EXH. CAK-5
DOCKETS UE-22___/UG-22___
2022 PSE GENERAL RATE CASE
WITNESS: CATHERINE A. KOCH

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-22____** **Docket UG-22____**

FOURTH EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

CATHERINE A. KOCH

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

PUGET SOUND ENERGY

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PUGET SOUND ENERGY

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I. PUGET SOUND ENERGY'S GRID MODERNIZATION INVESTMENTS SUPPORT HIGH PERFORMING CLEAN ENERGY DELIVERY

A. Overview

Q. Please briefly describe the investment programs presented in this case that sustain and advance the modernization of Puget Sound Energy's ("PSE") grid in more detail.

A. As discussed in my Prefiled Direct Testimony of Catherine A. Koch, Exh. CAK-1T, there are three overarching grid modernization programs:

1. **Grid Modernization – CEIP Program**: Directly supports PSE's Clean Energy Implementation Plan ("CEIP") plan.
2. **Grid Modernization – Core Program**: Addresses concerns with asset maintenance and replacement and improves circuit performance.
3. **Major Projects Electric and Specific Backbone Infrastructure Program**: Allows for strong transmission and substation systems.

Q. Please describe how investments are managed under these three programs.

A. Each of the three programs are broken down into approximately 30 investment plans. Most all of these plans are classified as "programmatic" investments, meaning that the individual projects are designed and built to support a common objective. Generally, larger project investments are non-recurring "specific"

investments, meaning a clearly defined, identifiable, or discrete investment related to the electric system backbone infrastructure. Table 1 provides the overarching program objective, plan, and used and useful category.

This testimony incorporates the Commission's Used and Useful Policy guidance,[1] which defines the type of investment that will be used and useful during the rate plan period and includes the estimated cost, a description of the investment and other existing documentation, offsetting factors, and expected date in service. Additionally, for programmatic investments, it demonstrates spending through historical trends related to the specific program.[2]

Table 1. Used and Useful Categorization of Programs and Program Plans

Overarching Program Objective	Program Plans	Used and Useful Category
Grid Modernization - CEIP	Virtual Power Plant	Programmatic
	Feeder-level Forecasting Tool	
	Hosting Capacity Analysis Tool, Map, and Customer Portal	
	Advanced Distribution Management System ("ADMS") – explained but not funded	
	ADMS Distributed Energy Resource Management System	
	Data Lake & Analytics	
	Substation Supervisory Control and Data Acquisition ("SCADA") - Accelerated	
	Circuit Enablement –Distributed Energy Resources ("DER") and Microgrids	
	Resilience Enhancement - Expanded	

[1] *In the Matter of the Commission Inquiry into the Valuation of Public Service Company Property that Becomes Used and Useful after Rate Effective Date*, Docket U-190531, Policy Statement on Property that Becomes Used and Useful After Rate Effective Date (Jan. 31, 2020) ("Used and Useful Policy").

[2] *Id.* at ¶ 35.

	Voltage Reduction for Distribution Efficiency – directly supports the CEIP but is not funded by the CEIP	
Grid Modernization - Core	Advanced Metering Infrastructure	Programmatic
	Cable Remediation	
	Submarine Cable Mitigation	
	Resilience Enhancement - Copper Conductor Replacement	
	Pole Inspection and Replacement	
	Substation Reliability	
	Voltage Reduction for Distribution Efficiency – funding within Grid Modernization-Core and thus explained in more detail in this program	
	Advance Distribution Management System – funding explained	
	Wildfire Mitigation	
	Worst Performing Circuit	
	Targeted Reliability	
	Distribution Automation	
	Transmission Automation	
	Reclosers	
	Fusesavers	
	Underground Conversion	
	Demonstrations and Pilots	
	Substation SCADA – non-accelerated	
	Additional Circuit Enablement	
	Tree Removal	
Major Projects Electric and Specific Backbone Infrastructure	Major Project Initiation	Programmatic
	Lake Hills-Phantom Lake Transmission Line Project	Specific

	Bellingham Substation Project	
	Sammamish-Juanita 115 kV Transmission Line	
	Electron Heights – Enumclaw 55/115 kV Conservation	
	Bainbridge Island	
	Thurston Transmission Capacity/Tono Substation	
	Lynden Substation	
	Sedro Woolley-Bellingham #4 115 kV	
	Energize Eastside	
	Small Backbone Projects	

Q. Please provide PSE's actual and planned capital investments relating to these three programs over the six rate periods presented in this case.

A. Table 2 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 2. Summary of Total Program Investments by Rate Period

Program ($ millions)	Up to Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/able31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Grid Modernization - CEIP	0	0	8.3	37.9	40.3	51.4
Grid Modernization - Core	212	66.3	124.6	246.6	291.2	305.0
Major Projects Electric and Backbone Infrastructure	60	35.5	98.0	126.5	80.0	81.7

Additionally, there is incremental Operations and Maintenance ("O&M") related to capital investment ("OMRC") associated with the above rate periods of about $18 million.

Q. Do these programs or plans address the same assets such that there could be some double counting of investments or benefits?

A. No. As discussed in Koch, Exh. CAK-1T, plans address specific populations of assets or improve circuit performance. While the type of equipment may be the same, PSE has defined each population carefully so there is no financial double counting. Appendix A, Grid Modernization by Circuit, best demonstrates this in matrix format by indicating how plans will be deployed for each circuit. These plans are not double counted but may be collectively considered as planners develop specific projects with all of these needs in mind.

Q. Are there O&M cost reductions that are expected to result from these program investments?

A. Yes. The total O&M expense that is reduced by the three programs is approximately $4.3 million to $5.8 million from 2022 to 2025 as a result of avoiding vegetation management and pole inspection when undergrounding infrastructure and emergency response and repair when proactive replacement occurs prior to asset failure. O&M expense includes operating activities such as emergency response for outages, metering, property and easement maintenance, asset health mitigation, quality control, repair of damaged infrastructure, and

patrols and inspections, much of which is driven by operational activities that are not influenced by the majority of the capital investments. This is because PSE's grid modernization capital investments are primarily focused on reducing the *duration* of outages, so an outage may still occur and need repair. This is also because emergency repairs are often a capital expense where equipment is replaced in kind, so the capital investment plan reduces other capital expenses more than O&M expenses.

The following are several examples of capital investments that reduce specific O&M expenses. The first example is by installing a device called a fusesaver, which I discuss in section I.C.15 below, approximately 56 outages a year will be avoided because the device protects the fuse on a pole from permanent failure, thus avoiding an unplanned emergency repair of the fuse and saving approximately $40,000 for every 150 devices installed. Another example is by converting portions of overhead circuits to underground, outages caused by trees or car-pole accidents are eliminated thus avoiding an unplanned emergency repair as well as eliminating the need to trim trees for that portion of a circuit. PSE's Targeted Reliability Business Plan, which I discuss in section I.C.11 below, includes this type of solution when appropriate, which PSE estimates an O&M expense savings of approximately $250,000 to $500,000 annually.

These O&M expense reductions help to relieve the increasing O&M expense pressures discussed in Koch, Exh. CAK-1T.

Q. What is the total benefit to cost ratio of these programs?

A. As discussed in Koch, Exh. CAK-1T, PSE uses a tool called the Investment Decision Optimization Tool ("iDOT") to evaluate portfolio benefits, including both quantitative and qualitative benefits. The total benefit grid modernization portfolio presented in this case is $7,251 million.

Q. Please describe each program and program plan.

A. Each program and program plan will be discussed below, describing the investment and core objectives and priorities, actual and forecasted investment over the six rate periods of this rate case, work completed and anticipated to be completed, basis for forecasted investment, and benefits realized and anticipated through the rate plan. Additionally, the incremental OMRC associated with each plan will also be discussed.

Q. Please describe how cost estimates are developed that support these programs.

A. PSE's Project Management Office ("PMO") provides planners with cost estimating tools that generally provide average costs based on historical projects and unit pricing contracts. Planners estimate using these tools based on a planning level scope of work. PSE's PMO updates these tools periodically.

Q. Please describe cost controls employed to efficiently deploy capital expenditures.

A. The cost controls deployed by PSE for these programmatic and specific investments are discussed in the Prefiled Direct Testimony of Roque B. Bamba, Exh. RBB-1T.

B. Grid Modernization – CEIP Program

Q. Please describe the key program plans included in the Grid Modernization – CEIP program.

A. As discussed in Koch, Exh. CAK-1T and in the PSE CEIP, grid modernization supports clean energy in a very broad way. Without the core investments relating to grid modernization, the incremental cost of the CEIP would be higher. For example, without the foundational work of Advanced Metering Infrastructure ("AMI"), historic focus on Substation Control and Data Acquisition ("SCADA"), or distribution automation, integrating Distributed Energy Resources ("DERs") would require adding these types of monitoring, control, and operating investments to each DER making each one more expensive and resulting in a slower pace and reactive operations.

That said, PSE has identified specific grid modernization investments that support the first four years of the Clean Energy Action Plan ("CEAP") directly and are included in the CEIP. There are ten key plans that PSE has or will be investing in

from the end of the test year through the rate plan and these discretionary plans are discussed in more detail below. These plans are supported by PSE business plans and Corporate Spending Authorization ("CSA") requests provided in Appendix B. PSE business plans and CSAs provide project background, statement of need, scope, benefits, cost estimate, alternatives, and funding risk.

Q. How do the planned investments in this program support clean energy initiatives?

A. Yes. Grid modernization investments support clean energy initiatives and specifically the CEIP in three ways. First, they enable DERs directly through tools and processes that interface with DERs broadly facilitating evaluation, interconnection, visibility, dispatch, and operation. These investments are captured in the CEIP as "DER Enablers."[3] Second, they enable broader opportunities for DERs and reduce barriers of integration and application; these investments are captured in the CEIP as "Enablement from Grid Modernization."[4] And third, they further energy efficiency targets through "Distribution Efficiency."[5]

There are six key plans that are considered DER Enablers: i) Virtual Power Plant ("VPP"); ii) Feeder level Forecasting Tool; iii) Hosting Capacity Analysis; iv)

[3] Exh. JJJ-3 at 156 (Puget Sound Energy, 2021 PSE Clean Energy Implementation Plan (Dec. 2021), at 140).
[4] *Id.* at 174.
[5] *Id.* at 125.

Advance Distribution Management System ("ADMS"); v) ADMS Integrated DER Management System ("DERMS"); and vi) Data Lake and Analytics.

There are three key plans that are considered Enablement from Grid Modernization: i) Substation SCADA – Accelerated; ii) Circuit Enablement-DER and Microgrids[6]; and iii) Resilience Enhancement-Expanded.

Finally, under Distribution Efficiency, the primary plan is Conservation Voltage Reduction ("CVR") or, at a heightened level of technology maturity, Volt-VAR Optimization ("VVO"). PSE's Voltage Reduction Business Plan captures the concept of various technologies or approaches that all drive towards the objective of lowering voltage to save energy.

These tools and investments are programmatically being implemented to deliver a holistic operating environment for DERs and success for the CEIP.

Q. Please describe each of the program plans in more detail.

A. The ten plans of the Grid Modernization – CEIP Program are discussed below.

[6] May be referred to as "DER Microgrid Circuit Enablement" program in other witnesses' testimony.

1. DER Enablers

Q. Please describe PSE's DER Enablers investment and core objectives and priorities.

A. The six tools associated with the CEIP DER Enablers provide that PSE is proactively approaching the future operation of the grid and resources on it, learning from the reactive results seen in states like Hawaii and California. With proactive planning and design, PSE will be able to absorb and operate more DERs in a more efficient way.

Q. Please provide PSE's actual and planned DER Enablers capital investments over the six rate periods presented in this case.

A. Table 3 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 3. Summary of DER Enablers Investments by Rate Period Allocated to the CEIP

Capital Plan ($ millions)	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
VPP	0	0	3.9	3.9	0	0
Feeder Level Forecasting Tool	0	0	0	0	0	0
Hosting Capacity Analysis	0	0	0	5.1	0.03	0.03
ADMS	0	0	0	0	0	0
DERMS	0	0	0	0	0.5	3.5
Data Lake and Analytics	0	0	0	0.9	1.1	1.6

Q. What portion of the DER Enablers investment is allocated to the CEIP?

A. Table 4 provides the percentage of allocation to the CEIP between January 1, 2022 and December 31, 2025. The remainder is captured in PSE's Grid Modernization – Core Program investments.

