed in more detail in Chapter 13.4.

The installation of low-head hydro at existing facilities such as Keno Dam could tie into existing distribution lines, potentially lowering interconnection costs. Overall project costs could be reduced by using and refurbishing existing facilities (Eastside and Westside powerhouses). In addition, certain hydropower projects can seek an exemption from Federal Energy Regulatory Commission ("FERC") licensing requirements. Exemptions are available if a generating facility is under 10 MW and built at an existing dam, or is under 40 MW and constructed on an existing conduit primarily to serve purposes other than power production, such as irrigation.⁴³ FERC, however, does not have jurisdiction over Federally-owned hydropower projects.

Potential Challenges

Potential barriers to development of low-head hydro in the Klamath Basin include capacity size limitations due to geography, limited generation potential due to seasonal versus year-round flows, transmission of generated power, and environmental impacts. Current regulatory policies

⁴³ All of the sites identified on the Klamath Project to date for potential hydro development would result in generating facilities smaller than 10 MW.

in both states limit the maximum generating capacity of renewable energy facility to no more than 80,000 kilowatts (kW) in order to be considered as a Qualifying Facility. To be considered as a Qualifying Facility, a hydropower facility requiring a new diversion must demonstrate that there is no adverse effect on the environment, including recreation and water quality, pursuant to Title 18 of the Code of Federal Regulations (CFR) §292.208.

New hydro generation facilities in the Klamath Basin must be interconnected to new or existing distribution or transmission lines. In general, interconnection costs depend on the project size and the length of the required interconnection line. These costs could make a project infeasible as the locations of many low-head hydro projects are often remote from loads, requiring longer transmission and distribution lines to connect to the local utility's power grid.

Generation development at Keno Dam and Eastside and Westside powerhouses would require consultation with the United States Fish and Wildlife Service and the National Marine Fisheries Service over Endangered Species Act-listed suckers and coho salmon. Also, future operations and the durability of low-head hydro development at these sites could be affected by changes to the existing biological opinions and the potential for anadromous fish passage following the removal of PacifiCorp's existing dams located on the Klamath River downstream of the Project.

In addition, water is typically available in many canals and conduits for only seven months out of the year, which acts to increase the cost per kilowatt-hour (kWh) generated and making it more difficult to recapture the initial capital costs. This limitation would not apply to Keno and Eastside/Westside.

Anticipated Net Power Cost Savings

Power cost savings from the potential development of small hydro generating plants in the Basin would likely flow directly to either Reclamation or to the irrigation districts who, in turn, could pass the dollar savings on to On-Project covered water users in the form of lower water delivery/O&M charges. Potential power cost savings are primarily a function of the development and operating costs of the new hydro facilities versus the benefit of either displacing a portion of a water customer's power purchase costs from PacifiCorp and/or selling the generation output and using the net revenues received to offset their PacifiCorp power purchase costs.

Estimated Costs for New Hydroelectric Generating Plant Development

Capital development costs for generic, small hydroelectric generating plants are available from several different publicly-available sources. In practice, however, the real-life capital costs associated with the development of small/low-head hydro plants can vary across a wide range depending upon multiple site-specific characteristics and the specific technologies to be employed. In addition, non-construction and equipment-related costs such as electric system interconnection costs, land costs, and environmental permitting are more difficult to quantify on a generic basis.

The *Capital Cost Review of Power Generation Technologies* (Western Electric Coordinating Council) provides reviews of several technologies and is often cited to compare potential renewable power projects. From the 2014 version of this report, which was utilized in the CAPP analysis to evaluate the feasibility of small hydro plant development in the Klamath Project, the

recommended capital development cost for small hydroelectric plants (unpowered dam, run-ofriver plants at 26 MW or smaller with no major dam or diversion work) was \$4,000/kW. The CAPP Study noted that development costs did not include the cost of interconnection, environmental permitting, or land costs.

In comparison, the Regional Hydropower Potential Scoping Study, which was prepared by the Northwest Hydroelectric Association and released in November 2014 estimated the capital costs of 13 new small northwest region hydroelectric generating plants with a benefit/cost ratio greater than 0.75 in the range of \$1,889 to \$5,075 per kW. The study cites that an average cost of \$3,500 per kW installed is a representative cost figure for benchmarking new hydropower development on unpowered dams. In addition to capital costs, the study provided a range of operating costs for new 28 different units at unpowered dams. The average annual operating costs is 3% of the capital cost for these units.

In addition to unpowered dam hydro development, the Team also surveyed available literature and interviewed several developers who offer in conduit technologies such as hydrokinetic systems to assess potential capital costs for this option. The Regional Hydropower Potential Scoping Study (Northwest Hydroelectric Association) cites an average cost range for in-conduit systems between \$4,000 and \$7,000 per kW. This figure is highly dependent on system configurations, existing infrastructure in place and the extent of civil engineering and development required for installation. The unit output of in-conduit units is generally considerably smaller than the generation capacity of units studied at the unpowered dams, making it more difficult to cost effectively generate energy at scale. These in-conduit units lend themselves primarily to local load servicing, running behind the meter.

Given the capital costs for mid-sized hydroelectric plants installed on unpowered dams average around \$3,500 per kW with an annual operations budget of around 3% of capital costs, the economic payback for plants is often built on an extended payback period – as long as 50 years for units in the 10 -30 MW range. If the power output from the hydro facility is sold to a third party in order to create a long-term revenue stream, the plant's developer would likely need to enter into a long-term power sales agreement of similar length with the purchaser in order to secure financing for the project.

Estimated Value of Power from a New Hydroelectric Generating Plant

There are several different mechanisms by which long-term revenue streams can be created from one or more low head hydro generating facilities to potentially be developed on the Klamath Project. In addition, the exact size and location of the hydro facilities are both key factors in order to maximize net benefits associated with the plants' generation output. For example, plants whose primary function is to help lower Reclamation's own Klamath Project pumping costs may likely be located in different locations than plants whose primary purpose is to maximize net revenues under a wholesale power sales agreement. Several different potential mechanisms by which the output of one or more small hydro generating plants can be monetized are summarized below:

Federal Project-use Power Supply for the Klamath Project

A new hydro generating facility at Keno Dam (and/or potentially at other locations within the Klamath Project) could be incorporated into a newly formed Federal Project-Use Power supply for the Klamath Project. This topic is discussed in more detail in Chapter 14.1. Also, as is described in detail in the accompanying PCB Report, all five of the Reclamation projects that were identified as being Similarly Projects to the Klamath Project have access to Federal Project-use Power for the purpose of operating pumping and/or drainage facilities that are part of the Projects' water delivery infrastructure.

Since power production is an authorized purpose of the Klamath Project, Reclamation has the ability to develop new sources of hydroelectric generation located at one or more points within the Project's boundaries. It should be noted that when the Project was originally being conceived and developed, Reclamation chose to purchase power from PacifiCorp under a 50-year agreement rather than develop its own power generation facilities to be located on the Project.

Sale to PacifiCorp under a Negotiated Rate

Power generated at Keno Dam or other hydro plants to be developed within the Klamath Project could be sold to PacifiCorp through a long-term power purchase agreement at negotiated rates. Such negotiated rates would, presumably, incorporate: 1) the full energy and capacity value of the generation produced at Keno Dam/other sites including potential locational benefits, and 2) the full value of the environmental attributes - such as renewable energy credits - associated with hydropower generation.

Sale to PacifiCorp under Avoided Cost Rates

Power generated at Keno Dam and/or other hydro plants could be sold to PacifiCorp through a standard-form power purchase agreement at PacifiCorp's avoided cost rates. PacifiCorp's 2015 avoided cost rates were 2.19 ¢/kWh and 2.77 ¢/kWh for off-peak and on-peak power deliveries, respectively. On-peak hours are Monday through Saturday from 6:00 am to 10:00 pm, excluding North American Electric Reliability Corporation (NERC) holidays, and off-peak hours are all other hours. It should be noted that PacifiCorp's standard avoided cost rates: 1) do not reflect the firm capacity value associated with generation at Keno Dam and potentially at other sites as well, and 2) do not fully value the environmental attributes of hydropower generation.

Sale to other Pacific Northwest Utilities under a Negotiated Rate

Although a generating plant located at Keno Dam and/or other sites on the Klamath Project would interconnect with PacifiCorp transmission/distribution facilities, power generated at the dam(s) could possibly be sold to other Pacific Northwest regional utilities through a long-term purchased power agreement at negotiated rates. Such negotiated rates would, presumably, incorporate: 1) the full energy and capacity value of the generation produced at Keno Dam/other sites including potential locational benefits, and 2) the full value of environmental attributes associated with hydropower generation.

Sales to utilities other than PacifiCorp, however, would be subject to additional transmission (and possibly distribution) costs associated with the wheeling of power across PacifiCorp's system to the purchasing utility. These additional delivery-related costs would need to be

recovered through a higher sales price to the purchaser than what could be received by selling the power directly to PacifiCorp.

Sale to other PNW Utilities under Avoided Cost Rate(s)

Power generated at Keno Dam/other sites could be sold to Pacific Northwest utilities other than PacifiCorp through a standard-form purchase power agreement at the purchasing utility's avoided cost rate. Since different electric utilities have established different sets of avoided cost rates, selling power to a utility other than PacifiCorp could result in a higher sales price. However, higher prices received from sales to other utilities may be partially, or even fully, offset by the additional transmission (and possibly distribution) costs associated with wheeling of power across PacifiCorp's system to the purchasing utility. In addition, other Pacific Northwest utilities' standard avoided cost rates: 1) may not reflect the firm capacity value associated with generation at Keno Dam/other sites, and 2) may not fully value the environmental attributes of hydropower generation.

