EXH. RBB-3
DOCKETS UE-240004/UG-240005
2024 PSE GENERAL RATE CASE
WITNESS: ROQUE B. BAMBA

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, **Complainant,** **v.** **PUGET SOUND ENERGY,** **Respondent.**	**Docket UE-240004** **Docket UG-240005**

SECOND EXHIBIT (NONCONFIDENTIAL) TO THE PREFILED DIRECT TESTIMONY OF

ROQUE B. BAMBA

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

PSE

FINAL ADVANCED METERING INFRASTRUCTURE BENEFITS PROGRESS REPORT

FEBRUARY 2024

PSE PUGET SOUND ENERGY

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PUGET SOUND ENERGY

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EXECUTIVE SUMMARY

Puget Sound Energy ("PSE" or "Company") completed its deployment of its Advanced Metering Infrastructure ("AMI") system in December 2023, on schedule and on budget. In total, PSE transitioned over 1.2 million electric customers and over 900,000 gas customers to AMI and deployed over 7,400 network devices.

In conjunction with PSE's deployment of AMI for its core purpose of measuring and transmitting customer energy use, PSE is currently utilizing AMI in 26 "benefit use cases" and is developing or evaluating the further use of AMI in 29 additional benefit use cases.[1] These use cases advance important Company objectives including customer energy management, operational efficiency, customer bill management, resource planning and investment, revenue assurance and financial analysis, field and customer safety, and grid performance. Collectively, these use cases are estimated to deliver over $1.3 billion in Company and customer benefits with additional qualitative benefits over the anticipated life of the AMI system.

PSE has prepared this final AMI benefits progress report as required by the Washington Utilities and Transportation Commission's Final Order in PSE's 2022 General Rate Case.[2] As required by the Final Order and settlement in that case, this report summarizes PSE's efforts to maximize Company and customer benefits under the AMI program, PSE's plans to continue such maximization efforts, and any new Company or customer AMI benefit use cases identified. The report also updates the reporting metrics agreed to in the 2022 General Rate Case, which includes equity considerations.

This report demonstrates that PSE has taken seriously the Commission's charge in the 2019 General Rate Case[3] that PSE maximize its use of AMI and that PSE will continue to explore and develop opportunities to utilize AMI, consistent with customer need and the Company's overall project portfolio.

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[1] Three use cases were evaluated but have now been discontinued.

[2] *WUTC v. PSE*, Dockets UE-220066/UG-220067/UG-210918 *(consolidated)*, Final Order 24/10 ¶ 65 (Dec. 22, 2022).

[3] *See WUTC v. PSE,* Dockets 190529/UG-190530 et al. (*consolidated*), Final Order 08/05/03 ¶ 157 (July 8, 2020).

ABOUT THIS REPORT

This final report fulfills the requirement regarding Advanced Metering Infrastrure ("AMI") in the Settlement Stipulation and Agreement approved by the Washington Utilities and Transportation Commission ("Commission") in Puget Sound Energy's ("PSE" or "Company") 2022 General Rate Case (the "Settlement Stipulation").[4] The Settlement Stipulation requires PSE to file a "final AMI benefits progress report" before it requests a final prudency determination on its AMI investment.[5] Under the Settlement Stipulation, the AMI benefits progress report must address:

- PSE's efforts to maximize Company and customer benefits realized under the program.
- PSE's plans to continue such maximization efforts.
- Any new Company or customer benefit use cases identified.
- Updates to PSE's AMI reporting metrics, including equity considerations.[6]

Each of these requirements is addressed below, including for each use case:

- a brief description of the AMI benefit use case and how AMI is utilized,
- a discussion of use case progress since 2022, a roadmap for use case implementation, and when implementation will be completed and estimated benefits will begin to be realized (if not already), and
- estimated quantified use case benefits either updated from the previous report or newly quantified, if quantification is possible at this time.

Appendix A updates the existing AMI metrics, including equity metrics.

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[4] *WUTC v. PSE*, Dockets UE-220066/UG-220067/UG-210918 *(consolidated)*.
[5] *WUTC v. PSE*, Dockets UE-220066/UG-220067/UG-210918 *(consolidated)*, Final Order 24/10 ¶ 65, Appendix A, Revenue Requirement Settlement at 5–6 (Dec. 22, 2022).
[6] *Id.*

HOW TO READ THIS REPORT

In addressing the requirements in the Settlement Stipulation, this report provides an overview of PSE's AMI implementation, and the efforts PSE has taken to maximize its use of AMI through "use cases." The use cases are categorized into three tiers:

- **Tier 1** are the six customer-facing set of programs identified by the Commission in PSE's 2019 General Rate Case[7] and reported on by PSE in its 2022 General Rate Case. These use case programs provide customer energy management benefits relating to 1) time of use rates, 2) real-time energy use feedback for customers, 3) behavior-based programs, 4) data disaggregation, 5) grid-interactive efficient buildings, and 6) conservation voltage reduction or volt/volt-amps reactive optimization.
- **Tier 2** are additional use cases PSE identified and reported on in its 2022 General Rate Case and include use cases focused on Company operational efficiencies including 1) smart streetlighting, 2) remote connect disconnect, 3) outage management, and 4) lower meter costs for solar and distributed generation.
- **Tier 3** are use cases that were identified as opportunities to be explored in PSE's 2022 General Rate Case but were not yet initiated or were in the early stages of development. This tier also includes new or emerging use cases since the 2022 General Rate Case that have potential to benefit customers or the Company and are in further development.

WHAT IS A "USE CASE"?

A "use case" is an application of AMI data or technology for a use beyond its core purpose of measuring and reporting on customer energy usage.

Examples of AMI use cases include:

- The use of AMI meter *data* to influence customer behavior to behave more energy efficiently.
- The use of AMI meter *technology* to remotely connect or disconnect a customer from service.
- The use of AMI meter *data* by PSE to better understand customer energy usage which can inform Company resource planning and investment.

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[7] *WUTC v. PSE,* Dockets 190529/UG-190530 et al. (*consolidated*), Final Order 08/05/03 ¶ 157 (July 8, 2020).

WHAT THIS REPORT DOES NOT ADDRESS

As required in the Settlement Stipulation, this report reports on PSE's continued efforts to maximize AMI, PSE's plans to continue such efforts, and any new benefit use cases identified. This report does not—nor is the report required to—provide the following:

- **Further justification for PSE's need-based decision to implement AMI in 2016.** The Commission already determined in PSE's 2019 General Rate Case that PSE's decision to implement AMI was the operationally prudent and correct business decision.[8] The Commission withheld full rate recovery for PSE's AMI investment pending completed deployment of AMI and PSE's development of certain AMI use case benefits.[9] PSE is not required to further justify the initial business decision to transition to AMI as that has already been decided.
- **Business justification for PSE projects that implement or utilize AMI.** This report does not provide a full explanation or justification for broader Company projects that use or may use AMI. For example, the initial business justification has been developed for the time varying rate pilot, which utilizes AMI. This report discusses how AMI is utilized as part of the time varying rate pilot, but a comprehensive discussion and justification of the time varying rate pilot is reported separately and is beyond the scope of this document. PSE's investment planning processes addresses business justification which is not described in this report.
- **The estimated cost of implementing every use case.** Tier 1 and Tier 2 use cases generally include AMI implementation costs, if any, but many Tier 3 use cases do not. Some use cases require little implementation cost, such as building dashboards, while other use cases require more significant implementation cost, such as the development of PSE's virtual power plant[10] for demand response and other load flexibility programs. As a result, a comprehensive net benefit analysis (benefit minus costs) is not included (or even available) for each use case.
- **Cost effectiveness test calculations.** In the 2022 General Rate Case, some intervenors proposed various methodologies for calculating AMI benefits (such as the "Total Resource Cost" test). Cost effectiveness test calculations are generally used to make decisions between types of energy resource programs and many states have adopted variations of cost effectiveness tests for energy efficiency and distributed energy resources.[11] For example, cost

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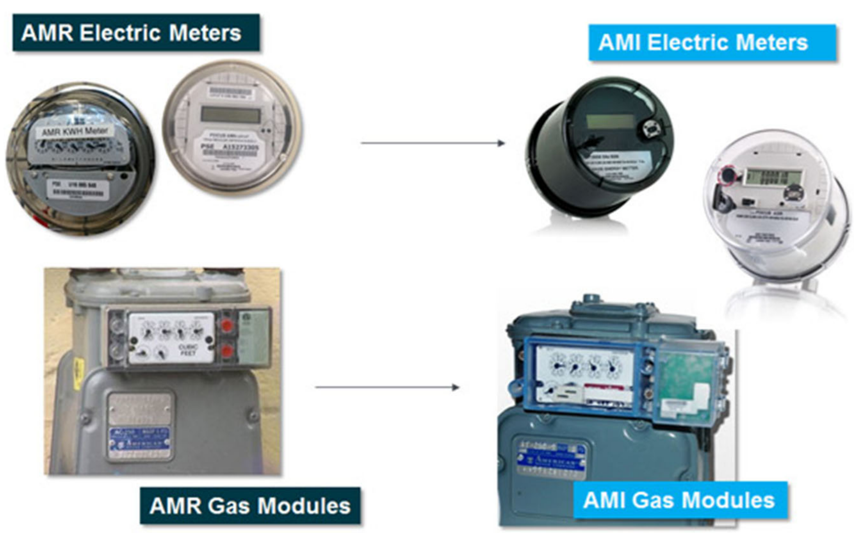
[8] *Id.* ¶ 153.
[9] *Id.* ¶¶ 155–57.
[10] A virtual power plant is software that facilitates the control and management of demand response programs and eventually distributed energy resources that span across many customers and locations, aggregating them to be managed similarly to a distinct power plant.
[11] *See* National Standard Practice Manual for Benefit-Cost Analysis of Distributed Energy Resources, at 3–1 (2020) (discussing the various cost-effectiveness tests used to evaluate DERs), available at https://www.synapse-energy.com/national-standard-practice-manual-benefit-cost-analysis-distributed-energy-resources; Snuller Price, E3, Cost-effectiveness Tests 'Current Practice', at 4, https://www.aceee.org/files/pdf/conferences/mt/2009/E2_Price.pdf.

effectiveness tests are used as part of PSE's energy efficiency program planning and implementation process and captured in PSE's conservation reports. However, the vast majority of Tier 2 and 3 use cases are not energy resource related which, for example, quantify process savings for both PSE and customers. This report is not comparing each of these use cases or deciding between them, but instead, consistent with the Commission's charge, reports on PSE's utilization and development of AMI benefit use cases.

MAXIMIZING AMI BENEFITS

COMPLETION OF AMI DEPLOYMENT

PSE began deployment of AMI in 2016 with installation of the AMI network followed by the installation of electric meters and gas modules in 2018. Deployment was substantially completed in December 2023. In total, PSE transitioned over 1.2 million electric customers and over 900,000 gas customers to AMI and deployed over 7,400 network devices.



PSE's AMI deployment employed over 70 gas and electric installers daily and was completed on-schedule, per the original deployment plan. PSE began retirement of the Automated Meter Reading ("AMR") network in 2022 and will retire the last AMR network device in December 2024. Through the course of implementation, 3,356 customers, 0.2% electric and 0.12% gas, opted-out of AMI and PSE installed a non-registering meter which requires manual reads. PSE's final capital AMI investment is on budget with the original 2016 estimate of $456 million.

With deployment complete, PSE is realizing the avoided AMR obsolescence benefit discussed in the 2016 AMI Business Case from an unacceptable failure rate of meters and modules, an unacceptable failure rate of the communication network, decreasing manufacturer product supply, and lack of market focus on enhancing the AMR technology to meet future needs. By implementing AMI, PSE will avoid the maintenance obligations that would otherwise increase if the existing AMR system were not replaced which included dependence on refurbishing existing equipment to meet replacement need, which was unsustainable.

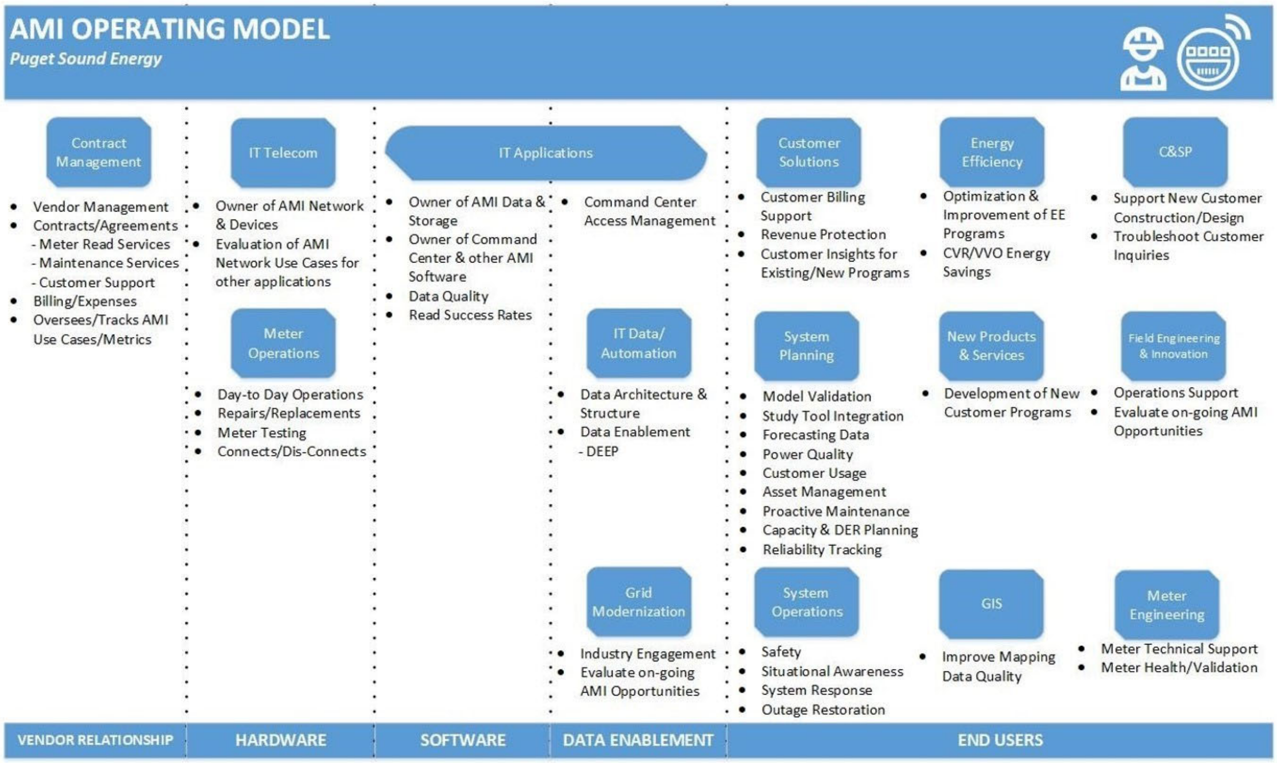
AMI BENEFITS FRAMEWORK

AMI benefit use cases vary as some can be implemented directly with AMI functionality and data, such as with the remote switch and conservation voltage reduction, while others use data dashboards and leveraging information technology data collection and presentation tools. Others progress further and faster with deployment completed such as improved bill generation and pilots such as the time varying rate pilot. AMI benefits will continue to expand as data is increasingly accessible to customers and to PSE processes, such as when AMI data is integrated with PSE's new Advanced Distribution Management System for monitoring and controlling the grid or a future distribution energy resource management system for monitoring and controlling customer and utility distributed energy resources. As AMI is fully embedded in the business, more uses will emerge and become business as usual.

PSE has quantified benefits based on best known information regarding how a use case will be implemented. In some of use cases, full feasibility is unknown, but PSE has calculated benefits based on currently available information. Benefits are calculated by each business owner and vary in approach, based on established data and judgement. Where possible, PSE has quantified both customer benefits and utility benefits through 2037 in alignment with the AMI life cycle. PSE reserves the right to update its benefit calculations as more information becomes available.

ORGANIZATIONAL COMMITMENT TO AMI

PSE has established an operating model to facilitate PSE's ongoing utilization of AMI. Sustaining AMI operational excellence and use case innovation requires an experienced operations and management team. To accomplish this, PSE's experienced AMI deployment team will substantially transition to ongoing maintenance and management of the AMI system, leveraging strong contract relationships and program management skills. As shown below, PSE's AMI operating model spans many departments across functional roles of vendor relationships, maintaining hardware and software, data enablement, and end use strategy and oversight.



PSE's Contract Management organization oversees the AMI operating model including the ongoing relationship with the AMI system vendor who performs digital meter reading services and minor maintenance. This organization employs five full time personnel who work closely with various departments that are responsible for operations and maintenance of the AMI system including:

- The Meter Operations department who maintains meter expertise, develops maintenance plans, and performs day to day meter management;
- The Information Technology department who maintains the AMI software and hardware and has expertise in managing AMI data;
- The Telecommunications department that maintains AMI network expertise; and
- The Planning department, specifically the Grid Modernization team, that specializes in technology innovation to modernize the grid and engages with industry to maintain strategic expertise relating to the AMI technology. Within this department is PSE's AMI Strategist who seeks, evaluates, and initiates the development of new use cases.

The Contract Management organization works closely with the AMI Strategist to track progress on existing use cases, evaluate benefit realization, and oversee new use cases that have been initiated for development. The Contract Management organization also guides an internal cross functional working group that helps to enable access to AMI data. To spread awareness and use of AMI data, PSE has recently soft launched the Meter Data Playbook which will help new and incoming users to learn about core meter data resources and database tools including access and connection information, key data source information, data source tips and facts, additional resources, and meter data subject matter experts.

What information can I find in the Meter Data Playbook?

- **Access and Connection Information** - Learn how to gain access to this data, what entitlements are needed, how to connect and interact with the data, connection parameters and settings for your tools, etc.
- **Key Data Source Information** - Database timings (refreshes, periods to avoid querying, etc.), diagrams, high-level lineage
- **Data Source Tips & FAQs** - Very helpful tips, guidance, and context to Meter Data sources to help understand the nuances of this data, particulars about certain datasets, and key considerations to help you use Meter Data accurately
- **Additional Resources** - Links, files, and additional resources to help your Meter Data efforts and to provide additional insights to working with this data
- **Contacts & Meter Data SMEs** - Have more questions or a question that isn't answered here? Reach out to the experts and Subject Matter Experts (SMEs) in the Meter Data domain

EQUITY

Energy equity is a priority for PSE, with the Company making significant strides towards incorporating equity across the business. While equity was not a mandated requirement when PSE decided to implement AMI in 2016, PSE has conscientiously worked to incorporate equity into the development and advancement of AMI use cases, including the equitable distribution of benefit outcomes across all segments of PSE's customer base.

The following are examples of how the AMI use cases meet the four core equity tenets:

Recognition Justice:

- Investment planning process as well as field safety and use cases such as Extreme Event Strategic Load Shedding will incorporate use of maps to identify named communities and prioritize actions as well as build maintenance and operating procedures that directly consider named communities.

Procedural Justice:

- Time Varying Rates Programs, Load Flexibility Programs, and other use cases like Customized Program Engagement and Optimization, incorporate equity focus by facilitating customer participation from a broader population of PSE's customer base.

Distributional Justice:

- The Improved Planning and Investment Decisions use case category addresses how projects are prioritized in the planning process. Delivery System investments are submitted through PSE's investment decision optimization process which now incorporates named community information to assess equity benefits using Customer Benefit Indicators such as Resilience.
- Grid Performance tools that support future investments also follow PSE's investment decision optimization process which has incorporated named community information to assess equity benefits using Customer Benefit Indicators such as Resilience and reduce named community burdens by prioritizing investments that reduce outages for those communities.

Restorative Justice:

- The Customer Bill Management use case category furthers the opportunity to engage customers in bill assistance programs directly supporting the energy burdened.
- The Clean Energy Integration use case category furthers policy advancements of distributed energy resources and electric vehicles with incentives and a focus on removing barriers in the process to invite engagement.

The table below describes how equity has been integrated within those use cases currently in the pilot and/or mature development stages of progression (i.e., Tier 1 and Tier 2). Use cases currently in the early discovery stages of development (i.e., Tier 3), to the extent equity has been incorporated to date, are addressed in the use case discussion below.

Table 1: Use case equity considerations

USE CASE	NAME	EQUITY CONSIDERATIONS
B1	TIME VARYING RATES PROGRAM	Time varying rates were designed concurrently with the Bill Discount Rate stakeholder process and PSE will utilize Bill Discount Rate as a primary equity component by studying Bill Discount Rate customer's price responsiveness in the pilot treatment population group(s) where possible. The evaluation, measurement, and verification process at the conclusion of the time varying rates pilots in 2025 will detail price responsiveness, load impacts, and bill impacts for the vulnerable customer groups. Also, as part of the 2022 General Rate Case settlement agreement, half of each of the low-income pilot population was and will be targeted to receive bill protection and half will receive smart thermostats. Finally, the project team is working on incorporating participation statistics of named vulnerable customers and deepest need customers in the evaluation, measurement, and verification reporting when possible.
B2	LOAD FLEXIBILITY PROGRAMS	Demand response programs utilize existing data and customer segmentation models so that marketing efforts target residential customers in named communities for both Automated Demand Response and Behavior Demand Response programs. Prioritization for Commercial and Industrial Demand Response customers will be on recruitment for Commercial and Industrial facilities in named communities. Through PSE's 2023 Biennial CEIP Update, PSE established distribution of energy benefit targets for named communities and deepest need. PSE is developing channels to provide demand response-enabled technology to named communities who may not have the means of acquiring devices themselves, with the intent of extending accessibility to PSE customer programs. Examples PSE customers may expect include, but are not limited to, (a) device provisioning, at-cost to free devices that enable demand response connectivity for their heating and/or cooling, and (b) enhanced incentives, increased enrollment incentives for enrolling their already-owned device in a demand response program.
B3	BEHAVIORAL BASED	Through PSE's 2023 Biennial CEIP Update, PSE established distribution of energy benefit targets for named communities and deepest need specifically for energy efficiency. Additionally, PSE's Virtual Commissioning program has a very low barrier to participation. There is no paperwork required, and a third-party consultant walks customers through implementation over phone calls and emails. The consultant has Spanish language program information that they share with customers as needed.
B4	CONSERVATION VOLTAGE REDUCTION	PSE's Delivery System Planning process reviews named community maps to identify potential opportunities for conservation voltage reduction. The investment decision optimization process values conservation voltage reduction within the Customer Energy Savings benefit category which is one of benefits in the equity category that is used to determine the optimal set of investments and project to move forward with. As a result, for the 2025 and 2026 investment portfolios, 64% of the investments in conservation voltage reduction benefit named communities,

		specifically highly impacted communities and highly vulnerable populations. Additionally, when PSE experienced operational challenges, substations that serve named communities were prioritized to restore to conservation voltage reduction settings first.
C1	SMART STREET LIGHTING	The Smart Street Light program automatically provides status and performance information, allowing PSE to proactively respond to streetlight outages, rather than waiting on customer reports. This helps eliminate equity bias and removes customer barriers from the resolution process. This benefits communities that may be less likely to contact PSE directly or through advocacy of their municipalities. Additionally, PSE will consider named communities as it continues to build out the annual deployment plan.
C2	REMOTE CONNECT DISCONNECT	PSE is actively taking steps to ensure equitable implementation of remote connect and disconnect ability. For example, for disconnects due to nonpayment, PSE continues to conduct premise visits for every residential customer prior to disconnect. Additionally, remote connect functionality enables faster reconnection in the event of a disconnection for nonpayment.
C3	OUTAGE MANAGEMENT DETECTION	Better outage information furthers PSE emergency response, which will include equity considerations into response practices in the 2024 Energy Emergency Plan.
C4	LOWER METERING COSTS FOR SOLAR AND DISTRIBUTED GENERATION	The benefit of the meter savings that is associated with this use case applies to all customers, including those customers participating in Schedule 667. PSE incorporated equity into its recently approved Schedule 667 regarding purchases from distributed solar photovoltaic systems, which engaged disenfranchised communities furthering procedural equity and directly provides financial benefits to equity focused customers.

In addition to the qualitative description of PSE's equity progress related to AMI above, this report includes calculations for four equity metrics shown in Appendix A. The calculations are provided for years 2022 and 2023 across three subsets of PSE's customer population of named communities: 1) customers in areas designated as highly impacted communities and high vulnerable population classification; 2) customers in areas designated as highly impacted communities and medium vulnerable population classification and 3) customers in areas designated as highly impacted communities and low vulnerable population classification. Metrics for *AMI electric bill read success rate*, *AMI gas bill read success rate* and *remote switch success rate* in these named community designated areas are similar or just slightly higher than that of the average PSE customer. Calculations for the *reduced energy consumption from voltage regulation* in these named community groups for 2023 is generally lower than that of the average PSE customer. However, the metric calculation is closer to that of the average PSE customer compared to the average calculation for all customers classified as high vulnerable populations (those in highly impacted communities and not), as noted in Appendix A. PSE looks to address these differences in average savings by focusing on voltage reduction projects in named communities in 2025 and 2026, as noted in Table 1 above.

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AMI USE CASE PROGRESS

A. AMI USE CASE OVERVIEW AND STRUCTURE

There are 58 benefit use cases that PSE has included in this progress report. Below are the use case benefit categories as divided by section in this report:

B. Customer Energy Management

C. Operational Efficiency

D. Customer Bill Management

E. Improved Planning and Investment Decisions

F. Clean Energy Integration

G. Improved Customer Participation and Program Deployment

H. Revenue Assurance and Financial Analysis

I. Field and Customer Safety

J. Grid Performance

K. Operations Reduction

The following table shows how each use case is categorized and the implementation phase. PSE has 13 uses cases in the discovery phase, 16 in development, five pilots running, 20 in deployment at some level, and one that is completed. Three use cases have been discontinued.

Table 2: AMI use case summary list

#	USE CASE	TYPE OF BENEFIT	NAME	TIER	IMPLEMENTATION PHASE
1	B1		RESIDENTIAL TIME OF USE	TIER 1	PILOT
2	B1		SMALL BUSINESS TIME OF USE	TIER 1	PILOT
3	B1		ELECTRIC VEHICLE TIME OF USE	TIER 1	PILOT
4	B2		SMART THERMOSTATS DEMAND RESPONSE	TIER 1	PILOT
5	B2		BEHAVIOR BASED DEMAND RESPONSE	TIER 1	DEPLOYMENT
6	B2		GRID INTERACTIVE WATER HEATING DEMAND RESPONSE	TIER 1	PILOT

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7	B2	CUSTOMER ENERGY MANAGEMENT	BAINBRIDGE ISLAND TARGETED DEMAND RESPONSE	TIER 1	DEPLOYMENT
8	B2		CITY OF DUVALL TARGETED DEMAND RESPONSE	TIER 1	DEPLOYMENT
9	B3		ONLINE USAGE PRESENTMENT ELECTRIC	TIER 1	DEPLOYMENT
10	B3		ONLINE USAGE PRESENTMENT GAS	TIER 1	DEPLOYMENT
11	B3		HIGH USAGE ALERT ELECTRIC	TIER 1	DEPLOYMENT
12	B3		HIGH USAGE ALERT GAS	TIER 1	DEPLOYMENT
13	B3		IN HOME DISPLAY PILOT	TIER 1	DISCONTINUED
14	B3		VIRTUAL COMMISSIONING PILOT	TIER 1	DEPLOYMENT
15	B4		CONSERVATION VOLTAGE REDUCTION	ORIGINAL BUSINESS CASE	DEPLOYMENT
16	C1	OPERATIONAL EFFICIENCY	SMART STREET LIGHTING	TIER 2	DEPLOYMENT
17	C2		REMOTE CONNECT DISCONNECT	TIER 2	PARTIAL DEPLOYMENT
18	C3		OUTAGE MANAGEMENT DETECTION	TIER 2	PARTIAL DEPLOYMENT
19	C4		LOWER METERING COSTS FOR SOLAR AND DISTRIBUTED GENERATION	TIER 2	DEPLOYMENT
20	D1	CUSTOMER BILL MANAGEMENT	IMPROVED BILL GENERATION	TIER 3	PARTIAL DEPLOYMENT
21	D2		IMPROVED CUSTOMER ENGAGEMENT WITH DATA	TIER 3 - NEW	DISCOVERY
22	D3		BILL PAYMENT – PRE-PAID	TIER 3- NEW	DISCOVERY
23	D4		METER ASSET HEALTH (ACCURATE METER TYPE INSTALLATION)	TIER 3- NEW	COMPLETED
24	E1	IMPROVED PLANNING AND INVESTMENT DECISIONS	ELECTRIC VEHICLE PLANNING AND INTEGRATION	TIER 3	DEVELOPMENT
25	E2		LOAD FORECASTING	TIER 3	DEVELOPMENT
26	E3		PHASE IDENTIFICATION	TIER 3- NEW	DEVELOPMENT
27	E4		NON-WIRES ALTERNATIVE	TIER 3- NEW	DEPLOYMENT
28	E5		SIZING TRANSFORMERS	TIER 3- NEW	DEPLOYMENT
29	E6		TRANSFORMER ASSET HEALTH (VOLTAGE ANOMALIES)	TIER 3- NEW	DEVELOPMENT
30	E7		MODEL VALIDATION (VOLTAGE)	TIER 3- NEW	DEVELOPMENT
31	E8		ENHANCED POWER FLOW MODELING	EMERGING	DEVELOPMENT
32	E9		MASKED LOAD IDENTIFICATION	EMERGING	DEVELOPMENT
33	E10		FIXED CAPACITOR MONITORING	EMERGING	DISCOVERY
34	E11		SECONDARY CIRCUIT PARAMETER ESTIMATION	EMERGING	DISCOVERY
35	F1		DISTRIBUTED ENERGY RESOURCES INTEGRATION	TIER 3	DEPLOYMENT

36	F2	CLEAN ENERGY INTEGRATION	HOSTING CAPACITY ANALYSIS	TIER 3	DEVELOPMENT
37	F3		BATTERY INCENTIVES	TIER 3- NEW	DEVELOPMENT
38	F4		ELECTRIC VEHICLE/BATTERY CHARGING CAPACITY MAP	EMERGING	DEVELOPMENT
39	F5		SMART INVERTER CONNECTION	EMERGING	DISCOVERY
40	F6		ALTERNATIVE TRANSPORTATION ELECTRIFICATION RATE SCHEDULES	TIER 3- NEW	DEVELOPMENT
41	F7		INTERCONNECTION COMMISSIONING	EMERGING	DEVELOPMENT
42	G1	IMPROVED CUSTOMER PARTICIPATION AND PROGRAM DEPLOYMENT	CUSTOMIZED PROGRAM ENGAGEMENT AND OPTIMIZATION	TIER 3- NEW	DEVELOPMENT
43	H1	REVENUE ASSURANCE AND FINANCIAL ANALYSIS	THEFT AND FRAUD	TIER 3	DISCOVERY
44	H2		COST OF SERVICE STUDIES	TIER 3- NEW	DEPLOYMENT
45	I1	FIELD AND CUSTOMER SAFETY	UNSAFE CONDITION (PHOTO VOLTAIC BACKFEED)	TIER 3- NEW	DEVELOPMENT
46	I2		DOWNED LIVE WIRE NOTIFICATION	TIER 3- NEW	DISCOVERY
47	I3		IMPROVED CUSTOMER SAFETY (FIRE NOTIFICATION)	TIER 3- NEW	DISCOVERY
48	I4		COMMUNICATIONS FOR METHANE DETECTION	EMERGING	DISCOVERY
49	J1	GRID PERFORMANCE	DISTRIBUTION AUTOMATION OVER AMI	ORIGINAL BUSINESS CASE	DISCONTINUED
50	J2		MOMENTARY OUTAGES / POWER QUALITY	TIER 3- NEW	DISCOVERY
51	J3		VOLTAGE COMPLIANCE (REAL-TIME OPERATIONS)	TIER 3- NEW	DEPLOYMENT
52	J4		PREDICTIVE ANALYTICS FOR OPERATIONS	TIER 3- NEW	DISCONTINUED
53	J5		RELIABILITY INDEX VALIDATION	EMERGING	DEVELOPMENT
54	J6		OUTAGE CAUSE PREDICTION	EMERGING	DISCOVERY
55	J7		COLD LOAD PICKUP PREVENTION	EMERGING	DISCOVERY
56	J8		EXTREME EVENT STRATEGIC LOAD SHEDDING	EMERGING	DISCOVERY
57	K1	OPERATIONS REDUCTION	METER SAMPLING	TIER 3- NEW	DEPLOYMENT
58	K2		ASSET UTILIZATION	TIER 3	DEVELOPMENT

These 58 use cases are estimated to bring over $1.3 billion in customer and utility benefits through 2037, as shown in Table 3 below.