Table 4. Summary of DER Enablers Investment Allocation

Capital Plan	% Allocated to the CEIP (%)	Total $ Allocated to the CEIP ($ millions)	Investment covered in Grid Mod - Core 1/1/2019 – 12/31/2025 ($ millions)
VPP	100	9.62	0
Feeder Level Forecasting Tool	0	0	0
Hosting Capacity Analysis	100	6.19	0
ADMS	0	0	7.45
DERMS	100	3.98	0
Data Lake and Analytics	50	3.65	3.65

Q. Please describe PSE's DER Enablers tool investments in more detail.

A. The six tools associated with the DER Enablers investment are discussed below.

i. Virtual Power Plant ("VPP")

A VPP is a software platform that provides visibility and control of distributed energy sources that will be integrated in PSE's distribution system to help meet PSE's CETA requirements. This will establish a more advanced DER operational capability and enable DER functionality, especially demand response. The primary function that VPP capability will provide is market dispatch of DERs for peak capacity management. The secondary function it will provide is control for DERs that are used to meet delivery system needs, factoring in how a DER is being used in a defined time period into dispatch decisions. PSE had originally envisioned implementing this functionality after it implemented ADMS in 2024.

However, the immediate need to integrate targeted DERs, facilitated by the required Targeted DER Request for Proposal, means PSE has to adapt faster. The alternative to a VPP would be to allow all DER bidders to propose integration and dispatch tools of all kinds and all sizes that PSE would then evaluate separately for integration, security, and operational requirements. Another alternative would be to standardize to the first type of tool proposed without fully appreciating the ADMS future integration or, more importantly, the ability for that tool to meet all the different kinds of DERs that may request integration. Both of these alternatives have been tried by other utilities, many of whom are now migrating to a central operational platform for DERs (such as a VPP), if not a full DERMS platform.[7] The VPP enables DERs to be successfully implemented, fulfilling CETA needs. PSE is in the process of selecting and partnering with a vendor to define requirements and capabilities with the intention of completing the bulk of implementation by the end of 2023, when DERs will begin operating on PSE's system. Once PSE finishes the ADMS project and further defines a DERMS platform, the future outlook for VPP is to integrate with ADMS DERMS, providing visibility of smaller DERs, or to become a full DERMS platform. Please see Appendix B starting on starting at page 1, Virtual Power Plant Corporate Spending Authorization, in support of this investment.

[7] A DERMS is a platform by which DERs can be effectively monitored, managed, capabilities enabled, and optimized for many use cases. Unlike a VPP, a DERMS uses a power flow model for situational awareness. Please see the discussion regarding DERMS in more detail in section I.B.1.vi below.

ii. Feeder-Level Forecasting Tool

The Feeder-Level Forecasting Tool is the Geospatial Load Forecasting Software which is a spatial load forecasting tool used by delivery system planners to predict load and power changes, where on the grid the loads will occur, how DERs change the load shape, and when it must be supplied. Spatial load forecasts address both short-term circuit trends and long-term grid expansion while remaining consistent with the system-level corporate load forecast for energy and peak demand. The resulting forecast provides system planners with substation, circuit, and small-area resolution time-series load growth and load shape changes. This type of granular load forecasting tool will enable PSE to develop non-wires alternative analysis with less dependence on consultant support and allocate load growth on the system in a more granular manner to understand system needs further. PSE will complete implementation of this tool by the end of 2021, further building out the analytics across all the circuits over the following few years. While this tool is mentioned in the CEIP, the minor costs are prior to the CEIP time period of 2022-2025. Please see Appendix B, starting on page 7, Geospatial Load Forecasting Corporate Spending Authorization, in support of this investment.

iii. Hosting Capacity Analysis

Hosting capacity is the amount of energy that a circuit or substation can add in addition to what it already services. Infrastructure with hosting capacity generally means that new load or DERs can be added with less costs associated with

upgrades or interconnection. Hosting Capacity Analysis based on powerflow modeling and technical criteria can be automated for the majority of interconnection application reviews. The result of the analysis can indicate whether an interconnection should be approved, rejected, or requires further analysis due to project complexity. An associated hosting capacity heatmap provided to customers and developers provides transparency to participants and locational value in relative terms. It will also reduce time and cost for the interconnection applicants, reduce the number of applications that may require further studies, and free up PSE's resources from interconnection projects that are infeasible due to inadequate hosting capacity.

To further provide permanent digital records and queuing information of the interconnection process to customers and to automate internal departmental review for DER interconnections, a customer-facing portal will be implemented. Through this portal, customers can enter interconnection requests with project information, such as location, DER type, and capacity. For applicants who are existing PSE customers, this portal can import customer information from the GIS. PSE anticipates completing the bulk of implementation of this tool by 2023. Please see Appendix B, starting at page 15, for the specific Hosting Capacity Analysis, Map, and Customer Portal CSA in support of this investment.

iv. Advanced Distribution Management System

ADMS is an integrated software platform that provides the tools to monitor and control the distribution network in real time. In addition to outage management

capabilities, ADMS provides visibility and control to SCADA devices, distribution system management, and advanced applications. Advanced applications include Fault Location, Isolation, Service Restoration ("FLISR"), VVO, and DERMS. ADMS provides the software platform by which distribution field assets monitored and controlled. The core implementation of ADMS is expected to be completed in 2023 with advanced applications rolled out through 2025. While this tool is mentioned in the CEIP, the costs are not allocated to the CEIP, as the bulk of the tool will be completed prior to the CEIP time period of 2022-2025. As a result, I discuss this tool within Grid Modernization – Core Program, section I.C.8 below.

v. ADMS Distributed Energy Resource Management System

A DERMS is a platform by which DERs can be effectively monitored, managed, capabilities enabled, and optimized for many use cases. Unlike a VPP, a DERMS uses a power flow model for situational awareness. PSE plans to implement DERMS as an integration to ADMS utilizing the ADMS power flow model. When DERMS is integrated with ADMS, it allows full visibility to the system operator and allows safe and optimal dispatch to be coordinated with other operations activities such as switch order management, VVO, and FLISR. This integrated architecture and process avoids the potential for conflicting commands to DERs and field devices that may be designed to prioritize different benefits. The DERMS will help to manage the two-way power flow expected on the distribution system as DERs proliferate and load patterns shift. The enhanced,

real-time power flow management from DERMS will enable PSE to realize grid and customer benefits from DERs that would be difficult to realize via standalone control systems. For example, DERs controlled by a DERMS can be used to deliver optimized or "stacked" value streams beyond delivering or storing clean energy when there is a grid need. Potential DER value streams include frequency regulation, voltage support, backup power/reliability, and local system capacity. Without DERMS, stacked benefits cannot be operationally coordinated broadly across the DER fleet and distribution system. The DERMS will also allow for a higher penetration of DERs over time. When DERs are prevalent in an area but not needed on the local grid for a period of time, the DERMS can manage the power flow to prevent damage to PSE's systems while still allowing the DERs to deliver value during other periods. PSE's research indicates utilities have or are implementing a DERMS to manage effectively in this new paradigm of DER proliferation.

The core implementation of DERMS will begin in 2025 with targeted completion by 2026. PSE has estimated about $4 million in the outer years of the CEIP to begin planning and design for this tool. Over the rate plan, PSE will develop more detail and analysis to support this tool implementation.

vi. Data Lake and Analytics

Data Lake and Analytics involves the development of three components together to establish an Information Technology/Operational Technology ("IT/OT") architecture that empowers data capabilities. Those three components are 1)

business processes and technology to improve Geospatial Information Systems ("GIS") data and update it much faster than occurs today; 2) an Operational Technology ("OT") data lake; and 3) an OT enterprise service bus.

Advanced operational and planning capabilities require significant enhancements to data availability and granularity. The grid modernization data lake brings these disparate data sources together to enable new system operations, planning functions, and business processes based in analytics. This project will also develop new business processes and tools to support analytics capabilities. Developing an architecture that enables data to be validated and utilized across the enterprise by planning and operational tools will allow PSE to scale DER deployment at the pace anticipated by the IRP. The architecture provides that all DER operational and planning tools are utilizing the same as-built and as-operated models and normalize data exchange and model information. This will be critical as the pace of interconnection increases and DER penetration increases throughout the service territory. New business processes and tools combined with analytics will enable PSE to perform operational planning and real-time operations that maximize the potential benefits of DERs. Preliminary funding was requested as the project gets further defined in 2022 for initiation in 2023. PSE has estimated about 50 percent of this functionality benefits the CEIP as a result of the value discussed above. Please see Appendix B, starting at page 23, for the Grid Modernization Corporate Spending Authorization – Operational Program, in support of this investment.

2. Enablement from Grid Modernization

Q. Please describe PSE's Enablement from Grid Modernization investments in the CEIP and core objectives and priorities.

A. The three grid modernization plans that enable and are associated with the CEIP represent investments that have been accelerated from their original plan timeline or new plans specifically focused on DERs and resilience as emphasized in CETA. The objective of accelerating grid modernization plans is to increase PSE's flexibility and ability to integrate DERs in as many locations as possible and to remove obstacles and barriers from moving towards clean energy at a pace much faster than the historical pace.

Q. Please provide PSE's actual and planned Enablement from Grid Modernization capital investments over the six rate periods presented in this case.

A. Table 5 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 5. Summary of Enablement from Grid Modernization Investments by Rate Period Allocated to the CEIP

Capital Plan ($ millions)	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Substation SCADA - Accelerated	0	0	3.6	9.6	14.1	14.1
Circuit Enablement – DER and Microgrids	0	0	0	15.0	17.5	25.0
Resilience Enhancement - Expanded	0	0	0.8	3.4	7.1	7.1

Q. What portion of the Enablement from Grid Modernization investment is allocated to the CEIP?

A. Table 6 provides the percentage of allocation to the CEIP between January 1, 2022 and December 31, 2025. The remainder is captured in PSE's Grid Modernization – Core investments.

Table 6. Summary of Enablement from Grid Modernization Investments Allocation

Capital Plan	% Allocated to the CEIP (%)	Total $ Allocated to the CEIP ($ millions)	Investment covered in Grid Mod - Core 1/1/2019 – 12/31/2025 ($ millions)
Substation SCADA - Accelerated	64	41.36	23.27
Circuit Enablement – DER and Microgrids	100	57.5	0
Resilience Enhancement - Expanded	70	18.43	7.9

Q. Please describe the specific Enablement from Grid Modernization plans that have been accelerated or are new plans in more detail.

A. The three plans associated with Enablement from Grid Modernization investment are discussed below.

i. Substation SCADA Business Plan – Accelerated

A. The Substation SCADA plan is a programmatic approach to deploy supervisory control capability to all PSE distribution circuits. Substation SCADA is a means of monitoring, protecting, and controlling different pieces of interconnected equipment on PSE's distribution circuits and substations through data collection and remote operation. SCADA enablement includes the installation of controllers, relays, sensors, software and Information Technology ("IT") upgrades for communication hubs along with the smart breakers in the substation. There are several benefits of Substation SCADA which include increasing use of distribution automation for improved reliability and resiliency, a customer benefit indicator desired by CETA, and the ability to operate and respond effectively to DER operations and the complexity that increases as more are added to a particular circuit or substation. Substation SCADA is also needed to advance the combination of these two benefits in the deployment of microgrids. These capabilities are not possible without Substation SCADA.