Net Cost/Benefit Summary for Small Hydroelectric Plants

[Cost/benefit analysis results under development]

Chapter 14 APM No. 8 Purchases of Federal Power

Overview/General Information

As was discussed in Chapter 3.0, when the Klamath Project was originally being developed in the early 1900's, Reclamation entered into a long-term power purchase arrangement with PacifiCorp whereby PacifiCorp provided the electricity needed by Reclamation and districts and water users to operate the Project at a negotiated rate in exchange for Reclamation allowing PacifiCorp to construct and operate Link River Dam. Later (in the 1950s) Reclamation effectively agreed to allow PacifiCorp to develop additional, valuable hydroelectric generation (J.C. Boyle, and later, Iron Gate) in exchange for continuation of a comparable negotiated rate. This arrangement was in contrast to many other irrigation projects that were being developed by Reclamation in the Pacific Northwest region around the same time whereby a portion of the electricity produced at dams being constructed by the Federal Government was dedicated to serving Reclamation's irrigation-related pumping loads.

Power produced at Federally-owned facilities in the Pacific Northwest region that is utilized by Reclamation at Reclamation projects is commonly referred to as "Project-use Power" or "Federal Reserved Power". In some cases, hydroelectric generating facilities were developed as part of Reclamation's irrigation projects; in these cases, the power produced at these dams is first utilized to serve Reclamation's own project-level pumping loads with any excess power being sold by the Bonneville Power Administration ("BPA") to other customers.⁴⁴ Typically, BPA sells Project-use Power to Reclamation "at cost", that is the cost of producing power at the specific set of facilities that are incorporated into that particular Project-use Power pool.⁴⁵ In addition, a limited number of irrigation districts located within Reclamation projects are also eligible to purchase Project-use Power in order to operate their own district-level pumps.

For Reclamation irrigation projects in the Pacific Northwest that do not have a dedicated pool of associated hydroelectric generating facilities, Reclamation can still purchase wholesale power from BPA to operate those projects under what is known as the PN rate. The PN rate is based upon the cost of owning and operating BPA's overall power resource portfolio, which consists primarily of hydroelectric generating facilities.⁴⁶ Historically, purchasing power from BPA at the PN rate has allowed Reclamation to operate its project-related pumping facilities at a lower overall cost than purchasing power from local electric utilities. Most of the publicly-owned electric utilities located in the Pacific Northwest region such as municipalities, public utility

⁴⁴ BPA is one of four Federally-owned Power Marketing Administrations that market wholesale power in the western portion of the United States. BPA markets wholesale power in the Pacific Northwest region to multiple different publicly-owned and tribally-owned utilities under cost-based rates. BPA also sells excess wholesale power supplies to multiple entities in the Northwest and California at market-based rates.

⁴⁵ For example, Reclamation's Boise, Minidoka, and Owyhee irrigation projects all purchase Project-use Power from BPA under what is referred to as the Southern Idaho Rate.

⁴⁶ BPA's overall power resource portfolio is commonly referred to as the Federal Columbia River Power System.
districts, and cooperatives, also purchase power from BPA under a similar cost-based rate referred to as the Priority Firm or PF rate.

Therefore, an opportunity may exist for Reclamation to reduce its power costs for operating the Klamath Project by replacing the power it currently purchases from PacifiCorp with a new wholesale power supply from BPA under either the existing PN rate or potentially under a new Project-use Power rate to be specifically established for the Klamath Project.⁴⁷

Potential Benefits

- On-Project covered water users could receive indirect benefits from Reclamation's purchase of Federal power via a reduction in water delivery charges to be assessed to the irrigation districts that serve these customers.
- Since the majority of Reclamation's power loads are located in Oregon, On-Project covered water users located in the California portion of the Klamath Project may still receive indirect benefits via lower water delivery rates being assessed by Reclamation to their local irrigation districts.
- Reclamation's purchase of Federal power from BPA at the PN Rate would not require the development of any new generating resources, either inside of or outside of the Upper Klamath Basin. PN Rate power would be supplied by BPA out of its existing resource portfolio.
- It is possible that new Federally-owned generating facilities could be developed in order to form a new Klamath Project-use Power portfolio that has a lower overall generating cost than the FCRPS. This would act to reduce Reclamation's overall power purchase costs to a greater degree as compared to it purchasing power from BPA under its standard PN Rate.

Potential Challenges

The primary challenges facing this APM are:

- The expected net benefit resulting from this APM are primarily a function of the differential between Reclamation's cost of purchasing power from a Federal supply versus purchasing an equivalent amount from PacifiCorp under its retail irrigation rate tariff(s). The costs for both of these power supply alternatives are subject to change across time.
- Although BPA has transmission facilities that run through the Upper Klamath Basin and are in relatively close proximity to some of Reclamation's irrigation pumping loads,

⁴⁷ It should be noted that even if Reclamation (and possibly some of the irrigation districts) were to purchase wholesale power from BPA, individual on-farm water users would still purchase their power supplies from PacifiCorp pursuant to PacifiCorp's retail rate tariffs in effect in Oregon and California.

absent the construction of new BPA and/or Reclamation-owned transmission/distribution lines, Federal power would need to be transmitted across PacifiCorp owned-lines in order to be delivered to Reclamation's loads. While the costs associated with wheeling Federal power across PacifiCorp' transmission system can presently be reasonably quantified, the additional costs associated with wheeling power across PacifiCorp's distribution facilities are not presently known.⁴⁸

- This APM could not be utilized by individual water users to replace the power they are currently purchasing from PacifiCorp with a new Federal and/or Project-use Power supply. On-Project covered users could still receive a benefit, however, in the form of lower water delivery charges from Reclamation and the local irrigation districts. However, it is not clear how Off-Project covered water-users could receive benefits under this APM.
- The creation of a new Klamath Project Project-use Power portfolio, consisting of a yetto-be determined pool of new generating resources, could involve a significant amount of time and effort on Reclamation's part.⁴⁹
- Federal power produced in the Pacific Northwest region probably could not be provided by BPA to water users located in the California portion of the Project, however, it may be possible for these users to receive Federal Klamath Project-use Power (likely from WAPA) from facilities developed within California.

Anticipated Net Power Cost Savings

The potential power cost savings associated with Reclamation, and potentially some of the irrigation districts in the Project as well, purchasing Federally-produced wholesale power from BPA are primarily a function of three key drivers: 1) the base cost of the wholesale power purchased from BPA, 2) the transmission and distribution costs associated with delivering Federal power to Reclamation's pumping loads in the Upper Klamath Basin, and 3) the estimated costs of Reclamation continuing to purchase power from PacifiCorp's under its retail irrigation rate tariffs.

[Cost/benefit analysis results under development]

⁴⁸ All of Reclamation's pumping loads located in the Klamath Project are presently interconnected to PacifiCorp's system at voltages of 2,300 volts or less. Therefore, some portion of PacifiCorp's lower-voltage distribution system would need to be utilized in order to deliver Federal power to Reclamation's loads.

⁴⁹ According to information provided by Reclamation and reviewed by the APM Analysis Team, power is an authorized use of the Klamath Project.

Chapter 15 APM No. 9 – Open-Access Power Purchases

Overview/General Information

Retail electricity customers located in Oregon have an option to purchase power from entities other than their local utility provider under what is generally referred to as "open access" programs. Irrigation customers served by PacifiCorp in Oregon can voluntarily elect to purchase power pursuant to PacifiCorp's existing Open Access Tariff which is Schedule 741. PacifiCorp currently does not have an open access program in place for irrigation customers located in California.

Under PacifiCorp's Schedule 741, customers choose their own third-party power supplier and PacifiCorp then transmits the power across its transmission and distribution facilities to the customer. Since it may be difficult for smaller power users to arrange a wholesale power supply on their own, entities known as "retail aggregators" often act as an intermediary in the open access process. Retail aggregators act to combine the power needs of a large group of individual end-use customers and then "shop around" the combined load pool to different wholesale power suppliers. In this fashion, small power users can often receive a lower price by being part of a larger "buying" pool. In addition, the aggregator handles many of the administrative functions needed to implement the wholesale power purchases for the entire load pool.

Potential Benefits

PacifiCorp's Schedule 741 allows end-use irrigation customers to replace the power supply component of PacifiCorp's fully-bundled retail rates (i.e. Schedule 41) with power supplies obtained by other regional suppliers. Depending upon prevailing wholesale power market conditions, the size and shape of the customer's load, and the length of time that the customer is willing to commit to an alternate power supply source, the customer may be able to moderately reduce their overall power costs by utilizing Schedule 741. As was previously mentioned, the customer can also choose to utilize the services of a retail aggregator, which may result in lower power supply costs to the customer through economies of scale.

Electing to take service under Schedule 714 is one of the APM alternatives that can be implemented both relatively quickly and with minimal startup costs (other than time and effort on the part of the customer to contact potential suppliers and/or retail aggregators). If irrigation customers arrange their power purchasers through a retail aggregator, the aggregator will perform many of the administrative functions required to effectuate the delivery of the wholesale power supply (on behalf the customer) to PacifiCorp.

Potential Challenges

An important feature of the Schedule 741 open access program is that it is not possible to bypass PacifiCorp's transmission and distribution charges; this remains the case whether or not a

customer arranges for their own wholesale power supply or utilizes the services of a retail aggregator. Therefore, the maximum savings that an end-use customer can receive under the open access program is the difference between PacifiCorp's own power supply cost as specified in Schedule 741 and the cost of acquiring power supplies on the open market from other entities.

Currently, Schedule 741's power supply component is between approximately 3.1 - 3.2 ¢/kWh. Therefore, an end-use customer would need to locate and acquire - either on their own or through a retail aggregator – power supplies from a non-PacifiCorp entity at a lower price in order reduce their overall power purchase costs. However, since customers cannot avoid paying PacifiCorp's transmission, distribution, and "base" power supply related costs - which make up approximately 65% of an irrigation customer's overall cost of power during the summer months - the maximum potential savings that customers can achieve by taking service under the open access program are considerably "squeezed down" into a fairly narrow range.