Table 3: Total AMI use case estimated benefit summary

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TYPE OF BENEFIT	CUSTOMER BENEFIT ESTIMATE	UTILITY BENEFIT ESTIMATE	TOTAL BENEFIT ESTIMATE
CUSTOMER ENERGY MANAGEMENT	$154.2M	$619.1M	$773.3M
OPERATIONAL EFFICIENCY	$4.8M	$320.4M	$325.2M
CUSTOMER BILL MANAGEMENT	$38M	$14M	$52M
IMPROVED PLANNING AND INVESTMENT DECISIONS	$34.8M	$122.5M	$157.3M
CLEAN ENERGY INTEGRATION	$13.6M	$25.4M	$39M
IMPROVED CUSTOMER PARTICIPATION AND PROGRAM DEPLOYMENT	$0M	$0M	$0M
REVENUE ASSURANCE AND FINANCIAL ANALYSIS	$0M	$0.06M	$0.06M
FIELD AND CUSTOMER SAFETY	$0.02M	$0.03M	$0.05M
GRID PERFORMANCE	$23M	$1.9M	$25M
OPERATIONS REDUCTION	$10.6M	$9.6M	$20.2M
TOTAL	**$279M**	**$1,112.9M**	**$1,392M**

B. CUSTOMER ENERGY MANAGEMENT

Customer Energy Management programs comprise the “Tier 1” use cases identified by the Commission in its 2019 General Rate Case Final Order, and to which PSE reported on in the 2022 General Rate Case. These programs provide tools and programs that customers can participate in to manage their energy use or enable the utility to manage energy for savings to customers overall. There are four categories of Customer Energy Management Programs: Time Varying Rates Programs, Behavior-based Programs, Load Flexibility Programs, and the Conservation Voltage Reduction Program, that together cover 15 use cases.

For Time Varying Rates Programs, AMI data is used to measure participant energy usage change over time. For Load Flexibility Programs, AMI data is leveraged through the virtual power plant where load reduction events related to demand response are dispatched and measured. For Behavior-based Programs, data is collected and then ported to established presentment systems and tools so that customers can view and export their usage. Additionally, data is used by PSE’s Energy Efficiency team to identify businesses that would benefit from improved energy efficiency and management measures. For the Conservation Voltage Reduction Program, AMI data is used to determine voltage settings and review Conservation Voltage Reduction Program maintenance over time.

Customer Energy Management Programs have progressed since the 2019 General Rate Case. Estimated quantified benefits through 2037 are significant as shown below.

Table 4: Customer Energy Management summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
$486.6M	$773.3M	$66.4M

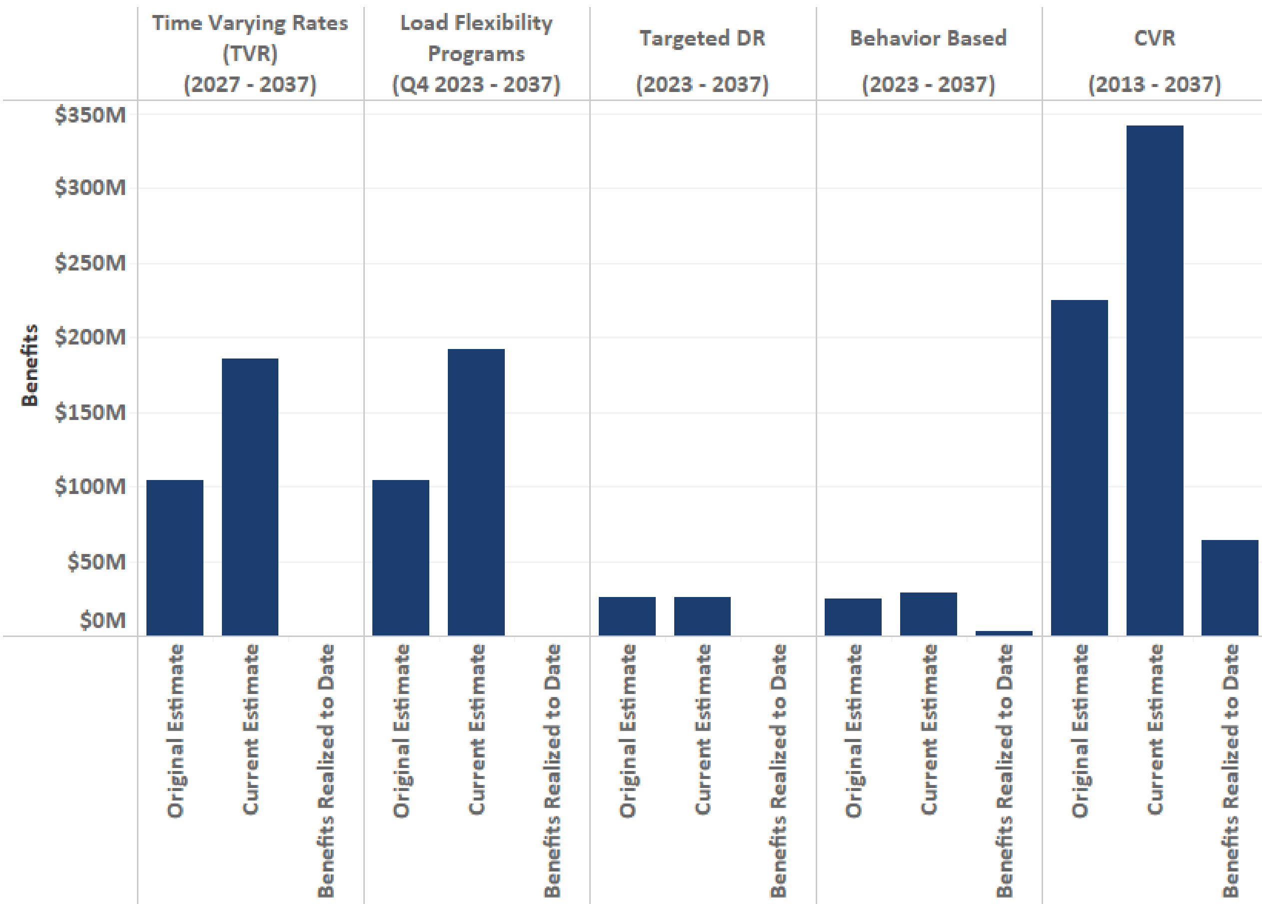

Figure 1: Customer Energy Management benefit summary breakdown

1. TIME VARYING RATES PROGRAMS

Time varying rates are designed to lower system costs by providing customers a price signal that encourages them to lower their monthly energy bills by reducing consumption during the peak period and shifting it to the off-peak period, when rates are less expensive. This lowers the need for additional generation and infrastructure capacity additions by managing system and local peaks, reducing customer costs, and integrating variable renewable generation. In the 2022 General Rate Case, the Commission approved PSE's proposal for a time varying rates pilot to test revenue-neutral time of use rates, peak time rebate, and time of use rates.[12]

AMI plays a critical role in the implementation of time varying rates. First, it was used to recruit customers for the pilot by modeling their usage with AMI interval data and providing the data to prospective customers to help them understand the rate opportunities and impacts through a Rate Education Report and online tools allowing customers to compare a personalized estimate of time of use rate with their current Schedule 7 inclining block rate. Over 175,000 electric customers received this data.

Second, after the pilot is implemented, PSE will use AMI data to evaluate the pilot including 1) load impact evaluation after the first year of the pilot; 2) load impact evaluation after the second year of the pilot; and 3) process evaluation after the second year of the pilot. The AMI data will allow PSE to determine if peak reduction and shifts align with the pilot design.

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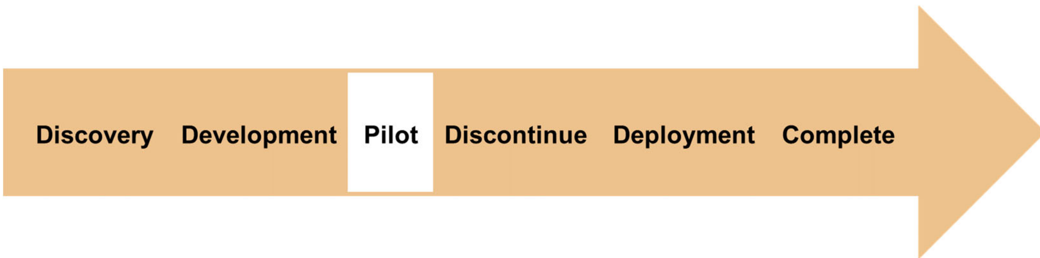
[12] *WUTC v. PSE*, Dockets UE-220066/UG-220067/UG-210918 *(consolidated)*, Final Order 24/10, ¶ 65(12) (Dec. 22, 2022).

PSE's time varying rates pilot implementation plan as described in the 2022 General Rate Case was to implement one pilot that would test a two-period time of use rate, a two-period time of use combined with peak time rebate, and a three-period time of use rate for residential electric vehicles, targeting 7,500 customers in recruitment for the pilot. Portions of this pilot would begin in winter of 2023 and conclude in 2025 with a likely rate offer to PSE customers in late 2026.

The 2022 time varying rates benefit calculation captured avoided costs relative to emissions, energy, transmission and distribution capacity, and generation capacity, totaling between $15.5 million and $63.4 million in customer benefits depending on customer peak reduction and participation rates with a base case of $104 million through 2037.

Progress since 2022:



The three use cases pilots associated with this program were broken into four tariff schedules: 1) residential two-tier time of use rates – Schedule 307; 2) residential two-tier time of use with a dispatchable peak time rebate mechanism – Schedule 317; 3) a residential whole-premise time of use rates designed for electric vehicle users – Schedule 327; 4) and a general service two-tier time of use with peak time rebate – Schedule 324. For the residential customer acquisition, in the summer 2023, the 175,000 residential electric customers were targeted through five customer waves ranging from 25,000-50,000 with AMI tools as described above. By leveraging customer AMI data, the personalized interactive bill impact analytics made available to customers has allowed PSE to surpass all minimum treatment populations and the pilot relating to electric vehicles reached maximum participant capacity. PSE is currently in the process of enrolling residential customers on the time of use rates, with general service recruiting to follow in 2024. The average opt-in rate to date is a successful 4%. PSE will ultimately test six treatment populations and enroll up to 15,000 customers, with a minimum target of 7,500 customers.

		Treatment	Schedule Cap	Minimum Pilot Treatment Population
Residential	Sch. 307	Residential Service TOU*	4,000	1,000
		Residential Service TOU + Bill Discount Rate		1,000
	Sch. 317	Residential Service TOU with PTR*	6,000	1,500
		Residential Service TOU with PTR + Bill Discount Rate		1,500
	Sch. 327	Residential Service TOU with Super Off-Peak (including Bill Discount Rate(s))	1000	500
GS*	Sch. 324	General Service TOU with PTR	4,000	2,000
		TOTAL	15,000	7,500

*TOU = Time of Use; PTR = Peak Time Rebate; GS = General Service

PSE has acquired 8,518 residential customers of the total allowed 11,000, putting the residential rime varying rates at over 77% capacity to date. Peak time rebate events are planned to begin in early 2024.

The timeline of advancing the use cases is shown below. The owner of this use case is Regulatory Affairs.

Table 5: Time Varying Rates Programs use case timeline

TIME VARYING RATES				
2021	2022	2023	2024	2025
PILOT PLANNING	PILOT FILLING THROUGH GENERAL RATE CASE FILING	CUSTOMER EDUCATION, OUTREACH, AND RECRUITING	PILOT IMPLEMENTATION Q4 2024, CUSTOMER ENGAGEMENT MANAGEMENT, NEW CONCEPT DEVELOPMENT AND EVALUATION	
	WUTC APPROVAL/MODIFY			WUTC TIME OF USE PILOT REPORT

Benefits are updated using the framework provided in the 2022 General Rate Case to capture avoided transmission and distribution capacity, avoided generation capacity, and load shifting benefits.

Table 6: Time Varying Rates Programs use case benefit summary (nominal)

<table>
<tr><th>PROGRAM</th><th>ORIGINAL PROJECTED BENEFIT ESTIMATE</th><th>CURRENT PROJECTED BENEFIT ESTIMATE</th><th>BENEFITS REALIZED TO DATE</th><th>ORIGINAL BENEFIT REALIZATION SCHEDULE</th><th>CURRENT BENEFIT REALIZATION SCHEDULE</th></tr>
<tr><td>RESIDENTIAL TIME OF USE</td><td>$52.4M</td><td rowspan="3">WILL CALCULATE WHEN PILOT IS COMPLETED</td><td>$0M</td><td>2027</td><td>2027</td></tr>
<tr><td>SMALL BUSINESS TIME OF USE</td><td>$7.0M</td><td>$0M</td><td>2027</td><td>2027</td></tr>
<tr><td>ELECTRIC VEHICLE TIME OF USE</td><td>$44.8M</td><td>$0M</td><td>2027</td><td>2027</td></tr>
</table>

2. LOAD FLEXIBILITY PROGRAMS

Load flexibility refers to the ability to modify residential or building load in response to real-time conditions of the electricity grid. In addition to providing grid services, load flexibility can also help optimize customer cost reduction, climate mitigation (by moving demand to periods when the grid is less carbon-intensive or by helping to integrate variable and intermittent renewable energy resources), and occupant needs and preferences.

PSE FLEX

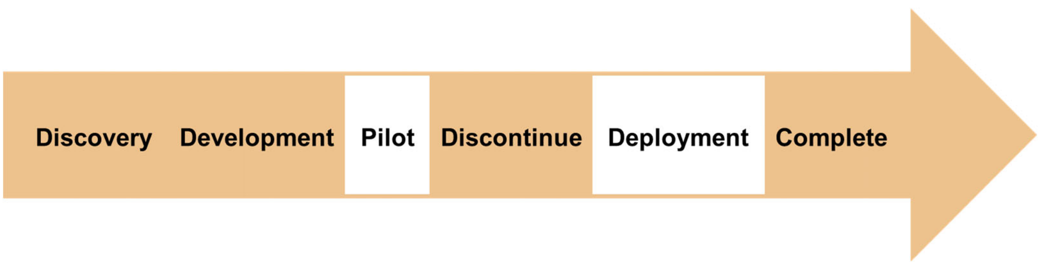
Join this smart approach to meeting our region's growing energy needs

There are four use cases associated with the Load Flexibility programs: 1) Direct Load Control programs including smart thermostat programs for space heating and grid-interactive water heating; 2) Behavioral Demand Response; 3) Targeted Demand Side Management including a Bainbridge Island electric demand response pilot and City of Duvall gas demand response pilot; and 4) Commercial and Industrial direct sales for curtailment.

AMI interval data is integrated into PSE's virtual power plant which sends communications to customers and controls devices when load reduction is needed, known as an "event." After the event, AMI usage data for each customer is compared to usage baseline profile to calculate the customer's usage reduction during the event. By integrating with the virtual power plant, the customer's event reduction benefit and overall system load reduction benefit can be calculated timely, and PSE can evaluate customer behavior. This provides an opportunity to improve event management for the next time.

PSE's plan described in the 2022 General Rate Case was to implement a system-wide load flexibility program with the goal of achieving 29 MW of capacity reduction by 2025 and 196 MW by 2031. Customer solicitation and acquisition were slated to begin in 2023 with 3,000 customers, expanding to 15,000 by 2025, and 100,000 by 2031. These programs include Direct Load Control and Behavioral Demand Response. PSE also planned to pilot Targeted Demand Side Management on Bainbridge Island that would ramp up to a full-scale program by 2028, with 200-300 participants added annually, and in the City of Duvall to reduce winter peak natural gas usage by 30,000 million BTU (British Thermal Unit) per hour by 2029 through a residential and commercial smart thermostat pilot. The initial pilot will ramp-up by 50-70 participants added annually to full-scale program by 2028.The 2022 benefit calculation captured avoided costs, relative energy, transmission and distribution capacity, and generation capacity, totaling between $72 million and $174 million, depending on customer peak reduction and participation rates with a base case of $130 million through 2037.

Progress since 2022:



PSE has made better-than-anticipated progress in rolling out the Load Flexibility programs. PSE is piloting the Direct Load Control programs, having enrolled 8,900 customers in these programs, specifically smart thermostats for winter season events between November 1, 2023 and March 31, 2024. PSE engaged approximately 450,000 customers in system wide Behavior Demand Response for which a two-hour load reduction event in August 2023 was communicated to customers and control dispatched through the virtual power plant. PSE plans to enroll 75 customers in the Targeted Demand Side Management programs and has called six events through the virtual power plant for the Targeted Demand Side Management Program thus far. PSE has also deployed the commercial and industrial direct sales for curtailments with target to achieve 40 MW savings through 2025. The timeline of advancing the use cases is shown below. The owner of this use case is Energy Efficiency.

Table 7: Load Flexibility Program use case timeline

LOAD FLEXIBILITY PROGAMS				
2021	2022	2023	2024	2025
VENDOR SELECTED		VENDORS SELECTED ROLL OUT TO C&I DIRECT SALES (10 CUSTOMERS)	C&I DR* (100 CUSTOMERS)	C&I DR (150 CUSTOMERS)
	SYSTEM WIDE RFP EVALUATION – VENDOR(S) SELECTED	BDR (230,000 CUSTOMERS)	BDR* (250,000 CUSTOMERS)	BDR (270,000 CUSTOMERS) WUTC SYSTEM WIDE FLEXIBILITY REPORT
VENDOR SELECTED		DLC ENROLLMENT (5000-7000 CUSTOMERS)	DLC* (20,000 CUSTOMERS)	DLC (29,000 CUSTOMERS)
	TDSM PILOTS (BAINBRIDGE & DUVALL – 133 CUSTOMER)	TDSM (375 CUSTOMERS)	TDSM* (675 CUSTOMERS)	TDSM (975 CUSTOMERS)

*C&I = Commercial & Industrial; DR = Demand Response; BDR = Behavior Demand Response; DLC = Direct Load Control; TDSM = Targeted Demand Side Management

Benefits are updated using the framework provided in the 2022 General Rate Case to capture avoided transmission and distribution capacity, avoided generation capacity, and total avoided energy benefits.

Table 8: Load Flexibility Program use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
DIRECT LOAD CONTROL - SMART THERMOSTATS	$29.7M	$54.8M	$0M	2023	2024
BEHAVIOR DEMAND RESPONSE	$36.9M	$68.1M	$0M	2023	2024
DIRECT LOAD CONTROL - GRID INTERACTIVE WATER HEATING	$38.0M	$68.6M	$0M	2023	2024
TARGETED DEMAND SIDE MANAGEMENT - BAINBRIDGE ISLAND	$13.0M	$13.0M	$0M	2023	2024
TARGETED DEMAND SIDE MANAGEMENT - CITY OF DUVALL	$13.0M	$13.0M	$0M	2023	2024

PSE PUGET SOUND ENERGY

3. BEHAVIOR-BASED PROGRAMS

Behavior-based programs provide customers with personalized energy consumption reports, motivating them to alter their energy usage pattern. While time varying rates and demand response programs are programs initiated by the utility to drive energy usage change, behavior-based programs are customer initiated based on their own interests in reducing energy.

AMI usage data enables customers to have near time informational feedback in the form of billing alerts and customer usage displayed through in-home displays and smart devices. This timely feedback can lead to more informed consumption decisions and typically energy conservation.

FOR PSE CUSTOMERS: MANAGE YOUR ENERGY USAGE ONLINE

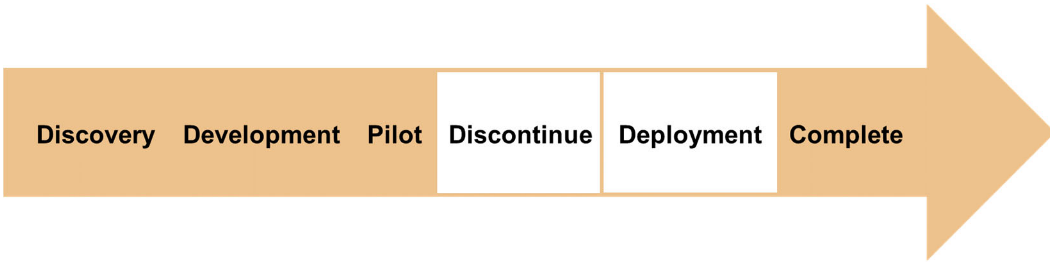
- For personalized energy-saving suggestions, complete an online home assessment to update your home's energy profile in the Analyze my usage section of your online account.
- Measure, and monitor your home's energy usage.
- Find additional energy efficiency suggestions in our Ways to save tips library.

To learn more or receive personalized advice over the phone, call a PSE Energy Advisor at 1-800-562-1482, Monday through Friday, 8 a.m. to 5 p.m.

There are four use cases associated with this program: 1) online usage presentment – gas and electric; 2) high usage alerts – gas and electric; 3) virtual small business commissioning pilot (now known as Virtual Commissioning); and 4) an in-home display residential pilot.

PSE's plan was to provide online information presentment of granular (1-hour) usage data for residential AMI customers in Q4 2021 and integrate load disaggregation insights when services were available. Also, PSE would build energy usage prediction models that alert customers more accurately and provide personalized insights to manage their consumption and lower bills. PSE would launch a Virtual Commissioning Program for business customers in 2022 with the goal of having 100 customers participate by the end of 2023. And finally, PSE would grow the in-home display pilot program to 1,500 in-home display units in 2022 concluding in 2023, at which point PSE would evaluate the program's cost effectiveness and determine whether to proceed with full-scale deployment. The 2022 benefit calculation captured avoided costs relative emissions, energy, transmission and distribution capacity, and generation capacity, totaling between $5 million and $71 million depending on customer peak reduction, energy conservation, and participation rates with a base case of $25 million through 2037.

Progress since 2022:



PSE has progressed from basic services previously provided with AMR data to full deployment of providing energy usage data through online information presentment within 48 hours and continues to pursue shortening processing time. High usage notifications are available to all with account information. In 2022, the Virtual Commissioning Program, which provides free energy efficiency recommendations to commercial customers, attained 39 participants in deployment which resulted in 2,824,171 kWh/yr in savings at customer sites. The 2023 year-to-date metrics as of October 6, 2023, include 42 participants and a total of 2,483,290 kWh/yr in savings. Finally, PSE enrolled over 2,000 customers in the in-home display pilot, exceeding the plan of 1,500. However, after the pilot, PSE determined that the In-Home Display Program would not be deployed as it was not cost effective, and therefore it was discontinued. The timeline of advancing the use cases is shown below. The owner of this use case is Energy Efficiency.

Table 9: Behavior-based Programs use case timeline

BEHAVIOR-BASED PROGRAMS				
2021	2022	2023	2024	2025
WUTC APPROVAL MODIFY BCP	IN HOME DISPLAY PILOT (2000 CUSTOMERS)	PROGRAM EVALUATION	SCALING IHD DETERMINED NOT COST EFFECTIVE	
	ONLINE ENERGY USAGE PRESENTMENT WITHIN 48 HOURS		ONLINE ENERGY USAGE PRESENTMENT WITHIN 48 HOURS	
	VCX* PROGRAM (39 CUSTOMERS)	VCX* PROGRAM (42 CUSTOMERS)	SCALE WHERE OPPORTUNITY IS HIGHEST	
		UPDATE HIGH USAGE ALERT LOGIC	ENROLLED CUSTOMERS RECEIVE ALERTS	

* VCx = Virtual Commissioning

Benefits are updated using the framework provided in the 2022 General Rate Case, which capture avoided transmission and distribution capacity, avoided generation capacity, total avoided energy, and total avoided emissions benefits.

Table 10: Behavior-based Programs use case benefit summary (nominal)

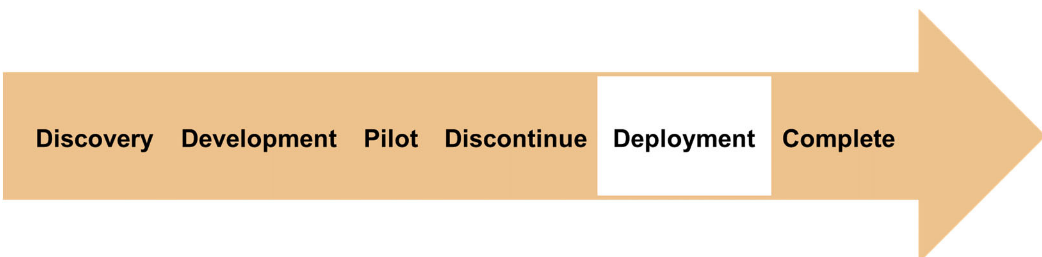
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
ONLINE USAGE PRESENTMENT ELECTRIC	$10.4M	$12.7M	$0.7M	2023	2023
ONLINE USAGE PRESENTMENT GAS	$10.4M	$10.4M	$0.39M	2023	2023
HIGH USAGE ALERT ELECTRIC	$2.2M	$2.3M	$0.15M	2023	2023
HIGH USAGE ALERT GAS	$2.2M	$1.9M	$0.16M	2023	2023
VCX PROGRAM	$1.53M	$1.53M	$1.28M	2023	2023
IN HOME DISPLAY PILOT	N/A	$0M	$0M	2023	DISCONTINUED

4. CONSERVATION VOLTAGE REDUCTION

Conservation voltage reduction, static or automated, adjusts the circuit voltage to the lower half of the standard voltage range moving away from higher and more conservative settings that results in customers using more energy. Customer action is not necessary in this program. AMI voltage data and customer load data are used by PSE to design, monitor, and make adjustments to the voltage of a circuit based on voltage levels indicated directly from the AMI meter.

PSE's conservation voltage reduction plan started with the initial implementation pilots in 2013 (with special AMI meters installed before full deployment began) and was expected to ramp to 12 substations per year through completion of 158 substations which was based on substations having 50% or greater mix of residential customers. The 2016 benefit calculation from the original AMI Business Case captured avoided costs relative energy, transmission and distribution capacity, and generation capacity, totaling between $394 million and $534 million depending on inflation, customer growth, meter cost, and avoided capacity cost with a base case of $436 million through 2037.

Progress since 2022:



PSE has implemented conservation voltage reduction in 40 substations. However, this program has experienced challenges including operational conflicts with the rollout of distribution automation which has temporarily prevented the initial load drop compensation or static design from being installed where distribution automation schemes were planned. Distribution automation schemes open and close switches that change the configuration of a circuit when a fault occurs. This causes the loading on the circuit to be different than what the conservation voltage reduction design accounted for which can cause the voltage to potentially drop below the standard range. Where reliability concerns are high, installing distribution automation schemes are more valuable than voltage reduction. Additionally, the static design creates conflicts with planned construction or unplanned events where equipment failure or switching to an abnormal electrical system configuration is necessary. As a result, in some cases, voltage settings have been restored to non-conservation voltage reduction settings for periods of time. PSE has continued to work through these challenges, including the upgrading of substation transformer controllers to Supervisory Control and Data Acquisition which allows distribution automation to be used and shutoff conservation voltage reduction temporarily when switched to a different feeder. However, these challenges have impacted the conservation voltage reduction implementation schedule in the short term but not the long term. PSE is nearing completion of its new Advanced Distribution

Management System which allows for greater control and a different distribution automation scheme structure (model based versus rules based). This will allow PSE to evolve to volt-var optimization or dynamic conservation voltage reduction which removes conflicts with distribution automation or necessary switching. This next evolution continues to leverage the same AMI infrastructure and data to build models, design, and make operational changes.