Due to the high DER targets identified in the CEAP, the Substation SCADA plan was accelerated by six years from planned completion in 2035 to completion in 2029, thus allowing enough time to achieve the 2030 CETA requirements with higher DER penetration as well as demand response. To move completion up six years, PSE will need to complete about 50 additional substations beyond the 30 that were planned to be completed during the CEIP period, targeting upgrades to about eighty substations. Additionally, consideration and priority of areas

identified as named communities make these grid modernization investments worth accelerating. Because PSE has historically invested in this programmatic plan, I discuss the Substation SCADA Business Plan in greater detail within Grid Modernization – Core Program, section I.B.18 below.

ii. DER and Microgrid Circuit Enablement Business Plan

PSE has identified the need to address technical constraints of circuit design such that as the DER portfolio scales, the peak capacity output for DERs on a circuit will not be limited. PSE's system has not been designed to accept high amounts of reverse power flow which may occur depending on the number of DERs on a circuit. PSE predicts that up to five percent of its circuits may have high DER penetration. Based on current data surrounding solar PV, there are high penetrations in Kittitas and Whatcom counties. Reverse power flow from DER production can result in voltage imbalances that impact reliability and power quality, which in turn limits available hosting capacity. With PSE's work to build transparency of where DERs can be hosted via hosting capacity analysis and maps, PSE expects circuits today with the greatest hosting capacity will attract higher numbers of DERs. PSE expects the specific circuits will be refined from interest through the DER Request for Proposal ("RFP") process and PSE will review and improve those circuits as necessary with the intent of enabling DERs where they maximize benefits as identified in the RFP and to minimize or avoid DER curtailment. PSE will also incorporate equity and named communities into defining the specific investments that will be made. PSE's estimate of these

programmatic costs are based on assumptions of necessary equipment that will need to be added or improvements necessary to eliminate the reverse power flow issues and enable microgrids with these energy sources in place. PSE's plan targets enabling 14 circuits in 2023, 17 additional circuits by 2024, and 24 additional circuits by 2025. Over the rate plan, PSE will develop more defined circuit improvement scope and adjust the plan as necessary. Please see Appendix B starting at page 30, for the specific DER and Microgrid Circuit Enablement Business Plan in support of this investment.

iii. Resilience Enhancement – Expanded Business Plan

The CEIP highlights resilience as a Customer Benefit Indicator that must be considered in the context of distributing clean energy equitably. While initial focus of actions is on improving reliability, resiliency during extreme, non-blue sky events is the objective. This elevated focus in the CEIP drove PSE to expand its traditional, singular, resilience-oriented focus on replacing copper conductors[8] to also include implementing more aggressive circuit condition monitoring to proactively make improvements that limit outage consequences even more than the traditional reliability focus. Additionally, it focuses on radial feeder resilience, recognizing the potential value of end of line generation in supporting this benefit. Efforts will include drone inspections to proactively identify high risk line assets needing replacement, distributed generation/storage to support radial feeder improvements, and next generation transformer monitoring equipment. This effort

[8] Copper conductors fail often and require lengthy repair.

directly supports the CETA goals and considers named community areas in its prioritizing, with the express intent to improve resiliency to those communities. PSE's estimate of these programmatic costs is based on condition monitoring equipment and historical average costs for improvements such as feeder ties. PSE's plan estimates condition monitoring equipment for about 120 high consequence transformers and anticipates annually addressing 15 to 20 high risk transformers with this plan. Over the rate plan, PSE will develop more defined scope and adjust the plan as necessary. The remainder of the resilience enhancement plan stays focused on replacing copper conductor which is funded through the Grid Modernization – Core Program and because PSE has historically invested in this programmatic plan, I discuss the Resilience Enhancement – Copper Conductor Replacement Plan in greater detail within the Grid Modernization – Core Program, section I.B.4 below. Please see Appendix B, starting at page 37, for the specific Resilience Enhancement – Expanded Business Plan in support of this investment. Both of the investments captured in the Resilience Enhancement – Expanded and Resilience Enhancement Copper Conductor Replacement Business Plans are accounted for in a singular program label of Resilience Enhancement discussed in Kensok, Exh. JAK-1T.

3. Voltage Reduction (Distribution Efficiency) Business Plan

Q. Please describe PSE's Voltage Reduction (Distribution Efficiency) Business Plan and core objectives and priorities.

A. Distribution Efficiency is a voltage reduction plan associated with energy efficiency and contributes to meeting PSE's overall energy efficiency targets. Today, this plan is supported and achieved through CVR. In the future, with ADMS advanced applications implemented, distribution efficiency will mature from a more static approach of CVR to integrated real time VVR optimization. While voltage reduction contributes to the energy efficiency targets, the funding is not covered by the Energy Efficiency Conservation Rider. As a result, PSE's plans and investments are covered under the Grid Modernization – Core Program; I discuss PSE's Voltage Reduction Business Plan in section I.C.7 below.

C. Grid Modernization – Core Program

Q. Please describe the key program plans included in the Grid Modernization – Core Program.

A. As discussed in Koch, Exh. CAK-1T, grid modernization supports clean energy in a very broad way and brings many additional benefits to customers. There are 20 key plans in addition to what is described in the Grid Modernization – CEIP Program that PSE is investing in over the rate plan. This program is supported by PSE's Grid Modernization Strategy, provided in Appendix C, which more fully discusses the vision of a modern grid. This is also supported by several business

plans, provided in Appendix D, which provide project background, statement of need, scope, benefits, cost estimate, alternatives, and funding risk.

Q. How do the planned investments in this program support clean energy?

A. Grid Modernization – Core investments provide that clean energy is delivered to the customer in the most reliable and resilient way. As discussed in Koch, Exh. CAK-1T, investments that sustain and advance the grid are both necessary. Investments in DERs alone do not guarantee that lights stay on for customers if the infrastructure between the DER and customers is in need of attention, whether due to age or condition or susceptibility to external forces such as trees. These investments prevent infrastructure from failing, diminish the duration of outages, or diminish the impact of poor reliability. Advanced technologies which are core grid modernization investments, such as ADMS or distribution automation, also provide ways to advance DER management through visibility, control, and automation.

Q. Please describe the performance metrics these investments impact.

A. The Grid Modernization – Core Program plans generally impact the corporate performance metrics as shown in Table 7.

Table 7. Relevant External Performance Metrics

SAIDI	SAIFI	Failure to restore power within 24 consecutive hours	Average Electric Safety Response Time	Failure to restore power within 120 hours	CEMI (Customers Experiencing Multiple Interruptions)

Q. Please describe each of the program plans in more detail.

A. The 20 plans of the Grid Modernization – Core Program are discussed below.

1. Advanced Metering Infrastructure

Q. Please describe the core objectives and priorities of AMI plan.

A. AMI is the current standard for metering technology for both gas and electric meters, replacing the end-of-life Automated Meter Reading ("AMR") system. AMI uses two-way communication and on-board memory to send more detailed and accurate meter data through a secure wireless network. AMI supports grid modernization through the use of granular data to implement customer programs such as demand response to reduce peak electric demand, provides a network to advance automation, and has embedded capabilities that allow for a modern approach to disconnect and reconnect service remotely in response to customer requests. I discuss AMI in detail in Exh. CAK-7.

2. Cable Remediation Business Plan

Q. Please describe PSE's Cable Remediation Business Plan and core objectives and priorities.

A. The Cable Remediation Business plan is a reliability initiative to remediate direct buried bare concentric neutral cables that have a trended probability of failure, of which high molecular weight ("HMW") cable type is the worst offender. The objective is to improve customer reliability and reduce unplanned outages by replacing this cable. Please see Appendix D, starting at page 1, for the specific Cable Remediation Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Cable Remediation Business Plan capital investments over the six rate periods presented in this case.

A. Table 8 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 8. Summary of Cable Remediation Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	60.2	10.2	20.0	30.0	40.0	40.0
Asset addressed (miles)	143	15	43	60	84	84

Additionally, there is incremental OMRC associated with the above rate periods of about $1.3 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE replaced 143 cable miles since the last rate case and up through the end of the current test year period. PSE anticipates replacing 286 cable miles from July 1, 2021 through December 31, 2025, cumulatively completing 78 percent of the total plan of 4,300 miles.

Q. Please describe the basis for the forecasted Cable Remediation Business Plan investments in more detail.

A. From 2016, when PSE began to aggressively address this issue, through 2019, PSE has replaced, on average, 135 miles a year of failure prone HMW cable, ranging from about 120 miles to 151 miles each year depending on the specific project conditions and business decisions. In 2020, PSE completed only 42 miles due to impacts from COVID-19. PSE's plan anticipates it will take time for the impacts of COVID-19 to recede and to ramp to a target about 80 miles per year within this rate plan, attempting to return to pre-COVID-19 levels eventually. This forecast is based on capacity of third-party resources, permitting processes, and street restoration requirements as well as managing scheduled outage impacts. The programmatic costs to complete the entire population of HMW per the Cable Remediation Business Plan is approximately $650 million. The cost is estimated

based on historical unit cost of dollars per trench foot which is converted into miles and current contractual unit pricing adjusted by traditional escalators.

Q. Have benefits been realized from the Cable Remediation Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan resulted in avoiding 5.37 million customer minute interruptions. Since 2015, in which customers experienced over 1,200 cable outages, cable outages have decreased by 38 percent.

Q. Please describe the benefits PSE's Cable Remediation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of the plan is improved reliability. This plan has an iDOT benefit to cost ratio of 0.69. Table 9 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 9. Summary of Cable Remediation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	5.3	0.83	1.69	1.7	2.3	2.1

3. Submarine Cable Mitigation Business Plan

Q. Please describe PSE's Submarine Cable Mitigation Business Plan and core objectives and priorities.

A. The Submarine Cable Mitigation Business Plan is a reliability initiative to proactively and programmatically address PSE's four transmission and 16 distribution submarine cables based on condition assessments or cable history that indicates degraded integrity. A reactive approach to this asset will result in higher costs associated with emergency temporary repairs or replacement recognizing specialty out-of-state crews are required. This programmatic approach allows PSE to spread costs across many years as well. The primary objectives of the plan are to warrant that there is continued service to our customers and avoid a lengthy unplanned outage if a cable were to fail before a replacement cable is in place. Please see Appendix D, starting at page 9, for the specific Submarine Cable Mitigation Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Submarine Cable Mitigation Business Plan capital investments over the six rate periods presented in this case.

A. Table 10 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 10. Summary of Submarine Cable Mitigation Business Plan Investment by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0	2.0	4.0	4.0	12.5
Asset addressed (miles)	0	0	0	0	0	0

Over the rate plan, no incremental OMRC is required.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. No capital projects were completed since the last rate case and up through the end of the current test year period. PSE anticipates beginning the project planning, engineering, and permitting for the stations where the cable enters the water for South Des Moines – Robinson Point submarine crossing from July 1, 2021 through December 31, 2025, cumulatively completing ten percent of the plan for transmission submarine cables. The installation of a new submarine cable will begin in 2027.

Q. Please describe the basis for the forecasted Submarine Cable Mitigation Business Plan investments in more detail.

A. This new plan is based initially on labor and plan development costs associated with engineering, permitting, and cable station upgrades adjusted for traditional escalators. Replacement of the four transmission submarine cables is

approximately $122 million, but further alternative analysis will consider the condition, risks, and feasibility of other mitigation actions. Mitigation for the distribution submarine cables will be determined through alternative review. PSE anticipates hiring consultants for more accurate replacement cost which may result in adjusting the plan over time.

Q. Have benefits been realized from the Submarine Cable Mitigation Business Plan?

A. No, not specifically per this plan. However, benefits from replacing assets that are failure prone similarly to cable remediation are good proxies for benefits that will be realized as this plan is completed.

Q. Please describe the benefits PSE's Submarine Cable Mitigation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of the plan is avoided reliability concerns. This plan has an iDOT benefit to cost ratio of 0.56. Table 11 provides benefits through the six rate periods presented in this case, which in this case are not realized until mitigation is completed, which is beyond this rate plan.

Table 11. Summary of Submarine Cable Mitigation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0	0	0	0	0	0

4. Resilience Enhancement – Copper Conductor Replacement Business Plan

Q. Please describe PSE's Resilience Enhancement-Copper Conductor Replacement Business Plan and core objectives and priorities of the.

A. The Resilience Enhancement-Copper Conductor Replacement Business Plan ("Copper Conductor Replacement Business Plan") focuses on replacing aging smaller overhead copper (CU) conductors in PSE's primary distribution system. This plan is part of the larger Resilience Enhancement focus which expanded from the singular focus on copper conductor replacement to benefit the CEIP more directly as discussed in section I.A.2 below. Copper conductor loses mechanical strength as it ages and has an increasing risk of failure. Investments will prioritize sections located in wildfire impact zones in addition to historically focusing on sections with the greatest degradation based on history of outages and/or splices on the conductor. Please see Appendix D, starting at page 20, for the specific Copper Conductor Replacement Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Copper Conductor Replacement Business Plan capital investments over the six rate periods presented in this case.

A. Table 12 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 12. Summary of Copper Conductor Replacement Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0	0.30	1.1	2.4	2.4
Asset addressed (miles)	0	0	1	4	8	8

Additionally, there is incremental OMRC associated with the above rate periods of about $0.46 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE completed zero miles of copper replacement since the last rate case and up through the end of the current test year period as captured within this plan. However, PSE replaced or retired approximately 25 miles of copper conductor since the last rate case and up through the end of the proforma period, as part of the Worst Performing Circuit and Targeted Reliability Business Plans discussed

below in section I.C.10 and I.C.11, respectively, which accounts for the investment and benefits. PSE anticipates completing 21 miles of copper replacement under this plan from July 1, 2021 through December 31, 2025, cumulatively completing 18 percent of the plan.

Q. Please describe the basis for the forecasted Copper Conductor Replacement Business Plan investments in more detail.

A. Since 2010, PSE has replaced or retired copper conductor at an average rate of about 16 miles annually. PSE's plan investments appear to be on a pace that is lower, targeting about 5.3 miles annually, but copper conductor will also be replaced through other business plans, including Wildfire Mitigation, Worst Performing Circuits, Targeted Reliability, Pole Inspection and Remediation, and Targeted Capacity Upgrades. The combination of these business plans will result in the replacement of five to ten miles of additional copper conductor per year, keeping the planned replacement of this aging asset on track. The business plan focuses on the next ten years, replacing about 116 miles, estimated at approximately $35 million. To address the entire population of copper conductor, 587 miles, the programmatic cost is approximately $176 million. The costs are estimated based on historical average costs of copper replacement projects adjusted for current contractual unit pricing and traditional escalators.