While end-use PacifiCorp irrigation customers have an opportunity to reduce their overall power costs by voluntarily taking service under Schedule 741, such savings are not guaranteed. In fact, depending upon the specific terms and conditions that apply to a customer's power purchase made from a non-PacifiCorp entity, the customer's overall total power costs could be higher than what they would have paid under PacifiCorp's standard Schedule 41 irrigation tariff. In addition, short-term wholesale power prices in the Pacific Northwest tend to be very volatile; customers therefore need to be aware that when they commit to a purchase at a specific price for a specified time period with a third-party power supplier or retail aggregator, there is no guarantee that the price will remain the same for a future purchase period.

Another potential challenge is that irrigation-related loads are very seasonal in nature and, in addition, can vary due to prevailing weather conditions. These load characteristics are somewhat unfavorable to potential alternative power suppliers who generally favor loads that are relatively constant across time. The seasonality and potential variability of irrigation loads will likely result in irrigation customers paying a higher rate for their power supplies from a third-party seller or aggregator as compared to customers that have steady loads throughout the year (for example a data center).

Customers that voluntarily choose to take service under Schedule 741 are required to enter into a written contract with PacifiCorp for a term of not less than three years. The ability of a customer to switch back to standard, fully bundled service (such as Schedule 41 for irrigation customers), and the timing of such change, would be subject to the specific terms and conditions contained in its contract with PacifiCorp.

Anticipated Net Power Cost Savings

As was highlighted in the previous chapters, it is important to stress that while use of PacifiCorp's Schedule 741 provides *an opportunity* for an end-use irrigation customer to lower their overall power costs, such savings *are not guaranteed*. In particular, short-term wholesale power prices in the Pacific Northwest region can be very volatile, especially during periods of high-power demand (which, unfortunately, can occur during the summer months when irrigation water use is also high). In the longer-term, wholesale power prices are driven by a variety of

factors such as natural gas prices, stream flows at regional hydroelectric plants, and Greenhouse Gas regulations that are difficult to predict and beyond the control of end-use customers.

The above factors act to create an additional degree of risk for end-use irrigation customers that choose to purchase their power supplies under Schedule 741 as compared to purchasing power from PacifiCorp at a known cost under Schedule 41. While some of these risks can reasonably be managed or reduced – for example by agreeing to purchase wholesale power from an alternate supplier at a fixed and known price across a pre-specified time period – other potential risks may be more difficult to mitigate. Helping to counteract these risks, however, is the ability of irrigation customers to return to receiving service from PacifiCorp under Schedule 41, subject to the timing provisions specified in their contracts with PacifiCorp.

Given current estimates of wholesale power prices in the Pacific Northwest region during Calendar Year 2020, there appears to be, at best, only a small differential between the market price for wholesale power supplies delivered to the Mid-Columbia ("Mid-C") and/or the California-Oregon Border ("COB") delivery points and the 3.1 - 3.2 ¢/kWh displaceable power supply cost that is incorporated into PacifiCorp's Schedule 741. The maximum near-term cost savings available to irrigation customers under Schedule 741 are forecasted to be only in the range of 4.0 - 5.0% of the customer's summer month power costs. Given these conditions, the opportunity to utilize this APM to create meaningful power cost reductions for water users in the Upper Klamath Basin appears to be extremely limited.⁵⁰

⁵⁰ It should be noted that power prices quoted by potential power suppliers and/or retail aggregators to individual irrigation customers are likely to be somewhat higher than wholesale market price quotes at the Mid-C and COB; these prices are referenced to fixed 25 MW blocks of wholesale power to be delivered across all 24 hours of the day, seven days a week. This condition further limits potential power cost savings under this APM, which are already projected to be quite low.

Chapter 16 APM No. 10 – PacifiCorp Irrigation Customer Cost-of-Service Evaluation

Overview/General Information

As has been previously described, the retail power rates that PacifiCorp charges to irrigation customers - including Reclamation - are subject to the jurisdiction of the Public Utility Commission of Oregon (for customers located in Oregon) and the California Public Utilities Commission (for customers located in California). When PacifiCorp proposes to make changes to its retail rates that are currently in effect, it generally does so through one of two regulatory processes; 1) filing a new General Rate Case, and 2) filing a new Power Cost Adjustment Case. These two rate-making processes are discussed in more detail in the following two Sub-chapters.

General Rate Cases

When PacifiCorp desires to make changes to one or more of its retail rates that are currently in effect and these changes involve issues other than just power supply-related costs, it will file what is referred to as a General Rate Case. General Rate Cases are usually complex processes that are broad in scope and entail large volumes of supporting documentation from the utility requesting the change in rates. General Rate Cases usually follow a very regimented process that allows for a considerable degree of public stakeholder involvement. Due to the complexity of these cases and the sheer volume of materials to be evaluated by the state rate commissions and stakeholders, it is common for General Rate Cases (including PacifiCorp's) to take up to approximately one year to complete.

General Rate Cases provide an opportunity for affected customers (or organizations that represent one or more groups of customers) to analyze and challenge the multiple inputs, assumptions, and calculations that impact the final sets of rates. Customers can also propose alternative approaches for consideration by the rate commissions that may result in lower rates than those proposed by the utility.⁵¹

General Rate Cases generally include what is referred to as a Cost-of-Service Analysis ("COSA"). In a COSA, the utility determines its cost to serve each of its individual rate classes, which usually includes an irrigation customer class. While some utility costs can be directly assigned to a particular customer class - for example a new substation constructed specifically to serve one or more new large industrial power users located in a specific area - many of a utility's

⁵¹ It is noted that for many decades water users in the Upper Klamath Basin had no interest or need in being active participants in PacifiCorp's retail rate tariff setting processes since they were purchasing power under a separate set of terms and conditions as specified in the 1917 and 1956 power purchase agreements. However, now that Reclamation, irrigation districts and covered water users in the Basin are all purchasing power from PacifiCorp under standard irrigation/drainage retail rate tariffs, these stakeholders now have a vested interest in working with PacifiCorp, the PUCs, and other stakeholders to ensure that PacifiCorp's rates are just and reasonable.

costs support multiple different customer classes (for example the costs associated with the utility's main office buildings and support staff).

A utility's shared costs are usually allocated among each of the individual customer classes using what is referred to as the "cost causation principle". Allocating these shared costs to individual customer classes – which ultimately feed into the individual retail rates – is an involved process that usually entails multiple different allocation mechanisms and assumptions. It is not uncommon for customers and/or other stakeholders to question the results of the utility's COSA in a General Rate Case and to present alternative sets of cost allocations and associated retail rates for consideration by the state rate commissions.

Due to the natural conflicts present between electric utilities who generally desire to increase retail rates, and customers/stakeholder groups who likely prefer rate decreases, many General Rate Cases are highly contested processes that are ultimately concluded through settlement agreements between the utility, stakeholders, and the state rate commission staffs. Once the state rate commission approves a settlement agreement, or in the absence of a settlement agreement comes to its own conclusions, a set of "Base Rates" are established for all retail customer classes. These Base Rates remain in effect until: 1) the utility files a new General Rate Case, and 2) the appropriate rate commission approves a new set of retail rates.

Power Cost Adjustment Cases

One of the major components of PacifiCorp's retail power rates in both Oregon and California is its cost of generating electricity from power plants that it owns and purchasing wholesale power supplies in the Pacific Northwest and California markets as needed to meet its overall load obligations. These power supply related costs are subject to multiple different factors that can cause these costs to be either higher than, or lower than, the assumed level of costs that were incorporated into the Base Rates established in its last approved General Rate Case filings.

The Power Cost Adjustment rate processes in place in Oregon and California allow PacifiCorp to pass through many "normal" variations in power supply costs to its retail customers on a regular basis without the utility having to file a General Rate Case (which usually is much broader in scope than a power cost adjustment process). In a Power Cost Adjustment process, many elements that would normally be subject to review in a General Rate Case are left unchanged. PacifiCorp's power cost adjustments are shown on retail customers' bills in both Oregon and California and, as previously mentioned, can either be an additional charge that acts to increase a customer's overall power costs.

Potential Benefits

PacifiCorp's last General Rate Case in Oregon took place in 2014 and in California there is currently an on-going 2019 Rate Case. Unlike the power cost adjustment cases that follow a regular, pre-defined schedule, there currently is no regular schedule for when PacifiCorp is required to file General Rate Cases in either state. In addition, if PacifiCorp's decides to file a new General Rate Case in one state, it does not necessarily have to file a new General Rate Case in the other state at the same time (although it could choose to do so).

In reviewing portions of PacifiCorp's last retail rate cases filed in Oregon and California, the APM Analysis Team believes that opportunities exist for stakeholders that have an interest in irrigation power rates - including Reclamation, irrigation districts, individual customers, and irrigation stakeholder groups - to actively participate in PacifiCorp's next set of General Rate Cases to attempt to reduce power costs to water users in the Upper Klamath Basin in several ways.

For example, many of PacifiCorp's general costs of doing business cannot be directly assigned to one or more specific customer groups – rather these costs are distributed across the different retail rates classes using multiple different allocation factors. In particular, Administrative and General costs and Operations and Maintenance costs are two large categories of PacifiCorp's costs that should be closely inspected in a General Rate Case setting to ensure that excess costs are not being allocated to PacifiCorp's irrigation rates as compared to its actual costs of providing power to water users located in the Upper Klamath Basin.

With regard to the allocation of PacifiCorp's transmission and distribution related costs, it should be noted that the California portion of the Basin has a relatively high concentration of irrigation loads as compared to PacifiCorp's other agricultural loads that are located within its northern California service territory (which tend to be more physically dispersed). Likewise, in Oregon, distribution infrastructure (and perhaps some transmission infrastructure as well) that PacifiCorp has developed for the purpose of serving end-use agricultural loads in areas located outside the Upper Klamath Basin is obviously not utilized to serve irrigation loads located within the Basin. These are examples of the types of items that Reclamation, stakeholder groups, and individual water users should consider carefully evaluating, and if appropriate make alternate cost allocation proposals, as part of PacifiCorp's future General Rate Case proceedings.