PSE has built a dashboard to review voltage compliance for a variety of uses, including monitoring voltage for conservation voltage reduction. This dashboard is used to identify voltage deviations in order to make adjustments to settings before a customer complains. The timeline of advancing the use case is shown below. The owner of this use case is Project and Program Management.

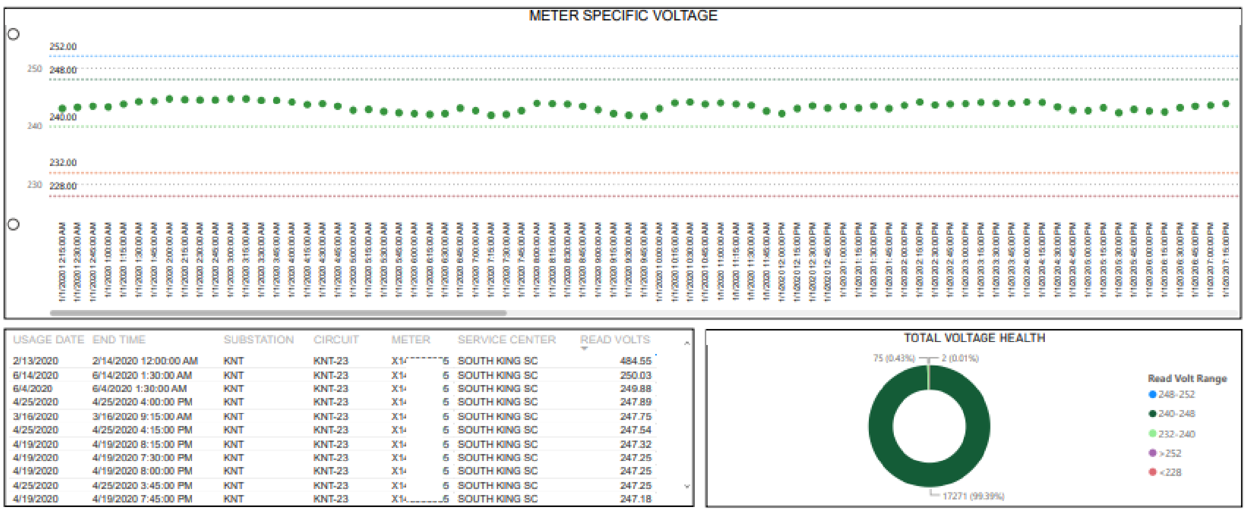


Table 11: Conservation voltage reduction use case timeline

CVR/VVO				
2021	2022	2023	2024	2025
HISTORIC IMPLEMENTATION (21 SUBSTATIONS)	DEPLOYMENT CHALLENGED	CUMULATIVE DEPLOYMENT (40 SUBSTATIONS)	CUMULATIVE DEPLOYMENT (57 SUBSTATIONS)	BEGIN DEPLOYING VOLT-VAR OPTIMIZATION ANNUAL DEPLOYMENT HERE OUT (12 SUBSTATIONS)

PSE reports conservation voltage reduction performance (Distribution Efficiency) in its Biennial Conservation Report as it delivers the similar objective of direct customer energy savings as traditional energy efficiency programs. PSE has calculated the benefits of conservation voltage reduction using methodology used in this energy efficiency program.

Table 12: Conservation voltage reduction use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
ENERGY SAVINGS	$225M	$189M	$53.4M	2013	2013
CUSTOMER COST SAVINGS (BILL SAVINGS)	N/A	$152.7M	$10.3M	2013	2013

PUGET SOUND ENERGY

C. OPERATIONAL EFFICIENCY

Operational Efficiency programs comprise the "Tier 2" use cases PSE reported on in the 2022 General Rate Case. Operational Efficiency programs aim to decrease costs, whether utility or customer costs, by using the AMI network or capabilities of the meter, beyond using AMI data.

There are four overarching Operational Efficiency programs: 1) Smart Street Lighting; 2) Remote Connect Disconnect; 3) Outage Management; and 4) Lower Metering costs for Solar and Distributed Generation.

The collection of these use cases identified and quantified in the 2022 General Rate Case have progressed. Estimated quantified benefits through 2037 are significant as shown below and detailed in a following figure by each use case. Each program and use cases associated with the program are described and progress since 2022 is discussed. However, the Remote Connect Disconnect benefit is lagging due to COVID and restrictions on remote disconnect and dunning practices allowed.[13]

Table 13: Operational Efficiency summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
$358.3M	$325.2M	$8.4M

[13] *See In the Matter of Response to the COVID-19 Pandemic*, Docket U-200281, Order 03 Related To The Suspension Of Disconnection of Energy Services For Nonpayment And Adopting Related Requirement (May 18, 2021).

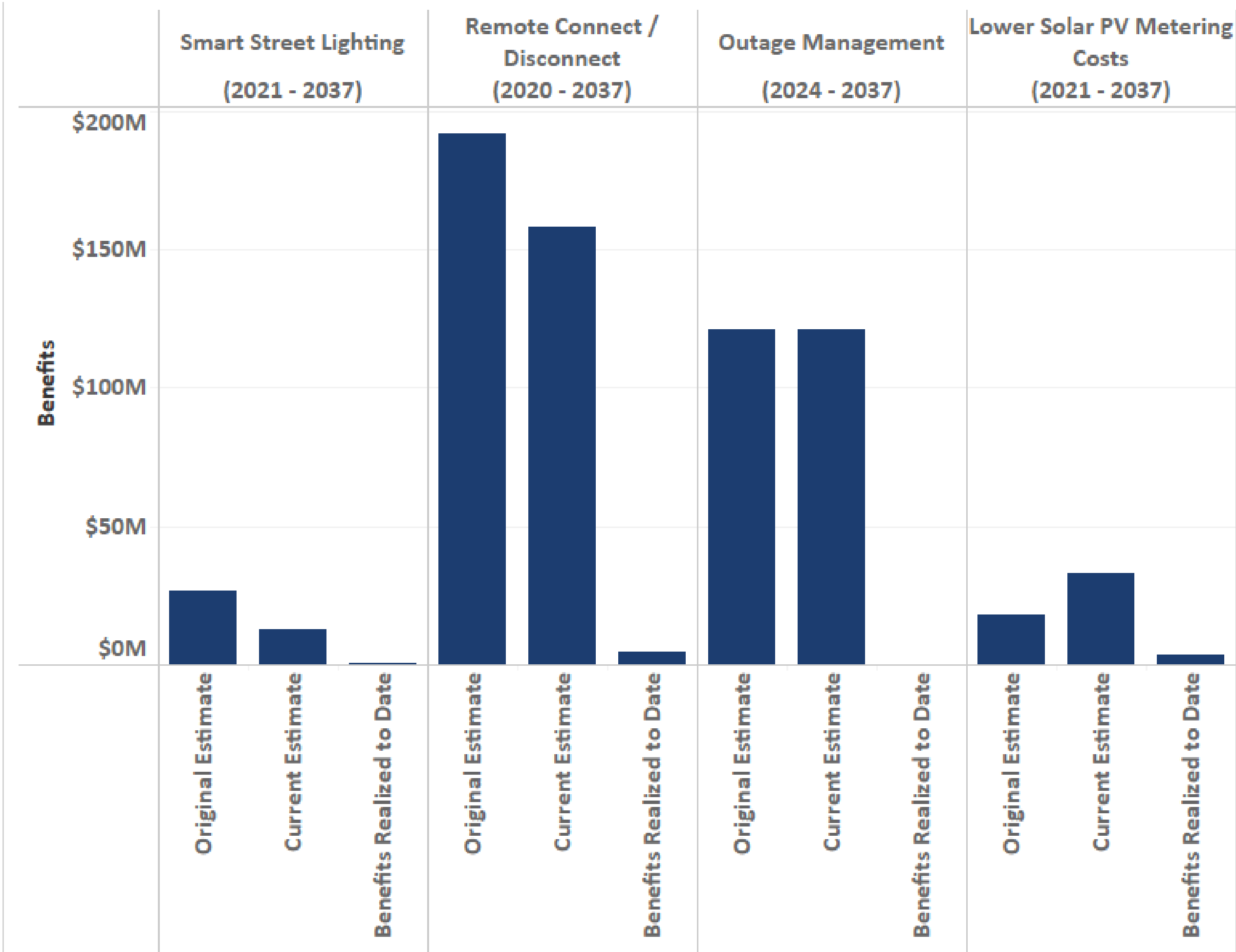


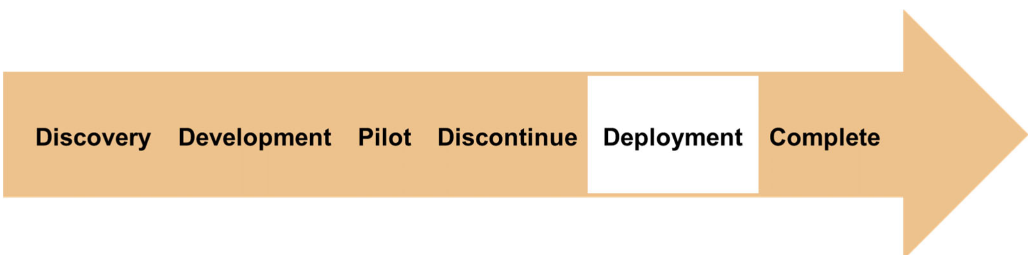
Figure 2: Operational Efficiency use case benefit summary breakdown

1. SMART STREET LIGHTING

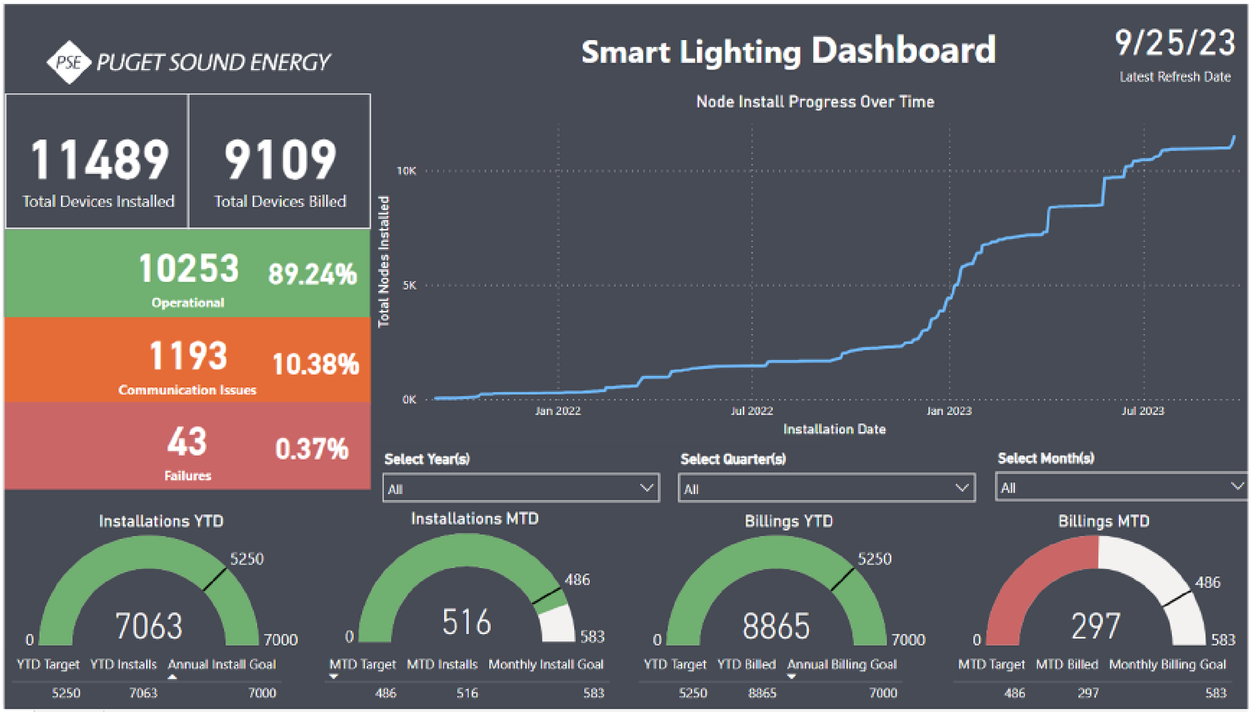
Smart Street Lighting controls enable remote monitoring of performance, consumption measurement, fault detection, and overall energy control and management of streetlights. PSE is aligning with leading energy providers across the country by standardizing use of smart streetlight controls on LED streetlights. The AMI network is foundational to the success of this program. The Smart Street Lighting controls on top of streetlights transmit status and performance data over the AMI mesh network. Additionally, these streetlights are now metered with an AMI meter and the energy usage is recorded for billing of actual energy consumed at each streetlight, rather than a flat rate per light. With the ability to meter, PSE now offers customers the opportunity to adjust energy levels at each light to lower monthly costs, improve energy efficiency, and enhance community aesthetics.

PSE's initial deployment plan included equipping 25,000 of the over 100,000 streetlights within its service territory with Smart Street Light controls by the end of 2024, at a pace of approximately 5,000 per year. The 2022 benefit calculation captured energy savings and reduced operations and maintenance cost savings, totaling between $12 million and $39 million depending on quantity of Smart Street Lighting controls installed with a base case of $27 million through 2037.

Progress since 2022:



PSE has made significant progress from initial deployment to meet the goal of installing 25,000 Smart Street Lighting controls by the end of 2024. In 2020 and 2021, the program pace was slowed by contractual delays, lack of resources, and supply chain issues, but has since overcome those challenges. The corrective maintenance process now integrates reports directly from the Smart Street Lighting controls to reduce customer-driven repairs. Previously unforeseen customer benefits have surfaced with Smart Street Light consumption metering, such as new accessibility to PSE's Green Power credits, and the ability to participate in demand response programs.



The timeline of advancing the use case is shown below. The owner of this use case is Street Lighting.

Table 14: Smart Street Lighting use case timeline

SMART STREET LIGHTING				
2021	2022	2023	2024	2025
STREET LIGHT CONTROL INITIAL DEPLOYMENT (3650 DEVICES)		CUMULATIVE DEPLOYMENT (25000 DEVICES)		CONTINUED DEPLOYMENT (5,000 DEVICES ANNUALLY)

Benefits are updated using the framework provided in the 2022 General Rate Case to capture labor cost for expense benefits. As PSE refreshed these benefits, truck rolls associated with corrective maintenance were overstated, reducing this benefit. This is offset, however, by the benefit to customers in lower bills.

Table 15: Smart Street Lighting use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
OUTAGE ADMINISTRATIVE EXPENSE	$1.7M	$2.9M	$0.06M	2021	2021
CORRECTIVE MAINTENANCE EXPENSE	$24.9M	$4.5M	$0.09M	2021	2021
ENERGY SAVINGS	N/A	$0.36M	$0.01M	2021	2021
CUSTOMER COST SAVINGS (LOWER BILLS)	N/A	$4.8M	$0.14M	2021	2021

2. REMOTE CONNECT DISCONNECT

AMI meters contain an internal switch that provides utilities the capability to remotely turn electric meters on and off to support changes in occupancy, reoccurring non-payment issues, and prepaid service offerings.

PSE's plan was to implement use of this switch in electric meters to remotely connect and/or disconnect services for customer-initiated requests and move in/move out in October 2019 and for non-payment in March 2020. However, the program was deferred due to COVID-19 and the disconnect moratorium in Washington state.[14] The moratorium ended on September 30, 2021. However, due to the ongoing rulemaking in Docket U-200281, a return to normal credit and collections processes has been slow, reducing near-term benefits.[15] The original benefit calculation captured reduced operations and maintenance cost savings (in the form of reduced number of service appointments, truck rolls, vehicle-miles traveled, and avoided postage and delivery costs) and reduced unauthorized energy usage ("UEU"), totaling between $192 million and $196 million depending on energy savings benefits with a base case of $194 million through 2037.

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[14] Proclamation 20-23 Proclamation By the Governor Amending Proclamation 20-05, UTC-Rate Payer Assistance, issued 03/18/2020.

[15] *See In the Matter of Response to the COVID-19 Pandemic*, Docket U-200281, Order 03 Related To The Suspension Of Disconnection of Energy Services For Nonpayment And Adopting Related Requirement (May 18, 2021).

Progress since 2022:

Discovery | Development | Pilot | Discontinue | **Partial Deployment** | Complete

PSE continues to utilize the remote switch for customer requested services. As of June 2023, 93% of all customer-requested connects were completed remotely. PSE began using the remote switch for disconnections related to non-payment in July 2022, but only after a field visit has occurred, eliminating the benefit of reduced operations and maintenance cost savings, thus only partially deploying as planned. The timeline of advancing the use case is shown below. The owner of this use case is Credit and Collections and Meter Network Services.

Table 16: Remote Connect/Disconnect use case timeline

REMOTE CONNECT/DISCONNECT					
2020	2021	2022	2023	2024	2025
USED FOR MOVE IN/MOVE OUT				USE FOR MOVE IN/MOVE OUT	
USED FOR DISCONNECTIONS FOR NON-PAYMENT AFTER FIELD VISIT HAS OCCURRED & SUBSEQUENT RECONNECTIONS				USE FOR DISCONNECTIONS & RECONNECTIONS RELATED TO NON-PAYMENT AS ALLOWED	
USED FOR UEU DISCONNECTIONS				USE FOR UEU DISCONNECTS	

Benefits are updated using the framework provided in the 2022 General Rate Case to capture labor cost for expense, postage and delivery cost, and energy savings benefits. PSE has recalculated the benefits based on progress, anticipating a reduction of $39 million in benefits through 2037, dramatically impacted by COVID-19 and ongoing rulemaking in Docket U-210800.

Table 17: Remote Connect/Disconnect use case benefit summary (nominal)

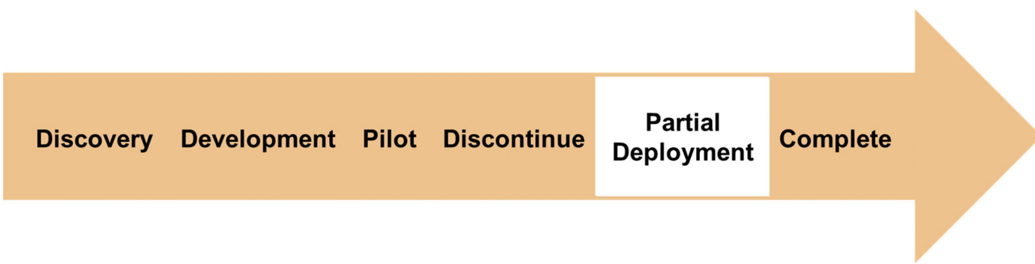
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
POSTAGE & DELIVERY COST REDUCTION	$0.2M	$0.2M	$0.03M	2020	FULL BENEFIT REALIZATION SCHEDULE PENDING
LABOR COST REDUCTION FOR MNS	$77.5M	$68.7M	$4.0M	2020	
BAD DEBT REDUCTION	$112.6M	$87.2M	$0.0M	2020	
ELECTRIC ENERGY SAVINGS	$1.0M	$1.0M	$0.35M	2020	
GAS – ENERGY SAVINGS	$0.8M	$0.8M	$0.2M	2020	

3. OUTAGE MANAGEMENT

Integrating information from grid field devices such as remote telemetry units and AMI power status from electric customer meter data with real-time operating systems such as PSE's Outage Management System or the Geospatial Information System enables utilities to deploy a prediction model that helps quickly diagnose the location and extent of unplanned outages, and to provide customers with more accurate and timely information about the cause and status of outages. PSE's AMR network was not reliable to integrate into these systems as less than 39% of the "power down" data made it back to PSE's command center in the time required to determine outage cause location. Additionally, individual AMI meters can be pinged/accessed to analyze meter status and operating voltage at the meter, relying less on customer calls. AMI can also help to reduce costs by detecting "false positive" outages which are outages due to the customer's internal electrical issues, or confirming a customer has power, therefore avoiding field visits. Finally, AMI power status can help identify complex outage issues such as nested outages which are outages that are localized but masked due to a larger encompassing outage.

PSE's plan was to integrate AMI into PSE's new grid software tool, Advanced Distribution Management System, which includes a new Outage Management System, in 2023. The 2022 benefit calculation captured avoided interruption costs due to quicker detection and restoration of outages, totaling between $72 million and $243 million depending on outage duration with a base case of $121 million through 2037.

Progress since 2022:



PSE's implementation of the new Outage Management System was delayed from 2023 to 2024. In lieu of the delay, in 2023, PSE implemented AMI data in the existing Outage Management System to begin utilizing AMI. AMI meters are now integrated into the existing Outage Management System by displaying meter status in a map view, as well as greatly improved response performance when individual meters are queried for their power status. Full benefits will begin as AMI is integrated into the prediction model of the new Outage Management System instead of being triggered by customer calls or reports on the PSE Outage App. The timeline of advancing the use case is shown below. The owner of this use case is System Operations and Information Technology.

Table 18: Outage Management use case timeline

OUTAGE MANAGEMENT				
2021	2022	2023	2024	2025
	DESIGN / BUILD	FACTORY, SITE, AND USER ACCEPTANCE TESTING	AMI INTEGRATED WITH OMS*	METER EVENTS INITIATE START TIME NESTED OUTAGE BASED ON METER DATA
			OMS GO LIVE Q4 2024	AMI METER VOLTAGE
		AMI INTEGRATED IN EX. OMS*	PING RESPONSE RELIABLE	

*OMS = Outage Management System

The benefits provided in the 2022 General Rate Case, which estimated the value to the customer for avoided outages and decreased outage duration using the Lawrence Berkley National Labs Interruption Cost Estimator, will be updated when AMI is integrated into the prediction model of the new Outage Management System. The benefits associated with the integration of AMI into the existing Outage Management System are increased data confidence and reduced truck rolls from higher reliable ping response.

Table 19: Outage Management use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	$121M	WILL CALCULATE WHEN INTEGRATED WITH OMS	$0M	2024	2025
REDUCED TRUCK ROLLS	N/A	QUALITATIVE	QUALITATIVE	N/A	2023

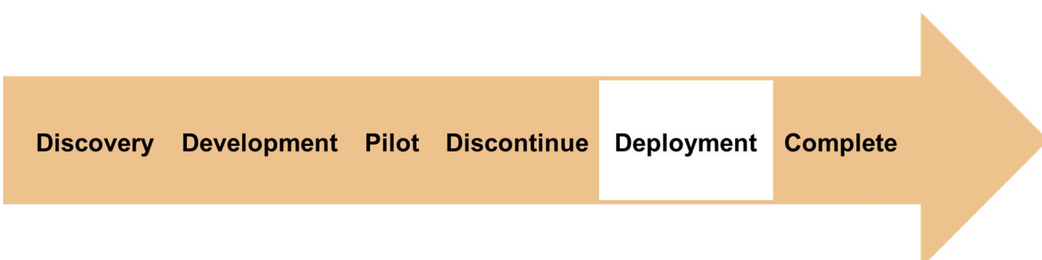
PUGET SOUND ENERGY

4. SOLAR PHOTOVOLTAIC AND DISTRIBUTED GENERATION

The deployment of AMI allows PSE to serve customers adopting solar with the technology they need for net metering. Because bi-directional metering capabilities are necessary for net metering, customers with AMR meters normally would need to upgrade their meters when installing rooftop solar. However, because all AMI meters are capable of measuring energy bi-directionally, when a customer with this meter adopts rooftop solar photovoltaic, a meter equipment exchange or upgrade is usually no longer necessary to convert the customer to net metering.

PSE's plan anticipated 2,000 new net-metering customers per year and enhancements to the billing system to move away from separate MV90 meters for large customers anticipating 24 additions per year. The 2022 benefit calculation captured avoided interruption costs due to quicker detection and restoration of outages, totaling $18.2 million through 2037.

Progress since 2022:



PSE has been progressing at a faster pace than anticipated and expects to exceed the 2024 estimate of net metering customers, putting PSE ahead of the avoided exchange target by 3,275 (41%). PSE's replacement process for installing AMI in place of MV90 meters is ahead of schedule. The timeline of advancing the use case is shown below. The owner of this use case is Customer Energy Renewable Programs.

Table 20: Solar Photovoltaic and Distributed Generation use case timeline

SOLAR PHOTOVOLTAIC AND DISTRIBUTED GENERATION				
2021	2022	2023	2024	2025
NET METERING ADDITIONS (2073 AVOIDED EXCHANGES)	NET METERING ADDITIONS (2775 AVOIDED EXCHANGES)	NET METERING ADDITIONS (ESTIMATED 2427 AVOIDED EXCHANGES)	NET METERING ADDITIONS (4000 ANNUALLY)	

Benefits are updated using the framework provided in the 2022 General Rate Case to capture avoided additional meter cost of $350 associated with historical practice for net metering customers.

Table 21: Solar Photovoltaic and Distributed Generation use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED ADDITIONAL RESIDENTIAL METER INSTALLATION COST	$15.2M	$29.5M	$3.4M	2021	2020
MVGO COST AVOIDANCE	$3.0M	$3.6M	$0.1M	2025	2023

D. CUSTOMER BILL MANAGEMENT

Customer Bill Management Programs aim to decrease costs associated with utility actions to generate bills or manage billing issues which decreases the need for estimated bills or bill corrections that lead to customer dissatisfaction and potentially financial hardship. Timely and accurate AMI data accessibility is the primary driver of these use cases.

Customer Bill Management Programs include four use cases that are designated as “Tier 3”: 1) Improved Bill Generation; 2) Improved Customer Engagement with Data; 3) Bill Payment – Automatic and Pre-paid; and 4) Accurate Meter Type Installations – Meter Asset Health.

In the 2022 General Rate Case, Improved Bill Generation was discussed briefly. The remaining use cases, while first envisioned in the AMI Data Enablement Strategy, have since become active and are considered new uses cases for this report. Estimated quantified benefits through 2037 are shown below and detailed in a following figure by each use case.

Table 22: Customer Bill Management summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
$0M	$52M	$0M

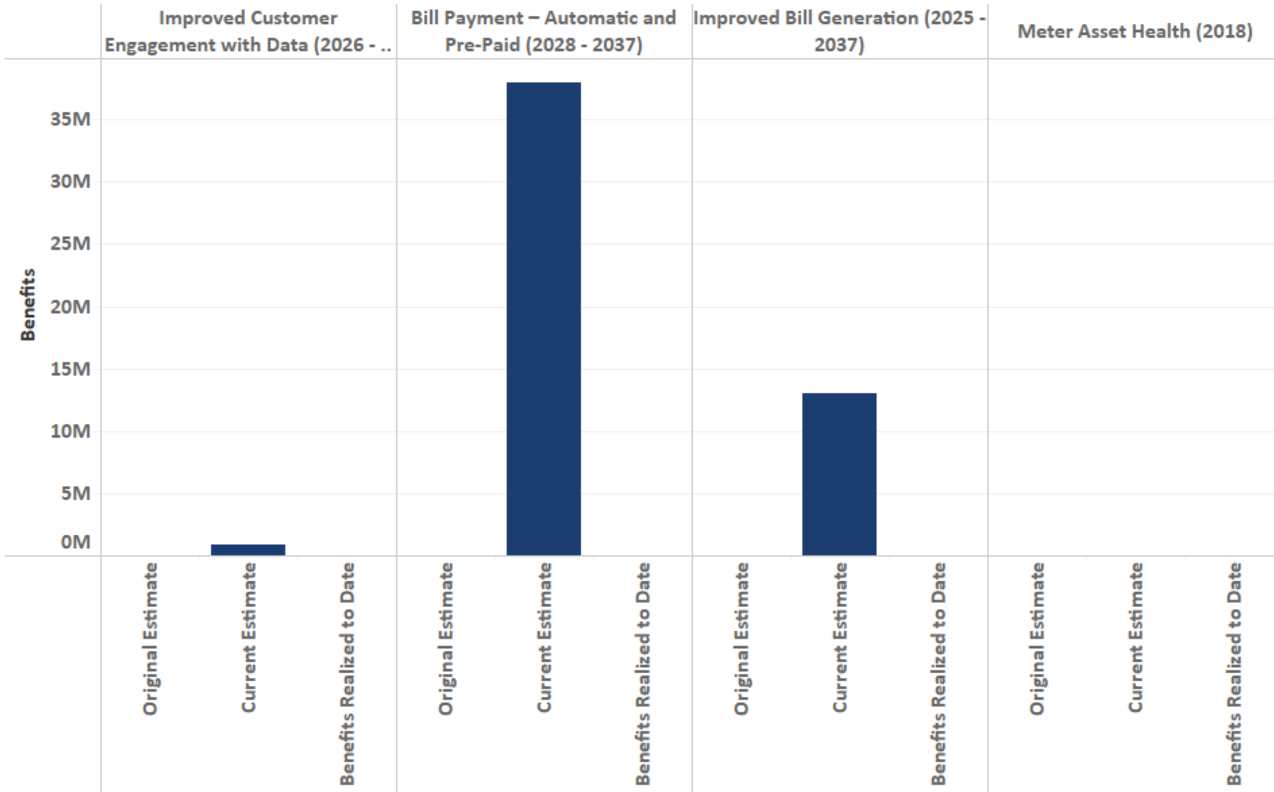
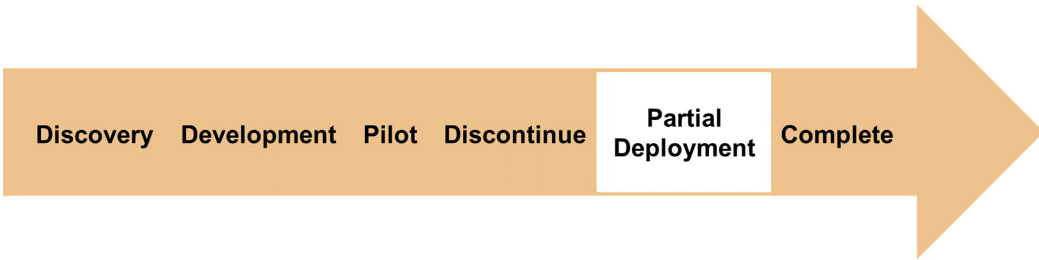


Figure 3: Customer Bill Management use case benefit summary breakdown

1. IMPROVED BILL GENERATION

The AMI meters and network reliability generates more consistent and accurate customer bills. AMI has increased read performance which reduces the need for manual reads and decreases the number of estimated bills due to missing reads. In the rare event that a billing failure occurs, AMI data provides better visibility of the meter status and AMI interval data makes it easier to diagnose concerns.