Q. Have benefits been realized from the Copper Conductor Replacement Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. In 2019, PSE back-casted[9] the performance of copper replacement projects completed in 2016 and found the investments made delivered 100 percent of the predicted benefits to SAIDI and SAIFI.

Q. Please describe the benefits PSE's Copper Conductor Replacement Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is avoided reliability and safety concerns. This plan has an iDOT benefit to cost ratio of 1.59. Table 13 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case. As discussed above, to avoid double counting of benefits, the benefits realized from copper conductor replaced through other plans—specifically the Worst Performing Circuits plan and the Targeted Reliability plan—are captured within those plans.

Table 13. Summary of Copper Conductor Replacement Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0	0	0.002	.08	0.16	0.14

[9] I discuss "back-casting" in the Prefiled Direct Testimony of Catherine A. Koch, Exh. CAK-1T.

5. Pole Inspection and Remediation Business Plan

Q. Please describe PSE's Pole Inspection and Remediation Business Plan and core objectives and priorities.

A. This is a programmatic plan to address pole health, extend pole life, and address poor condition assets before they fail and cause an outage. The objective of this plan is to provide that PSE's pole assets are reliable and resilient to the many external forces experienced. At the time of inspection, PSE will perform treatment that defends against insect damage, extending the life of a healthy pole for ten years. If poles are found to be deficient, they are remediated through reinforcement and replacement. Please see Appendix D, starting at page 26, for the specific Pole Inspection and Remediation Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Pole Inspection and Remediation Business Plan capital investments over the six rate periods presented in this case.

A. Table 14 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 14. Summary of Pole Inspection and Remediation Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	22.9	12.3	20.5	38.5	21.5	21.5
Asset addressed (#)	1,860	518	1,262	2,130	1,196	1,243
Assets inspected (#)	108,760	3,861	23,600	59,000	34,100	34,100

Additionally, there is incremental OMRC associated with the above rate periods of about $8.5 million and O&M expense of about $5 million related to inspections.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE completed 108,760 pole inspections and replaced 2,050 pole projects since the last rate case and up through the end of the current test year period. PSE anticipates completing 154,661 pole inspections from July 1, 2021 through December 31, 2025, cumulatively completing 77 percent of the first cycle (2019-2029) of the plan inspections and 75 percent of the anticipated resulting remediation.

Q. Please describe the basis for the forecasted Pole Inspection and Remediation Business Plan investments in more detail.

A. In 2019, PSE had completed a ten-year inspection and remediation cycle of transmission poles, but had only inspected 24 percent of distribution poles,

operating on a 30-year inspection and remediation cycle. PSE reviewed this plan against industry and moved to performing pole inspection of transmission and distribution infrastructure on a ten-year cycle. Between 2017 and 2019, PSE invested an average of $6.5 million annually in pole remediation work. Since then, PSE has ramped up investments to about $19 million in 2021, starting to tackle a backlog of degraded poles. PSE's plan accelerates further through 2023 to resolve backlogs and then settles out at a pace of about $20 million annually to maintain the ten-year inspection and remediation cycle. The programmatic cost to complete the ten-year cycle is approximately $169 million. The cost estimate is based on contractual unit pricing and overall average historical costs per pole adjusted by traditional escalators.

Q. Have benefits been realized from the Pole Inspection and Remediation Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan avoided 8.18 million customer minutes of interruption in reliability benefit.

Q. Please describe the benefits that the Pole Inspection and Remediation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of the plan is improved reliability and capital cost savings through addressing poles proactively as opposed to on an emergency, unplanned

basis. The plan also improves overall resiliency of the transmission and distribution infrastructure and reduces the risk of safety concerns to the public. This plan has an iDOT benefit to cost ratio of 1.09 for transmission poles and 3.1 for distribution poles. Table 15 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 15. Summary of Pole Inspection and Remediation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	8.18	1.83	3.44	4.82	3.23	3.33

6. Substation Reliability Business Plan

Q. Please describe the Substation Reliability Business Plan and core objectives and priorities.

A. The Substation Reliability Business Plan is an on-going proactive plan to replace aging major substation assets, reducing the reliability risk and cost due to unplanned outages caused by equipment failure. The objective of the plan is to address aging, obsolete, and defective substation assets, informed through inspections, diagnostics, and condition assessments, to improve safety and reliability. This plan recognizes substation failures result in large outages that have a significant impact on customers. Some of the priorities include addressing equipment operating above normal specified ratings, which creates unsafe

conditions, and the retirement of specific oil-filled assets where spare parts are no longer available. Approximately 67 percent of transformer and regulator configurations are over 40 years old, which increases risk for unplanned failures each year. By programmatically replacing aged obsolete equipment with newer technology, PSE can deliver improved operational flexibility, lower maintenance costs, and a safer work environment, which improves overall system reliability and resiliency. Please see Appendix D, starting at page 36, for the specific Substation Reliability Plan Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Substation Reliability Business Plan capital investments over the six rate periods presented in this case.

A. Table 16 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 16. Summary of Substation Reliability Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	18.2	3.3	9.2	30.2	30.2	30.2
Asset addressed (#)	115	4	47	94	87	96

Additionally, there is incremental OMRC associated with the above rate periods of about $0.30 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE completed 115 assets since the last rate case and up through the end of the current test year period. PSE anticipates completing 308 assets from July 1, 2021 through December 31, 2025, cumulatively completing 78 percent of the current plan through 2026.

Q. Please describe the basis for the forecasted Substation Reliability Business Plan investments in more detail.

A. Between 2017 and 2019, PSE invested an average of $12 million per year. In 2020, when COVID-19 hit, PSE's investment reduced to about $7 million. PSE is working to ramp up investments to about $9 million by 2022, starting to tackle a backlog of work. PSE's plan accelerates further in 2023 to address the objectives discussed above and resolve backlogs, a pace of about $30 million, addressing 100 percent of specific obsolete assets such as over-dutied transformer fuses and oil breakers by 2026. The programmatic cost to complete the plan—addressing known poor condition assets, oil filled assets, and address obsolete technology—is approximately $130 million. The cost estimate is based on average historical costs per asset type adjusted by traditional escalators.

Q. Have benefits been realized from the Substation Reliability Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan resulted in avoiding approximately 190,000 customer minutes of interruption.

Q. Please describe the benefits PSE's Substation Reliability Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of the plan is improved reliability. This plan has an iDOT benefit to cost ratio of 2.16. Table 17 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case. There are other benefits achieved such as improved safety to public and substation crews by replacing under-sized equipment such as bank fuses that poses a safety risk and reducing the quantity of oil-filled equipment that can ignite or release lead into the environment.

Table 17. Summary of Substation Reliability Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0.19	0.06	0.06	0.26	0.235	0.21

7. Voltage Reduction (for Distribution Efficiency) Business Plan

Q. Please describe the core objectives and priorities of the Voltage Reduction Business Plan.

A. As introduced in the Grid Modernization – CEIP Program, section I.B.3, voltage reduction is a proven technology for reducing energy and peak demand. There are several ways to achieve voltage reduction. The static approach to implementing voltage reduction is called CVR using Line Drop Compensation, in which the substation circuits are studied and modeled to determine substation voltage settings that keep the service voltage to the customer in lower half, but acceptable, voltage range during all normal load variations. This method requires manual intervention if unusual load or circuit configurations occur. A second, more sophisticated methodology of implementing voltage reduction is called Automatic Voltage Feedback Control, which sends real time voltage information from the end of line and to the substation where voltage regulators automatically adjust to maintain end of line service voltage within the appropriate range. With a distribution management system, voltage reduction can mature to a more integrated VVO that manages voltages and reactive power flows in the distribution network. The objective of this plan is to levelize voltage profile for all the customers on a feeder, improve power factor and reduce line losses, create energy savings for customers, and reduce demand. Please see Appendix D, starting at page 46, for the specific Voltage Reduction Business Plan in support of this investment. I discuss CVR in Exh. CAK-7, as it is a key benefit of AMI that

PSE is already realizing. The purpose of the Voltage Reduction Business Plan is to implement the committed benefits identified in the 2016 AMI Business Case. The discussion that follows is meant to support information in Exh. CAK-7, not represent it as double counting.

Q. Please provide PSE's actual and planned Voltage Reduction Business Plan capital investments over the six rate periods presented in this case.

A. Table 18 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 18. Summary of Voltage Reduction Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0.006	0.19	0.63	2.1	5.2	5.7
Asset addressed (# substations)	6	7	12	12	12	12

Additionally, this plan requires incremental O&M of approximately $2.0 million (captured in the 2016 AMI Business Case).

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE implemented voltage reduction on six substations since the last rate case and up through the end of the current test year period. PSE anticipates completing an additional 55 substations from July 1, 2021 through December 31, 2025, cumulatively completing 48 percent of the plan. PSE will pilot VVO in 2022/2023, ordering and testing the functionality of the new equipment, developing a new standard operating procedure, and coordinating new roles/responsibilities and change management practices. PSE will install switchgear on the circuits of two substations and develop training guides. By 2024, the pilot will support rolling out VVO for four to six substations and connected circuits targeted at residential customers.

Q. Please describe the basis for the forecasted Voltage Reduction Business Plan investments in more detail.

A. Since AMI implementation began in 2016, PSE has been ramping up to the expected plan in the 2016 AMI Business Case of implementing CVR on 12 substations and connected circuits annually. Implementing CVR at 12 substations annually aligns with recent Distribution Efficiency targets which deliver avoided cost savings to meet the CEIP. The programmatic cost to complete voltage reduction on 160 substations by 2036 is approximately $12 million, which is mostly O&M. The cost estimates are based on historical average costs adjusted by

traditional escalators. Outer years of the plan reflect capital investments anticipated in support of VVO integration based on anticipated equipment that will be needed. However, the pilot will inform how the voltage reduction method transitions to the integrated VVO and the plan may need to be adjusted.

Q. Have benefits been realized from the Voltage Reduction Business Plan?

A. Yes. Confidence in future benefits can be based on historical benefits realized. Since inception through June 30, 2021, PSE has completed CVR implementations at fifteen substations and the total annual energy savings is 12,183,176 kWh with a cumulative energy saving for customers of 47,044,274 kWh.

Q. Please describe the benefits PSE's Voltage Reduction Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is avoided energy costs. This plan has an iDOT benefit to cost ratio of 80.83. Table 19 provides benefits through the six rate periods presented in this case, which are also discussed in Exh. CAK-7.

Table 19. Summary of Voltage Reduction Business Plan Benefits by Rate Period

Type of benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Savings over 20 years for voltage reduction installed during the rate period ($ millions)	6.0	8.3	14.4	14.9	15.4	15.9

8. ADMS Business Case

Q. Please describe PSE's ADMS project and core objectives and priorities.

A. As introduced in the Grid Modernization – CEIP Program, section I.B.1.vii, ADMS is an integrated software platform that provides the tools to monitor and control the distribution network in real time. This tool was discussed in the Grid Modernization – CEIP Program because it supports clean energy, but its programmatic funding is accounted for in the Grid Modernization – Core Program because it nearly completed before the CEIP period and rate plan period.

In addition to outage management capabilities, ADMS provides visibility and control to distribution SCADA devices, distribution system management, and advanced applications, all functions that provide enable DERs to operate effectively on the distribution system. Advanced applications include Fault Location, Isolation, Service Restoration FLISR, VVO, and DERMS. ADMS provides the software platform by which distribution field assets are monitored and controlled. The project is broken out into three implementation phases: 1) Distribution SCADA, which transitions all existing distribution SCADA devices and all distribution substation displays from the Energy Management System; 2) Outage Management System ("OMS") migration, which moves all OMS functionality to the ADMS system, retiring the obsolete OMS system and completing the load flow analysis pilot; and 3) Advanced Applications, which develops capability to implement electrical state estimation, performs load flow

analysis on a set of circuits, and enables VVO and FLISR enhancements. The core implementation of ADMS is expected to be completed in 2023, with advanced applications rolled out through 2025. The ADMS implementation will enable advanced operational capabilities for DERs, including an integrated DERMS. As DERs become more prevalent, PSE will need to: 1) monitor and visualize DERs and their interactions with the distribution grid; 2) control the DERs; and 3) dispatch the DERs. DERMS allows PSE to perform these tasks. When DERMS is integrated with ADMS, it will allow full visibility to the system operator and allow for safe and optimal dispatch coordinated with other operational activities. Please see Appendix D, starting at page 51, for the ADMS Business Case in support of this investment. ADMS project management and costs are discussed in Tamayo, Exh. SLT-1T.