Therefore, an opportunity exists for Upper Klamath Basin stakeholders to work with PacifiCorp and the Oregon and California rate commissions in order to re-design irrigation retail rates to better reflect PacifiCorp's actual costs of providing electric service in the Basin. While the exact outcome of such actions in helping to reduce power costs in the Basin cannot be predicted at present due to multiple factors – including the willingness of the state rate commissions to support an irrigation rate re-design – there nevertheless appears to be limited downside for Reclamation and stakeholders in exploring such options.

Potential Challenges

There are few downsides to irrigation customers and/or stakeholder groups being more highly involved in PacifiCorp's rate setting processes with the primary investment costs being in the form of time and effort. Given the potential benefits in the form of reduced power rates for some, or perhaps all irrigation customers located in the Upper Klamath Basin, there appears to be minimal risk in being active participants in these processes.

One potential challenge to be navigated is the uncertain timing with regard to future PacifiCorp general retail rate cases in Oregon and California. While PacifiCorp's Power Cost Adjustment cases are filed pursuant to a predictable yearly schedule, General Rate Cases are not. Instead, General Rate Case processes are generally initiated at PacifiCorp's discretion and at irregular

intervals.⁵² Because the annual Power Cost Adjustment filings only address a pre-determined and limited set of the full universe of potential retail rate issues, irrigation customers and stakeholders may need to wait until PacifiCorp's next Oregon and/or California General Rate Cases proceedings in order to address certain topics of importance.

Also, irrigation customers and stakeholders should note that both of PacifiCorp's retail rate setting processes are conducted pursuant to very structured and formal regulatory requirements that have been established by the two rate commissions. It is therefore important that customers and stakeholder groups become familiar with each rate case's schedule and be prepared to attend open hearings on the indicated dates and/or submit written comments by the established deadlines. Failure to abide by the formal schedules established by the Commissions may result in lost opportunities for irrigation customers and stakeholders to present their positions and have their voices heard.

Anticipated Net Power Cost Savings

It is difficult at the present time to estimate the potential power cost savings associated with irrigation stakeholders located in the Upper Klamath Basin (including Reclamation, irrigation districts, water user groups and individual on-farm users) becoming more active participants in PacifiCorp's retail rate setting processes. In general, power cost savings may be achievable by working with PacifiCorp, the state rate commissions, and other stakeholders with the goal of modifying PacifiCorp's current Schedule 41 and Schedule PA-20 irrigation rate tariffs to incorporate some form of reduced charges. Such reductions might be achieved via the cost reallocation review process described above or by the Oregon or California rate commissions agreeing to establish PacifiCorp's irrigation rates at below cost-of-service levels as a matter of public policy that takes into account the importance of healthy agricultural communities to the public's overall well-being.

⁵² For example, PacifiCorp's last general rate case in Oregon took place in 2014.

Chapter 17 APM Implementation Summary

Overview

The ten APMs discussed in detail in Chapters 7.0-15.0 cover a broad range of potential mechanisms that can be implemented in order to help reduce power costs for water users in the Upper Klamath Basin. An important feature of this suite of cost-reduction measures is that many of the APMs can be implemented in a concurrent fashion or in different combinations that best fit the needs of individual water users. While it is true that some of the APMs may not be available and/or provide an equal level of benefits to all covered water users in the Basin, the APM Analysis Team attempted to identify and evaluate the APMs so that Reclamation, irrigation districts, and individual covered water users would all have multiple viable power cost alternatives available for consideration.

An important feature of the identified APMs is the question of who can actually implement the measures. For example, some of the APMs would either need to be, or could be, implemented by Reclamation, with the associated power cost reduction benefits flowing down to individual On-Project covered users via lower water delivery charges. In other cases, individual On-Project and Off-Project cover users could choose, on their own, to implement one or more APM's with the associated benefits accruing solely to themselves.

Table 17-1 summarizes the 10 APMs along with information regarding how the measures could be implemented.

APM	Affordable Power	Who	How is the	Time Horizon	Distribution of
No.	Measure	Implements	Measure	For	Benefits
		the Measure?	Implemented?	Implementation	
	Solar PV Development		Individual		Individual water
	Alternative 1 - (small	Individual power	customer installs		user or groups of
1	facilities)	customer	solar PV facility	Weeks to months	water users
		Groups of power	Individual power		
		customers under	customer decision		Groups of Off-
	Solar PV Development	a central	with central entity		Project and/or
	Alternative 2 – (shared	coordinating	installing solar PV		On-Project water
1	facilities)	entity	facility	12 – 24 months	users
		A central	Developer		Developer enters
	Solar PV Development	developer and a	commits to		into arrangement
	Alternative 3 – (grid	central benefits	develop solar PV		with group(s) of
1	scale facilities0	administrator	facility	24-36 Months	water users
					Individual water
		Individual power	Customer signs		users who have
2	Net Metering	customers	up with PacifiCorp	1-2 Months	self-generation
		A central	Developer		Developer enters
	Out-of-Basin	developer and a	commits to invest		into arrangement
	Renewable	central benefits	in a renewable		with group(s)
3	Investment	administrator	energy project	24-36 Months	water users
			Individual power		Individual water
			customer		user or groups of
	Equipment/efficiency	Individual power	purchases/installs		On-Project water
4	Upgrades	customers	equipment	1-6 Months	users

Table 17-1. APM Implementation Summary

APM	Affordable Power	Who	How is the	Time Horizon	Distribution of
No.	Measure	Implements	Measure	For	Benefits
		the Measure?	Implemented?	Implementation	
				TBD based on	Individual water
				post-pilot program	user or groups of
	Time-of-use Power	Individual power	Customer signs	terms and	On-Project water
5	Rates	customers	up with PacifiCorp	conditions	users
				TBD based on	Individual water
				post-pilot program	users or groups
_	Irrigation Load Control	Individual power	Customer signs	terms and	of On-Project
6	Programs	customers	up with PacifiCorp	conditions	water users
			Developer		
			commits to		0.0.4
-	Small Hydro Plant	Reclamation or	construct hydro	0.5.1/2.2.2	On-Project water
/	Development	Imgation districts	Tacility	3-5 Years	users
			Reclamation		
	Burehesse of Federal		Endered new		On Braiget water
0	Purchases of Federal	Poclamation	supply portfolio	2.5 Voor	
0	Fower	Reciamation	Customor signs	2-5 Teal	users
			and commits to an		
	Open-access Power	Individual power	alternative power		Individual water
9	Purchases	customers	supply	Months	users
			Active		
			participation in		
	PacifiCorp Irrigation	Individual or	PacifiCorp rate	Ongoing with	
	Cost of Service	group(s) of power	setting processes	initial action in	
10	Evaluation	customers	in OR and CA	months	All water users

Note to Table 17-1

An "Individual Power Customer" can refer to: 1) Reclamation, 2) an irrigation district, 3) an On-Project water user, or 4) an Off-Project water user. Power cost benefits associated with measures implemented by an individual On-Project or Off-Project water would be conveyed to that specific user while measures implemented by Reclamation and/or irrigation districts would be conveyed (indirectly) to On-Project users, generally via lower water delivery/O&M charges.

High Priority Affordable Power Measures

Based on an overall evaluation of each APM, six Measures were identified as exhibiting the best balance between: 1) a reasonable expectation of meaningful power cost reductions, 2) an ability to implement the Measure in a realistic timeframe, and 3) a widespread distribution of benefits across multiple categories of water users in the Basin. These High Priority Measures are listed in Table 17-2.

APM No.	Affordable Power Measure	Interest In Federal Funding?
1	Solar PV Development – Alternative 1 (individual facilities)	Yes
1	Solar PV Development – Alternative 2 (shared/community-scale)	Yes
1	Solar PV Development – Alternative 3 (grid-Scale)	Yes
2	Net Metering (used in conjunction with Solar PV Alternatives 1 & 2)	NA

Table 17-2. High Priority Affordable Power Measu	res
--	-----

APM No.	Affordable Power Measure	Interest In Federal Funding?
4	Equipment/Efficiency Upgrades	Yes
5	Time-of-Use Power Rates	Note 1
6	Irrigation Load-Control Programs	Note 1
7	PacifiCorp Irrigation Cost-of-Service Evaluation	No

Note 1:

To the extent that implementation of these APMs by Reclamation or irrigation districts causes negative impacts to other water users in the Upper Klamath Basin, Federal Funding might be utilized to either: 1) provide financial offsets to the affected users, or 2) develop additional water system infrastructure to directly reduce the negative water delivery/timing impacts.

Chapter 18 Potential Resources for Implementing the APMs

Overview

During the process of identifying and evaluating the set of ten APMs, the APM Analysis Team recognized that irrigation customers may need (or desire) assistance in further analyzing the power savings potential for their particular situation and, perhaps more importantly, how to proceed in order to implement the cost-savings measures in a cost-effective and timely fashion.

Appendix C contain a listing of various organizations that the APM Analysis Team either contacted during the preparation of this Report or were already aware of, that can provide general knowledge, technical expertise, and in some cases funding, to assist water users in implementing one or more of the identified APMs.

Chapter 19 Recommendations/Next Steps

The Power Cost Benchmark Analysis that accompanies this Report concluded that the average per-unit cost of power for irrigation and drainage use in the Upper Klamath Basin is approximately 97.3% higher than the costs paid by agricultural water users located in five Reclamation Projects in the Pacific Northwest region that were identified as being similarly situated to the Klamath Project.⁵³ The Affordable Power Measures that have been evaluated and discussed in this report - and especially those Measures identified as High Priority Measures in Table 17-2 - were designed to assist water users including Reclamation, irrigation districts, and individual covered water users in reducing their respective power costs using a multi-prong approach.