Progress since 2022:



The AMI bill read success rate has continued to improve as AMI deployment is completed. PSE reported AMI bill read success rate metrics for customers in the 2022 Multiyear Rate Plan Compliance filing which was 99.09% and 96.89%, for electric and gas, respectively. With AMR, PSE performed 50,000-60,000 manual reads every month. In comparison, with AMI deployment complete, AMI manual reads, not including AMI opt out customers, averaged 11,400 per month through October 2023. The timeline of advancing the use case is shown below. The owner of this use case is Customer Solutions.

Table 23: Improved Bill Generation use case timeline

IMPROVED BILL GENERATION				
2021	2022	2023	2024	2025
TRACK AMI SYSTEM PERFORMANCE MANAGE DEPLOYMENT AND MAINTENANCE CASES			RESOLVE OUTSTANDING ISSUES	TARGET PERFORMANCE

Benefits are projected from reduced manual meter reads from nearly 285,000 AMR reads in 2022 as well as reduction in the maintenance work orders called Enhanced Message Management Analysis ("EMMA") cases.

PUGET SOUND ENERGY

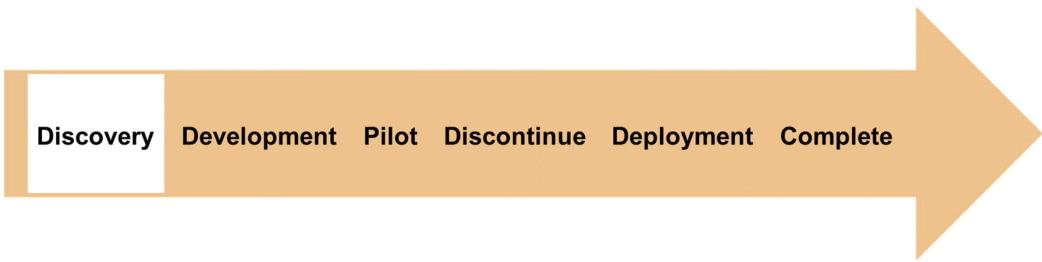
Table 24: Improved Bill Generation use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
MANUAL METER READ SAVINGS	N/A	$8.5M	$0M	N/A	2025
EMMA CASE REDUCTION	N/A	$4.6M	$0M	N/A	2025

2. IMPROVED CUSTOMER ENGAGEMENT WITH DATA

When a customer contacts PSE with a billing or energy usage inquiry, AMI data can be used by customer service agents to help troubleshoot customer questions and resolve calls more effectively, enabling a review of detailed usage trends and anomalies that was not available when reviewing daily data provided by AMR meters.

Progress since 2022:



With completion of AMI deployment, PSE is evaluating the requirements for increased accessibility of interval data for PSE call center representatives. This will require bringing a substantial amount of data into the system that the call center representatives access, likely requiring hardware expansion and data storage considerations. Training call center representatives on how to use the interval data will be required as well. The timeline of advancing the use case is shown below. The owner of this use case is Customer Solutions.

Table 25: Improved Customer Engagement with Data use case timeline

IMPROVED CUSTOMER ENGATEMENT WITH DATA				
2022	2023	2024	2025	2026
	MONITOR DEPLOYMENT COMPLETION	DEFINE DATA REQUIREMENTS	REVISE BUSINESS PROCESS AND ESTABLISH TRAINING	LAUNCH

Primary benefits anticipated are improved billing first call resolution, reducing the number of times a customer calls back on the same issue. PSE assumes a reduction of over 3,800 customer calls saved annually.

Table 26: Improved Customer Engagement with Data use case benefit summary (nominal)

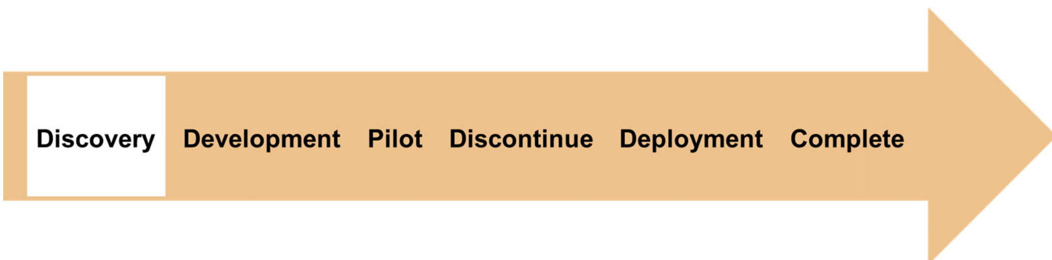
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
INCREASED FIRST CALL RESOLUTION NUMBERS	N/A	$0.9M	$0M	N/A	2026

3. BILL PAYMENT – PREPAID (NEW)

A prepay billing program is where a customer pays for a certain amount of electricity at a price set in advance of consuming that electricity. When the purchased prepaid electricity is fully consumed, the customer must either purchase more electricity or service will be shut-off. The use of prepay billing by other utilities has demonstrated that prepay billing programs reduce billing fluctuations, unanticipated high electric bills, and service disruptions for customers by communicating usage on regular intervals.[16] AMI is integral in a prepay program because it allows timely usage monitoring by the utility to support the customer. In some utilities, a prepayment meter is installed that the customer can use to increase the credit needed for the anticipated electricity use. These meters would use the AMI network to transmit data as well.

PSE has been considering prepaid billing programs since 2022 as, in addition to the benefits described above, the program brings benefits such as increased cash flow from payments upfront before electricity is used, reduction in number of delinquent payments, reduction in cost and frequency of manual service disconnection and reconnection, and customer benefits arising from no deposit requirement, no late fees, no monthly bills, no disconnect/reconnect fees, and better energy use information.

Progress since 2022:



Designing PSE's prepay program is anticipated to begin in 2026, but PSE will need support from regulators and tariff approvals. The timeline of advancing the use case is shown below. The owner of this use case is Customer Solutions.

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[16] *See* B. Neenan, *Paying Upfront: A Review of Salt River Projects' M-Power Prepaid Program 1020260*, ELECTRIC POWER RESEARCH INSTITUTE (Oct. 2010), https://www.epri.com/research/products/000000000001020260.

Table 27: Bill Payment – Prepaid use case timeline

BILL PAYMENT – PREPAID				
2023	2024	2025	2026	2027/2028
PARTICIPATE IN INDUSTRY AND WUTC FORUMS			DESIGN AND SOCIALIZE PILOT	PILOT/EVALUATE/MODIFY LAUNCH

Should PSE pursue this benefit, PSE would anticipate constomers to benefit from reduced energy use, which in turn decreases their bill. Industry data shows that consumers use up to 12% less energy than other residential customers.[17]

Table 28: Bill Payment – Prepaid use case benefit summary (nominal)

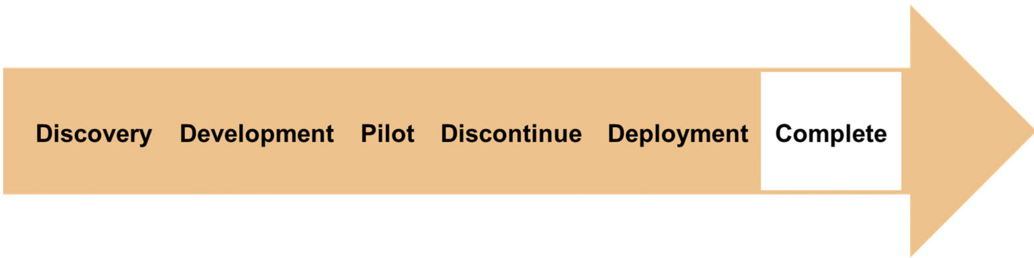
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
PARTICIPANT ENERGY SAVINGS	N/A	$38M	$0M	N/A	2028

[17] *See* Yueming (Lucy) Qiu, Bo Xing, *Pre-paid electricity plan and electricity consumption behavior*, GEORGE MASON UNIVERSITY CENTER FOR MICRO-ECONOMIC POLICY RESEARCH (CMEPR), 1 (Feb. 2, 2015), https://cmepr.gmu.edu/wp-content/uploads/2014/01/Qiu_pre-paid-pricing_0202.pdf.

4. METER ASSET HEALTH (ACCURATE METER TYPE INSTALLATION) (NEW)

AMI voltage data can be reviewed for expected meter operation within standard service voltage classes to identify any meter data abnormalities, meaning the meter data does not align with the customer class. As meter data is entered into the system of record, voltage data can validate that the proper meter has been installed.

Progress since 2022:



As AMI meter data became available once the AMI system was installed, PSE discovered 133 customers had the incorrect meter types installed which would impact quality of service and billing if undiscovered. PSE deems this use case complete since deployment is substantially complete. The timeline of the use case is shown below. The owner of this use case is Metering.

Table 29: Meter Asset Health (Accurate Meter Type Installation) use case timeline

METER ASSET HEALTH (ACCURATE METER TYPE INSTALLATION)				
2021	2022	2023	2024	2025
MONITORED METER VOLTAGE AND RESOLVED 133 INCORRECT METER TYPES DURING DEPLOYMENT			BUSINES AS USUAL	

The incorrect meter type resulted in customers being underbilled for their energy usage estimated at $45,000. Moving forward, this situation could occur only with new customers or replacement meters for maintenance. As a result, PSE is not estimating a future quantified benefit, although there will likely be some ongoing benefit.

E. IMPROVED PLANNING AND INVESTMENT DECISIONS

The Improved Planning and Investment Decisions category of use cases use AMI to improve transmission, distribution, and generation infrastructure Delivery System Planning processes that shape investment decisions including support for electric vehicles and distributed energy load. This is done with just in time investments as well as asset health analysis tools that proactively replace poor condition equipment avoiding unplanned emergency costs and tools that build more detailed planning models that result in saved study time, avoided outages, and infrastructure deferral. AMI data feeds the customer and Delivery System Planning process for more accurate modeling. Improved Planning and Investment Decisions includes 12 “Tier 3” use cases: 1) Electric Vehicle Planning and Integration; 2) Load Forecasting; 3) Phase Identification; 4) Non-wires Alternatives; 5) Sizing Transformers; 6) Identifying Customer Owned Distributed Energy Resource; 7) Transformer Asset Health; 8) Model Validation; 9) Enhanced Power Flow Modeling; 10) Masked Load Identification; 11) Fixed Capacitor Monitoring; and 12) Secondary Circuit Parameter Estimation. These use case benefits are derived by improving accessibility to AMI data for use in planning tools and investment decision criteria. Estimated quantified benefits through 2037 are shown below and detailed in a following figure by each use case.

Table 30: Improved Planning and Investment Decisions summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
$0M	$157.3M	$0M

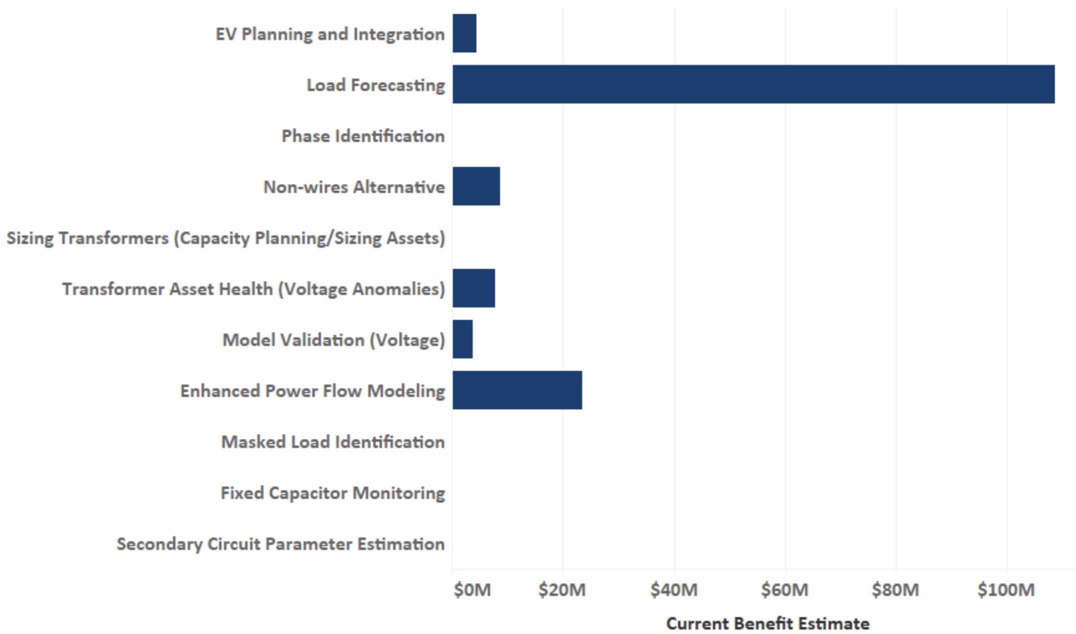
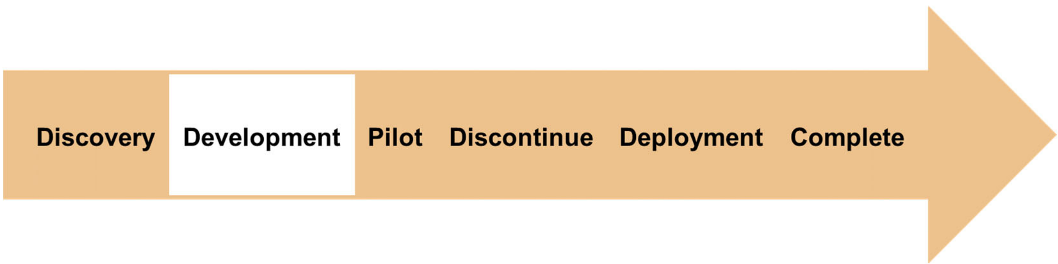


Figure 4: Improved Planning and Investment Decisions use case benefit summary

1. ELECTRIC VEHICLE PLANNING AND INTEGRATION

AMI usage data can be analyzed to understand trends in electric vehicle adoption and customer charging habits, which will have an impact on the size and timing of electricity demand as the market for electric vehicles continues to grow. PSE's electric vehicle forecast analysis provides data at the zip code level which does not provide granular understanding of circuit impact. Data disaggregation models that can single out the load associated with a customer's electric vehicle, evaluate the electric vehicle load profile, and aggregate for multiple customers on a circuit, will allow PSE to plan for these changes by locating where and when electric vehicles are charging.

Progress since 2022:



PSE estimates system-wide electric vehicle load to increase from 62 MW in 2022 to approximately 566 MW in 2030, putting a significant strain on distribution service transformers. PSE is evaluating the identification of electric vehicle charging using a third-party software solution, as well as developing in-house data disaggregation capabilities. The electric vehicle charging load will be disaggregated from other load in this software using AMI interval usage data which will allow for timely identification of locations with high electric vehicle penetration, improving locational forecasting to anticipate infrastructure investments to meet reliability needs. The timeline of advancing the use case is shown below. The owner of this use case is Load Forecasting and Delivery System Planning.

Table 31: Electric Vehicle Planning and Integration use case timeline

ELECTRIC VEHICLE PLANNING AND INTEGRATION				
2021	2022	2023	2024	2025
		EVALUATE ANALYSIS SOFTWARE AND PURCHASE	PILOT ANALYSIS DEVELOP PLANNING INTEGRATION PROCESSES	UTILIZE TO DEVELOP 2028 INFRASTRUCTURE PLAN

Benefits anticipated are primarily associated with reliability and ensuring investments to meet growing capacity are in place to prevent future outages. PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement from being able to make targeted system enhancements.

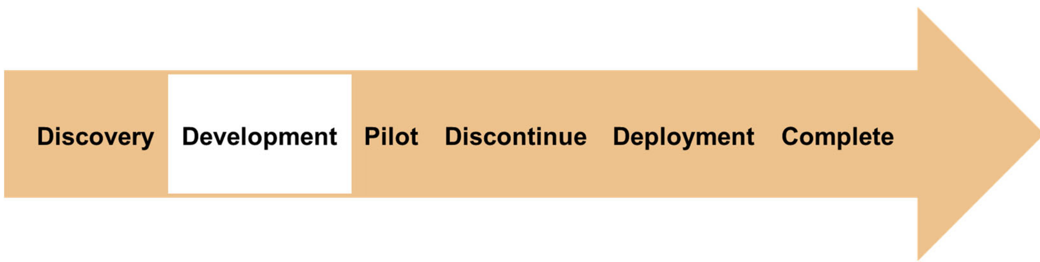
Table 32: Electric Vehicle Planning and Integration use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$4.5M	$0M	N/A	2028

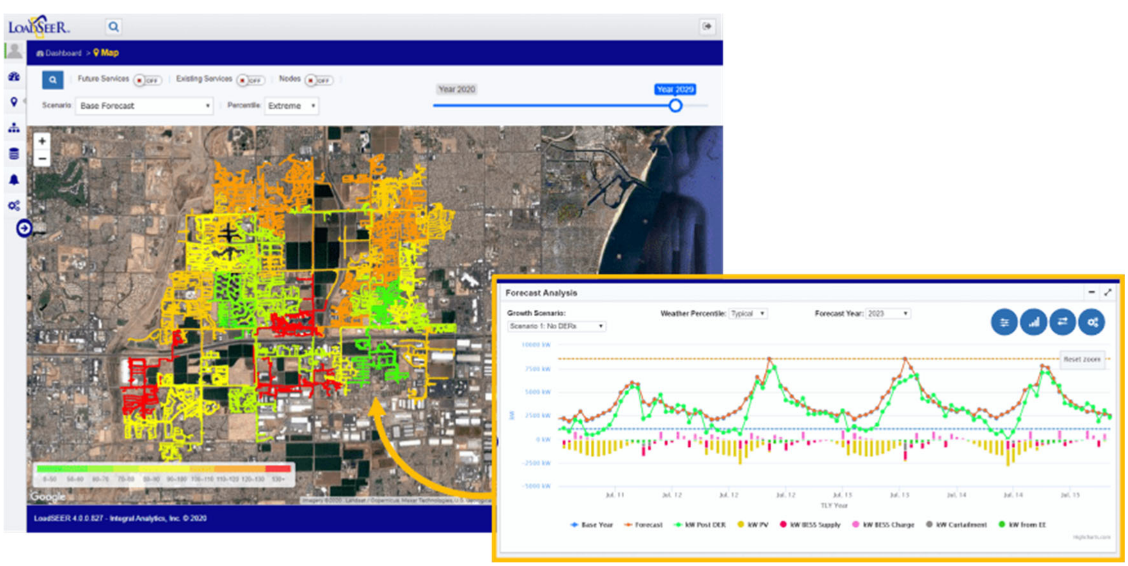
2. LOAD FORECASTING

AMI usage data is valuable for improving load forecasts to determine short-term circuit trends and long-term system and resource needs. In the past, PSE used county-level peak demand forecast derived from the system-wide peak demand forecast used for the Integrated Resource Plan. From this forecast, planning would apply growth and decline forecasts to the substation level based on historic load data, the individual planner's knowledge of the area, and load requests. PSE is now implementing a spatial forecasting tool, LoadSEER, which will leverage AMI hourly data along with other factors to forecast load at the circuit level, a bottom up approach. This will help engineers better identify future load changes, areas where load changes create system needs, and forecast how distributed generation will change customer and circuit load shapes.

Progress since 2022:



PSE has been working with vendor Integral Analytics to implement LoadSEER. Preliminary spatial forecasting results from LoadSEER using integrated AMI data have now been achieved, and the Planning team is working with the vendor to validate and fine-tune the forecasting results. The next step in the process is to import the LoadSEER spatial forecast into the Synergi modeling software for further load flow planning analysis.



PSE PUGET SOUND ENERGY

The timeline of advancing the use case is shown below. The owner of this use case is Load Forecasting and Delivery System Planning.

Table 33: Load Forecasting use case timeline

LOAD FORECASTING				
2021	2022	2023	2024	2025
INITIATE VENDOR SELECTION AND IMPLEMENTATION WITH INDUSTRY DATA	DEVELOP BUSINESS PROCESSES PRELIMINARY AMI DATA TESTING AND MODELING ANALYSIS	ALL AMI DATA INTEGRATED INTO SOFTWARE	BUSINESS AS USUAL USED IN STUDIES AND INVESTMENT PLANNING	

The benefit of LoadSEER is providing granular data and analysis that avoids the need for contract expertise to translate system-wide data to a circuit level for studies. In 2019, PSE spent over $1 million on contracting support to perform non-wires analysis with granular data. PSE estimates this savings to continue as PSE delivers on 22 MW of distributed energy resources in lieu of delivery system wired solutions to meet system needs per PSE's 2021 Integrated System Plan. Additionally, LoadSEER provides faster modeling as loads at the circuit level are changing much faster than they have historically. PSE estimates a subset of the study requests would save an average of eight hours in total process time for customers. Capacity studies can be conducted more efficiently but at risk of double counting, these benefits are captured in the E.8, Model Validation use case. Faster modeling enables PSE to perform more studies with the goal of anticipating future infrastructure needs that enable service to customers when requested. PSE's ability to service customers immediately, specifically large customers, provides the ability to secure revenue faster than being reactive and having the customer wait to receive service.

Table 34: Load Forecasting use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED CONTRACTOR EXPERTISE	N/A	$3.8M	$0M	N/A	2024
AVOIDED LOST REVENUE FROM UNSERVED ENERGY	N/A	$103M	$0M	N/A	2024
AVOIDED PLANNING STUDY HOURS COST	N/A	$1.2M	$0M	N/A	2024
IMPROVED BUSINESS EFFICIENCY (CUSTOMER TIME SAVINGS)	N/A	$0.58M	$0M	N/A	2024

3. PHASE IDENTIFICATION

AMI meter voltage data is utilized to perform predictive analytics to estimate which of three distribution conductors on a pole (or “phase”) a customer meter is installed on. Customer meter data is compared to the substation circuit breaker voltage to detect trends that indicate which meter corresponds to each conductor or phase. These phase predictions are compared to the phase documented on PSE’s Geographic Information System to detect meters that may be inaccurately mapped. This enables map updates without the need to roll a truck for a field visit and provides that planning models, system operations tools—like Advanced Distribution Management System—and other tools that depend on accurate configuration, have integrity. Accurate configuration can drive planning and field operations decisions. Additionally, when phases are inaccurately configured and not carrying the same amount of electricity or are imbalanced, it can result in “line loss” or the loss of energy on a power line. Phase predictions using AMI data can help avoid this problem.

Progress since 2022:

PSE has built a phase prediction tool and dashboard. Phase predictions have been completed for ten substations as a preliminary sample. From this sample, PSE found that 13% of the customers on the circuits served by these ten substations were mapped on the wrong phases. Internal discussions are taking place to develop the business processes needed to scale this use case, continue to validate the accuracy of the predictive model, and implement Geographic Information System updates. The timeline of advancing the use case is shown below. The owner of this use case is Maps and Records and Delivery System Planning.

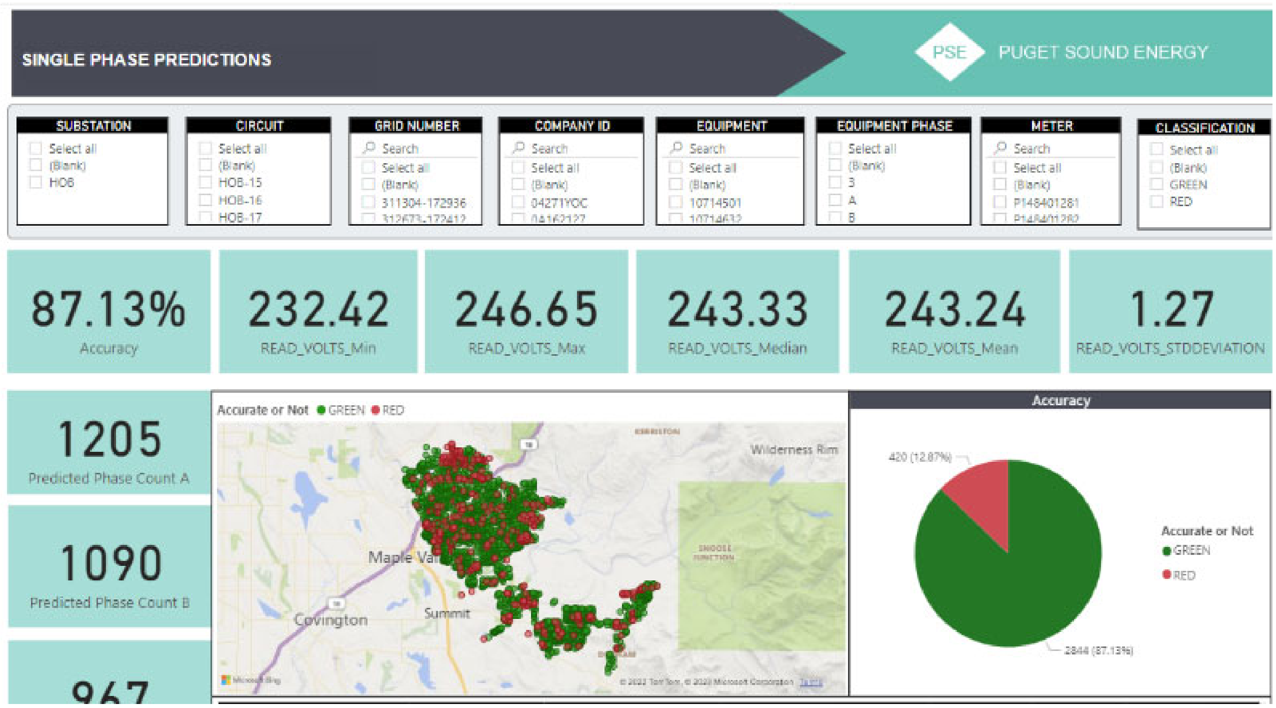


Table 35: Phase Identification use case timeline

PHASE IDENTIFICATION				
2021	2022	2023	2024	2025
		DEVELOP PHASE PILOT AND EVALUATE ACCURACY (10 SUBSTATIONS)	DEVELOP BUSINESS PROCESSES	MONITORS AND ADDRESSES PHASE DISCREPANCIES TIMELY

Benefits anticipated are line loss reduction attributed to phase balancing. However, the phase balancing required to achieve line loss reduction is already captured in the Conservation Voltage Reduction Program described in use case B.4. The energy savings in the conservation voltage reduction use case are achieved from a balanced configuration state. Thus, to avoid double counting benefits, PSE is not attributing a benefit value to this use case. Additional benefits are attributable to more effective outage management, outage communications to customers, and an array of planning investment value from correcting maps with the correct phase for a customer in the field. This has both a reputational value for PSE and an accuracy planning value and benefit for the customer (i.e., the customer receives the correct outage information at the correct time). These benefits are noted qualitatively for now until this use case develops further.

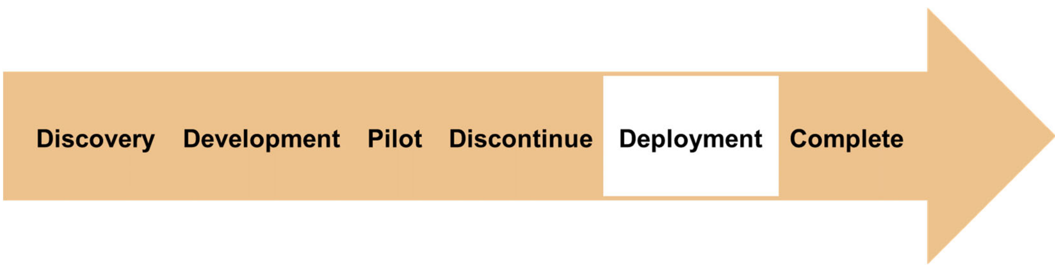
Table 36: Phase Identification use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
PHASE IDENTIFICATION	N/A	QUALITATIVE	QUALITATIVE	N/A	2025

4. NON-WIRES ALTERNATIVES (NEW)

AMI facilitates the analysis and execution of non-wires alternatives. There are several ways that AMI supports the study of non-wire solutions. First AMI provides granular usage data needed to optimize solutions for targeted area. Using a full year of hourly AMI data and analyzing load coincidental peaks from this data is useful to determine value and impact of technologies such batteries, demand response, and distributed generation. A challenge of non-wire solutions is building confidence they will operate when expected and needed in order to defer traditional infrastructure. As more distributed energy resources are installed to meet PSE system resource needs, the load shapes from AMI meters help PSE understand how these intermittent type resources increase or decrease circuit operation and patterns that can be relied on, especially in a local area. Overall, AMI data will allow PSE to expand and improve the analysis, justification, and operation of non-wire solutions.

Progress since 2022:



PSE has been assessing potential non-wire solutions for future system needs for several years. With each project, PSE develops knowledge on how non-wire solutions can benefit the system and defer traditional projects. As AMI meters were deployed, AMI data was used in place of substation data and corporate forecast assumptions. With AMI deployment substantially complete, all non-wires alternative analysis will use AMI data and the study process will be updated with lessons learned from past analysis completed in 2023. Note: PSE's Load Forecasting use case, E.2, also supports non-wire alternatives analysis by improving PSE's load forecasting capabilities to translate system-wide data to circuit level for studies. However, these are considered separate use cases because LoadSEER improves the forecasting component of identifying where a non-wire alternative is needed whereas this use case focuses on studying the system impacts of that non-wire alternative project. The timeline of advancing the use case is shown below. The owner of this use case is Maps and Records and Delivery System Planning.

Table 37: Non-Wires Alternatives use case timeline

NON-WIRES ALTERNATIVES				
2021	2022	2023	2024	2025
DEVELOP BUSINESS PROCESSES TO COLLECT AND ANALYZE AMI DATA	CONTINUE TO ANALYZE NON-WIRE ALTERNATIVES USING PROVIDED TOOLS	PERFORM NON-WIRE ALTERNATIVE ANALYSIS AND IDENTIFY GAPS	CLOSE NON-WIRE ALTERNATIVE DATA GAPS NEEDED TO IMPROVE ANALYSIS	FINALIZE REPEATABLE NON-WIRE ALTERNATIVES FOR ALL PROJECTS

Benefits anticipated are opportunities to defer or avoid traditional transmission and distribution solutions in lieu of less costly non-wire solutions as well as a reduction in planning time due to avoiding manual augmentation to the file to address how non-wire technology operates.