Q. Please provide PSE's actual and planned ADMS Business Case capital investments over the six rate periods presented in this case.

A. Table 20 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 20. Summary of ADMS Business Case Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	Costs accounted for in Prefiled Direct Testimony of Suzanne L. Tamayo, Exh. SLT-1T					
Tool subparts completed (#)	1	-	-	1	-	1

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. Since the last rate case and up through the end of the current test year period, PSE has completed the integration of all existing Distribution SCADA devices into ADMS distribution substation displays that are now operational. PSE anticipates completing the upgrade and migration of OMS, completing a load flow pilot and advanced applications for daily operations management, power flow state estimation and load flows, and enabling VVO and FLISR from July 1, 2021 through December 31, 2025, cumulatively completing 100 percent of the implementation. DERMS implementation will continue beyond the rate plan.

Q. Please describe the basis for the forecasted ADMS Business Case investments in more detail.

A. PSE's forecast is based on the design phase estimate, informed by signed contracts and completed work thus far. This is discussed further in Tamayo, Exh. SLT-1T.

Q. Have benefits been realized from the ADMS Business Case?

A. Yes. With the work completed in 2021, PSE will avoid $1.7 million in licensing and maintenance costs for SCADA points that would have been added to the existing Energy Management System ("EMS") system between 2021-2025.

Q. Please describe the benefits PSE's ADMS will deliver for customers.

A. The primary benefit of ADMS is avoided costs related to acquiring, licensing, and full time employees for maintaining standalone applications. Additional benefits include energy savings through VVO,[10] reliability improvements from model-based FLISR, switching error reductions, and operational efficiencies. Table 21 provides benefits through the six rate periods presented in this case.

Table 21. Summary of ADMS Business Case Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Avoided costs ($ million)	0	7.5	9.5	2.5	2.4	2.5
VVO ($ millions Peak and Energy savings)	0	0	0	0	0.006	0.04
Single outage positive reduction	0	0	0	0	0	0.03

[10] Energy savings are not captured in the current Voltage Reduction Business Plan (or 2016 AMI Business Case), but are in addition to what PSE is already deploying under the more static conservation voltage reduction method because the VVO method enables dynamic, real time voltage adjustment.

9. Wildfire Mitigation Business Plan

Q. Please describe PSE's Wildfire Mitigation Business Plan and core objectives and priorities.

A. The Wildfire Mitigation Business Plan objective is focused on safety and reliability by developing situational awareness, targeted operational response, and system hardening. This prevents wildfire ignition and reduces consequences of ignition associated with electricity delivery. PSE's Wildfire Mitigation and Response Plan was submitted to the Washington Utilities and Transportation Commission in July 2021. The Wildfire Mitigation Business Plan drives implementation of PSE's Wildfire Mitigation and Response Plan through investments that bring greater awareness and response ability in wildfire areas and infrastructure improvements that are made through this plan and other PSE business plans. Adding the lens of wildfire risk over reliability, which is a primary benefit of many of the other PSE business plans, helps to drive resiliency in these communities. Wildfires represent an evolving risk due to both climate conditions and growth of populations that have creeped closer and closer to what was distant wildland historically which is now called the Wildland Urban Interface ("WUI"). PSE has not experienced PSE-caused wildfire-related loss events, but recent events impacting utilities throughout the Western U.S. demonstrate that climate conditions are shifting the risk landscape, even in those areas that were not previously considered wildfire-prone. As a result, mitigation efforts are also evolving as a better understanding of ignition and fire spread is developed. Please

see Appendix D, starting at page 88, for the specific Wildfire Mitigation Business Plan in support of this investment. Table 22, from the Wildfire Mitigation Business Plan provides summary of how this plan and other PSE business plans contribute to the broader wildfire mitigation focus. The total investment across all plans towards wildfire areas is approximately $129.5 million.

Table 22. Summary of Wildfire Mitigation Contribution from All PSE Business Plans

Business Plan	Wildfire Impact			$ Millions	Relevant Investments
	High	Medium	Low		
Resilience Enhancement -Copper Conductor Replacement	X			1.3	4.2 miles in wildfire impact zones
Distribution Automation		X		33.3	Prevent reclosing into faults
Circuit Enablement - DERs and Migrogrids			X	11.9	Enablement for microgrid to lessen impact of wildfire outages
Circuit Enablement - EV			X	1.3	Prevent overloading the circuit due to EV use
Poles Inspection and Remediation	X			20.8	Identify failing poles and inspect pole-mounted equipment
Underground Conversions		X		3.2	Directly remove exposure and ignition source
Reclosers			X	5.6	DA enablement, SCADA control for sectionalizing
Resilience Enhancement - Expanded			X	0.2	Equipment drone inspection, radial feeder microgrid enablement to lessen impact
Targeted Reliability		X		12.6	Capacity upgrades, tree-wire, UG Conversion, reliability improvements
Targeted Reliability - Root Cause Analysis			X	0.1	Framework for tracking and learning from failures
Substation SCADA			X	2.3	SCADA control for sectionalizing and DA enablement
Transmission Automation		X		6.1	Prevent reclosing into faults
Worst Performing Circuits	X			18.3	6 priority wildfire circuits, and 14 other wildfire circuits are WPC, direct reliability improvements
Wildfire Mitigation	X			13.0	Fuse, Transformer, crossarms replacement, fast tripping, rebuilds

Q. Please provide PSE's actual and planned Wildfire Mitigation Business Plan capital investments over the six rate periods presented in this case.

A. Table 23 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 23. Summary of Wildfire Mitigation Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0	2.0	2.0	2.5	3.0
Circuits improved (#)	2	1	11	11	5	6
Circuits improved across all other business plans (#)	120					

Additionally, there is incremental OMRC associated with the above rate periods of about $0.40 million and O&M expense of about $0.6 million related to inspections.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE's investment since the last rate case and up through the end of the current test year period and proforma period include several demonstration projects that were O&M expense to determine constructability and efficacy of new equipment. For example, these include service transformers using "FR3," a fire-retardant and

biodegradable replacement for conventional mineral oil and low-exhaust fuses. PSE has also inspected the top priority wildfire circuits every year to determine vegetation and equipment concerns prior to wildfire season. Under this specific business plan, PSE anticipates assessing needs relating to approximately 20 distribution and six transmission circuits and implementing solutions such as insulator replacement, non-wood cross-arms and poles, pole wraps, current limiting expulsion-type fuses, FR3-filled service transformers, covered conductors, line detection, and enhanced fault detection from July 1, 2021 through December 31, 2025. Subsequent assessments and solutions will occur on the remainder of circuits after this programmatic approach to the initial set is completed. PSE will also focus on enhanced situational awareness including localized weather stations at about half the priority circuits by the end of the rate plan.

As noted above, PSE's other business plans will contribute to addressing the 108 distribution and 37 transmission circuits that are designated as having extreme or high burn potential, anticipating the wildfire risk will be reduced in some way on over eighty percent of these through the rate plan as a result.

Q. Please describe the basis for the forecasted Wildfire Mitigation Business Plan investments in more detail.

A. The circuits in scope for this plan is defined from risk weighting circuits based on exposure to elevated burn potential, time until the next vegetation management

cycle, proximity to WUI communities, and line construction type. From this assessment, 55 miles of circuits will benefit from an initial set of enhancements and improvements to reduce the inherent risk. The forecast is based on historical average costs for the specific activities identified and mentioned above.

Q. Have benefits been realized from the Wildfire Mitigation Business Plan?

A. Yes. Risk models have been developed to prioritize inspection and mitigation efforts and a real-time system dashboard has been developed to provide improved situational awareness to system operators. In 2021, the benefit of this work was the effective operational triggers in response to a series of Red-flag Warnings issued by the National Weather Service. PSE triggered a Level 1 response eight times by removing non-load-serving transmission exposure and requiring visual circuit inspection before line testing. PSE triggered a Level 2 response two times which initiated a non-reclose order on SCADA circuit breakers in the affected areas. The risk and weather mapping dashboards provided real-time situational awareness, allowing Operations to mitigate risk while keeping a high level of reliability.

Q. Please describe the benefits PSE's Wildfire Mitigation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of the plan is to reduce the likelihood and impact of large, destructive fires for customers and communities that are PSE infrastructure sourced. This plan has an iDOT benefit to cost ratio of 21.23. Table 24 provides

the number of circuits for which wildfire risk is reduced in some way over the six rate periods presented in this case. Over the next year PSE will develop a way to quantify risk reduction in lieu of simply counting circuits.

Table 24. Summary of Wildfire Mitigation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Risk reduction (Circuits mitigated)	1	1	2	8	8	8

10. Worst Performing Circuits Business Plan

Q. Please describe PSE's Worst Performing Circuit Business Plan and core objectives and priorities.

A. In addition to PSE's long history of addressing the "areas of greatest reliability concern" as required by WAC 480-100-393(3)(a), in 2017, PSE formalized a focus on 135 circuits that historically had poor reliability performance with high customer minutes of interruption ("CMI") and high circuit SAIDI and SAIFI performance associated with non-major event days. This became the Worst Performing Circuit ("WPC") plan. The criteria for this plan were "areas of greatest reliability concern"[11] or at least on one of the criteria shown in Table 25.

[11] Per Docket UE-110060 associated with WAC 480-100-393, each circuit is ranked by the total CMI seen by the circuit for each of the previous five years, and those with the highest ranking are considered the top 50 WPCs.

Table 25: Summary of Worst Performing Circuit Criteria

Metric	Criteria
Circuit 3 year CMI	3,000,000 CMI over 3 years
Circuit Annual CMI	CMI > 750,000 for 2 out of 3 years
Circuit Annual SAIDI	SAIDI > 300 minutes for 2 out of 3 years
Circuit SAIFI	SAIFI > 2 for 2 out of 3 years

The main objective for this plan is to reduce the duration and frequency of outages for those customers that continue to experience the worst performance each year. Specifically, the intent of the WPC Business Plan is to improve the reliability metric that put the circuit on the list by 50 percent. Please see Appendix D, starting at page 100, for the specific Worst Performing Circuit Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Worst Performing Circuit Business Plan capital investments over the six rate periods presented in this case.

A. Table 26 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 26. Summary of Worst Performing Circuit Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	44.3	23.7	11.7	23.0	25.3	23.0
Assets addressed (miles)	96	51	25	50	55	50

Additionally, there is incremental OMRC associated with the above rate periods of about $2.4 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE addressed 96 miles of WPC since the last rate case and up through the end of the current test year period. PSE anticipates addressing 231 miles from July 1, 2021 through December 31, 2025, cumulatively completing 100 percent of the current plan.

Q. Please describe the basis for the forecasted Worst Performing Circuit Business Plan investments in more detail.

A. Since the beginning of this plan in 2017, PSE has been programmatically tackling the 135 circuits by developing specific project scopes that serve as the basis of the plan costs. Because each circuit is unique based on outage cause and best solution (i.e., tree wire, underground conversions, overhead rebuilds, adding new feeder ties), the annual total WPC scope of work and accomplishments vary. In 2017, PSE addressed 70 circuits, while in years 2018 to 2020, PSE addressed less circuits due to delayed project schedules and then COVID-19. The programmatic cost to complete the WPC by 2025 is approximately $123 million. The cost estimate is based on historical cost averages for each proposed circuit solution and adjusted for traditional escalators. Circuits for which reliability concerns have

surfaced that are not the identified 135 WPC circuits are addressed in the Targeted Reliability Business Plan. Through the rate plan, PSE will be developing the next WPC plan to commence in 2026, informed by the circuits emerging and being addressed through the Targeted Reliability Business Plan.

Q. Have benefits been realized from the Worst Performing Circuit Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan avoided 5.2 million customer minutes of interruption. PSE back-casted performance of 64 circuits for which work was completed in 2019, finding circuit SAIDI performance trended positive with improvements on over 66 percent of the circuits.

Q. Please describe the benefits that PSE's Worst Performing Circuit Business Plan investments will deliver for customers through the rate plan.