In developing the final list of High Priority APM's, an emphasis was placed on those Measures that could implemented in a relatively short period of time so as to present water users with viable near-term power savings options that they could consider enacting, either on an individual customer basis or, in some cases, as part of a group. In addition, Measures implemented by Reclamation and/or irrigation districts will provide benefits to multiple individual water users.

Given the results presented in this Report, Reclamation recommends that it proceed to conduct feasibility analyses for the set of High Priority APMs listed in Table 17-2.

⁵³ See PCB Report, Chapter 13.2. The cited figure is based upon the weighted average per-unit cost of power for irrigation/drainage customers located in both the Oregon and California portions of the Basin.

Abbreviations and Acronyms

\$/MWh	Dollars Per Megawatt-Hour
¢/kWh	Cents Per Kilowatt-Hour
APM	Affordable Power Measures
AWIA	America's Water Infrastructure Act of 2018 (Pub L. 115-270)
BPA	Bonneville Power Administration
CAPP	Comprehensive Affordable Power Plan
CBP	Columbia Basin Project
COPCO	California Oregon Power Company
Corps	U.S. Army Corps of Engineers
Draft PCB Report	Draft Power Cost Benchmark Report
Draft PCT Report	Draft Klamath Power Cost Target Study Report
EIA	U.S. Energy Information Administration
FERC	Federal Energy Regulatory Commission
GAO	Government Accountability Office
IOUs	Investor-Owned Utilities
IRP's	Integrated Resource Plans
KBRA	Klamath Basin Restoration Agreement
kW	Kilowatt
kWh	Kilowatt-Hour
KWUA	Klamath Water Users Association
М	Million
Measures	Potential Power Cost Savings Measures
MWh	Megawatt-Hour
NASS	U.S. Department of Agriculture's National Agricultural Statistical Service
O&M	Operations and Maintenance
PCB	Power Cost Benchmark
PF	Priority Firm
PMA	Power Marketing Administration
PNW	Pacific Northwest
POUs	Publicly-Owned Utilities
Reclamation	U.S. Bureau of Reclamation
ResEx	Residential Exchange Program
U.S. EIA	United States Energy Information Administration

This page intentionally left blank

Second Table of Contents

Page

Appendix A – Chapter 1	72
Affordable Power Measures Team members/organization list	.72
Appendix B – Chapter 2	73
Synopsis of the September 10, 2019 Public Stakeholder Meeting	.73
Appendix C – Chapter 3	.74
Organizations and resources for implementation of the Affordable Power Measures	.74
Appendix D – Chapter 4	.75
Affordable Power Measures Technical Details	.75
Appendix E – Chapter 5	.76
List of documents referenced in the APM Report	76

This page intentionally left blank

Appendix A – Chapter 1

Affordable Power Measures Team members/organization list

Affordable Power Measures Analysis Team

Name	Title	Company
Devin Baez	Associate Project Manager	Bureau of Reclamation
Ed Blair	Klamath ID Project Irrigator	Klamath ID/Bair Farms
Gary Derry	Shasta View Irrigation District	Shasta View Irrigation District
Glen DeWillie	Project Manager	Kleinschmidt
Ben Duval	Klamath Water Users Assoc.	Klamath Water Users Assoc.
John Hancock	Landell Valley ID	Landell Valley ID
Michael (Mike) Neuman	Lead/Special Projects/GIS	Bureau of Reclamation
Fatima Oswald	Coordinator	Kleinschmidt
Lloyd Reed	Technical Lead/SME	Reed Consulting
Don Russell	Horsefly ID Manager	Horsefly Irrigation District
Gary Saleba	EES Consulting/KWUA	EES Consulting
Dean Seggay	Contract Specialist	Bureau of Reclamation
Scott Seus	Tulelake Irrigation District	Tulelake Irrigation District
Chelsea Shearer	Executive Assistant	Klamath Water Users Assoc.
Paul Simmons	Executive Director	Klamath Water Users Assoc.
Gail Tabone	EES Consulting/KWUA	EES Consulting
Bill Walker	Klamath Water Users Assoc.	Klamath Water Users Assoc.
Matt Walter	Off-Project Water Users	Off-Project Water Users
Gary Wright	KWUA/Tulelake ID	KWUA/Tulelake ID

Appendix B – Chapter 2

Synopsis of the September 10, 2019 Public Stakeholder Meeting

INFORMATION/BRIEFING MEMORANDUM

DATE:	September 17, 2019
FROM:	Jeff Nettleton, Area Manager, Klamath Basin Area Office
SUBJECT:	Affordable Power in the Klamath Basin

This briefing provides an update on the status of affordable power efforts in the Klamath Basin with respect to the requirements of the America's Water Infrastructure Act of 2018 (Pub. L. 117-270) (AWIA).

KEY TAKEAWAYS

- Affordable power for irrigation and drainage pumping is an objective of the Klamath Basin irrigation community.
- Section 4308 of the AWIA requires the Department to conduct affordable power studies.
- Reclamation has contracted with The Kleinschmidt Group to conduct the studies in collaboration with stakeholders.
- Reclamation determined that the studies could not be completed within the 180 days required by the legislation (April 21, 2019). However, with the consent of legislators and stakeholders, they will be completed in November 2019 and forwarded to Congress by the end of the year.

BACKGROUND

Klamath Basin irrigators (including those within the Klamath Project as well as upper basin irrigators) have been impacted by power rate increases of up to 2,000% following the 2006 expiration of a low-cost power contract with Pacific Power. As a result, power rate relief has been a central objective of the irrigator community in over a decade of negotiations to resolve Klamath Basin water and fisheries issues.

The Klamath Basin Restoration Agreement (KBRA) was one such effort. In anticipation of KBRA implementation, Reclamation concluded a study in 2016 (the Comprehensive Agricultural Power Plan [CAPP]) to identify a path to affordable power. However, the KBRA expired at the end of 2015 for lack of Congressional action and no further affordable power efforts were initiated.

More recently, irrigation interests were successful in getting language added to the AWIA that directs the Department to conduct a study to identify a "power cost benchmark" that represents a power rate needed for Klamath Basin agriculture to remain competitive with similar irrigation projects in the Pacific Northwest, and to identify affordable power measures to achieve that benchmark.

In February 2019, Reclamation's Klamath Basin Area Office contracted with Kleinschmidt Group to conduct the studies in collaboration with Klamath Basin stakeholders.

DISCUSSION

For the Power Cost Benchmark Study, Kleinschmidt and the Klamath Water Users Association (KWUA) are in the process of researching power use and rate data from districts and contractors

within four "similarly situated" Reclamation projects in the Pacific Northwest.

For the Affordable Power Measures Study, Kleinschmidt is developing appraisal-level concepts for projects to reduce power costs, such as community solar, battery storage, small hydro, and floating solar.

Because the legislation also emphasizes stakeholder engagement, Kleinschmidt and the KWUA held a public workshop on September 10, 2019 to brief interested irrigators and community members on the work they have been doing. Vendors such as Pacific Power, Farmers Conservation Alliance, and Sustainable Northwest were present to provide information on energy conservation and other affordable power programs. Approximately 30 local irrigators attended the meeting.

According to the AWIA, the studies were to have been completed in April 2019. However, Reclamation determined while initiating the studies that additional time was needed, and with the consent of the Congressional delegation and stakeholders, established a new deadline for Congressional submittal of December 2019. Draft reports are expected by late September.

Subsequent actions are not defined but could include stakeholder requests for support of feasibility-level studies of affordable power measures, possibly followed by a request for federal funding for implementation. Any or all of these actions have the potential to become components of a basin-wide water settlement being developed by Alan Mikkelsen.

POSITION OF INTERESTED PARTIES

Irrigation interests in the Klamath Basin, both within and outside the Klamath Project, are keenly interested in reducing their power costs.

America's Water Infrastructure Act Irrigation Power Costs/Cost Control Planning Event September 10, 2019

AGENDA

9:00 - 9:05 AM	Introduction (Jeff Nettleton, Area Manager, Klamath Basin Area Office, Bureau of Reclamation)
9:05 - 9:20 AM	Background. How did we get here? Where have we been? (Paul Simmons, Executive Director, KWUA)
9:20 - 9:30 AM	What has been done in the recent past? What we are doing now? Affordable Power Measure History & Context, CAPP Review <u>https://www.usbr.gov/mp/kbao/programs/affordable-power.html</u> (<i>Mike Neuman, Bureau of Reclamation</i>)
9:30 - 10:00 AM	Power Cost Benchmark (PCB) – Preliminary Findings Overview (Lloyd Reed, Lloyd Reed Consulting (Kleinschmidt Team))
10:00 - 10:15 AM	BREAK
10:15 - 11:15 AM	Affordable Power Measure (APM) Studies – Preliminary Findings Overview (Lloyd Reed, Lloyd Reed Consulting (Kleinschmidt Team))
11:15 - 11:45 PM	Q&A Next Steps
11:45 - 12:30 PM	Informal Discussion/Presentations by Partners
12:30 PM	END

America's Water Infrastructure Act (AWIA) Power Cost Benchmark & Affordable Power Measure Studies Preliminary Findings







Agenda

- 9:00 AM Project Intro / Background / Overview
- 9:30 AM Power Cost Benchmark (PCB) Preliminary Findings PCB Q&A
- 10:00 AM BREAK
- 10:15 AM Affordable Power Measure (APM) Studies Preliminary Findings APM Q&A
- 11:45 PM Presentations by Partners



History of Power Costs for Upper Klamath Basin Irrigation

Paul Simmons KWUA Executive Director



Approximate Klamath Project Areas

Initial Conditions

- 1903-1905: Engineering investigations initiated for the Klamath Project
- May 1905: Klamath Project authorized under Reclamation Act
 - 1904-1905 Water right filings included power
 - Power facilities and pumping contemplated
 - Link River Dam a major planned facility