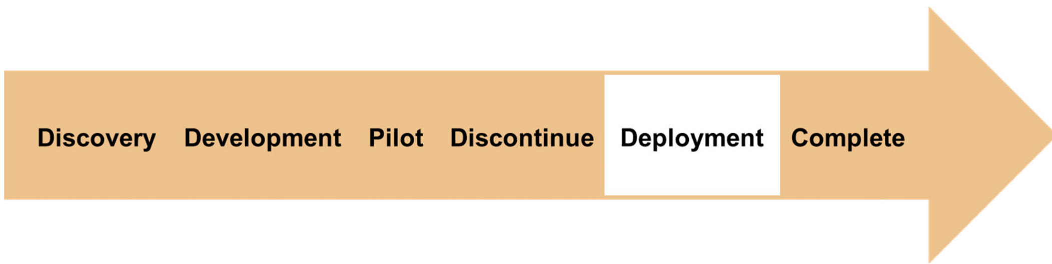
Table 38: Non-Wires Alternatives use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED T&D CAPACITY COST	N/A	$8.1M	$0M	N/A	2024
REDUCED PLANNING TIME	N/A	$0.58M	$0M	N/A	2024

5. SIZING TRANSFORMERS (NEW)

AMI enables PSE to compile actual customer load data and usage trends for sizing equipment and capacity planning. AMI data facilitated a substantial improvement to PSE's previous capacity planning tools that were only able to approximate transformer demand from average daily usage data. This data can be used when a new customer request is made to determine if the transformer should be upgraded to serve the new customer load.

Progress since 2022:



PSE has developed a Transformer Load History Dashboard that compiles AMI meter usage data to report monthly peak coincidental demand on a specified service transformer. The Transformer Load History Dashboard is valuable as a project manager can review the transformer loading quickly and then determine whether a new transformer is necessary now or in the future because of other customer loads on the same transformer. AMI loading data accounts for the direction of power flow, so this dashboard also shows the amount of generation known for each transformer. The timeline of advancing the use case is shown below. The owner of this use case is Customer and System Projects.

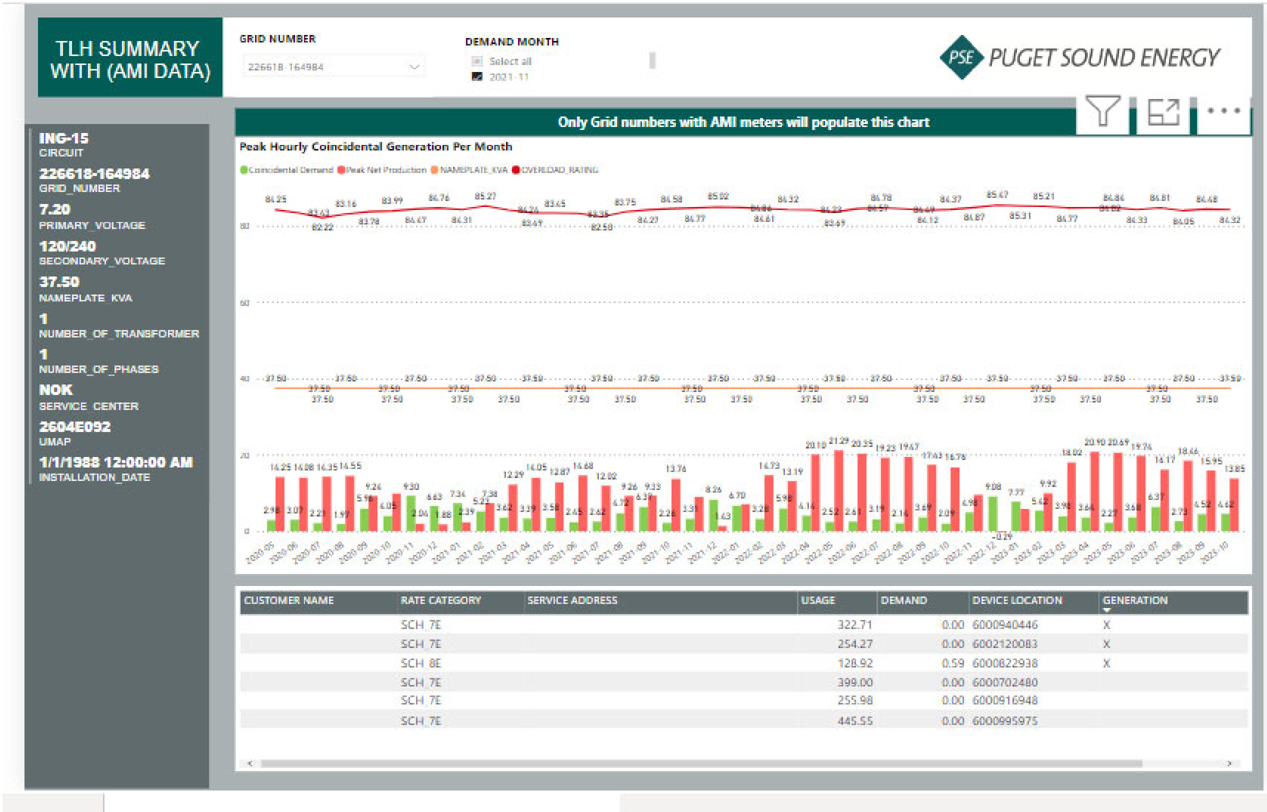


Table 39: Sizing Transformers use case timeline

SIZING TRANSFORMERS				
2021	2022	2023	2024	2025
	DEVELOPED TLH* DASHBOARD	BUSINESS AS USUAL		

*TLH = Transformer Load History

The benefit anticipated is avoiding a conservative material standard approach of upsizing all transformers whenever a new customer load is requested. PSE is unable to quantify this benefit as the occurrence of upgrades has not been tracked to date.

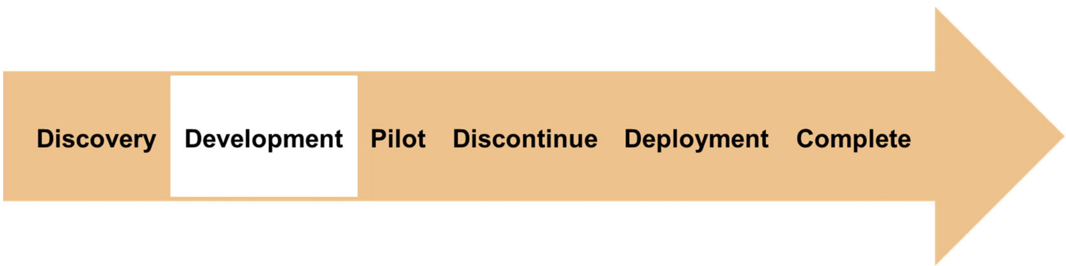
Table 40: Sizing Transformers use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED UNNECESSARY UPSIZED TRANSFORMER	N/A	QUALITATIVE	QUALITATIVE	N/A	2023

6. TRANSFORMER ASSET HEALTH (VOLTAGE ANOMALIES) (NEW)

AMI voltage data can be used to analyze service transformer health and assist with equipment failure prediction. This use case would provide an overview of transformers that deviate from the typical healthy voltage range over a given period of time. Pairing AMI data at the service transformer level allows for screening of anomalies in voltage that could be a precursor to asset failure. Prior to AMI, PSE would not identify a voltage issue until it received a customer complaint and then investigated the complaint by installing voltage measurement equipment, gathered data, and then evaluated the data. Customers would have to wait for engineering to resolve the issue, potentially experiencing equipment damage or outage. The use of AMI voltage data significantly improves PSE's ability to evaluate transformer health and assess when failure may occur.

Progress since 2022:



This use case is in early development as the Grid Modernization team works with various internal groups to identify and prioritize use cases as part of building its "data lake," a large repository for data that can be accessed and analyzed easily in a self-service model and predictive algorithms. Business processes will be established for screening asset health issues, how to run prediction model, and then building a proactive replacement program. The anticipated timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

Table 41: Transformer Asset Health use case timeline

TRANSFORMER ASSET HEALTH				
2021	2022	2023	2024	2025
		DEVELOP TOOL	DEVELOP BUSINESS PROCESSES	BUSINESS AS USUAL TO INCORPORATE ASSET HEALTH CONCERNS INTO 2028 INVESTMENT PLAN AND ISSUES EMERGENCY WORK ORDER IF NECESSARY

PSE PUGET SOUND ENERGY

Benefits anticipated include replacing as planned work that ensures future loading is considered instead of having to replace a service transformer in an emergency with equipment on hand with little future planning or evaluation. Additionally, this avoids an unplanned outage that PSE has estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability. The benefit assumed 0.6 minutes of SAIDI is saved associated with these unplanned outages.

Table 42: Transformer Asset Health use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED UNPLANNED SERVICE TRANSFORMER REPLACEMENT COST	N/A	$3.6M	$0M	N/A	2024
CUSTOMER COST SAVINGS	N/A	$4.4M	$0M	N/A	2024

7. MODEL VALIDATION (VOLTAGE) (NEW)

AMI measures voltage, which can be used to validate investment planning models. AMI meter voltage data helps identify areas that experience abnormal service voltage. This is used to confirm that modeled system voltages match what is actually measured at the customer's meter. Fifteen-minute meter readings are compared with standard service voltages (120, 240, and 277V) to screen for anomalies. Prior to AMI, PSE validated the model at the substation or through specifically installed voltage devices and PSE reviewed loads through billing records to ensure accurate modeling or to investigate if model results identified overloads. AMI significantly improves the accuracy and timing of the model validation process. Accurate models provide that system improvements are identified promptly, that PSE's published Hosting Capacity Map is accurate as discussed in use case F.2, Hosting Capacity Analysis, and that generation interconnection studies can be completed efficiently.

Progress since 2022:

A voltage anomaly dashboard compiles AMI meter voltage data to highlight areas that experience abnormal service voltage and will automate routine voltage issue identification. When a meter's voltage registers outside of expected range, it will be flagged and displayed on this dashboard. The voltage anomaly dashboard can be used to compare with load flow study results to validate if the model is identifying deficiencies accurately. If study results do not match, PSE investigates loading in the model. However, to be fully effective, PSE's dashboard requires additional enhancements which are in development. The timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

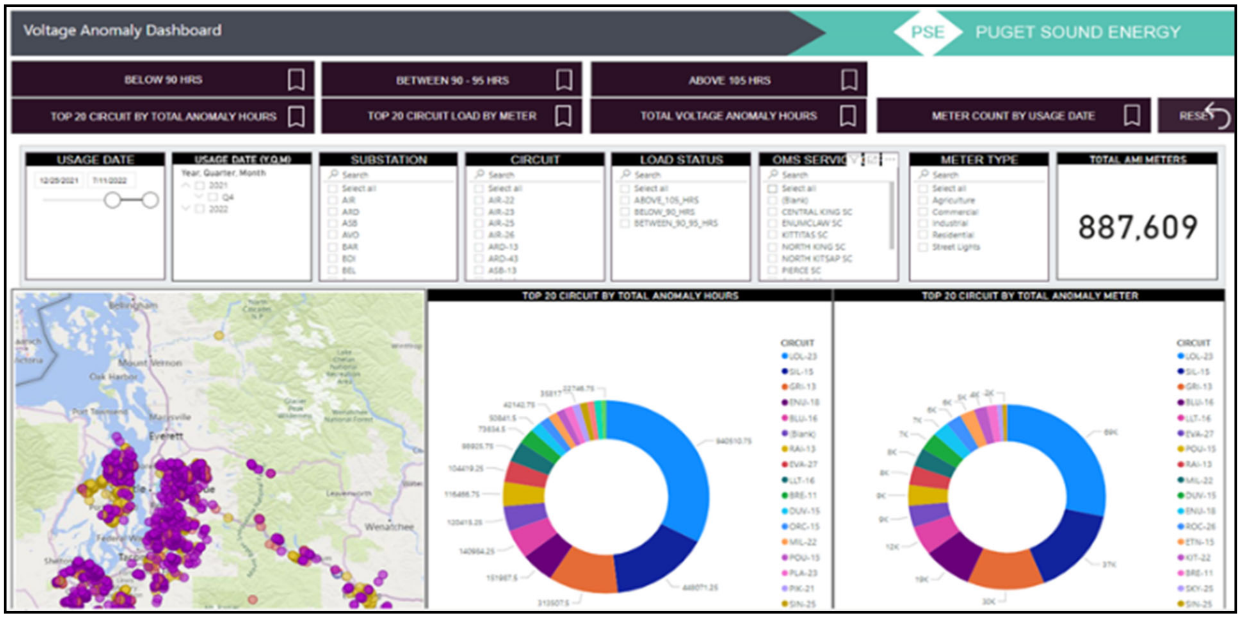


Table 43: Model Validation (Voltage) use case timeline

MODEL VALIDATION (VOLTAGE)				
2021	2022	2023	2024	2025
	DEVELOP DASHBOARD	REVIEW BUSINESS PROCESS	ADDITIONAL DASHBOARD REFINEMENT LEVERAGE FOR 2024 PLANNING STUDIES	BUSINESS AS USUAL

Benefits of the AMI integration will allow planning studies to be performed more efficiently which has been quantified in Hosting Capacity Analysis use case, F.2. About one-third of all the requests require studies that need extensive model validation and clean up time. Validated models shorten the load approval process time, which saves the customer an estimated ten hours of productive time. This decrease in processing time also decreases costs that the customer would pay for the study hours, estimated at two hours of savings depending on the type of customer request and required study. Validated models avoid capacity planning study time, estimated at 20 hours per study. In addition, PSE estimates about 100 meter issues are discovered in this validation process as well, for which two hours are saved by having remote access to AMI data. This tool also provides beneficial information to support other use cases, such as the Voltage Compliance Dashboard mentioned in use case J.3, as well as conservation voltage reduction/volt-var optimization implementation, which is captured in use case B.4.

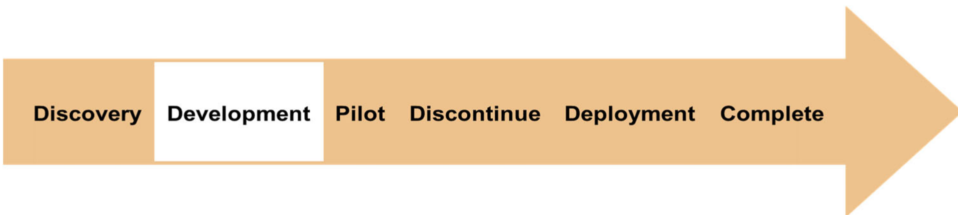
Table 44: Model Validation (Voltage) use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED PLANNING STUDY HOURS COST	N/A	$1.2M	$0M	N/A	2024
AVOIDED GIS/MAPPING LABOR COST	N/A	$0.58M	$0M	N/A	2024
AVOIDED CUSTOMER APPLICATION COST	N/A	$0.58M	$0M	N/A	2024
AVOIDED PROCESS LENGTH THAT RECOGNIZES CUSTOMER VALUE	N/A	$1.4M	$0M	N/A	2024

8. ENHANCED POWER FLOW MODELING (EMERGING)

Sequential-time power flow studies are valuable for analyzing new customer loads or generation that alters the typical load shape of the distribution system. AMI data can be integrated with PSE's power flow modeling tools to account for customer coincidence factors, which in turn can improve modeled load allocation and time-based studies. A coincidence factor is a measure of how likely a customer (or group of customers) is to use their electric load at a given time of day, such as during system peak. In conjunction with LoadSEER's spatial forecast of use case E.2, this use case helps predict customer usage patterns to better understand the system impact of a new customer load at a specified time.

Progress since 2022:



PSE is scoping a tool that slices AMI hourly data by customer class or other groups to view hour by hour customer and equipment coincidence without having to manually review the large volume of data. PSE's Data Enrichment and Enablement Program team is currently evaluating projects for implementation in 2024, with this project likely beginning in 2025/2026, depending on portfolio prioritization. The anticipated timeline of the use case is shown below. The owner is Delivery System Planning.

Table 45: Enhanced Power Flow Modeling use case timeline

ENHANCED POWER FLOW MODELING				
2022	2023	2024	2025	2026
	PREPARE PRELIMINARY SCOPE FOR DATA ENRICHMENT AND ENABLEMENT PROGRAM TEAM	MONITOR SCHEDULE	COMPLETE TOOL	

The benefit anticipates that with this enhanced capacity modeling, PSE may be able to avoid upgrades estimated at $100,000 for approximately 15 customers requesting load or load increase requests. Additional benefit is reduced planning study time of about 30 minutes for incoming load requests estimated at approximately 300 requests annually.

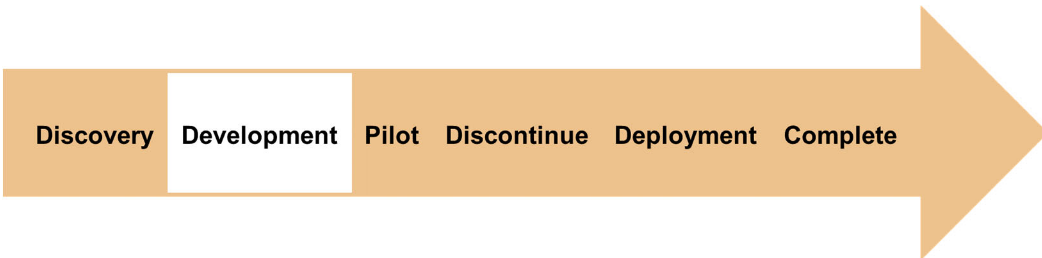
Table 46: Enhanced Power Flow Modeling use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED CUSTOMER PAID INFRASTRUCTURE UPGRADES	N/A	$23.3M	$0M	N/A	2025+
AVOIDED PLANNING STUDY HOURS COST	N/A	$0.2M	$0M	N/A	2025+

9. MASKED LOAD IDENTIFICATION (EMERGING)

There are areas in PSE's service territory that have a very high penetration of distributed energy resources, specifically solar photovoltaic. For planning studies and system forecasting at the feeder level, this can make it difficult to know how much actual customer load is on the circuit where large amounts of generation is located because the generation offsets or "masks" the load measured at the circuit breaker. Actual customer demand can be calculated using AMI data on these types of circuits, differentiating customer load from the generated supply resource.

Progress since 2022:



PSE's Kittitas territory is an example of where generation is greater than the load, so power is flowing into the circuit breaker instead of out of it at times. PSE has to calculate the load by reviewing each meter and transformer to determine the appropriate load profile to plan for. With AMI, PSE has visibility to service transformer loading and generation as described in the use case E.5, Sizing Transformers. PSE is scoping a tool that aggregates this service transformer detail up to the circuit breaker. PSE's Data Enrichment and Enablement Program team is currently evaluating projects for 2024, with this project likely beginning in 2025. The estimated timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

Table 47: Masked Load Identification use case timeline

MASKED LOAD IDENTIFICATION				
2022	2023	2024	2025	2026
	PREPARE PRELIMINARY SCOPE FOR DATA ENRICHMENT AND ENABLEMENT PROGRAM TEAM	MONITOR SCHEDULE	COMPLETE TOOL	IMPLEMENT INTO PLANNING STUDIES

The benefit estimate anticipates that planning study time can be decreased by approximately 30 minutes relative to the circuits that have significant generation, which PSE estimates will be about 25% of its circuits over time.

Table 48: Masked Load Identification use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED PLANNING STUDY HOURS COST	N/A	$0.17M	$0M	N/A	2025+

10. FIXED CAPACITOR MONITORING (EMERGING)

Ongoing research by the Electric Power Research Institute ("EPRI")[18] suggests a 120V residential AMI meter connected through a current transformer can monitor capacitor health. This is not utilizing an AMI meter on a customer's premise but instead, AMI meters are installed on a current transformer to a capacitor which can identify capacitor health. Additional adaptors can be installed that have electronics to monitor and control a switched capacitor based on the status of an AMI meter with connect and disconnect capabilities. Ultimately, the AMI meter becomes the monitor and controller and completely replaces the capacitor control. This would require the additional cost of a meter, but the AMI network may be able to provide the communications back to the control center.

Progress since 2022:

Discovery **Development** **Pilot** **Discontinue** **Deployment** **Complete**

This use case was published by EPRI in 2022 and is still being evaluated by PSE. However, Louisville Gas & Electric and Kentucky Utilities are both deploying the technology using Landis + Gyr AMI equipment, which is the same equipment PSE uses. PSE will engage with these utilities and evaluate the potential for pilots to advance this use case. The estimated timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

Table 49: Fixed Capacitor Monitoring use case timeline

<table>
<tr><th colspan="5">FIXED CAPACITOR MONITORING</th></tr>
<tr><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th></tr>
<tr><td>MONITOR INDUSTRY MATURITY</td><td colspan="2">ENGAGE LOUISVILLE GAS & ELECTRIC, KENTUCKY UTILITIES TO MONITOR PROGRESS AND APPLICATION
INVESTIGATE OTHER UTILITY PILOTS</td><td colspan="2">PERFORM EVALUATION OF TOOLS AND INTEGRATION NEED BASED ON OTHER PILOTS</td></tr>
</table>

[18] V. Holsomback, Operational Benefits of Advanced Metering Infrastructure Louisville Gas & Electric – Kentucky Utilities Use Cases 3002019487, Electric Power Research Institute 2–4 (May 20, 2020), https://www.epri.com/research/products/000000003002019487.

PSE PUGET SOUND ENERGY

Benefits quantified are primarily associated with field and engineering time savings to evaluate capacitor health on an established cycle that assumes approximately five inspections are required annually. Additional benefits due to failed capacitors that can lead to customer outages will be quantified as more data is available about this occurrence.

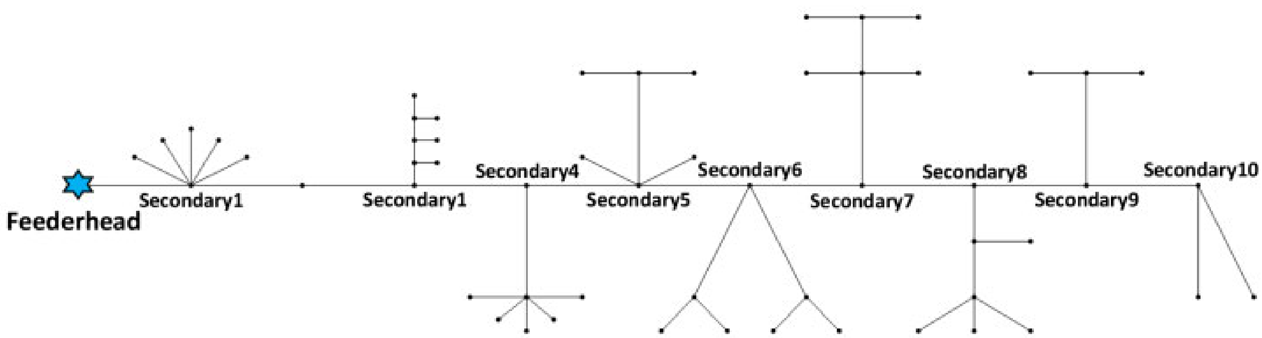
Table 50: Fixed Capacitor Monitoring use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REDUCED INSPECTION HOURS	N/A	$0.02M	$0M	N/A	2025+

11. SECONDARY CIRCUIT PARAMETER ESTIMATION (EMERGING)

Ongoing research by EPRI suggests multiple linear regression with AMI data can be used to estimate the parameters of secondary circuits.[19]

PSE does not currently model secondary conductors, which is not uncommon among utilities as historically load did not change much on these last legs of the grid. However, with electric vehicles and distributed energy resources, these elements of the grid will begin to experience significant load changes and knowing secondary circuit parameters may become increasingly important to determine if distributed energy resources and electric vehicle charging will cause overload or voltage issues on a customer's service conductor. AMI data that aids this use case includes active power, reactive power, and voltage measurements.



Progress since 2022:

Discovery **Development** **Pilot** **Discontinue** **Deployment** **Complete**

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[19] *Artificial Intelligence for Distribution Analysis Using Advanced Metering Infrastructure Data: Research Highlights*, ELECTRIC POWER RESEARCH INSTITUTE (Dec. 19, 2022), https://www.epri.com/research/products/000000003002023915.

PUGET SOUND ENERGY

According to EPRI, using AMI active power, reactive power, and voltage measurements, algorithms can help to develop accurate representation of low voltage secondary circuit models in order to increase accuracy of distribution system state estimators and advance application with high penetration of distributed energy resources. More will be possible with the completion of the Advanced Distribution Management System. PSE will investigate other utility applications and monitor pilots to further analyze benefits and burdens with this application. The estimated timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

Table 51: Secondary Circuit Parameter Estimation use case timeline

SECONDARY CIRCUIT PARAMETER ESTIMATION				
2023	2024	2025	2026	2027
MONITOR INDUSTRY MATURITY	INVESTIGATE UTILITY PILOTS ADMS COMPLETED	INVESTIGATE UTILITY PILOTS	PERFORM EVALUATION OF TOOLS AND INTEGRATION NEED BASED ON OTHER PILOTS	

Benefits are primarily associated and quantified for field and engineering time savings to investigate customer services associated with service quality concerns with added distributed energy resources or load, estimating approximately ten investigations annually. Additional benefits may surface as this new modeling is utilized.

Table 52: Secondary Circuit Parameter Estimation use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REDUCED INVESTIGATION HOURS	N/A	$0.04M	$0M	N/A	2026

F. CLEAN ENERGY INTEGRATION

Clean Energy Integration benefits aim to enable distributed energy resources and electric vehicle growth through tools that use AMI data to provide insight in ideal distributed energy resource and electric vehicle/battery charging locations, enable incentives and affordable rates, and ultimately reduce costs to customers to interconnect. Clean Energy Integration includes seven “Tier 3” benefit use cases: 1) Distributed Energy Resources Integration; 2) Hosting Capacity Analysis; 3) Battery Incentives; 4) Electric Vehicle/Battery Charging Capacity Map; 5) Smart Inverter Connections; 6) Alternative Transportation Electrification Rate Schedules; and 7) Interconnection Commissioning. These benefits are derived by improving accessibility to AMI usage data in performing engineering studies for interconnections, developing external system maps, validating and measuring programs, and designing new rates. Additional benefits may be possible by using the AMI network to transmit interconnection information using the remote switch to facilitate interconnection commissioning. Estimated quantified benefits through 2037 are shown below and detailed in each use case.

Table 53: Clean Energy Integration summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
N/A	$39M	$0M

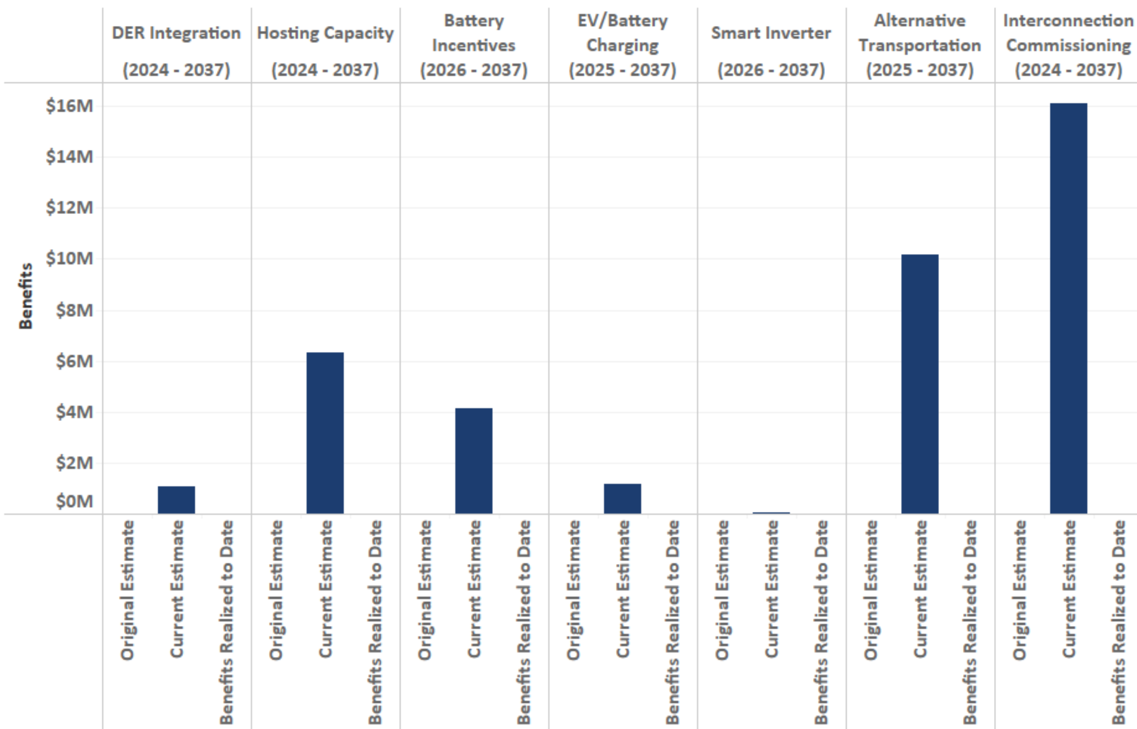


Figure 5: Clean Energy Integration use case benefit summary breakdown

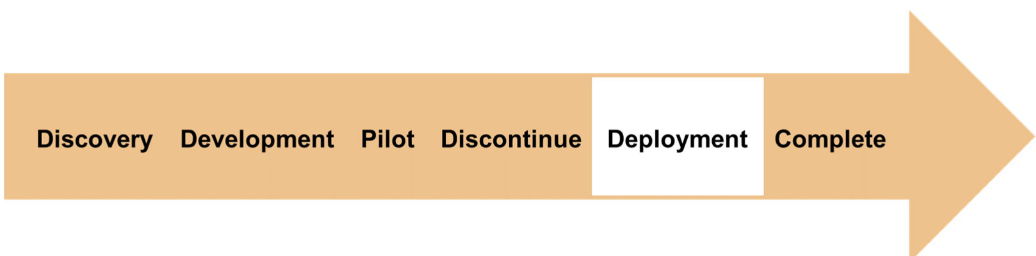
PUGET SOUND ENERGY

1. DISTRIBUTED ENERGY RESOURCES INTEGRATION

AMI meters facilitate the implementation of distributed energy resources and are foundational to distributed energy resources program development. There are numerous ways AMI supports distributed energy resources integration, including enabling a virtual power plant platform (discussed in B.2) that manages distributed energy resources, giving better visibility into the impact of distributed energy resources on the system, improving data analytical capabilities, and providing customer usage and voltage data to support studying distributed energy resources interconnections. AMI meters directly facilitate the distributed energy resources interconnection process. The distribution system is a real-time operation, and distributed energy resources can and do operate within the same timescale.