A. PSE's primary benefits of this plan are preventing or reducing the number of future outages and outage duration experienced by customers and addressing specific customer inquiries regarding the customer's history of outage duration, outage frequency, and power quality issues. This plan has an iDOT benefit to cost ratio of 1.78. Table 27 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 27. Summary of Worst Performing Circuit Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	5.2	2.8	1.2	1.5	1.0	2.7

11. Targeted Reliability Business Plan

Q. Please describe PSE's Targeted Reliability Business Plan and core objectives and priorities.

A. The Targeted Reliability Business Plan supports distribution electric reliability needs that result in solutions that have high positive benefit-cost ratios. This plan includes overhead ("OH") or underground ("UG") rebuilds, Tree Wire upgrades, UG conversion, feeder ties, root cause analysis ("RCA") identified improvements, and other reliability improvements such as investment in mobile generation. This is a programmatic plan to improve the customer reliability experience across PSE's approximately 965 distribution circuits outside the 135 WPCs. This plan is different than many other business plans that are asset-focused because the WPC and Targeted Reliability plans are focused on circuit performance. As a result, these plans continue iterating because circuit performance may change over time and require periodic review for needed improvements. The objective of the Targeted Reliability Business Plan is to target and improve the customer experience for feeders or laterals experiencing a lower level of reliability that can

result in customer complaints and individual customers or smaller pockets of customers experiencing a lower level of reliability. Additionally, both the system enhancements and mobile generation provide operational flexibility to better support customers during planned work and outages. Please see Appendix D, starting at page 110, for the specific Targeted Reliability Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Targeted Reliability Business Plan capital investments over the six rate periods presented in this case.

A. Table 28 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 28. Summary of Targeted Reliability Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	33.9	6.7	36.9	60.9	76.2	73.7
Miles addressed (#)	30	6	33	54	67	65

Additionally, there is incremental OMRC associated with the above rate periods of about $3.5 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE completed 35 projects, addressing 30 miles of circuits, since the last rate case and up through the end of the current test year period. PSE anticipates completing over 357 projects from July 1, 2021 through December 31, 2025.

Q. Please describe the basis for the forecasted Targeted Reliability Business Plan investments in more detail.

A. From 2018 to 2021, PSE addressed reliability concerns associated with 90 circuits, an investment of about $67 million. PSE's plan investments dropped during COVID-19. Because this plan focuses on investments with the highest benefit to cost ratio, it can have one of the largest impacts on reliability performance. Through the rate plan, PSE's plan will invest at an accelerated pace as a result of degrading system reliability, targeting an improvement of four to seven SAIDI minutes annually. Like the WPC business plan investments, each project is unique based on outage cause and best solution and, as such, the annual plan can vary. The forecast is based on historical project cost averages adjusted by traditional escalators.

Q. Have benefits been realized from the Targeted Reliability Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year

period, the plan avoided 1.5 million customer minutes of interruption. In 2020, PSE back-casted performance of 38 circuits by project type (OH rebuild, OH upgrade, treewire, UG conversion, UG rebuild), finding the investments made in 2016 avoided 99 to 100 percent of the predicted customer minutes of interruption and outages. In addition to this demonstrative performance relative to predicted performance, this plan includes over four SAIDI minutes of improvements that could result from identified solutions resulting PSE's root cause analysis of large impact outages.

Q. Please describe the benefits that PSE's Target Reliability Business Plan investments will deliver for customers through the rate plan.

A. PSE's primary benefits of this plan are preventing or reducing the number of future outages and outage duration experienced by customers and addressing specific customer inquiries regarding the customer's history of outage duration, outage frequency, and power quality issues. This plan has an iDOT benefit to cost ratio of 4.93. Table 29 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 29. Summary of Targeted Reliability Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	1.5	0.3	5.1	8.4	6.1	5.9

12. Distribution Automation Business Plan

Q. Please describe PSE's Distribution Automation Business Plan and core objectives and priorities.

A. The Distribution Automation Business Plan drives deployment of smart technology to dramatically reduce the length of outages that customers experience, having piloted this technology as far back as 2016. Specifically, Distribution Automation – Fault Location, Isolation, Service Restoration ("DA FLISR"), sometimes also referred to as just "Distribution Automation" or "DA," automates outage restoration on PSE's distribution system by using sensors to locate faults, remotely operating switches to isolate faulted sections, and restoring power to the non-faulted sections. The DA FLISR system collects information from devices and determines the optimal switching to restore power to the largest number of customers in less than five minutes. The faulted section will still remain without power until crews can repair the damage. Strategic deployment of the DA FLISR schemes will reduce customer minutes of interruption, SAIDI, and SAIFI, by reducing the number of customers experiencing a sustained service interruption from any one outage event. Distribution reclosers deployed by this plan allow the distribution system to quickly and automatically respond to and switch around an outage event. Please see Appendix D, starting at page 116, for the specific Distribution Automation plan in support of this investment. I discuss Distribution Automation in Exh. CAK-7, as it is a primary benefit of AMI,

specifically the savings associated with the use of the AMI network for smart device communication as opposed to additional cellular costs.

Q. Please provide PSE's actual and planned Distribution Automation Business Plan capital investments over the six rate periods presented in this case.

A. Table 30 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 30. Summary of Distribution Automation Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	11.4	3.8	8.1	12.0	21.0	28.0
Circuits addressed (#)	29	7	32	48	84	112

Additionally, there is incremental OMRC associated with the above rate periods of about $0.3 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE installed DA FLISR on 29 circuits since the last rate case and up through the end of the current test year period. PSE anticipates installing DA FLISR on 283 circuits from July 1, 2021 through December 31, 2025, cumulatively completing 50 percent of the plan.

Q. Please describe the basis for the forecasted Distribution Automation Business Plan investments in more detail.

A. Between 2016 and 2020, PSE installed DA FLISR on 94 circuits,[12] investing an average of $5 million per year, ranging from about $4 million to $8 million each year. PSE plans to invest at an accelerated rate, ramping up to $28 million by 2025, with foundational AMI and ADMS technology making implementation easier. Additionally, because of the high reliability benefit associated with DA FLISR, this focus will help to turn PSE's SAIDI trend towards improvement in a dramatic way. The programmatic cost to complete the installation of DA FLISR on 532 circuits by 2027 is approximately $133 million. The cost estimates are based on historical average costs of the typical work needed to implement a DA scheme on a per circuit basis adjusted by traditional escalators.

Q. Have benefits been realized from the Distribution Automation Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan avoided 8.4 million customer minutes of interruption. Evaluating the 34 DA FLISR operation events in 2020, for example, PSE's customers

[12] Some of these circuits utilize reclosers communicating over the AMI network as it has been more fully deployed, as the 2016 AMI Business Case expected.

avoided almost three SAIDI minutes and another two SAIDI minutes from 2021 operations.

Q. Please describe the benefits that PSE's Distribution Automation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is improved reliability. Automation will save customer minutes of interruption by reducing the number of customers affected by sustained substation or circuit outages. This plan has an iDOT benefit to cost ratio 6.67. Table 31 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 31. Summary of Distribution Automation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	8.4	0.68	1.9	2.5	4.1	4.1

13. Transmission Automation Business Plan

Q. Please describe PSE's Transmission Automation Business Plan and core objectives and priorities.

A. Transmission Automation is a method of automatic switching that uses sensors to detect transmission line faults. Once a fault is detected, a centralized controller performs automatic switching to isolate the faulted line section and restore the

remaining sections. This method, called Transmission Line Automated Switching ("TLAS"), improves on the existing automatic switching method that uses trial-and-error, rather than sensors, to determine the location of a transmission line fault. Please see Appendix D, starting at page 122, for the specific Transmission Automation Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Transmission Automation Business Plan capital investments over the six rate periods presented in this case.

A. Table 32 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 32. Summary of Transmission Automation Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	3.6	1.1	1.0	2.0	4.5	4.5
Lines addressed (#)	0	2	3	3	5	5
Substations addressed (#)	8	5	10	16	27	27

Additionally, there is incremental OMRC associated with the above rate periods of about $0.15 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE installed TLAS equipment at eight substations on two pilot transmission lines for testing purposes during the test year period.

PSE anticipates enabling TLAS schemes on 18 transmission lines from July 1, 2021 through December 31, 2025, cumulatively completing 26 percent of the plan.

Q. Please describe the basis for the forecasted Transmission Automation Business Plan investments in more detail.

A. While PSE has had a form of transmission automation, this plan deploys the next level of maturity more widely, informed from pilots completed between 2018 and 2021. PSE plans target a steady pace of four to five TLAS installations annually. The programmatic cost to complete the installation of TLAS on 68 circuits by 2036 is approximately $57 million. The cost estimate is based on the pilot cost analysis adjusted by traditional escalators.

Q. Have benefits been realized from the Transmission Automation Business Plan?

A. No. Quantified benefits, in the form of customer minutes of interruption avoided, will begin to be realized in 2022 when TLAS is enabled.

Q. Please describe the benefits PSE's Transmission Automation Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is improved reliability. Transmission automation will save customer minutes of interruption by avoiding sustained substation outages. This plan has an iDOT benefit to cost ratio 6.67. Table 33 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 33. Summary of Transmission Automation Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0	0	0.9	1.4	1.7	2.0

14. Reclosers Business Plan

Q. Please describe PSE's Reclosers Business Plan and core objectives and priorities.

A. This plan will address the addition of new reclosers for reliability/sectionalizing purposes on a subset of PSE's feeder circuits company-wide and replacement of aging/obsolete (oil filled and Joslyn/SEL-351J) reclosers and sectionalizers. These specialized protective devices sectionalize and reduce the number of customers impacted by a permanent fault on the main line feeder. The priority will be given to areas with the highest customer minutes of interruption. The plan

objectives are to increase situational awareness for PSE's operators and enable faster outage restoration by providing increased data points and automation. The installation of reclosers will also support the Distribution Automation Business Plan, but metrics for that plan are accounted for separately to prevent double counting of costs and benefits. Please see Appendix D, starting at page 130, for the specific Reclosers Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Reclosers Business Plan capital investments over the six rate periods presented in this case.

A. Table 34 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 34. Summary of Reclosers Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	1.3	2.3	2.0	3.0	3.5	3.5
Assets addressed (#)	24	26	27	40	47	47

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE installed 24 reclosers since the last rate case and up through the end of the current test year period. PSE anticipates installing 187 reclosers from July 1, 2021 through December 31, 2025, cumulatively completing 38 percent of the plan.

Q. Please describe the basis for the forecasted Recloser Business Plan investments in more detail.

A. Since 2017, PSE has invested between approximately $500,000 and $1.5 million per year in this work, but due to COVID-19, the investment was reduced to about $270,000 in 2020. PSE's investment plan ramped up back up to $2.5 million in 2021 and will continue at an elevated pace of about $2 million to $3.5 million annually due to the high benefit to cost value of this plan. The programmatic cost to complete the installation of 558 reclosers by 2036 is approximately $47 million. The cost estimates are based on historical average costs adjusted by traditional escalators.

Q. Have benefits been realized from the Recloser Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan has avoided 200,000 customer minutes of interruption.

Q. Please describe the benefits PSE's Reclosers Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is improved reliability. Reclosers will save customer minutes of interruption by avoiding sustained outages. This plan has an iDOT benefit to cost ratio 4.01. Table 35 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 35. Summary of Reclosers Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0.2	0.4	0.4	0.6	0.6	0.6

15. Fusesavers Business Plan

Q. Please describe PSE's Fusesavers Business Plan and core objectives and priorities.

A. The Fusesaver Business Plan will replace existing fuses (100T) on the electric distribution system with specialized protection devices. These devices reduce the frequency of sustained power interruptions by quickly tripping to clear temporary faults and restoring power following a momentary outage. Please see Appendix D, starting at page 135, for the specific Fusesavers Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Fusesavers Business Plan capital investments over the six rate periods presented in this case.

A. Table 36 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 36. Summary of Fusesavers Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0.44	1.0	1.0	3.0	4.0	4.0
Assets addressed (#)	14	33	40	120	160	160

Additionally, there is incremental OMRC associated with the above rate periods of about $0.50 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE installed fourteen fusesavers since the last rate case and up through the end of the current test year period. PSE anticipates installing approximately 500 fusesavers from July 1, 2021 through December 31, 2025, completing 83 percent of the plan.

Q. Please describe the basis for the forecasted Fusesaver Business Plan investments in more detail.

A. Ramping from the pilots in 2017, PSE began installing fusesavers programmatically in 2020, investing about $225,000. PSE's plan ramps up from about $1 million in 2021 to a steady level of about $3 million to $4 million annually going forward, targeting about 160 installations each year. The programmatic cost to complete this plan, installing 600 fusesavers by 2026, is approximately $15 million. The cost estimates are based on historical average costs adjusted by traditional escalators.

Q. Have benefits been realized from the Fusesaver Business Plan?

A. Yes. Confidence in future plan benefits can be based on pilot benefits realized. Since the last rate case and up through the end of the current test year period, the plan avoided about 100,000 customer minutes of interruption.

Q. Please describe the benefits PSE's Fusesaver Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is the elimination of sustained outages by clearing temporary faults on fused laterals. This plan has a positive iDOT benefit to cost ratio of 1.4. Table 37 provides the benefits of customer minute interruption avoided over the six rate periods.