Early History

- Approx. 1912-1917: COPCO (PacifiCorp Predecessor) constructed "Copco 1" on Klamath River in California
 - COPCO was also considering "Copco 2" and possibly other developments
- 1917: COPCO Proposal to Reclamation COPCO will build and operate Link River Dam and develop more power, in lieu of federal development
 - Convey title to Link River Dam to Reclamation
 - COPCO's downstream use of water subordinate to Klamath Project irrigation needs
 - COPCO will sell power at low cost (7.5 mils / Kwh) to Reclamation and Project water users for 50 years
- Fifty-year contract entered consistent with the above (some amendments after 1917)



1951

COPCO applied for

- State Water rights for proposed J.C. Boyle facility in Oregon
- Federal Power Commission (FERC) license for proposed J.C. Boyle and existing COPCO I and COPCO II



1951-1953

- Strong opposition to COPCO's application from Department of the Interior, local irrigation interests
 - > Further power development should a be Federal undertaking, to supply low-cost Power for irrigation and revenue to offset irrigators' costs (as elsewhere)
 - Concerns about protecting future irrigation development
- KWUA formed in 1953
- Negotiations COPCO, KWUA, Reclamation



1954 - 1956

- 1954: FERC license issued for project 2082 (J.C. Boyle and COPCO I & II)
 - 50-year term license
 - Condition: license only effective if COPCO enters renewed power contract with Reclamation for period equivalent to license
- 1954-1956: Negotiations
- 1956: New 50 year contract between Reclamation and COPCO
 - Link River Dam management
 - Low cost power to project (4 mils, 6 mils)



1956

Off Project Contract

 KWUA – COPCO agreed to 7.5 mil rate for "offproject"



Compact Article IV addressed power development:

195/

KLAMATH RIVER BASIN COMPACT

BETWEEN THE STATES OF

OREGON AND CALIFORNIA

STATE OF OREGON, APRIL 17, 1957 Chapter 142, Greger Stoke Laws, 1957)

STATE OF CALIFORNIA, APRIL 17, 1987 (Chapter 113, Culturnie service, 1957)

Consented to by THE UNITED STATES CONGRESS ACT OF AUQUST SD. 1957 (71 STAT. 497)

Effective September 11, 1957

"It shall be the objective of each state . . . to provide for the most efficient use of available power head . . . in order to secure the most economical distribution and use of water and lowest power rates which may be reasonable for irrigation and drainage pumping, including pumping from wells."
2004

- 2004 PacifiCorp files application to renew license
- No proposal to extend power contract
- Administrative and court proceedings regarding duty to continue low-cost power arrangements: largely resolved against reclamation and irrigators



2006

- Special power contracts expire / terminate
- Stair-step rate increases to tariff
 - Oregon per statute and OPUC
 - California per CPUC



Reclamation's Affordable Power Efforts for KBRA

Power for Water Management Program

- > Power Cost Target Study
- > Federal Power Program
- > Renewable Power Program



Affordable Power Measures Study builds on CAPP

Comprehensive Agricultural Power Plan (CAPP)

- > Evaluated 13 Alternatives
- > Screening Criteria
- > Results arranged in Tiers
 - 1st Tier Solar, Out-of-Basin Investment, Net Metering
 - 2nd Tier Solar, Revenue Stream, Efficiency, Demand Management, Keno Dam Hydro-Power, Biomass
 - 3rd Tier Other Hydro-Power, Natural Gas, Geothermal



America's Water Infrastructure Act of 2018 (Sec. 4308)

180 days* to submit to Congress a report that

- > Identifies Power Cost Benchmark;
- > Recommends actions (other than direct payments) to ensure that the net delivered power cost for *covered power use* is equal to, or less than the PCB in the near- and long-term.
 - Emphasis on water and power conservation and efficiency, renewable energy development, and regional economic development;
- > Describes public input regarding the proposed actions and the degree to which water users concur with the recommendations



Power Cost Benchmark (PCB) Overview

The PCB is defined in Section 4(a)(3) of the AWIA:

"The term 'power cost benchmark' means the average net delivered cost of power for irrigation and drainage at Reclamation projects in the area surrounding the Klamath Project that are similarly situated to the Klamath Project, including Reclamation projects that: (A) are located in the Pacific Northwest, and (B) receive project-use power."

- The PCB is a measure of the average <u>per-unit cost</u> of electricity (measured in cents/Kilowatt-hour) used for irrigation and/or drainage purposes in similarly situated areas (i.e. "Similar Projects").
- The PCB is intended to be an <u>objective measure</u> of how per-unit irrigation/drainage electricity costs in the Klamath Basin compare against per-unit electricity costs in the Similar Projects.



Identification of the Similar Projects

- A total of 15 Reclamation Projects located in the Pacific Northwest region were originally evaluated as potential Similar Projects.
- Five Reclamation Projects were ultimately selected to be the Similar Projects used in the computation of the PCB. These are:
 - 1. Boise Project Located in south-central Idaho.
 - 2. Columbia Basin Project Located in central Washington.
 - 3. Minidoka Project Located in south-eastern Idaho.
 - 4. Owyhee Project Located in south-west Idaho and eastern Oregon.
 - 5. Yakima Project Located in south-central Washington.



Irrigation Power Costs in the Similar Projects

- A total of 12 different electric utilities serve the majority of the irrigation customers located in the five Similar Projects.
 - Three of these utilities Avista Utilities, Idaho Power, and PacifiCorp have separate rates for irrigation customers located in different states.
- In 2018, the average rates charged to irrigation customers in the Similar Projects by the 12 utilities ranged from a low of 4.30 cents/Kwh to a high of 10.34 cents/Kwh.
- The power rates cited above <u>do not</u> include Public Use Power that Reclamation and some irrigation districts purchase from the Bonneville Power Administration.
 - > In general, power rates for Public Use Power in each of the Similar Projects <u>are lower than</u> the rates available from the local electric utilities.
- In comparison, PacifiCorp's 2018 average irrigation rate in Oregon was approximately 10.36 cents/Kwh and in California the average rate was approximately 13.41 cents/Kwh (preliminary figures).



Current Status of the PCB Calculations

- 2017 and 2018 power cost and usage data for the 12 electric utilities that serve the majority of the irrigation and drainage loads located in the five Similar Projects has been assembled and is being reviewed.
- Some additional actual 2017 and 2018 power cost and usage data for Reclamation's own power usage in some of the five Similar Projects is still being acquired.
- Power usage weighting factors for irrigation and drainage loads located in the different electric utility service areas of the five Similar Projects are being finalized.
- The derivation of the PCB including the supporting datasets and associated calculations will be available for public review and comment following the release of the Draft PCB Report.



Power Cost Benchmark Q&A

Questions?





AWIA requirements for APM Study

Emphasis on:

- > Water & power conservation & efficiency
- > Renewable energy development
- > Regional economic development



Affordable Power Measures (APM) Overview

- Developing the list of Draft APMs:
 - The APMs previously identified in the CAPP Report were re-assessed based upon updated information and currently forecasted conditions.
 - Several potential new APMs were identified that were not previously considered in the CAPP Report.

> From a total of 18 candidates, ten Draft APMs were selected for further evaluation.



Draft APM No. 1 - Solar Photovoltaic Generation

Alternative 1 – Individual Customer Facilities

Description

Develop new sources of solar Photovoltaic generation in the Upper Klamath Basin (potentially coupled with battery storage) that are designed to provide all, or a portion of, individual customer's irrigation loads. Solar PV facilities would generally be in the range of approximately 5 KV to 20 KV (with potentially bigger facilities for some larger pumping loads).

Potential Benefits

- Very flexible installation potential minimal land/space requirements.
- Solar PV facilities can be installed "behind-the-meter".
- Solar PV generation acts to directly reduce each individual customer's power purchase costs from PacifiCorp.
- Existing programs to assist customers in acquiring solar PV equipment.

- Relatively high up front costs for individual customers as compared to other Draft APMs.
- Individual customers would be responsible for performing (or contracting out for) operations, maintenance and administrative functions.



Draft APM No. 1 - Solar Photovoltaic Generation

Alternative 2 – Shared/Community Facilities

Description

Develop new sources of solar Photovoltaic generation in the Upper Klamath Basin (potentially coupled with battery storage) that are designed to provide power to multiple customer's irrigation loads. Solar PV facilities would generally be in the range of up to approximately 1,000 KW for facilities located in California and up to 2,000 KW for facilities located in Oregon.

Potential Benefits

- Provides some moderate economies of scale (i.e. lower \$/KW installation costs than for individual customer sized facilities).
- Solar PV generation acts to directly reduce each participating customer's power purchase costs from PacifiCorp.
- Operations, maintenance and administrative functions provided by a central entity.

- Availability of space in the Klamath Basin for one or more moderate-scale solar PV facilities.
- Potential costs of interconnecting moderate-sized solar PV facilities to the local bulk power grid.
- Potential power cost savings are subject to the net metering programs in effect in Oregon and California (including maximum solar PV facility size restrictions).



Draft APM No. 1 - Solar Photovoltaic Generation

Alternative 3 – Utility-Scale Facilities

Description

Develop new sources of solar Photovoltaic generation in the Upper Klamath Basin (potentially couple with battery storage) that are designed to provide bulk power supplies to one or more of the region's electric utilities (which could include PacifiCorp). Solar PV facilities would generally be in the range of approximately 50,000 KW to 200,000 KW.

Potential Benefits

- Provides significant economies of scale (i.e. lower \$/KW installation costs than for shared/community sized facilities).
- Could provide a long-term revenue stream to help off-set PacifiCorp power purchase costs for all covered water users.
- Provides an opportunity to work jointly with PacifiCorp to develop new large sources of renewable generation.

- Availability of space in the Klamath Basin for one or more large-scale solar PV facilities.
- Potential costs of interconnecting large-size solar PV facilities to the local bulk power grid.
- Added transmission costs of selling power to regional utilities other than PacifiCorp.