High-resolution AMI data has given way to the capability for on-demand download of historical usage data by customers from their online PSE account. For a customer, knowing their high-resolution consumption data allows for optimized and effective design of that individual's complete distributed energy resources system (photovoltaic, battery energy storage system, electric vehicle charging, thermostats, etc.). This data has been a popular request from PSE's trade allies, the distributed energy resources installer community, and customers who have the ability share this data with trade allies. Industry standard meter data sharing authorization protocols are planned to be implemented to further improve access of AMI data to customers and installers.

Progress since 2022:



PSE has established processes for handling customer generating facilities of all sizes. AMI data is already providing value to these distributed energy resources processes including use cases B.2, Load Flexibility Programs, E.4, Non-Wires Alternatives, E.5, Sizing Transformers, and E.8, Enhanced Power Flow Modeling. Additionally, AMI data has been fully deployed to help streamline the interconnection process as demonstrated in interconnection studies since 2022. Despite an increase in the volume of interconnection requests, interconnection studies have largely become less complicated. For certain interconnection requests, PSE has established an "EZ" version of study, as hosting capacity data and high-resolution AMI measurements, have, with less effort and greater speed, helped Engineering determine interconnection export effects on the distribution system. Engineering and business practices have adapted to faster processes while retaining analytical confidence to ease the path for higher volumes of interconnections and thus higher penetrations of distributed energy resources.

PUGET SOUND ENERGY

One example and template-in-development for similar projects in the future, can be seen in the PSE Samish Island Microgrid. PSE used AMI data to determine coincident demand of the customers connected to the Samish Island Microgrid to inform the battery size needed to provide back-up power during outages for those customers. PSE will use AMI data in the same manner for future microgrids to optimize the resiliency benefits associated with those projects. The timeline of advancing the use case is shown below. The owner of this use case is Customer Renewable Energy Programs and Delivery System Planning.

Table 54: Distributed Energy Resources Integration use case timeline

DISTRIBUTED ENERGY RESOURCES INTEGRATION				
2021	2022	2023	2024	2025
REIMAGINE INTERCONNECTION PROCESS	INCORPORATE AMI DATA IN DER* STUDIES	INCORPORATED AMI DATA IN VPP*	BUSINESS AS USUAL LEVERAGING AMI DATA IN DER STUDIES	

*DER = Distributed Energy Resources; VPP = Virtual Power Plant

The primary benefits from this use case, not to duplicate benefits accounted for in B.2, Load Flexibility Programs, E.4, Non-Wires Alternatives, E.5, Sizing Transformers, or E.8, Enhanced Power Flow Modeling, is a streamlined Schedule 152 interconnection process which shortens planning and engineering study time ultimately reducing the cost of the study that is paid by the developer. Pre- and post-AMI data/streamlined process hours and billed study cost is the basis for this benefit.

Table 55: Distributed Energy Resources Integration use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
STREAMLINED INTERCONNECTION STUDY LABOR SAVINGS	N/A	$0.08M	$0M	N/A	2024
AVOIDED DEVELOPER COST	N/A	$1.0M	$0M	N/A	2024

2. HOSTING CAPACITY ANALYSIS

Hosting Capacity Analysis is a type of planning study that estimates the amount of generation that can be added to the electric distribution system at a given time and location under existing grid conditions. AMI loading data can be integrated with planning simulation tools like Synergi to more accurately calculate the hosting capacity in a given area. These results are displayed on a Hosting Capacity Analysis map to help visualize the available generation capacity on PSE's system, which is helpful for identifying where distributed energy resources can be placed and can be made available to external parties.

Progress since 2022:

In 2021, PSE launched a Hosting Capacity Map to provide visibility and transparency into the capacity of a given area.[20] This is an external facing map to give visibility to customers and distributed energy resource developers, as well as an internal facing map with additional system information for planning purposes. The first iteration of the Hosting Capacity Map did not incorporate AMI data, but work started in 2023 to enhance the capabilities of the map, integrating AMI load data into the photovoltaic hosting capacity simulation for a more streamlined process, and improved result accuracy. The timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

[20] https://pugetsoundenergy.maps.arcgis.com/apps/webappviewer/index.html?id=980fc190ffd648489a492f8363a1d2cc

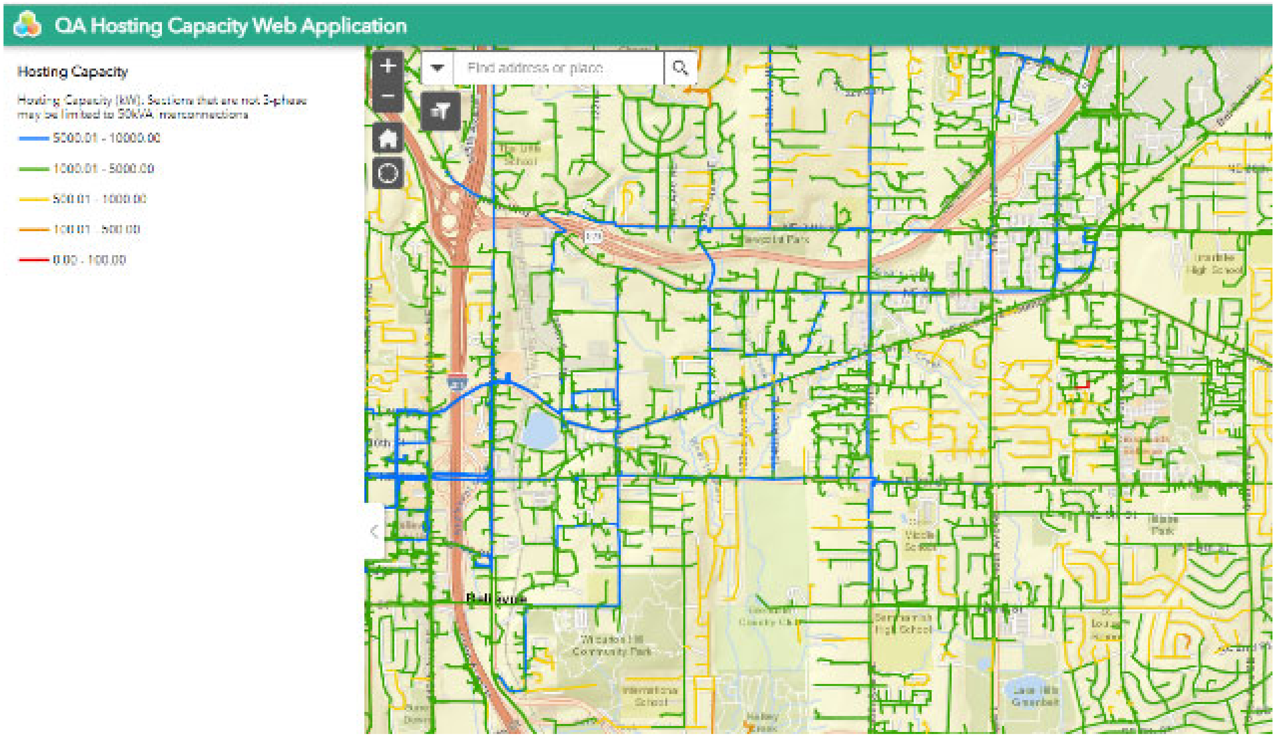


Table 56: Hosting Capacity Analysis use case timeline

HOSTING CAPACITY				
2021	2022	2023	2024	2025
DEVELOP HOSTING CAPACITY MAP VERSION 1	DISCOVERY ON VERSION 2 AND SCOPED	KICK OFF VERSION 2 PROJECT TO INCORPORATE AMI DATA IN HOSTING CAPACITY MAP VERSION 2	COMPLETE AMI INTEGRATION AND POST TO WEBSITE	

PSE will perform routine studies to update the Hosting Capacity Map on a periodic basis. Benefits of the AMI integration will allow these planning studies to be performed faster. Additionally, as customers request service where capacity is available, planning studies will be performed more efficiently, eventually not being necessary based on threshold criteria. This shortens the load approval process time, which shortens the overall duration by an estimated ten hours per customer, as well as avoiding costs customers would pay for the study hours, estimated at one to ten hours of savings depending on the type of customer request and required study. It also avoids PSE planning study time, estimated at one to two hours per application request, allowing time for other work.

For customers with locational flexibility to identify where capacity is available, it also avoids required upgrades they would pay for had they located in an area that did not have capacity as provided by the hosting capacity analysis.

Table 57: Hosting Capacity Analysis use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REDUCED PROCESS LENGTH CUSTOMER VALUE	N/A	$5.0M	$0M	N/A	2024
AVOIDED CUSTOMER APPLICATION COST	N/A	$0.65M	$0M	N/A	2024
AVOIDED PLANNING STUDY HOURS COST	N/A	$0.4M	$0M	N/A	2024
AVOIDED SUPPORT HOURS COSTS	N/A	$0.2M	$0M	N/A	2024

3. BATTERY INCENTIVES

PSE is evaluating battery programs for all customer classes to increase customer choice and contribute to PSE's clean energy supply needs by allowing customer-owned batteries to be dispatched through the virtual power plant platform. Battery energy storage systems have numerous use cases beyond standby back up power, including voltage and frequency regulation, load shifting, better renewable penetration, grid resilience, and peak demand reduction. All of these use cases require technology that allows connection to and commands from the grid operator. These grid-interactive technologies open the door on these uses, and the high frequency interval data provided by AMI meters is used to validate the efficacy of distributed energy resources.

Storing Your Own Power

Progress since 2022:

Discovery	**Development**	Pilot	Discontinue	Deployment	Complete

At the beginning of 2023, the New Product Development team initiated development of a residential battery program and an interface between a commercial battery and the virtual power plant to inform future commercial and industrial battery programs. All battery programs will use the virtual power plant to dispatch the battery during system or local peaks, and measurement and verification

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data will be sourced from AMI meters. Additionally, AMI data will be used in evaluating customer load profiles to facilitate siting commercial and industrial batteries. PSE filed a tariff for Residential Battery Energy Storage System Services, Schedule 611, with the Commission on October 6, 2023, and it became effective on November 10, 2023.[21] New Products and Services introduced a Battery Energy Storage Systems product that provides generous incentives for several classes of customers at the time of purchase. The timeline of advancing the use case is shown below. The owner of this use case is New Products and Services.

Table 58: Battery Incentives use case timeline

BATTERY INCENTIVES				
2021	2022	2023	2024	2025
		DEVELOP RESIDENTIAL BATTERY PROGRAM WUTC TARIFF APPROVAL	DEVELOP C&I* INCENTIVE PROGRAM DEPLOY RESIDENTIAL PROGRAM TO SCALE	

*C&I = Commercial and Industrial

Benefits anticipated are from a reduction in upfront purchase costs that customers can receive as well as annual participation in dispatch events per the tariff. Additionally, there are savings from avoided transmission and distribution capacity. PSE also calculated an incentive that eligible vulnerable populations can receive when purchasing a battery energy storage system that participates in the virtual power plant.

[21] Docket UE-230827.

Table 59: Battery Incentives use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INCENTIVES SAVINGS	N/A	$1.3M	$0M	N/A	2024/2025
AVOIDED CAPACITY COST	N/A	$2.8M	$0M	N/A	2024
VULNERABLE POPULATION CUSTOMER INCENTIVES SAVINGS	N/A	$0.1M	$0M	N/A	2024

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4. ELECTRIC VEHICLE/BATTERY CHARGING CAPACITY MAP (EMERGING)

As a variation of the Hosting Capacity Map for generation, PSE is in the early stages of developing a load-serving capacity map for electric vehicle and battery charging applications. PSE would perform routine studies to periodically update an external map that shows where there is capacity in the distribution system to serve the load associated with charging public electric vehicle stations and utility scale batteries. Customers would be able to anticipate where feasibility studies would indicate lower cost interconnection associated with delivery system infrastructure upgrades. AMI customer usage data as well as electric vehicle and battery charging profiles data can be used in modeling assumptions for faster updates and better map accuracy as battery studies are more complex than typical load requests.

Progress since 2022:

Discovery | **Development** | **Pilot** | **Discontinue** | **Deployment** | **Complete**

A development project was kicked off in mid-2023 to expand PSE's Hosting Capacity Map capabilities and improve the customer interconnection portal. This project focuses on developing additional hosting capacity capabilities, such as load-serving hosting capacity for large new customer load requests like fleet electric vehicle charging. PSE is evaluating modeling data and assumptions using AMI customer usage data, as well as electric vehicle and battery charging profiles. The development of a map and accessibility will follow completion of version 2 of PSE's Hosting Capacity Map and lessons learned from users to ensure effective interface. The timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning.

Table 60: Electric Vehicle/Battery Charging Capacity Map use case timeline

ELECTRIC VEHICLE/BATTERY CHARGING CAPACITY MAP				
2022	2023	2024	2025	2026
	IDENTIFIED USE CASE AND BEGIN EVALUATION	EVALUATE MODELING AND MAPPING REQUIREMENTS	COMPLETE AMI INTEGRATION AND POST TO WEBSITE AFTER VERSION 2 OF HOSTING CAPACITY MAP COMPLETED	LEVERAGE MAP IN LOAD REQUEST PROCESS

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Benefits of the AMI integration includes faster planning studies to keep the map updated as well as faster or avoided feasibility studies when customers request service where charging capacity is available. This shortens the load approval process time which shortens the overall process time by an estimated 40 hours per customer. It also avoids additional studies, estimated at two requests annually, that are likely not feasible which the map would indicate, but that customers would pay for the study hours. It avoids PSE planning study time, estimated at 8-16 hours per application request, allowing time for other work. For some customers that locate where capacity is available, it also avoids required upgrades that they would pay for had they located in an area that did not have capacity as provided by the hosting capacity.

Table 61: Electric Vehicle/Battery Charging Capacity use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REDUCED PROCESS LENGTH CUSTOMER VALUE	N/A	$0.7M	$0M	N/A	2026+
AVOIDED CUSTOMER TIME FROM NON-FEASIBLE REQUESTS	N/A	$0.09M	$0M	N/A	2026+
AVOIDED PLANNING STUDY HOURS COST	N/A	$0.3M	$0M	N/A	2026+

5. SMART INVERTER CONNECTION (EMERGING)

A research paper by EPRI published in 2022[22] suggests a combination of power over ethernet and the AMI network can be used for cost-effective smart inverter communications for advanced distribution energy resources integration. EPRI's white paper states that "smart inverter uses cases that may be reasonable to send over the AMI network range from seasonal control updates to 15 minutes monitoring and control."[23] The research highlights barriers and potential opportunities based on AMI technologies, but notes the societal benefits of the communication solutions currently greatly exceed costs due to no ongoing cellular network costs and reduced installation time.

Progress since 2022:

PSE will gain more knowledge about this potential AMI use case in collaborating with Landis + Gyr as technology continues to evolve. PSE will perform technology analysis to evaluate future opportunities to leverage the AMI network. Additionally, as with the distribution automation over AMI use case, J.1, low cellular costs and data latency may make the application less probable today, but the future may be different. The timeline of advancing the use case is shown below. The owner of this use case is Delivery System Planning and Distributed Energy Resources Programs.

Table 62: Smart Inverter Connection use case timeline

SMART INVERTER CONNECTION				
2023	2024	2025	2026	2027
MONITOR INDUSTRY MATURITY	EVALUATE CURRENT TECHNOLOGY CAPABILITY WITH LANDIS + GYR		IDENTIFY FUTURE TECHNOLOGY UPGRADES AND PATH INFORMED BY UTILITY PILOTS	

[22] S. Fabus, Connecting to Smart Inverters Opportunities and Limitations of Using Power Over Ethernet and Advanced Metering Infrastructure Networks 3002025137, ELECTRIC POWER RESEARCH INSTITUTE (July 21, 2022), https://www.epri.com/research/products/000000003002025137.
[23] *Id.* at vii.

Benefits are based on avoided communication infrastructure at a distributed energy resource site. PSE assumes some distributed energy resource sites are communication ready via other mediums like cellular, so a conservative number of sites were estimated in the benefit calculation. PSE's quantification does not extend to customer owned distributed energy resources simply due to the uncertainty in adapting technology across the system.

Table 63: Smart Inverter Connection use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED COMMUNICATIONS INFRASTRUCTURE COST	N/A	$0.04M	$0M	N/A	2026+

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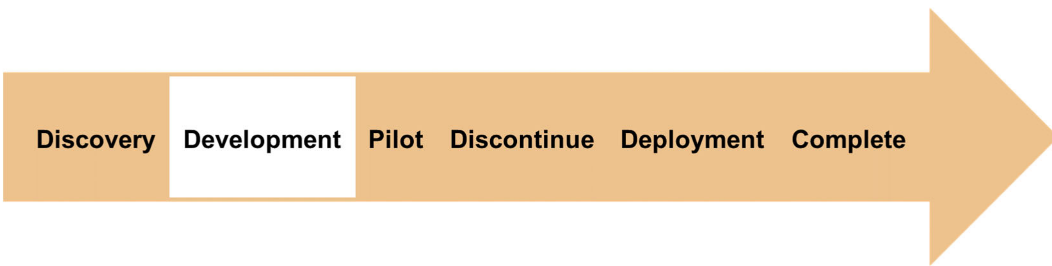
6. ALTERNATIVE TRANSPORTATION ELECTRIFICATION RATE SCHEDULES (EMERGING)

As discussed in several use cases, including E.1. Electric Vehicle Planning and Integration, F.4, Electric Vehicle / Battery Charging Capacity Map, and more broadly with PSE's Transportation Electrification Program led by PSE's Products and Services team, PSE is exploring the opportunity to leverage AMI data for load research on electric vehicle charging. This use case expands on this to use the corresponding load shapes to devise alternative rate schedules for different charging use cases, particularly for public and fleet charging. These alternative rate schedules are intended to 1) achieve closer cost-rate parity for these customers, 2) promote the deployment of additional charging infrastructure and thus promote transportation electrification, and 3) shift charging loads outside of system peak hours. Through these goals, PSE customers will experience the following benefits: (a) rates more closely aligned with the cost of service, (b) expanded transportation electrification and the many benefits that carries, and (c) a reduction in system upgrade and demand-related costs due to load management.

Progress since 2022:



To develop these alternative rate schedules, the Company requires statistically robust load shapes, which can only be obtained through the use of AMI data. The estimated timeline of advancing the use case is shown below. PSE has begun analyzing how to adjust the tariff which bills public charging on commercial rate to account for low capacity factor (long times between use) and steep demand charges. The owner of this use case is Delivery System Planning and Distributed Energy Resources Programs.

Table 64: Alternative Transportation Electrification Rate Schedules timeline

ALTERNATIVE TRANSPORTATION ELECTRIFICATION RATE SCHEDULES				
2023	2024	2025	2026	2027
DEVELOP LOAD RESEARCH	DESIGN AND LAUNCH PILOT	MONITOR PILOT	EVALUATE PILOT AND DESIGN NEW TARIFF FOR WUTC APPROVAL	IMPLEMENT NEW TARIFF

Benefits anticipate shifting demand charges to more appropriate users which is revenue neutral for PSE. This will also encourage expansion of public charging which has already been accounted for in the overall transportation electrification plan. Appropriate billing will influence charging patterns which are assumed to shift load from peak times ultimately reducing infrastructure investments associated with a growing demand peak. Residential electric vehicle charging load shift is already accounted for in the demand response programs associated with the B.2 use case.

Table 65: Alternative Transportation Electrification Rate Schedules timeline benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED T&D CAPACITY COSTS	N/A	$10.1M	$0M	N/A	TBD

7. INTERCONNECTION COMMISSIONING (EMERGING)

A witness test is completed on new customer generator interconnections so the customer does not back feed on the grid during an outage condition, which poses a significant safety concern to electrical workers and the public. The remote disconnect capability of an AMI meter can be used to simulate an outage and observe whether there is reverse flow. PSE recognizes the increasing requests for interconnections, which historically require on-site visual validation of proper equipment and connection is resulting in lengthy commissioning times for customers. The interconnection commissioning demand will continue and must consider new processes to confirm proper operation for timely commissioning, which improves customer satisfaction and helps avoid backlogs.

Progress since 2022:

Discovery	Development	Pilot	Discontinue	Deployment	Complete

PSE engaged a third-party expert to evaluate best practices for interconnections and from this, learned that few, if any, utilities perform an on-site visual validation if AMI is available. Because AMI service meters are distributed energy resource-ready, PSE has the opportunity to rethink the Journeyman commissioning process. For the simplest "Tier 1" customer-owned interconnections, PSE is considering whether a Journeyman visit is no longer required to exchange the meter. PSE is evaluating if and how other aspects of the current Journeyman commissioning process could be avoided, replaced, or made more efficient for the simplest types of residential interconnections. Doing so would not only avoid the costs of a single Journeyman site visit, but also would improve the customer experience (reducing wait time for permission to operate a distributed energy resource and therefore avoid PSE customer service costs as well). PSE also needs to engineer a solution for when the disconnect switch operates to simulate outage, but the solar array is off, which means the test for reverse flow does not conclusively eliminate the safety concern. PSE's development towards this requires electrical worker support and consideration of IBEW rules so the evaluation plan will include pilots and ensure safety concerns are addressed. Use case I.1, Unsafe Condition, will be an important compliment to this use case to identify unsafe photovoltaic backfeed once routine operation is established. The estimated timeline of advancing the use case is shown below. The owner of this use case is Customer Renewable Energy Programs and Electric Operations.

Table 66: Interconnection Commissioning use case timeline

INTERCONNECTION COMMISSIONING				
2022	2023	2024	2025	2026
	IDENTIFIED USE CASE	DEVELOP EVALUATION PLAN WITH ELECTRIC OPERATIONS	IMPLEMENT EVALUATION AND ADJUST DEPLOYMENT PLAN AS NECESSARY	DEPLOY PROCESSES OR DISCONTINUE IF SAFETY CAN'T BE ADDRESSED

Benefits anticipated from this use case include shortening the time it takes to get a customer commissioned, reducing four to six weeks down to one day. Not yet quantified, but additional potential savings are from reducing field visits for installers, as well as benefits to PSE for avoided costs associated with handling complaints regarding the interconnection timeline.

Table 67: Interconnection Commissioning use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER COST SAVINGS (REDUCED DELAY, KWH SAVINGS)	N/A	$5.6M	$0M	N/A	2024
OPERATIONAL EFFICIENCY, DECREASE IN LABOR TIME PER DISTRIBUTED ENERGY RESOURCE SYSTEM	N/A	$10.5M	$0M	N/A	2024

G. IMPROVED CUSTOMER PARTICIPATION AND PROGRAM DEPLOYMENT

Improved Customer Participation and Program Deployment benefits aim to enhance product and services including energy efficiency program design to target desired participation. There is one use case under this program, Customized Program Engagement and Optimization, designated as “Tier 3.” This use case is focused on customized engagement around products/services and energy efficiency program optimization. Benefits are derived by accessibility to customer AMI usage data for program developers to use in developing new ideas to meet customer interest, clean energy policies, and PSE goals and objectives. This includes developing tools that help program designers review load profiles and usage patterns for expanding products and services, including energy efficiency programs. At this time, the use of AMI data to identify innovative ideas and potential programs is currently designated as qualitative from a benefits standpoint. PSE recognizes customer privacy and trust is paramount as this use case progresses, and PSE anticipates additional quantified benefits once specific program design begins.

Table 68: Improved Customer Participation and Program Deployment summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
N/A	QUALITATIVE	QUALITATIVE

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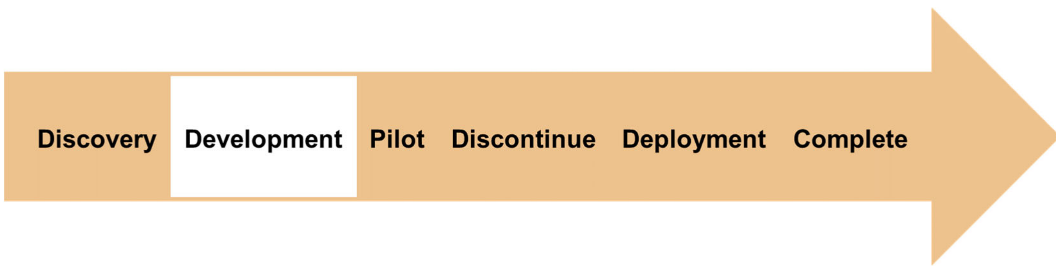
1. CUSTOMIZED PROGRAM ENGAGEMENT AND OPTIMIZATION (NEW)

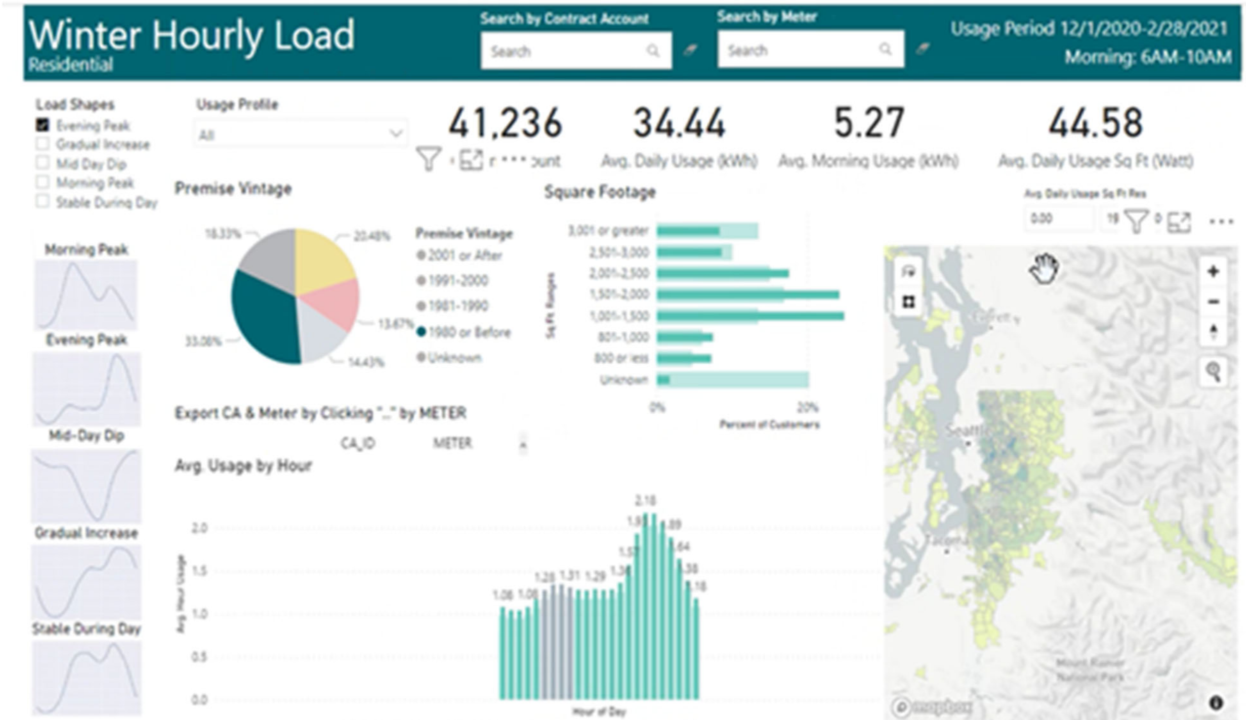
AMI usage data allows PSE to identify customized product and services and energy efficiency solutions for groups of residential and business customers based on their energy usage, behaviors, and preferences. There are many use cases associated with specific programs that PSE has included in this progress report such as Time Varying Rates Programs and Load Flexibility Programs. This use case captures the opportunity to leverage AMI data for more programs yet to be defined and enables PSE to better advise customers about different programs, services, and technologies that would provide them the most value for their needs and preferences.

Progress since 2022:



There are a few examples, beyond the use cases of the Customer Energy Management category, B.1, B.2, or B.3, of how program teams have used AMI data, including:

- PSE developed a thermal profiling model to identify customers with similar heating and cooling patterns. This uses temperature and AMI usage data to identify the likelihood of a customer having electric/gas heating or cooling. The applications of this use case include identifying areas with gas-only heating to optimize hybrid heat pump incentives.
- AMI interval data is being used to design a study of dual fuel heat pumps to improve energy efficiency and minimize bills for PSE customers.
- The Customer Insights team built a data analytics dashboard that groups similar household types by their energy usage patterns. Better visibility into energy usage profiles helps to pinpoint energy efficiency opportunities.
- The Energy Efficiency team plans to use AMI data as part of an electrification pilot to observe what happens to energy consumption after a customer's transition to a hybrid heating system. The lessons learned from this will be used to form better assumptions about hybrid technology impacts when they are implemented at scale in PSE's service territory.



PSE is working slowly in this space to honor customer privacy and commitments made when PSE rolled out the AMI deployment, being mindful of misusing customer data. The timeline of advancing the use case is shown below. The owner of this use case is Energy Efficiency and Products and Services.