Table 37. Summary of Fusesavers Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0.1	0.23	0.45	1.0	1.1	0.9

16. Underground Conversion Business Plan

Q. Please describe PSE's Underground Conversion Business Plan and core objectives and priorities.

A. This plan will programmatically convert to underground a targeted subset of PSE's electric distribution feeder system. The purpose of this plan is to improve system reliability by reducing exposure to hazards and to substantially improve the resiliency of the distribution system during major events, which is where the value of this more expensive solution is gained. While outages on feeder lines are less frequent than on radial lines, they are a significant contributor to overall company SAIDI, so decreasing feeder outages will have a measurable impact at the overall system level. This plan is different from the Targeted Reliability Business Plan because it proactively targets highest risk feeders exclusively for underground conversion. While past performance is taken into account, expected future performance and risk based on exposure and high customer counts are assessed to enhance predictive reliability, specifically targeting more heavily

loaded high exposure feeders. Please see Appendix D, starting at page 141, for the specific Underground Conversion[13] Business Plan in support of this investment.

Q. Please provide PSE's actual and planned Underground Conversion Business Plan capital investments over the six rate periods presented in this case.

A. Table 38 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 38. Summary of Underground Conversion Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0	0	15.0	25.0	25.0
Assets addressed (miles)	0	0	0	6	10	10

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE has completed several underground projects as part of the targeted reliability, WPC, and wildfire mitigation plans, but not specifically relative to this new plan starting in 2023. PSE anticipates completing 26 miles of feeder conversions from

[13] May be referred to as "Underground Feeders" program in other witnesses' testimony.

July 1, 2021 through December 31, 2025, cumulatively completing 30 percent of the plan.

Q. Please describe the basis for the forecasted Underground Conversion Business Plan investments in more detail.

A. This new programmatic plan harvests value from historic inclusion in other circuit performance plans. PSE's plan invests at a pace that converts roughly three percent of the feeder population over a ten-year period. The first year ramps up with six miles of conversion anticipated, followed by about nine miles per year. The programmatic cost to complete this plan, undergrounding an initial high value 86 miles of feeder by 2033, is approximately $215 million. The cost estimates are based on historical average costs adjusted by traditional escalators.

Q. Have benefits been realized from the Underground Conversion Business Plan?

A. No, not specific to this plan. However, confidence in future plan benefits can be based on historical benefits realized from similar underground conversion work. In 2020, PSE back-casted performance of targeted reliability projects by project type and found the investments made avoided 100 percent of the predicted customer minutes of interruption for the three underground feeder conversion projects represented in the back-cast data.

Q. Please describe the benefits PSE's Underground Conversion Business Plan will deliver for customers through the rate plan.

A. The primary benefit of this plan is improved reliability anticipated during major weather events. This plan has an iDOT benefit to cost ratio 1.5. Table 39 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 39. Summary of Underground Conversion Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruption (# millions)	0	0	0	0.14	0.22	0.22

17. Demonstrations and Pilots

Q. Please describe PSE demonstration and pilots and core objectives and priorities.

A. When it comes to demonstrations and pilots, PSE is primarily focused on its Clean Energy Fund ("CEF") projects in partnership with the Washington Department of Commerce. In February 2020, PSE was awarded a CEF3 grant to install a utility scale 150 kW solar plus 1 MW/2 MWh storage microgrid to provide backup power to the Tenino High School in Tenino, Washington and test both frequency response and voltage support, and to install a standalone neighborhood 300 kW/60 kWh battery to support the neighboring town of Bucoda

during an outage. In August 2021, PSE was conditionally awarded a CEF4 grant to perform a feasibility study on two possible forms of backup generation in the Tenino CEF3 project: a 100 percent hydrogen fuel cell and Renewable Natural Gas blended with hydrogen (fifteen percent minimum target). PSE expects these projects to be executed in 2022/2023 with close out in 2024. PSE's Grid Modernization Emerging Technology Council is a cross functional group that reviews and evaluates emerging grid technology and, as such, will work with internal departments to propose additional pilot opportunities for consideration through the rate plan. Please see Appendix D, starting at page 147, for the CEF3 CSA, and starting at page 158, CEF4 Application, in support of this investment.

Q. Please provide PSE's actual and planned demonstration and pilot investments, specifically the CEF3 and CEF4 capital investments over the six rate periods presented in this case.

A. Table 40 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 40. Summary of Demonstration and Pilot Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0.9	3.8	0.9	0.25	0.25
Demonstration and Pilots (#)	2					0

Additionally, this plan requires incremental OMRC which totals $0.11 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE executed a contract with the Department of Commerce, hired engineering consultants to support the development and execution of the pilot, and began development of an RFP to acquire detailed engineering and construction resources for implementation since the last rate case and up through the end of the current test year period. PSE anticipates executing and commissioning the projects and completing feasibility studies in Tenino and Bucoda from July 1, 2021 through December 31, 2025, cumulatively completing one hundred percent of the pilot. Depending on future grant or CEF opportunities, there is potential for future demonstration and pilot projects.

Q. Please describe the basis for the forecasted demonstration and pilot investments in more detail.

A. The forecasted investment is based on costs for the two pilot projects that have been refined on an on-going basis through a combination of labor historicals, expertise from consultants, and RFI/RFP processes for material, construction, and commissioning.

Q. Have benefits been realized from these demonstrations and pilots?

A. No. PSE is in the process of quantifying the benefit that will begin to be realized 2024, but PSE is learning along the way what it means to partner in a DER implementation.

Q. Please describe the benefits PSE's demonstrations and pilots will deliver for customers through the rate plan.

A. PSE's primary benefit of the Tenino solar plus storage microgrid implementation includes backup power for reliability and resilience. PSE will also test secondary use-cases including frequency response and voltage support. The primary benefit of the Bucoda battery implementation includes backup power for reliability of an underperforming circuit—specifically to island the town of Bucoda during an outage. The details of the benefits are to be determined as part of the demonstration and pilot effort. Table 41 notes the learning opportunity and benefit development yet to be quantified over the six rate periods presented in this case.

Table 41. Summary of Demonstration and Pilot Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Learning and benefit development		TBD				

18. SCADA Business Plan

Q. Please describe PSE's Substation SCADA Business Plan and core objectives and priorities.

A. The Substation SCADA Business Plan ("Substation SCADA Business Plan") is a programmatic approach to bringing supervisory control capability to all PSE distribution circuits by prioritizing substation circuits based on customer counts and historical outages. I also discussed the need to accelerate Substation SCADA to support the CEIP. Traditionally, and in addition to advancing the CEIP, the primary objective of the plan is to improve reliability on distribution circuits, restore power to customers faster, and reduce outage durations. Please see Appendix D, starting at page 178, for the specific Substation SCADA Business Plan in support of this investment. The business plan covers investments associated with both the Grid Modernization – Core Program and the investments associated with the Grid Modernization – CEIP Program.

Q. Please provide PSE's actual and planned Substation SCADA Business Plan capital investments over the six rate periods presented in this case.

A. Table 42 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans. The table delineates the investments associated with the Grid Modernization – Core Program and the investments associated with the Grid Modernization – CEIP Program.

Table 42. Summary of Substation SCADA Business Plan Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Core - Capital investment ($ Millions)	15.6	1.5	2	5.4	7.9	7.9
Core - Asset addressed (# Substations)	29	3	3	7	10	10
CEIP - Accelerated Capital investment ($ Millions)	-	-	3.6	9.6	14.1	14.1
CEIP - Asset addressed (# Substations)	-	-	5	12	17	17

Additionally, there is incremental OMRC associated with the above rate periods of about $0.13 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE completed SCADA at 29 substations since the last rate case and up through the end of the current test year period. PSE anticipates completing SCADA at 84 substations from July 1, 2021 through December 31, 2025, completing 84 percent of the plan.

Q. Please describe the basis for forecasted Substation SCADA Business Plan investments in more detail.

A. The reliability benefits from deploying Substation SCADA are significant. As a result, PSE began ramping up investments by almost two times each year

beginning in 2017 and going forward, escalating from approximately $1.4 million invested in 2017 to $8.3 million by 2020. COVID-19 then impacted this activity and investment dropped to about half. After a constrained 2021 and 2022, PSE will ramp up significantly to a level of about $22 million annually to support the CEIP. The programmatic cost to complete the remaining 145 substations by 2029 is approximately $113 million. The cost estimate is based on contractual unit pricing and overall average historical costs adjusted by traditional escalators.

Q. Have benefits been realized from the Substation SCADA Business Plan?

A. Yes. Confidence in future plan benefits can be based on historical benefits realized. Since the last rate case and up through the end of the current test year period, the plan resulted in avoiding approximately 8.6 million customer minutes of interruption.

Q. Please describe the benefits PSE's Substation SCADA Business Plan will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is improved reliability. This plan has an iDOT benefit to cost ratio 3.73. Table 43 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 43. Summary of Substation SCADA Business Plan Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruptions saved (# millions)	8.6	1.8	2.0	4.0	6.3	6.6

19. Additional Circuit Enablement

Q. Please describe PSE's additional circuit enablement investments and objectives and priorities.

A. Similar to the Circuit Enablement – DERs and Microgrids Business Plan discussed in section I.A.2., PSE has identified the need to proactively enable clean energy. There are two areas of focus: 1) address constraints that limit the advancement of electric vehicle ("EV") stations and individual proliferation of EVs; and 2) consider current property expansion opportunities to support utility scale DERs. To enable EVs, the increased load associated with EVs may be mitigated by demand response programs that focus on shifting EV charging off peak. However, that type of program as envisioned in the CEIP likely begins in the later part of 2025. In the meantime, customer EV adoption will test PSE's historical system design in places. For example, other utilities have found in studies that customer transformers can become undersized as EV charging increases, which means that although circuit conductor may be adequate, line

transformer overloads and failures may begin to occur.[14] This is only exacerbated by EV fleet locations and buildings that become parking lot charging hubs. This distribution plan that supports EVs is specifically not allocated to the CEIP because EVs are categorized as an alternate compliance method, but the need and concerns will still exist. Please see Appendix D, starting at page 170, specifically the Circuit Enablement – Electric Vehicle Impact[15] Business Plan in support of this investment.

Regarding property expansion to support utility scale DERs, PSE recognizes the value of offering opportunities to locate DERs next to substations and key infrastructure because doing so decreases costs and increases security and reliability. PSE's substation footprints vary across the system—some with room for future equipment, but much without. PSE's pursuit of property expansion will enable expansion and substation reconfiguration to accommodate more reliable bus layouts and the siting of DERs. The ability to site DERs close to PSE infrastructure improves reliability by eliminating the exposure of the resource to outages on the lines they might be on and also reduces the cost to interconnect these resources. PSE's plan estimates expansion of ten percent of its substation properties and right of ways to support greater resiliency. As with EV enablement, this plan supports the CEIP, but is not directly allocated because it will be

[14] Black & Veatch, *Beyond the Meter Planning for the Distributed Energy Future Volume II: A Case Study of Integrated DER Planning by Sacramento Municipal Utility District* (May 2017), at 21.
[15] May be referred to as "EV Circuit" program in other witnesses' testimony.

informed by the targeted DER RFP in understanding the type and magnitude of DERs that will better define specific locations for acquisition expansion.

Q. Please provide PSE's actual and planned additional circuit enablement capital investments over the six rate periods presented in this case.

A. Table 44 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic plans.

Table 44. Summary of Additional Circuit Enablement Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment ($ Millions)	0	0	3.4	13.2	17.6	19.6
Asset addressed by EV enablement (#)	0	0	58	1,300	2,000	2,200

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE began conceptual planning during the period lasting from the last rate case up through the end of the current test year period. PSE anticipates defining the plan further, addressing 5,230 transformers and expanding substation and right-of-way rights to encourage DERs, if appropriate, from July 1, 2021 through December 31, 2025.

Q. Please describe the basis for the forecasted additional circuit enablement investment in more detail.

A. PSE estimates about 5,200 service transformers, each of which typically serves five to six customers, are nearing load levels and need to be replaced before overload and failure. PSE also estimates four to five additional acres may be acquired annually to support utility scale DERs. This is a new programmatic plan and pace will be informed by EV and DER proliferation moving forward and, as such, PSE's programmatic costs are defined only through the rate plan period, approximately $54 million. The cost estimate is based on property cost assumptions and historical transformer replacement costs adjusted by traditional escalators.

Q. Have benefits been realized from the additional circuit enablement plans?

A. No. However, PSE's experience is that unplanned work due to failure such as a transformer is more expensive, over 20 percent higher if repair is required during non-core hours than planned replacement work.