Draft APM No. 2 – PacifiCorp Net Metering Programs

Description

Utilize existing or future PacifiCorp net metering programs in Oregon and/or California to foster the development of individual and multiple shared/community generating facilities (e.g. solar PV, battery storage) to be located in the Upper Klamath Basin.

Potential Benefits

- Provides an opportunity for individual customers or groups of customers to reduce their overall power costs by selfgenerating a portion, or all of, their own power needs (by displacing power formally purchased from PacifiCorp).
- Self-generation in excess of a customer's own power usage can be effectively "sold back" to PacifiCorp.

- Currently-in-effect net metering programs in Oregon and/or California could change in the future (subject to the appropriate regulatory approvals).
- Issues regarding the price of power sold to PacifiCorp that is in excess of the customer's overall usage.
- Current maximum size limits for shared/community generating facilities in Oregon and California limits economy of scale benefits.



Draft APM No. 3 – Out-of-Basin Renewable Energy Investment

Description

Form one or more entities to invest in new renewable generating facilities to be located outside of the Upper Klamath Basin.

Potential Benefits

- Significantly expands the universe of potential renewable investment opportunities by considering locations outside of the Upper Klamath Basin.
- Does not require the delivery of out-of-basin renewable generation directly to covered water-users.
- The revenue stream(s) from the renewable investments can be distributed among all covered water-users.

- Potential negative reaction from the local public-at-large regarding investments to be made outside of the Upper Klamath Basin.
- Potentially high up-front investment costs.





Draft APM No. 4 – Equipment/Efficiency Upgrades

Description

Upgrade/replace existing water delivery system components to utilize more energy efficient equipment and thereby reduce overall electricity consumption in the Upper Klamath Basin.

Potential Benefits

- Individual customers can reduce their power costs by reducing their overall electricity usage.
- Minimum expected power cost savings over time can generally be determined at the time of the upgrade investment.
- Programs exist to assist individual customers and groups in implementing efficiency upgrades.

- Relatively high up front costs for individual customers as compared to other Draft APMs.
- Cost-effective efficiency upgrades may not be available to all covered water-users.



Draft APM No. 5 – PacifiCorp Time-of-Use Power Rates

Description

Utilize existing or future PacifiCorp Time-of-Use retail rate programs for irrigation/drainage customers located in Oregon and/or California.

Potential Benefits

- Reduce overall net power costs by shifting electricity usage as much as possible off of the hours designated by PacifiCorp as "onpeak" hours.
- "On-peak" hours are defined in advance allows for long-term pumping/power usage planning.
- Participation in the Program is voluntary.
- Customers can opt out of the program (subject to notice requirements).

- Individual customer's overall power costs could be higher than under PacifiCorp's standard irrigation rates.
- Large dollar penalty for power usage during the designated "on-peak" hours.
- Customers located in the lower parts of the Klamath Project could be negatively impacted by the shifting of pumping operations occurring in the upper parts of the Project.
- Potential up-front new electric meter costs.

Draft APM No. 6 - PacifiCorp Irrigation Load Control Programs

Description

Utilize existing or future PacifiCorp load control programs for irrigation/drainage customers located in Oregon and/or California.

Potential Benefits

- Individual customers' overall net power costs can moderately by reduced by allowing PacifiCorp to curtail electricity usage on short notice in exchange for receiving dollar payments from PacifiCorp.
- Participation in the Program is voluntary.
- Customers can opt out of the program (subject to notice requirements).

- Requires that customers have significant flexibility regarding their water delivery/pumping operations.
- Uncertain timing regarding power curtailment events.
- Customers located in the lower parts of the Klamath Project could be negatively impacted by the shifting of pumping
 operations occurring in the upper parts of the Project.
- Potential up-front new electric meter costs.

Draft APM No. 7 - Small Hydroelectric Generation Development

Description

Develop one or more small hydroelectric generating plants on existing water diversion/delivery facilities of the Klamath Project.

Potential Benefits

- Can take advantage of small-size "modular" hydro units to reduce overall installation costs.
- Power produced at the plant(s) can either be used to meet a portion of the Project's power needs or sold to PacifiCorp or other regional utilities at prevailing market rates.
- Could provide a long-term revenue stream to help off-set PacifiCorp power purchase costs for all covered water-users.

- Relatively high up-front installation costs.
- Limited number of potential sites.
- Potential environmental and/or permitting issues.

Draft APM No. 8 - Purchases of Public Use Power

Description

Reclamation could purchase power from BPA under Public Use Power rates to meet all, or a portion of, Reclamation's own Project-related power needs.

Potential Benefits

- Potential lower cost power to operate Reclamation's Klamath Project pumps.
- Relatively low up-front costs (i.e. no new generating facilities would need to be developed).

- Would only apply to Reclamation's own pumping loads.
- Public Use Power deliveries to Reclamation facilities would be subject to PacifiCorp transmission and/or distribution charges.
- Unclear how off-Project covered water-users could receive benefits.



Draft APM No. 9 - Open-Access Power Purchases

Description

Utilize PacifiCorp's existing Open-Access rate schedule in Oregon (Schedule 741) and a potential new PacifiCorp rate schedule in California so that irrigation/drainage customers would purchase their power supplies from third parties other than PacifiCorp.

Potential Benefits

- May be possible to moderately reduce individual irrigation customers' overall power costs.
- Utilizing a retail aggregator may provide individual customers with increased "buying power" and help reduce administrative overhead.

- Power cost savings are not guaranteed.
- Currently there are no open-access programs available to PacifiCorp's irrigation customers located in California.
- Maximum potential power cost savings are significantly limited power supply purchases from third parties are still subject to PacifiCorp's transmission, distribution, and other charges.
- Prevailing market prices for wholesale power can vary significantly across time due to conditions beyond the customer's control.
- Potentially high administrative overhead.

Draft APM No. 10 - PacifiCorp Retail Rates Cost-of-Service Review

Description

As part of PacifiCorp's next general rate cases in Oregon and California, evaluate PacifiCorp's cost-of-service analyses with regard to its retail irrigation rates and make appropriate recommendations to the Oregon Public Utility Commission and/or the California Public Utility Commission to reduce power rates to Klamath Basin water-users.

Potential Benefits

• May result in lower overall power costs for PacifiCorp's irrigation customers.



- Requires an investment of time and effort on the part of irrigation customers and/or customer groups.
- Uncertain timing with regard to future PacifiCorp retail rate cases in Oregon and California.



APMs – Ongoing Activities

- New generating/energy storage facility installation cost information is being assembled and finalized (associated with Draft APMs Nos. 1, 2, 3, 6, and 7).
- Short-term and long-term wholesale power price forecasts are being finalized (associated with Draft APMs Nos. 3 and 9).
- Potential ranges of power cost reduction benefits are being finalized (associated with all Draft APMs).
- List of programs and/or organizations that can assist irrigation customers in implementing certain APMs is being finalized (associated primarily with Draft APMs Nos. 1, 2, 4, and 9).



APMs – Next Steps

- Review comments received from covered water users and/or other stakeholders regarding the list of Draft APMs.
- Modify the list of Draft APMs as appropriate based upon the comments received from covered water-users and/or other stakeholders.
- Finalize the cost/benefit analyses for the Draft APMs.
- Complete and release the Draft APM Report for public review and comment.



Future Pathways to Success



Affordable Power Measures Q&A

Questions?





Thank you Questions/Comments:

Mike Neuman US Bureau of Reclamation 541-880-2547

MNeuman@usbr.gov

Glen DeWillie, PE Kleinschmidt Associates 503-345-7958 <u>Glen.DeWillie@KleinschmidtGroup.com</u> Paul Simmons Klamath Water Users Association 541-883-6100 <u>PSimmons@somachlaw.com</u>

Lloyd Reed Reed Consulting 303-279-9508 <u>lloyd.reed@lloydreedconsulting.com</u>

September 10, 2019

Public Meeting Questions and Answers

Q1. For the Power Cost Benchmark study and investigation of power charges normally aggregated on an electric bill, were all charges appropriately accounted in comparing PacifiCorp power costs to those of other utilities?

A1. Yes, the various costs including reactive charges, demand pricing, and custom charges approved by Public Utility Commissions (PUCs) were taken into consideration, with the goal of providing an "apples to apples" comparison.

Q2. In comparing costs with Idaho Power to PacifiCorp, what is the acreage served in the Idaho Power basin compared to the Klamath basin?

A2. The acreage cannot be compared directly as there are complex service territories with other power providers that are not clearly delineated, making it difficult to assess directly. The Kleinschmidt team continues to research information from across the compared basins with direct calls being made to Minedoka project irrigators who did not answer survey requests earlier to gain higher resolution of the data.

Q3. On PacifiCorp bills, do the various "candies" found on the bill appear in other service territories?

A3. Yes, each "adder" to a bill must be closely examined to assess its relevance in the power cost benchmark calculations.

Q4. Does the state line separating California and Oregon matter in calculating power costs?

A4. Yes, each state is governed by a different PUC that assesses rate cases and approves each on a case by case basis.

Q5. How many acres does it take to provide a 2,000 Kw solar plant?

A5. It takes approximately 2.8 acres/1 GWh

Q6. The Kleinschmidt team presented 3 categories of solar powered solutions for generating electricity. Are there other options or categories besides those presented?

A6. The categories presented are driven by PUC approved project sizes. In Oregon, the limit for a new project is 1 MW; for California, the limit increases to 2 MW.

Q7. Can two projects be collocated to get around the power project size limitations?

A7. ?

Q8. What are the timelines for full project buildout for the solar alternatives?

A8. There are examples of smaller scale projects like option 2 that take from 1-2 years including permitting through construction and time scales differ depending on regulatory approvals including zoning exemptions. For alternative 3 (solar plant scale projects), typical project timelines exceed 2 years.