Table 69: Customized Program Engagement and Optimization use case timeline

CUSTOMIZED PROGRAM ENGAGEMENT AND OPTIMIZATION				
2021	2022	2023	2024	2025
		LEVERAGE AMI DATA TO DEVELOP PROGRAM IDEAS	LEVERAGE AMI DATA TO DEVELOP PROGRAM IDEAS AND DESIGN PROGRAMS	

Because this use of AMI data is to identify innovative ideas and possible programs, the benefits are expressed only qualitatively as specifics are not yet available for quantification.

Table 70: Customized Program Engagement and Optimization use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
INCREASED CUSTOMER PARTICIPATION/ ENGAGEMENT	N/A	QUALITATIVE	QUALITATIVE	N/A	N/A
PROGRAM OPTIMIZATION	N/A	QUALITATIVE	QUALITATIVE	N/A	N/A

H. REVENUE ASSURANCE AND FINANCIAL ANALYSIS

Revenue Assurance and Financial Analysis benefits aim to address financial health. This includes two use cases that are designated as “Tier 3”: 1) Theft and Fraud use case and 2) Cost of Service Studies. These benefits are derived by using AMI hourly data in key parts of developing the revenue requirement allocation in rate cases as well as monitoring usage data for theft. PSE is using AMI data in the current rate case cost of service studies, while the theft use case is developing. Estimated quantified benefits through 2037 are shown below and detailed in a following figure by each use case.

Table 71: Revenue Assurance and Financial Analysis summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
N/A	$0.06M	$0M

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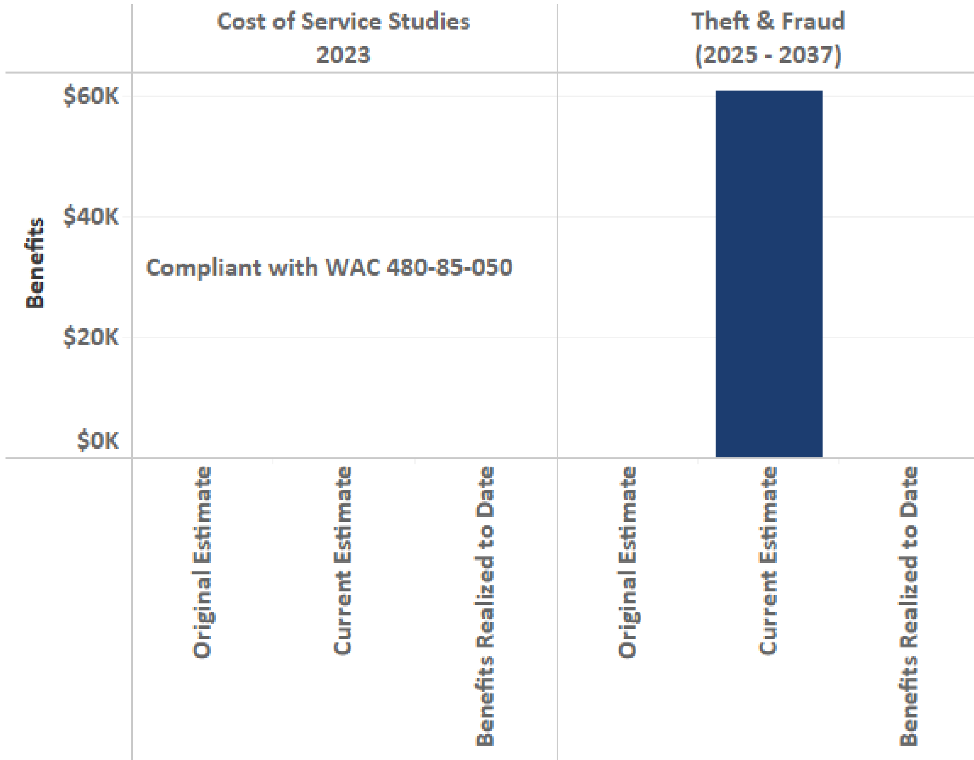


Figure 6: Revenue Assurance and Financial Analysis use case benefit summary breakdown

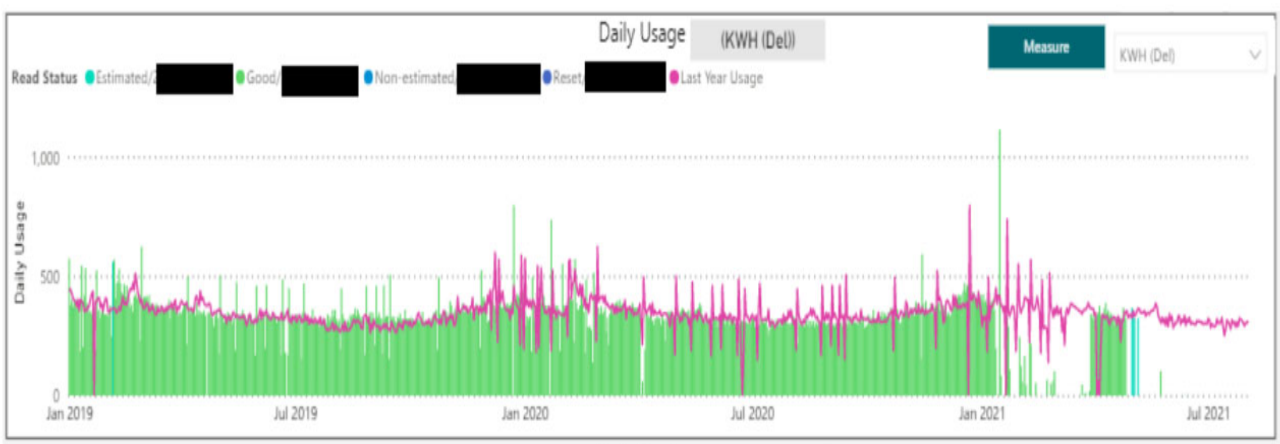
1. THEFT AND FRAUD

AMI meters can help detect instances of meter tampering and electricity theft by monitoring significant variations in usage patterns as well as detecting and reporting the number of times a meter has been turned off/on and when a meter is removed or relocated.

Progress since 2022:

PSE has tackled this use case in two ways. First, PSE's AMI deployment vendor noted a specific code in instances where the installer suspected meter tampering or energy theft. A work order called an "EMMA case" was generated and reviewed by the AMI back office team and a service notification is created, as needed, for field operations to investigate.

Second, concurrently and for post-deployment steady state, PSE developed Meter Analytics Solution algorithms and a dashboard to deliver data-driven insights, including early discovery and detection of zero consumption. Algorithms were developed to identify gas and electric meter patterns and alarms that signal a potential operational concern. PSE continues to enhance these algorithms to incorporate new capabilities. When zero usage is detected, a service order is auto generated for field investigation and resolution. Through this investigation process, instances of meter tampering and electricity theft can be identified.



The timeline of advancing the use case is shown below. The owner of this use case is Performance Quality, Gas First Response.

Table 72: Theft and Fraud use case timeline

THEFT AND FRAUD				
2021	2022	2023	2024	2025
DEVELOP DASHBOARD	MONITOR AND GENERATE EMMA CASES AS NEEDED DURING DEPLOYMENT		DEVELOP FURTHER TOOLS AND BUSINESS PROCESSES TO IDENTIFY UNEXPECTED ZERO USAGE.	DEPLOY FULL SET OF TOOLS AND PROCESSES

Protecting PSE's revenue stream is beneficial so paying customers are not supplementing those that engage in energy theft. Benefits are estimated based on historical occurrences.

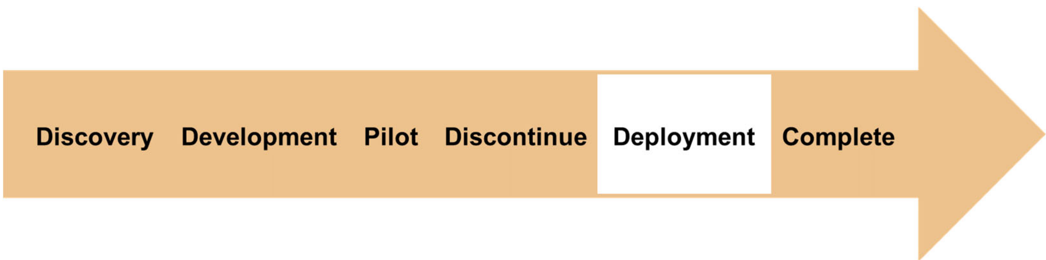
Table 73: Theft and Fraud use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REVENUE RECOVERED	N/A	$0.06M	$0M	N/A	2020

2. COST OF SERVICE STUDIES (NEW)

Utility rate case process requires the allocation of overall revenue requirement through rates which are based on studies that evaluate historical or test year cost of service for a utility's customer classes. Cost of service uses information such as monthly total and average load estimates, co-incident, and non-coincident peak demands. Historically, load research studies estimated hourly load profiles by rate class on the basis of AMR interval usage data for the test year for about 1,500 sampled customers. PSE used a sample of AMR interval usage data to develop these profiles since interval data for the full population was not available. PSE's AMR system did not record interval data except for specifically identified customers either because the customer required interval data or the Company intentionally gathered it for purposes such as cost of service studies. AMI interval usage data results in more accurate cost of service studies and complies with WAC 480-85-050.

Progress since 2022:



PSE's 2024 multiyear rate case filling developed the electric load profiles required for the cost of service study utilizing AMI interval usage data, which was available for all customer meters installed during the test year period instead of using only the sample of approximately 1,500 meters from AMR data. Since PSE's mass implementation of AMI meters was not complete at the time of the test period, the number of meters that had a full years' worth of historical hourly interval data yielded a coverage rate of 60 to 80% across different rates. PSE used daily data in the development of the gas load research analysis in PSE's 2022 General Rate Case and replicated this analyses for the 2024 General Rate Case. This use case is considered in deployment with completion expected in the next rate case when all data is supported by full AMI deployment. The estimated timeline of advancing the use case is shown below. The owner of this use case is Regulatory Affairs.

Table 74: Cost of Service Studies use case timeline

COST OF SERVICE STUDIES				
2021	2022	2023	2024	2025
SECURE ANALYSIS VENDOR UTILIZE AVAILABLE AMI DATA FOR GAS LOAD RESEARCH		SECURE ANALYSIS VENDOR UTILIZE AVAILABLE AMI DATA FOR ELECTRIC LOAD RESEARCH	EVALUATE RESULTS TO STATISTICAL SAMPLING FOR FUTURE STUDIES	

In the near future, PSE will evaluate the benefit of the population-based load study with the sample-based method that uses a relatively large sample but less than the full population data since the population based load research comes with a high cost. Studies on the load research field found that there is no significant benefit from using a large sample to full population data for developing load profiles. PSE will be able to quantify a benefit after this evaluation. For now, the primary benefit of using full population AMI data is that PSE is compliant with regulatory requirements.

Table 75: Cost of Service Studies use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
ELECTRIC AND GAS LOAD RESEARCH	N/A	COMPLIANT WITH WAC 480-85 050	N/A	N/A	2023

I. FIELD AND CUSTOMER SAFETY

Field and Customer Safety benefits aim to address unsafe conditions for field personnel and customers. This includes four use cases that are "Tier 3" benefits: 1) Unsafe Condition; 2) Downed Live Wire Notification; 3) Improved Customer Safety; 4) Voltage Compliance along with emerging use case of Communication for Methane Detection Monitors. Benefits are derived by deploying AMI technology to improve safety. Benefits that can be quantified now are estimated through 2037. Other benefits are qualitative, as discussed below.

Table 76: Field and Customer Safety summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
N/A	$0.05M	$0M

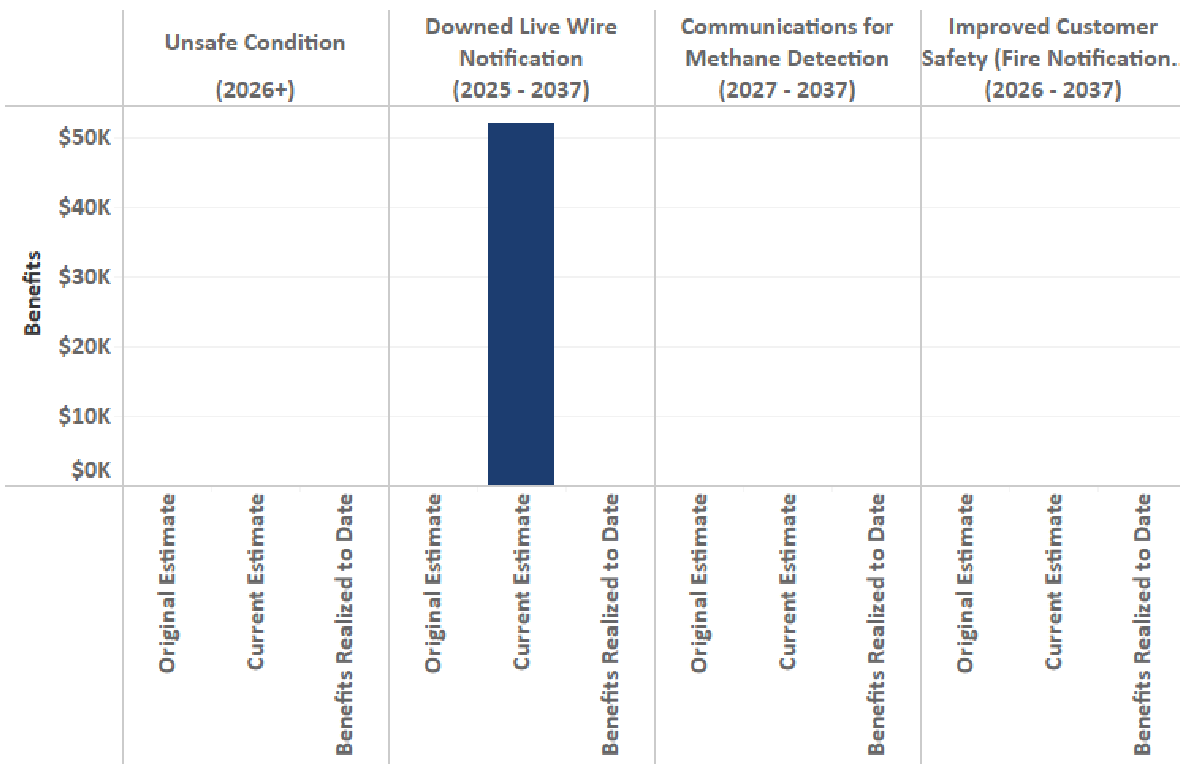


Figure 7: Field and Customer Safety use case benefit summary breakdown

1. UNSAFE CONDITION (PHOTOVOLTAIC BACKFEED) (NEW)

PSE has approval and safety processes in place for customers to interconnect new distributed energy resources on the system. These processes provide that PSE is aware of the distributed energy resources and that it can operate safely. In the unlikely event a customer does not follow this process, it can create an unsafe condition where energy is back fed on the system during an outage. AMI meters have reverse rotation flags that can be used to identify unauthorized energy back feed on the grid. PSE's AMR system provided reverse rotation flags but did not generate enough data to fully evaluate the situation such as the amount of reverse flow.

Progress since 2022:

Currently, PSE is seeing flags being triggered indicating energy back feed, but after investigation, has determined these are largely false flags. PSE is evaluating the cause of these false flags but assesses so far that unauthorized interconnections are rare, and as such, has slowed the process development for this use case. The estimated timeline of advancing the use case is shown below. The owner of this use case is Customer Renewable Energy Programs.

Table 77: Unsafe Condition (Photovoltaic Backfeed) use case timeline

UNSAFE CONDITION (PHOTOVOLTAIC BACKFEED)				
2022	2023	2024	2025	2026
	IDENTIFIED USE CASE	DEVELOP EVALUATION PLAN	IMPLEMENT BUSINESS PROCESS EVALUATION	DEPLOY PROCESSES AFTER INTERCONNECTION BACKLOGS ELIMINATED

The qualitative benefit anticipated from this use case is avoiding an unsafe event. PSE has not quantified the avoided employee or public injury at this time.

Table 78: Unsafe Condition (Photovoltaic Backfeed) use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
SAFETY RISK	N/A	QUALITATIVE	QUALITATIVE	N/A	2026+

2. DOWNED LIVE WIRE NOTIFICATION (NEW)

Downed live wire can create a high impedance fault condition that cannot be detected by most protection schemes. AMI data can be used to screen for voltage fluctuations and customer outages that support detecting a downed live conductor. Identifying wire down reduces the risk of exposure to an energized conductor on the ground by customers and restoration crews, and helps to reduce the time needed to locate system damage.

Progress since 2022:

This use case is in early discovery as the Grid Modernization team works with various internal groups to identify and prioritize use cases as part of the Data Lake and Data Analytics project. Business processes will be established for how AMI voltage and power status data will be used to identify downed conductors for emergency response. The timeline of advancing the use case is shown below. The owner of this use case is Regional System Planning and System Operations.

Table 79: Downed Live Wire Notification use case timeline

DOWNED LIVE WIRE NOTIFICATION				
2021	2022	2023	2024	2025
		INITIATE DATA LAKE USE CASE	DEVELOP BUSINESS PROCESS WITH AVAILABLE DATA	MONITOR FOR EVENTS

Benefits anticipate a downed live wire notification will lead to the ability to address approximately ten occurrences annually reducing outage durations. PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement. The benefit assumed one hour outage event duration is saved for a subset of customers. Additionally, this notification eliminates the need to send a first responder by sending a construction crew immediately instead. There is a significant qualitative safety benefit anticipated. However, PSE has not quantified the avoided employee or public injury at this time.

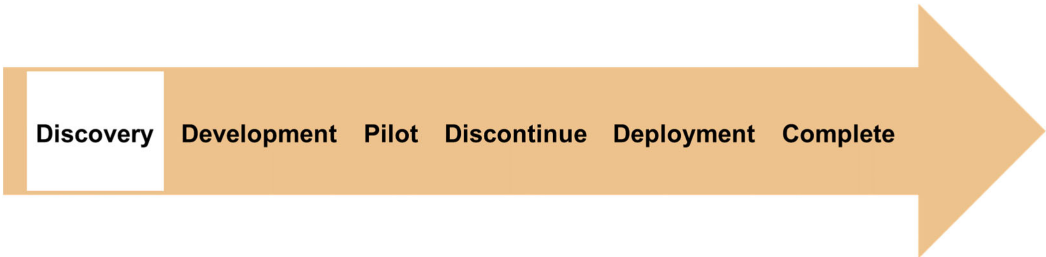
Table 80: Downed Live Wire Notification use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$0.02M	$0M	N/A	2025
REDUCED OR AVOIDED O&M EXPENSE	N/A	$0.03M	$0M	N/A	2025
SAFETY RISK	N/A	QUALITATIVE	QUALITATIVE	N/A	2025

3. IMPROVED CUSTOMER SAFETY (FIRE NOTIFICATION) (NEW)

AMI meters measure meter temperature which can be used to determine fire-caused outages. When the meter detects a temperature above a set threshold value, a flag is generated to indicate a fire has occurred.

Progress since 2022:



With AMI deployment, PSE has been receiving temperature flags from the AMI meters. However, upon investigation, PSE has determined that many of the flags proved to be non-fire related, such as heat caused by sun exposure or heat from nearby vent. PSE slowed efforts on this use case as more testing and evaluation was necessary to determine an effective way to leverage this temperature data for greater confidence in the flag alerts. Over time it may require revising meter location standards to prevent heat vents from being located near meters or consider sun impacts. Ideally, if effective, PSE would be able to dispatch or remotely shut down electric service faster than waiting for emergency notification. This may be useful in high wildfire risk areas. Additional work to refine alert timing will be necessary for the benefit of improving fire response safety and response with faster electric service shutoff. The timeline of advancing the use case is shown below. The owner of this use case is Metering.

Table 81: Improved Customer Safety (Fire Notification) use case timeline

IMPROVED CUSTOMER SAFETY (FIRE NOTIFICATION)				
2021	2022	2023	2024	2025
	TESTED WHEN PURCHASED AMI SYSTEM – TEMPERATURE FLAG MONITORING AND INVESTIGATION	EVALUATE FURTHER GIVEN THE FALSE POSITIVES	FUTURE WORK WITH VENDOR TO EVALUATE USE	

PSE is not estimating a future benefit until more evaluation can be done but the qualitative benefit of reduced shutdown time for emergency response is noted.

Table 82: Improved Customer Safety (Fire Notification) use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
REDUCED SHUTDOWN TIME FOR EMERGENCY RESPONSE ACCESS	N/A	QUALITATIVE	QUALITATIVE	N/A	2026+

4. COMMUNICATIONS FOR METHANE DETECTION MONITORS (EMERGING)

There is methane detection monitoring technology that uses ultrasonic AMI systems to detect and communicate early notification of methane leaks. PSE is evaluating whether this technology is compatible with its AMI system.

Progress since 2022:

PSE's current AMI network technology is not compatible with the currently available methane detection products. PSE has performed an initial assessment of available products that would detect methane utilizing a device capable of communicating back to a central network. Because of this, PSE is in the discovery phase, evaluating alternate and future implementations as AMI module and network technology, as well as when PSE's diaphragm and rotary metering technology is upgraded. PSE will evaluate applications for larger commercial and industrial customers as well as potential ultrasonic future roadmap. The estimated timeline of advancing the use case is shown below. The owner of this use case is System Planning and Gas First Response.

Table 83: Communications for Methane Detection Monitors use case timeline

COMMUNICATIONS FOR METHANE DETECTION MONITORS				
2022	2023	2024	2025	2026
	INITIAL IDEA	DEFINE FUTURE AMI MODULE REQUIREMENTS	DEVELOP TECHNOLOGY ROADMAP	

As a result of the current technology issues, PSE is not yet quantifying the benefit but notes the significant qualitative benefits, such as customer safety, and cost savings associated with responding to leaks before customer discovery and evacuation occurs.

PUGET SOUND ENERGY

Table 84: Communications for Methane Detection Monitors use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED CUSTOMER EVACUATION COST SAVINGS	N/A	QUALITATIVE	QUALITATIVE	N/A	2027+
AVOIDED METHANE EMISSIONS	N/A	QUALITATIVE	QUALITATIVE	N/A	2027+

J. GRID PERFORMANCE

Grid Performance use case benefits aim to address outages and outage duration recognizing the interruption cost to customers as well as utility costs because of increased planning study and restoration time.

The Grid Performance use case benefit category includes eight "Tier 3" use case benefits: 1) Distribution Automation of AMI; 2) Momentary Outage/Power Quality; 3) Voltage Compliance (Real-Time Operating Conditions); 4) Predictive Analytics for Operations; 5) Reliability Index Validation; 6) Outage Cause Prediction; 7) Cold Load Pick-up Prevention; and 8) Extreme Event Strategic Load Shedding. These benefits are derived by improving accessibility to AMI data for use in tools that identify momentary and sustained outage causes and ways to reaffirm confidence in Outage Management System functionality, and leverages the AMI meter remote disconnect/connect switch in minimizing outages. The collection of these use cases are progressing through investigation as PSE completes implementation of the Advanced Distribution Management System and the new Outage Management System.

Table 85: Grid Performance summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
$1.5M	$25M	$0M

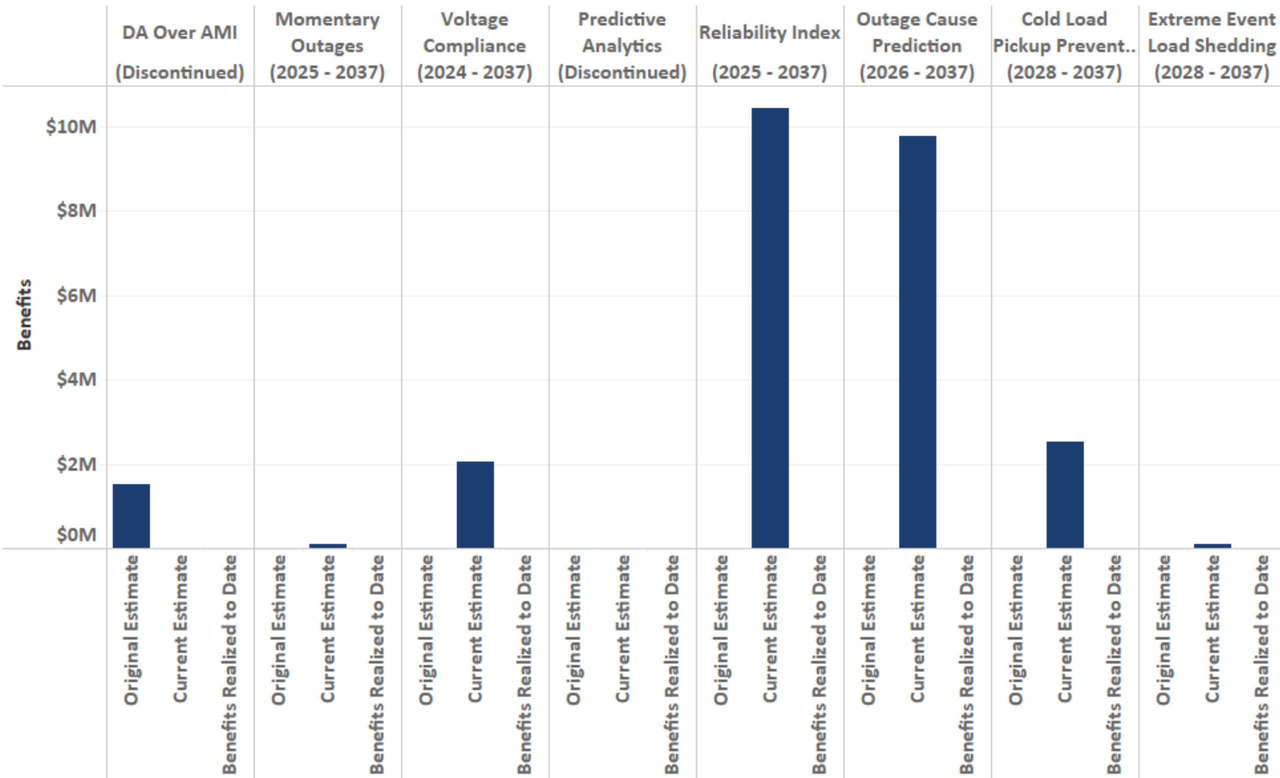
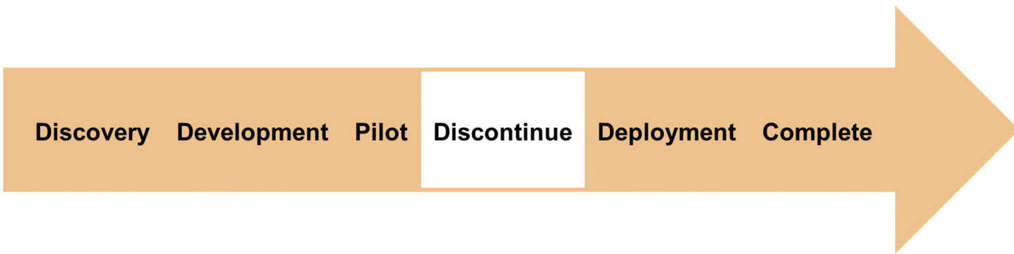


Figure 8: Grid Performance use case benefit summary breakdown

1. DISTRIBUTION AUTOMATION OVER AMI

One of PSE's original AMI use cases, distribution automation over AMI would utilize the AMI mesh radio network to transport communication messages for command and control of distribution grid assets such as reclosers and switches instead of traditional commercial cellular radio networks. The use of commercially available cellular networks requires a fixed investment in the cellular radio and a reoccurring service cost per device, while the use of the AMI mesh radio network would avoid these reoccurring service costs. PSE's initial benefits analysis for this use case estimated the avoidance of cellular costs, totaling $1.5 million through 2037.

Progress since 2022:



PSE initially installed reclosers and devices leveraging the AMI mesh radio network, but experienced technical challenges with the desired response rate needed for distribution automation (milliseconds). PSE evaluated pursing additional devices and hardware/software upgrades to meet PSE's requirements. However, these costs, along with decreasing cellular fees, far outweigh the $1.5 million in benefits associated with the savings in cellular costs. The majority of the electric and gas utility industry has moved away from leveraging the AMI mesh radio network for these reasons. This use case has been discontinued because the cost to utilize the AMI mesh network has turned out to be more expensive than continuing to use traditional commercial cellular networks. The timeline of the use case is shown below. The owner of this use case is Project and Program Management.

Table 86: Distribution Automation over AMI use case timeline

DISTRIBUTION AUTOMATION OVER AMI				
2021	2022	2023	2024	2025
INSTALLED INITIAL EQUIPMENT	DEVELOPING DA* SCHEME PROCESS	EVALUATING FUNCTIONALITY WITH VENDOR	NO LONGER VIABLE TO CONTINUE IMPLEMENTING	

*DA= Distribution Automation

PSE has recalculated the benefits based on progress to date and diminished implementation moving forward, anticipating $158,290 in benefits through 2037, dramatically impacted by decreasing cellular costs and system requirements for distribution automation. Over time, the reclosers utilizing AMI mesh network will be transitioned to cellular, eliminating the benefit in full.

2. MOMENTARY OUTAGES (NEW)

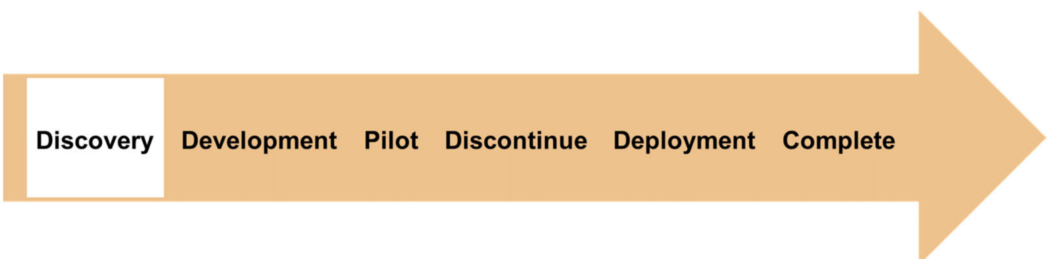
Momentary electric service interruptions, which are service interruptions lasting less than five minutes, while not as impactful as sustained interruptions, still impact customers, in some cases significantly. AMI data can be used to identify the equipment issues causing the momentary interruptions and predict future permanent faults. Customer complaints regarding power quality may stem from momentary outages and the customer complaint process as well as PSE's investigation process impacts customer time.