Q. Please describe the benefits PSE's additional circuit enablement plans will deliver for customers through the rate plan.

A. PSE's primary benefit of this work is cost savings associated with performing work proactively as opposed to unplanned emergency repair and then cost savings

for DER interconnections. However, the benefit for this work will be estimated as the plan develops more. Table 45 frames the potential benefits.

Table 45. Summary of Additional Circuit Enablement Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruptions saved (# millions)	-	-	0.54	1.62	2.17	2.48
Avoided costs of unplanned work	0	0	TBD	TBD	TBD	TBD
Reduced interconnection costs	0	0	TBD	TBD	TBD	TBD

20. Tree Removal

Q. Please describe PSE's current tree removal plan and core objectives and priorities.

A. Roughly 32 percent of outages and 77 percent of SAIDI minutes on PSE's electric transmission and distribution systems are caused by vegetation. With nearly 75 percent of PSE's right of way edged by trees, PSE has a comprehensive vegetation management plan to keep the OH electric system operating safely and to maintain reliability. Trees along the OH distribution system are trimmed every four years in urban areas and every six years in rural areas. For the high voltage 55/115 kV transmission corridor system, trees are trimmed every three years. For the 230 kV transmission corridor system, trees are trimmed annually.

PSE's tree removal plan, TreeWatch, addresses hazard trees that are on private property, generally beyond PSE's 12-foot public right-of-way. It primarily focuses on the tree-related outages on the worst performing circuits, working with property owners to remove hazard trees through education, negotiation, and replacement with acceptable trees. PSE's current TreeWatch plan and O&M expense is the on-going legacy of the more robust TreeWatch plan deployed between 1999 and 2005, investing approximately $43 million through a deferred O&M cost recovery mechanism.[16]

With urban forests experiencing several years of drought and changing weather conditions, declining health of native tree species and changing growing patterns means the historical vegetation management approach needs to change.

Q. Please provide PSE's actual and planned TreeWatch and tree trimming investments over the six rate periods presented in this case.

A. My Prefiled Direct Testimony focuses on capital investments but managing vegetation and O&M expense as part of a reliable modern grid is important. To ignore PSE's focus on this issue would ignore the value in remaining committed to and expanding on this plan. Table 46 provides the actual investments from January 1, 2019 through the end of the test year of June 30, 2021 for PSE's

[16] *Puget Sound Energy's Petition For the Order Regarding the Accounting Treatment of a Proposed Virtual Right-Of -Way Program*, Docket UE-980877, Order Authorizing Accounting Treatment (July 8, 1998).

TreeWatch plan and PSE's tree trimming plan. The remaining periods are estimated based on current programmatic plans.

Table 46. Summary of TreeWatch and Tree Trimming Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Tree Watch O&M ($ Millions)	2.1	0.3	0-2.2	2.2	2.3	2.3
Tree Trimming O&M ($ Millions)	42.6	9.9	15.8	21.3	21.3	22.5
Circuits addressed (#)	737	149	296	322	358	414

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. PSE removed 2,717 hazard trees associated with its current legacy TreeWatch program and relative to PSE's cyclical tree trimming program, PSE trimmed 377,849 trees from along 6,529 miles of OH distribution and transmission greater that 55 kV since the last rate case and up through the end of the current test year period. PSE anticipates removing over 7,700 hazard trees associated with it current legacy TreeWatch program (between 2023 and 2025)[17] and relative to PSE's cyclical tree trimming program anticipates trimming 797,698 trees from July 1, 2021 through December 31, 2025.

[17] PSE will need to reduce the current TreeWatch program for 2022 to maintain within financial constraints and put focus towards safety trimming.

Q. Have benefits been realized from the current TreeWatch plan?

A. Yes. Confidence in plan benefits can be based on historical benefits realized as demonstrated by the 1999 to 2005 TreeWatch results, which reduced vegetation related outages by 22 percent.

Q. Please describe PSE's Tree Removal Business Case that PSE would like to pursue.

A. With PSE's robust tree trimming plan, less than ten percent of outages are caused by trees within the right-of-way. Most of the tree-caused outages are from trees that fall-in or have branches that break from beyond the right of way.

While PSE's current vegetation maintenance practices provide a baseline level of reliability improvement, there is opportunity to further improve reliability and resiliency by increasing the removal of hazard trees from beyond the right-of-way and removing fast growing "cycle busters" within the right-of-way. Refreshing PSE's TreeWatch plan would improve reliability and resiliency by addressing these at-risk trees.

Q. Is the refreshed TreeWatch plan included in PSE's O&M expense plan presented in this case?

A. No. PSE is providing visibility to the vision in order to propose a cost recovery philosophy that provides support over the current level of constrained O&M expense plan through the end of the rate plan.

Q. Please describe PSE's TreeWatch Business Case that refreshes the current TreeWatch plan in more detail.

A. The first phase would be the three-year period from 2023 to 2025 and would be focused on building the capabilities to best prioritize work and measuring results of the program on approximately 120 circuits. The second three-to-five-year phase would increase the amount of work performed and improve any first phase implementation lessons.

PSE has implemented a machine learning model using PSE's historical outage, weather, and vegetation management data to predict avoided circuit outage savings. This model will improve with greater amounts and quality of data that comes from the first phase of the plan. The plan will initially prioritize implementation based on the reliability benefits and wildfire risk and work to improve data collection using advanced tools and data sets, such as from satellite and Light Detection and Ranging (LIDAR). Please see Appendix D, starting at page 185, for the specific Tree Removal Business Case in support of this future investment.

Q. Please describe the benefits PSE's TreeWatch Business Case will deliver for customers through the rate plan.

A. PSE's primary benefit of this plan is safety and compliance, but improved reliability is a benefit as well. This plan has an iDOT benefit to cost ratio 4.7.

Table 47 provides the benefits of customer minute interruption avoided over the six rate periods presented in this case.

Table 47. Summary of TreeWatch Business Case Benefits by Rate Period

Type of Benefit	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Customer Minute Interruptions saved (# millions)	-	-	-	2.5	3.9	5.4

PSE estimates that the program can prevent approximately 20 percent of vegetation related outages on all impacted circuits. This estimate based on the 1999 to 2005 TreeWatch results, which reduced vegetation related outages by 22 percent, and by using the model which predicts avoided vegetation related outage of 24 percent for a subset of circuits. PSE estimates 390 outages would be avoided annually, which could save approximately $2 million capital and O&M expense investment associated with emergency repairs.

Q. Please describe the estimated TreeWatch Busines Case investment.

A. PSE estimates this plan would cost approximately $83 million spanning from 2023-2030, addressing over 370 circuits. PSE anticipates trimming 797,698 trees and removing 50,555 hazard trees. PSE would invest $6.1 million in 2023, $8.3 million in 2024, and $11.8 million in 2025.

Q. Please describe PSE's next steps to expand the current TreeWatch as described in the TreeWatch Business Case.

A. The recently approved Infrastructure Investment and Jobs Act provides expansive opportunities to seek grants related to the electric grid, including to prevent outages and enhance resiliency. PSE is reviewing the opportunity to seek funding for this holistic approach to vegetation management. Should PSE be successful, grant funding would cover some but not all of this plan. PSE would likely need to revise its grid modernization plan to add or reprioritize investments. PSE would be seeking a first step with the Commission to refresh the accounting treatment that was used in the 1999 to 2005 TreeWatch program that reduces the impact these O&M investments have on customer rates by amortizing in a manner similar to capital investments.

D. Major Projects Electric and Specific Backbone Infrastructure Program

Q. Please describe the key plans that advance grid modernization in the area of backbone infrastructure.

A. In the theme of system reliability, the Major Projects Electric and Specific Backbone Infrastructure ("Backbone Infrastructure Plan") work is focused on transmission and substations that allow for safe and reliable delivery of energy to the distribution system. These major backbone infrastructure projects are driven by compliance with the NERC Reliability Standards and by reliability concerns. There are nine specific backbone major projects that are greater than $10 million

that have been completed or will be completed through the end of the rate plan. Eight of the specific projects are discussed in Bamba, Exh. RBB-1T, which are the completed i) Lake Hills - Phantom Lake Transmission Line Project and ii) Bellingham Substation Project; and the projects that will be completed during the rate plan: iii) Sammamish - Juanita 115 kV, iv) Electron Heights - Enumclaw 55/115 kV Conversion, v) Bainbridge Island Transmission Lines and non-wire solutions, vi) Thurston Transmission Capacity/Tono Substation, vii) Lynden Substation, and viii) Sedro Woolley - Bellingham #4 115 kV. The ninth project is Energize Eastside, which is discussed in Koch, Exh. DRK-1T.

PSE has identified several areas that need to be addressed over the next five to ten years due to forecasted deficiencies. The "Initiation" phase process discussed by Mr. Bamba includes detailed reviews of future needs and solutions identified through the planning process to confirm the project is scheduled and funded appropriately for success.

In the CEIP, three non-wire alternative analysis related to transmission infrastructure are discussed: i) Bainbridge Island Transmission Lines and Non-wire Solutions; ii) Sumner Valley Capacity; and iii) Issaquah Capacity.[18] The Bainbridge Island Transmission Lines and Non-wire Solutions is a set of projects that are currently in the design phase. The Sumner Valley Capacity and Issaquah

[18] Exh. JJJ-3 at 147 (Puget Sound Energy, *2021 PSE Clean Energy Implementation Plan* (Dec. 2021), at 131).

Capacity needs and solutions will progress through initiation, completing the non-wire analysis indicated in the CEIP.

Q. Please provide PSE's actual and planned Backbone Infrastructure capital investments over the six rate periods presented in this case.

A. Table 48 provides the actual plant in service amounts from January 1, 2019 through the end of the test year of June 30, 2021. The remaining periods are estimated based on current programmatic initiation plans and specific project plans.

Table 48. Summary of Backbone Infrastructure Investments by Rate Period

Plan	Up through Current Test Year 1/1/2019 – 6/30/2021	Proforma 7/1/2021 – 12/31/2021	Gap Year 2022	Rate Plan Year 1 2023	Rate Plan Year 2 2024	Rate Plan Year 3 2025
Capital investment $ millions)	60	35.5	98	126.5	80	81.7
Projects placed in service(#)	2	0	1	1	2	3

Additionally, this plan requires incremental OMRC which totals $0.4 million.

Q. Please describe the work completed and anticipated through the end of the rate plan.

A. Please see Koch, Exh. DRK-1T, and Bamba, Exh. RBB-1T, for specific projects work through the end of the rate plan. Relative to the initiation work, PSE anticipates initiating evaluation on eighteen specific area needs (including the

Sumner Capacity and Issaquah Capacity needs) from July 1, 2021 through December 31, 2025.

Q. Please describe the basis for the forecasted Backbone Infrastructure Plan investments in more detail.

A. PSE provides the actual investment associated with the completed Lake Hills – Phantom Lake Transmission Line Project and Bellingham Substation Project work. Bamba, Exh. RBB-1T, discusses the basis for the forecasted investments of Sammamish – Juanita 115 kV, Electron Heights – Enumclaw 55/115 kV Conversion, Bainbridge Island Transmission Lines and non-wire solutions, Thurston Transmission Capacity/Tono Substation, Lynden Substation, and Sedro Woolley – Bellingham #4 115 kV. Koch, Exh. DRK-1T, discusses the basis for the forecasted Energize Eastside investment. The initiation investment is estimated based on historical cost averages for similar potential solutions and optimistic schedules. Due to the preliminary nature of these projects, the total annual budget is programmatically adjusted to a lower total number to account for uncertainty that generally impacts schedule including undefined permit conditions, potential variability from permit conditions based on historical trends, stakeholder engagement, property acquisition challenges, schedule deferrals due to emergent company priorities or resource constraints, and shifts in schedule due to changes in need drivers such as load growth assumption changes.

Q. Have benefits been realized from the Backbone Infrastructure Plan?

A. Yes. With Lake Hills – Phantom Lake Transmission Line Project and Bellingham Substation Project complete, customers benefit from increased reliability as discussed by Bamba, Exh. RBB-1T. The Initiation project development process brings increased confidence and estimated customers benefits. This phase makes sure the need is fully understood, and PSE is well prepared to implement the recommended solution.

Q. Please describe the benefits that the Backbone Infrastructure Plan will deliver for customers through the rate plan.

A. Bamba, Exh. RBB-1T, and Koch, Exh. DRK-1T, discuss the benefits the nine backbone infrastructure projects will deliver through the rate plan. The Initiation process managed by Mr. Bamba will define the schedule and benefits associated with the Initiation investment and subsequent defined projects through the rate plan.

II. CONCLUSION

Q. Does this conclude your testimony?

A. Yes, it does.