Q9. What are the costs for solar power per kw?

A9. Solar power costs vary depending on the complexity of permitting costs, and other variables. Rooftop solar has been delivered close to \$1/kW in select locations, however, some of those locations are subsidized with state grants to reduce customer costs.

Q10. For Alternative Power Measure 5 (Time of Use charges), how is the meter paid for in PacifiCorp territory?

A10. PacifiCorp provides the meter free of charge to the customer.

Q11. Is the time of use charge program limited only to the irrigation season?

A11. Yes, and the season extends from June through the end of August.

Plans target irrigation power cost reduction: KWUA hearing details water study progress |... Page 1 of 5

https://www.heraldandnews.com/news/local_news/plans-target-irrigation-power-cost-reduction-kwuahearing-details-water/article_10c01c5b-8c4a-50bc-9615-5dc366fc781a.html



Plans target irrigation power cost reduction: KWUA hearing details water study progress

By KURT LIEDTKE For the Herald and News Sep 11, 2019



Glen DeWillie, vice president of the Kleinschmidt Group engineering team, details progress in an ongoing study costs to irrigators in the Klamath Basin during a public meeting at Klamath Community College on Tuesday. Photo by Kurt Liedtke

A final draft is still several months away, but on Tuesday Klamath Project irrigators had the opportunity to hear firsthand from agencies involved in drafting potential solutions to reduce growing power costs in the Klamath Basin.

Under the America's Water Infrastructure Act, passed last year thanks to a bipartisan collaborative effort by California and Oregon members of Congress, a collective of representatives from multiple partners involved in an ongoing study about rising power costs presented information and answered questions during a presentation at Klamath Community College. The goal was to present information related to the ongoing Affordable Power Measures Study, which builds on the Comprehensive Agricultural Power Plan (CAPP).

Expired contract

A need for cost reduction has emerged over the past decade following the expiration of a 50-year contract in 2006 that had guaranteed favorable power rates via Pacific Power for on-project irrigators. That long-established power purchase agreement prevented the Klamath Project from accessing Project Use Power – power generated at federally owned facilities such as Bonneville Dam – which has been a contributing factor to rising costs following the agreement's expiration. Following several failed efforts to extend that deal, some irrigators have seen power costs increase as much as 2,000%, according to the Klamath Water Users Association (KWUA).

Individuals present represented groups such as the Bureau of Reclamation (BOR), U.S. Department of the Interior, the Farmers Conservation Alliance, Sustainable Northwest, Pacific Power, Energy Trust of Oregon, and Oregon Tech. The event was presented by KWUA.

Basin study

Per last year's legislation, the study seeks to identify a Power Cost Benchmark (PCB), a "net delivered cost to power after calculating expense," including credits and other factors related to placing water on crops within the Klamath Project. This includes recommended actions, alternative energy options, and public input to reach a point where net delivered power use is equal to or less than the PCB for both near and long-term expectations.

"People know that power rates are a challenge here, but I really think we are going to do something about it," said Paul Simmons, executive director of KWUA. "We find ourselves on an island not having the same opportunities as other areas since the contract expired."

Simmons detailed what has led to this point, from original planning of the Klamath Project over a century ago to dam construction to the contracts and licenses under review. Mike Neumann of the BOR followed, highlighting why competitive pricing is difficult to calculate due to a wide variety of factors, further complicated by what Neumann described as, "a patchwork of overlays of providers in the power cost landscape" that can result in varying expense among neighbors regionally.

Federal power

According to Neumann, tapping into federal reserve power is theoretically feasible, but not practical in execution with minimal savings and no provisions for how to handle the costs in part due to use fees on Pacific Power-owned transmission lines.

To calculate the PCB, five similar reclamation projects in the Pacific Northwest were targeted for cost comparisons. These were the Boise Project, Columbia Basin Project, Minidoka Project, Owyhee Project, and Yakima Project. Based on information compiled from these projects, 10 alternatives were recognized from the CAPP report as potential tools to reduce power costs.

"Our goal is to find achievable measures to reduce your power bill," added Neumann.

Presenting potential cost-reduction measures under consideration in the yet-to-becompleted draft was Lloyd Reed of Lloyd Reed Consulting, part of the Kleinschmidt Group engineering team tasked by BOR for study completion. Reed highlighted possible efforts including utilization of Pacific Power's net metering programs for shared power generating facilities, Pacific Power's Time-of-Use retail rate programs by limiting power use during designated peak hours of energy consumption, equipment and efficiency upgrades, and investment in renewable energy generation facilities outside of the Upper Klamath Basin.

Potential options

Other potential alternatives include utilizing existing and future Pacific Power load control programs, development of small hydroelectric generation plants, purchasing federal power, open-access power purchases, and proactive participation in Pacific Power's retail rates cost-of-service review.

Additionally, several solar photovoltaic options were discussed, from small structures built on individual farms to shared community facilities and large utility-scale solar plants. There was even discussion about floating solar plants as a potential solution, something which Oregon Tech students recently developed for Upper Klamath Lake.

According to Lloyd, solar photovoltaic user costs for implementation range from \$3,000 per kilowatt-hour to as low as \$800 per kilowatt-hour, dependent on scale, number of participants, and other varying factors.

Each group present was also granted the opportunity to speak, highlighting various costcutting programs and incentives to irrigators related to equipment modernization and water use reduction such as low-flow nozzle and sprinkler systems. Oregon Tech noted the interest of students in seeking partnerships with regional water users for potential projects, from floating solar plants to automated pumping systems.

Sustainable Northwest, an active partner in forging long-term strategies for energy consumption in the Klamath Basin, announced an upcoming energy symposium to be held in Klamath Falls Oct. 17-18 at Oregon Tech to tour facilities and discuss cost-saving measures.

"We thought contract extension was deserved, but it didn't happen, so we got help from Congress to get this launched," added Simmons. "BOR has done a great job managing this project, the team is solid. We are off to a good start, and we are going to keep working."

The draft report is expected to be submitted by late November.

Energy symposium set for October

Sustainable Northwest, one of several organizations presenting at Tuesday's hearing, will host a two-day energy symposium in Klamath Falls Oct. 17-18. The Making Energy Work for Rural Oregon 2019 Fall Symposium will include a Modoc Point Irrigation District field tour and social reception on Thursday, Oct. 17. On Friday, Oct. 18 at Oregon Tech, a series of presentations will cover relevant topics such as disaster mitigation and energy storage, the future of farming through mitigation, climate resiliency fostered through the agricultural community, and solar power development. For registration and more information about the fall symposium visit www.sustainablenorthwest.org.
PLANNING FOR REDUCED POWER COSTS FOR IRRIGATION





YOU'RE INVITED TO A PUBLIC MEETING FOR INFORMATION AND INPUT ON IRRIGATION POWER COSTS AND PLANNING FOR COST CONTROL



What:	An Informative Update on a
	Report that Identifies
	Appropriate Irrigation Power
	Costs and a Plan to Achieve
	Them

- When: Tuesday, September 10th 9:00am - 12:30pm
- Where:Klamath Community College
Conference Center, Building 7
7390 S 6th St, Klamath Falls, OR

AGENDA

- 9-11:30am Presentation of Preliminary Study Status and Preliminary Findings on Irrigation Power Costs and Cost Reduction (includes Q&A, and break)
- 11:30-12:30 Informal Discussion/Booth Event Various solution providers will be on site to discuss various energy efficiency programs, distributed generation solutions, and other potential energy related solutions to address reducing power costs and power consumption in the Basin

EVENT SPECIFICS

Irrigation power costs in the Klamath Project and Upper Klamath Basin are high. In 2018, the United States Congress addressed this issue in America's Water Infrastructure Act. That law requires the Bureau of Reclamation to prepare a report to Congress that:

> 1) identifies a "Power Cost Benchmark" based on costs for power paid in similarly situated projects in the Pacific Northwest; and

2) provides a plan for achieving the Power Cost Benchmark.

The components of this report are being referred to as the Power Cost Benchmark (PCB) & Alternative Power Measure



(APM) Studies. Reclamation has engaged an expert team of consultants to prepare the report, and KWUA has been meeting regularly with these parties since March.

At the September 10 public meeting, KWUA and Reclamation will present preliminary findings from the PCB and APM Studies and welcome comments and input. There will subsequently be drafts of the report for public review and comment. The September 10 meeting will also present an opportunity to meet with known or potential APM entities such as Farmers Conservation Alliance, Sustainable Northwest, Energy Trust of Oregon, as well as Pacific Power, in regard to energy efficiency programs, distributed generation (solar, hydro, batteries, etc.), and incentive/efficiency programs.

Hosted by:

Klamath Water Users Association (KWUA) is a non-profit, voluntary membership corporation formed in 1953. Its members are Klamath Project contractors who receive water from Upper Klamath Lake and the Klamath River. Membership serves approximately 175,000 irrigated acres.

The United States Bureau of Reclamation (Reclamation) is a federal agency under the U.S. Department of the Interior, which oversees water resource management, specifically as it applies to the oversight and operation of the diversion, delivery, and storage projects that it has built throughout the western United States for irrigation, water supply, and attendant hydroelectric power generation.

Kleinschmidt Associates is an engineering, regulatory and environmental consulting firm that serves North American energy companies and governmental agencies who strive to protect and enhance the natural environment without compromising performance. Kleinschmidt works at the intersection of regulatory requirements, environmental science, and engineering solutions to achieve our client's objectives.







Appendix C – Chapter 3

Organizations and resources for implementation of the Affordable Power Measures

Organizations and resources for implementation of the Affordable Power Measures

UNDER DEVELOPMENT

Appendix D – Chapter 4

Affordable Power Measures Technical Details

Affordable Power Measures Technical Details

UNDER DEVELOPMENT

Appendix E – Chapter 5

List of documents referenced in the APM Report

List of documents referenced in the APM Report

UNDER DEVELOPMENT