This use case would use AMI power status data to calculate momentary average interruption frequency index ("MAIFI").

$$\mathrm{MAIFI} = \frac{\sum \text{No. of Momentary Customer Interruptions}}{\text{Total No. of Customers Served}}$$

Certain equipment such as fusesavers and reclosers are intended to close momentarily and reopen, staying closed only when a line continues to have a fault. When operating as intended, these devices cause momentary outages for customers. As PSE installs more of these to minimize long outages, it is important to understand the impact on customers. While the data is available from AMI meters, additional data storage and query capability will be necessary to determine outages between one and five minutes.

Progress since 2022:



This use case is in discovery as part of the Data Lakes and Data Analytics project. The Grid Modernization team is working with various internal departments to identify and prioritize Data Lake use cases. Business processes will need to be established for identifying, tracking, and implementing MAIFI and solutions to momentary interruptions. The timeline of advancing the use case is shown below. The owner of this use case is Grid Modernization and Regional System Planning.

Table 87: Momentary Outages use case timeline

MOMENTARY OUTAGES				
2021	2022	2023	2024	2025
		DEVELOP TOOL	DEVELOP BUSINESS PROCESSES	BEGIN CALCULATING MAIFI AND BUILDING INVESTMENT PLANS THAT CONSIDER IMPACT

With momentary outages, interruption cost impact to customers is unclear and the Lawrence Berkley National Labs Interruption Cost Estimator does not address these types of outages. However, customer complaints regarding power quality may stem from momentary outages. The complaint process as well as investigation process impacts customers' time. Additional benefits are anticipated from planning time saved, an estimated 20 minutes, in performing equipment performance validation (called "backcasting") as momentary outages must be researched independently. Furthermore, planning time is saved, an estimated ten minutes, as targeted recloser and fusesaver programs are defined annually.

Table 88: Momentary Outages use case benefit summary (nominal)

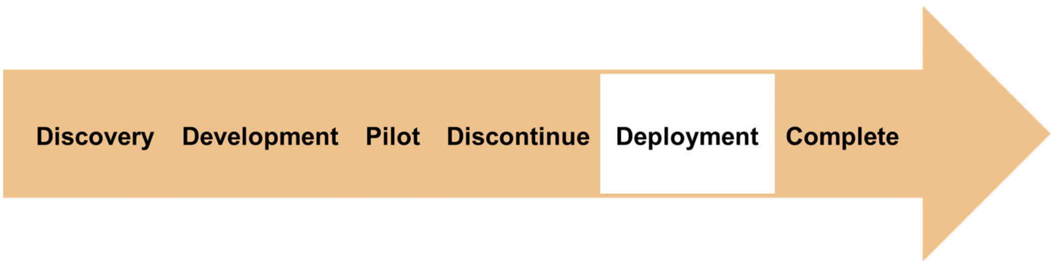
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER'S AVOIDED TIME ASSOCIATED WITH POWER QUALITY COMPLAINT	N/A	$0.07M	$0M	N/A	2025
AVOIDED BACKCASTING AND PROGRAM DEVELOPMENT PLANNING TIME	N/A	$0.03M	$0M	N/A	2025

PSE PUGET SOUND ENERGY

3. VOLTAGE COMPLIANCE (REAL-TIME OPERATING CONDITIONS) (NEW)

AMI voltage data can be used to monitor voltage profiles for customers and the system over time to ensure compliance with ANSI standards, which supports resolving customer power quality issues more timely. This eliminates the need to install a voltage device and wait for weeks to gather enough data to draw conclusions. Resolving power quality concerns quickly reduces the risk of PSE or customer equipment from being damaged. Being able to access AMI voltage data also provides the opportunity for the field to understand whether there are potential safety concerns as they respond on site. Finally, it can help identify new opportunities for volt-var optimization that were not envisioned in the original Conservation Voltage Reduction Program.

Progress since 2022:



PSE developed an AMI voltage meter dashboard that displays the voltage profile of select meters over time. When a customer raises a power quality concern, engineering and field personnel can review this dashboard for historic voltage performance. In one example, PSE was able to confirm very easily what the customer was experiencing and move to solutions more quickly using this dashboard. This dashboard is also useful to verify performance which is discussed in use case B.4, conservation voltage reduction. It also provides the opportunity to evaluate additional conservation voltage reduction that can be implemented above the initial plan outlined in the original AMI Business Case. The timeline of advancing the use case is shown below. The owner of this use case is Grid Modernization and System Operations.

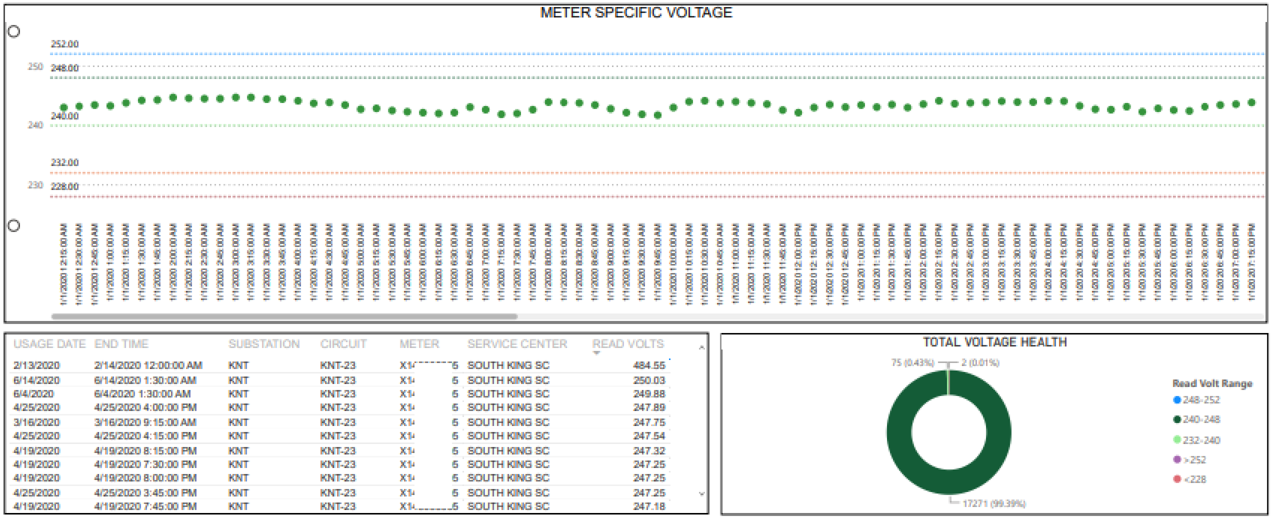


Table 89: Voltage Compliance (Real-Time Operating Conditions) use case timeline

VOLTAGE COMPLIANCE (REAL-TIME OPERATING CONDITIONS)				
2021	2022	2023	2024	2025
	DEVELOP DASHBOARD	BUSINESS AS USUAL FOR PLANNING AND ENGINEERING	EXPAND DIRECT ACCESS TO FIELD PERSONNEL	

Through this use case, PSE can perform voltage investigations faster, avoiding the need to deploy a truck and an estimated four hours of investigation time for the estimated 100-200 power quality concerns in a year. For a small number of customers, the historic process would take an estimated ten hours to address. PSE did not quantify the risk of equipment damage as it historically has been rare, but the concern is real and thus noted qualitatively.

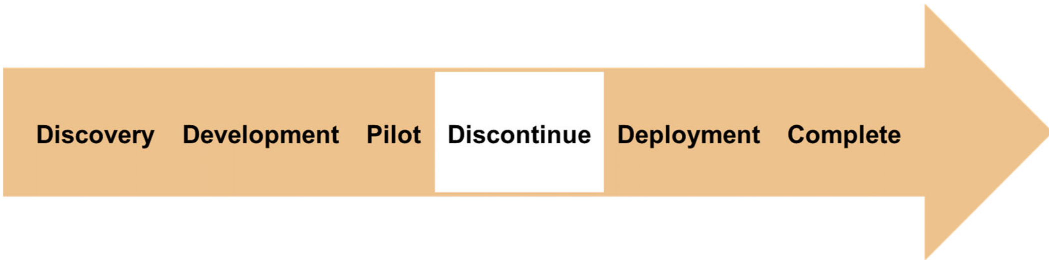
Table 90: Voltage Compliance (Real-Time Operating Conditions) use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
AVOIDED PROCESS LENGTH THAT RECOGNIZES CUSTOMER VALUE	N/A	$0.15M	$0M	N/A	2024
AVOIDED INVESTIGATION COSTS	N/A	$1.9M	$0M	N/A	2024

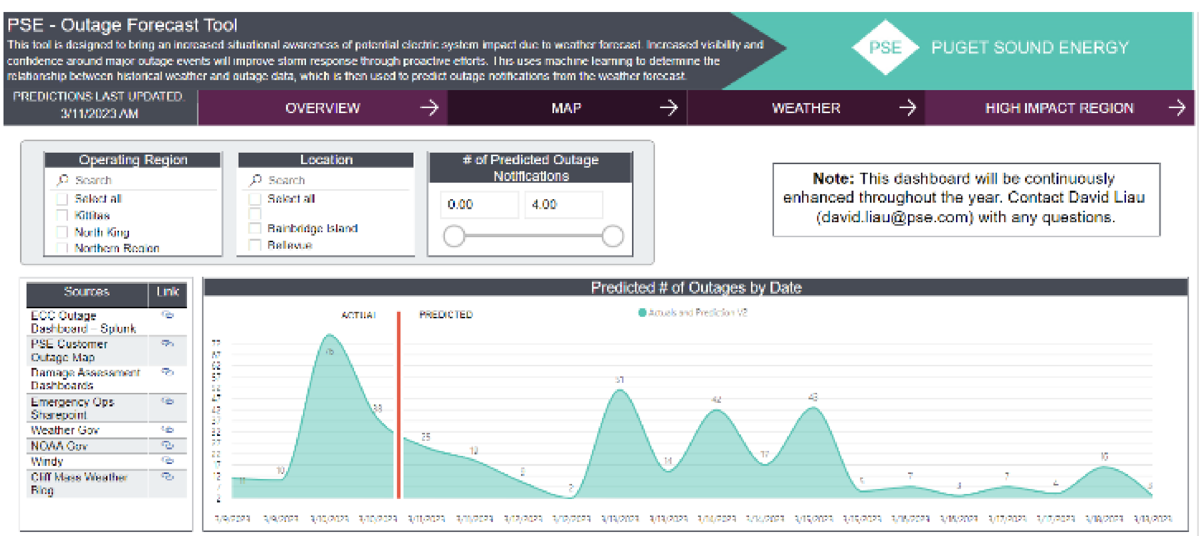
4. PREDICTIVE ANALYTICS FOR OPERATIONS (NEW)

AMI data can be used for predictive analytics, leveraging weather data and historical outage data to predict system level outages in advance of a weather event for improved preparation. Power status, outage, loading, and voltage data can be used to model reliability and capacity trends under varying weather conditions.

Progress since 2022:



The first use case for predictive analytics for operations was to create a dashboard that displays outage forecasts based on historic system level outage data and predictive weather models. This dashboard uses weather data and historical system level outages data recorded in SAP, PSE's data and business management system. SAP outage data comes from the Outage Management System after data is scrubbed. Increasing the accuracy of the outage data in Outage Management System is enabled through other use cases, including E.3, Phase Identification, that use dashboards to identify changes to configurations and data in grid management systems or J.2, Momentary Outages, that use power status data to fine tune reliability metrics and in doing so deploys on-going data cleansing processes.



PUGET SOUND ENERGY

These use cases make the translation of customer power status and loading data used in Outage Management System from SAP effective without “cleaning.” The end result is that tools such as the Outage Forecast Tool are more accurate from indirectly leveraging AMI data. This is not a direct use case as originally anticipated and is discontinued. It was included to demonstrate the breadth of considerations and was in the original AMI Data Enablement Strategy. The timeline of the use case is shown below. The owner of this use case is Grid Modernization and System Operations. No benefits are calculated as a result of discontinuing this use case.

Table 91: Predictive Analytics for Operations use case timeline

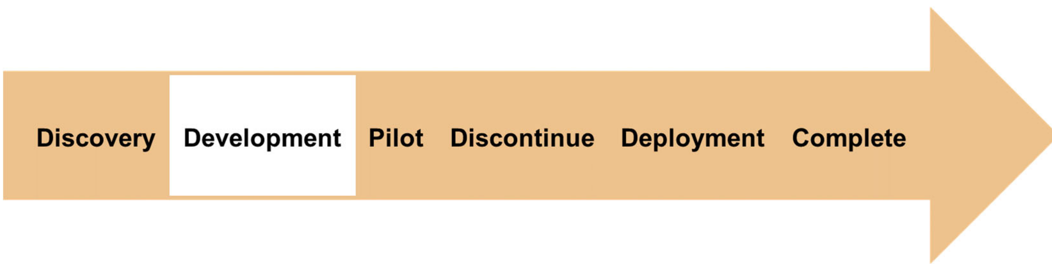
PREDICTIVE ANALYTICS FOR OPERATIONS				
2021	2022	2023	2024	2025
OUTAGE FORECAST TOOL BUILT		EVALUATED USE CASE ADVANCEMENT	NO LONGER VIABLE TO CONTINUE IMPLEMENTING	

PSE PUGET SOUND ENERGY

5. RELIABILITY INDEX VALIDATION (EMERGING)

AMI data can be used to validate that the Outage Management System is accurately recording the number and duration of outages. PSE can use AMI data directly from the meters to calculate outage start times to compare to what is reported through SAP, PSE's data and business management system, and the Outage Management System, which is then used to determine actual customer minutes of interruption. PSE can then make adjustments to the prediction model and reporting processes if necessary. This use case was identified through a report provided by EPRI,[24] which highlighted the possibility of outage associations[25] recognizing that the Outage Management System may not record nested outages, localized outages masked by larger encompassing outages, accurately.

Progress since 2022:



This use case is in development and is currently being prioritized by the Data Enrichment and Enablement Program. The estimated timeline of advancing the use case is shown below. The owner of this use case is System Planning.

Table 92: Reliability Index Validation use case timeline

RELIABILITY INDEX VALIDATION				
2022	2023	2024	2025	2026
	IDENTIFIED USE CASE AND DETERMINE DEVELOPMENT TIMELINE	ASSESS INTEGRATION WITH COMPLETION OF OMS*	IMPLEMENT DEPENDING ON DEVELOPMENT TIMELINE	

*OMS= Outage Management System

[24] V. Holsomback, Operational Benefits of Advanced Metering Infrastructure Louisville Gas & Electric – Kentucky Utilities Use Cases 3002019487, ELECTRIC POWER RESEARCH INSTITUTE 3–1 (May 20, 2020), https://www.epri.com/research/products/000000003002019487.
[25] *Id.*

The benefits of this use case anticipate the outage prediction model is improved with periodic validation using AMI. With improvements in Outage Management System prediction, field restoration can occur faster as device location confidence is fine-tuned and nested outages are not misreported. PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement from decreased outage duration. The benefit assumed 0.5 minutes of SAIDI is saved for all customers.

Table 93: Reliability Index Validation use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$10.5M	$0M	N/A	2025+
REDUCED LABOR HOURS LOCATING CORRECT DEVICE	N/A	QUALITATIVE	QUALITATIVE	N/A	2025+

6. OUTAGE CAUSE PREDICTION (EMERGING)

Ongoing research by EPRI suggests it is useful to monitor and track trends of outages including momentary outages by feeder or radial circuit, examining outage data from nearby meters.[26] AMI data, combined with weather data and known outages cause data, can be analyzed using machine learning platforms to help differentiate and predict outages more effectively including outages caused by trees, animals, lightning, and other unspecified causes.

Progress since 2022:

This use case was published by EPRI in 2022.[27] PSE will continue to evaluate this potential use case with the completed implementation of the Outage Management System upgrade and the Advanced Distribution Management System. Discovery will come from monitoring for industry pilots and further analyzing benefits and burdens with this application. Approximately 1.8% of PSE's SAIDI outages are categorized as unknown, which while a small percentage, investment planning would benefit from validating all causes. The estimated timeline of advancing the use case is shown below. The owner of this use case is System Planning.

Table 94: Outage Cause Prediction use case timeline

OUTAGE CAUSE PREDICTION				
2023	2024	2025	2025	2027
MONITOR INDUSTRY MATURITY	MONITOR INDUSTRY MATURITY ADMS* COMPLETED	MONITOR INDUSTRY MATURITY	BUILD BUSINESS CASE AND PROCEED IF APPROPRIATE AFTER J.2 BUSINESS PROCESS DEVELOPED	

*ADMS= Advance Distribution Management System

[26] *Analyzing and Categorizing Momentary Outages from Advanced Metering Infrasetructure (AMI) Data*, Electric Power Research Institute (Dec. 15, 2022), https://www.epri.com/research/products/000000003002024107.
[27] *Id.*

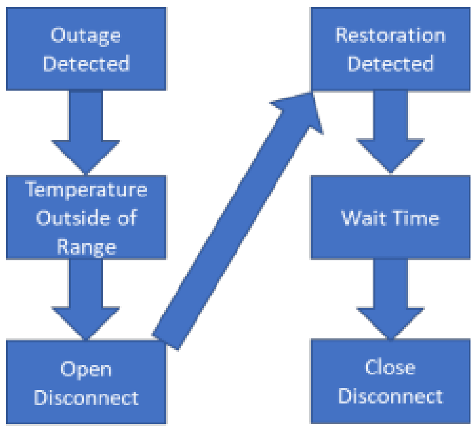
Benefits anticipate prediction of outage cause will lead to the ability to proactively address and reduce outages and outage duration. PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of potential improvement to reliability. The benefit assumed 0.5 minutes of SAIDI is saved for all customers annually.

Table 95: Outage Cause Prediction use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$9.8M	$0M	N/A	2026+
REDUCED PLANNING STUDY HOURS	N/A	QUALITATIVE	QUALITATIVE	N/A	2026+

7. COLD LOAD PICK-UP PREVENTION (EMERGING)

It may be possible to use the remote disconnect switch on AMI meters to mitigate temporary overloads that occur during outage restoration activities. PSE can individually disconnect service to meters, but would benefit from being able to disconnect multiple meters in order to restore subparts of a circuit over time and avoid potential overload and subsequent outage during cold load restoration.



This use case was identified through the evaluation of an EPRI report, which highlighted the possibility of step restoration with reconnect disconnect meters.[28] The report explains:

> "If meters with a built in disconnect have a stored energy source that can open the disconnect without AC present, the disconnect switch can be used to mitigate temporary overloads that might occur during restoration activities. The temporary overload condition might be a result of cold load, or it might be the result of distributed energy resources (DER) disconnecting during the disturbance. The logic to disconnect includes a temperature variable so that the disconnect occur only during high or low temperatures. This function would extend an outage but the extension would be minimal and occur only during high-load periods. A wait time of 2 minutes would be sufficient. If all the residential meters have disconnect ability, the reconnect wait time can be a random number within a range to keep all meters from reconnecting at the same time."[29]

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[28] V. Holsomback, Operational Benefits of Advanced Metering Infrastructure Louisville Gas & Electric – Kentucky Utilities Use Cases 3002019487, ELECTRIC POWER RESEARCH INSTITUTE (May 20, 2020), https://www.epri.com/research/products/000000003002019487.
[29] *Id.* at 3-1.

Progress since 2022:

Louisville Gas & Electric and Kentucky Utilities use the same AMI technology PSE uses and are currently exploring this use case. In addition, more will be possible with the completion of the Outage Management System upgrade and the Advanced Distribution Management System. The estimated timeline of advancing the use case is shown below. The owner of this use case is System Planning and Grid Modernization.

Table 96: Cold Load Pick-up Prevention use case timeline

COLD LOAD PICK-UP PREVENTION				
2023	2024	2025	2026	2027
MONITOR INDUSTRY MATURITY	INVESTIGATE UTILITY PILOTS ADMS* COMPLETED	INVESTIGATE UTILITY PILOTS	INVESTIGATE UTILITY PILOTS	

*ADMS= Advance Distribution Management System

PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement from being able to target cold load pick up. The benefit assumed 0.5 minutes of SAIDI is saved.

Table 97: Cold Load Pick-up Prevention use case benefit summary (nominal)

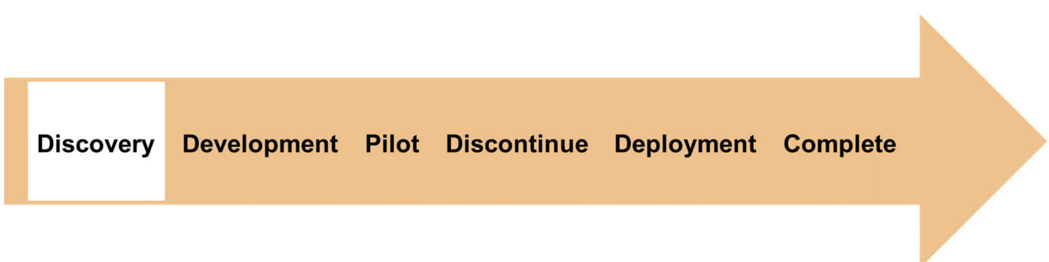
PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$2.5M	$0M	N/A	2028+
REDUCED OR AVOIDED O&M EXPENSE	N/A	QUALITATIVE	QUALITATIVE	N/A	2028+

8. EXTREME EVENT STRATEGIC LOAD SHEDDING (EMERGING)

Ongoing research by EPRI suggests in an extreme event that warrants load shedding, such as under-frequency, the remote disconnect capability of AMI may be able to move the load shed further out on the distribution system so fewer customers are impacted. From EPRI's white paper, this use case is described further:

> "To protect the integrity of the bulk transmission system, grid operators are tasked with matching the available generation to the connected load. In normal conditions, additional generation is added or throttled as the load varies. During periods when there is not enough generation capability to serve the load, grid operators are tasked with reducing the demand on the system to match the availability of generation. A generation constrained load shed event describes an event where the amount of generation sources falls short of the amount of generation required to operate the bulk power system reliably. These events are rare but very impactful to both the utility and their connected customers. The grid operator has many tools that initiate a load reduction, including dispatchable voltage reduction, demand response programs, and voluntary appeals to the public. If the utilization of demand reduction tools does not sufficiently reduce the demand to the desired level, grid operators initiate load shed to disconnect distribution feeders from the grid. The installation of AMI systems and distribution sited automation enable distribution companies the opportunity to move this disconnection further out on the distribution system, closer to the load they desire to disconnect first. In the instance of using AMI enabled disconnect meters, the disconnection can be moved all the way to the customer interface. Moving the disconnection of load further out the distribution line offers both societal and operating benefits. These benefits are evaluated against the cost and complexity involved with modifying a process that is rarely utilized."[30]

Progress since 2022:



[30] *Using AMI for Strategic Load Shedding During Extreme Events*, Electric Power Research Institute 2 (Nov. 14, 2022), https://www.epri.com/research/programs/062333/results/3002024673.

This use case was published by EPRI in 2022. PSE will continue to gain knowledge about this potential AMI use case with the completed implementation of the Outage Management System upgrade and the Advanced Distribution Management System, monitoring for industry pilots and further analyzing benefits and burdens with this application. The estimated timeline of advancing the use case is shown below. The owner of this use case is Grid Modernization and System Operations.

Table 98: Extreme Event Strategic Load Shedding use case timeline

EXTREME EVENT STRATEGIC LOAD SHEDDING				
2023	2024	2025	2026	2027
MONITOR INDUSTRY MATURITY	INVESTIGATE UTILITY PILOTS ADMS* COMPLETED	INVESTIGATE UTILITY PILOTS	INVESTIGATE UTILITY PILOTS	

*ADMS= Advance Distribution Management System

PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement from being able to target load reduction based on load and type of customer, essentially being able to match disconnection of customers to load reduction needed. The benefit assumed one circuit in 20 years requires load shedding and only 20% of the customers on the circuit are shed as opposed to losing the entire circuit by operating the substation switch.

Table 99: Extreme Event Strategic Load Shedding use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$0.09M	$0M	N/A	2028+

PSE PUGET SOUND ENERGY

K. OPERATIONS REDUCTION

Operations Reduction benefits aim to reduce operational processes directly associated with managing the AMI system including the ability to avoid operational maintenance of the PSE Delivery System. This includes two new use cases that are “Tier 3” benefits: 1) Meter Sampling and 2) Asset Utilization. These benefits are derived by reducing meter sampling and using AMI data in tools that identify proactive replacement to avoid unplanned equipment failure that brings reduction of momentary and sustained outages. The estimated quantified benefits through 2037 are shown below and detailed in a following figure by each use case.

Table 100: Operations Reduction summary (nominal)

BENEFITS SUMMARY		
ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE
N/A	$20.2M	$0.07M

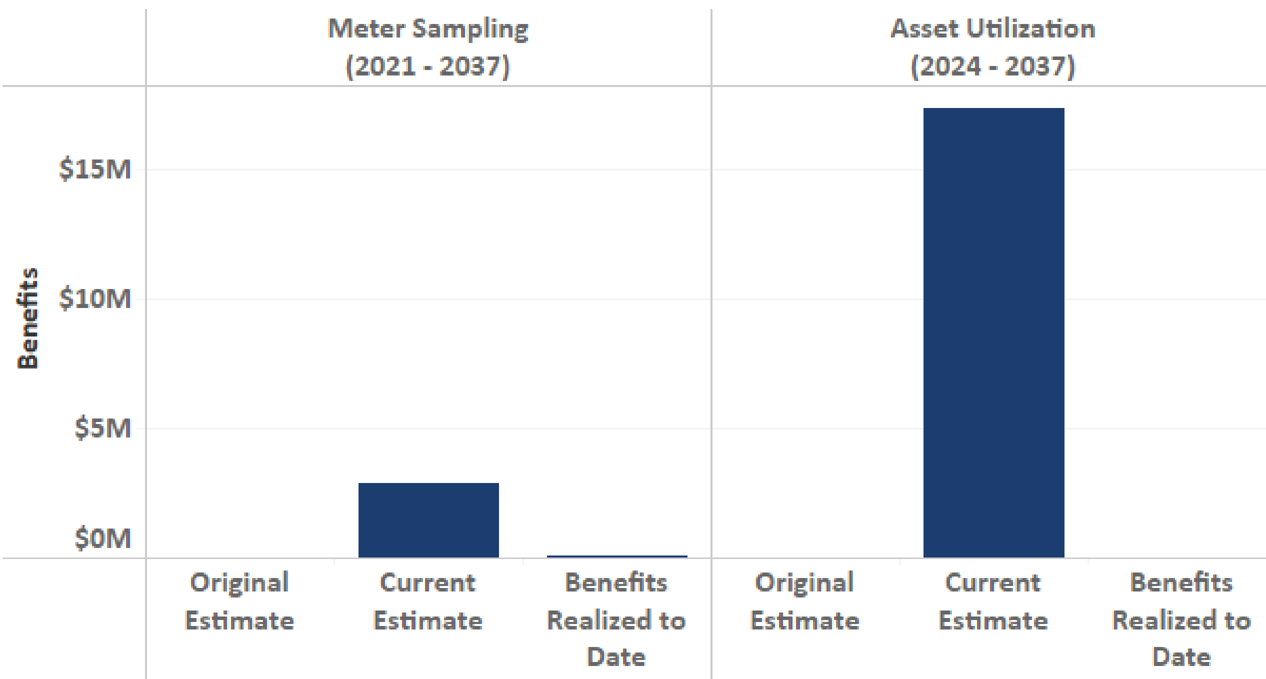


Figure 9: Operations Reduction summary breakdown

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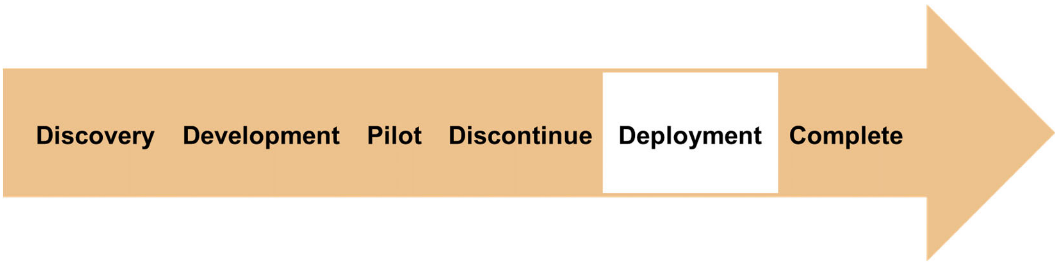
1. METER SAMPLING (NEW)

In compliance with ANSI standards, PSE samples all in-service electric watthour meter types at sample rates. At the beginning of the AMI deployment, PSE had 40 separate meter types. As a result of the AMI deployment, the majority of PSE's meters will be one of two types. This will reduce the complexity of equipment in the field as well as drastically reduce the amount of sampling that will need to occur each year and avoid a customer outage when a meter is removed and replaced.

Progress since 2022:



In order to comply with the ANSI meter testing standard, each year, PSE randomly selects the appropriate statistical sample from each meter classification for testing. Meters are tested on the customer's premises by a Meter Journeyman or Meter Tester. Since the beginning of the AMI deployment, the number of meter classifications have been eliminated and as a result, the number of samples needed has declined and others have their populations greatly reduced. The estimated timeline of the use case is shown below. The owner of this use case is Meter Operations.

Table 101: Meter Sampling use case timeline

METER SAMPLING				
2021	2022	2023	2024	2025
EVALUATE METER SAMPLING REQUIREMENT CHANGE AND REDUCE SAMPLING (< 193)	REDUCED SAMPLING AS AMI ROLL OUT CONTINUES (< 267)	REDUCED SAMPLING AS AMI ROLL OUT CONTINUES (< 494)	REDUCED SAMPLING AS AMI ROLL OUT CONTINUES (< 709)	REDUCED SAMPLING AS AMI ROLL OUT CONTINUES (< 288)

Benefits are calculated based on reduced labor cost as meter sampling requirements decrease. At the beginning of deployment, PSE was sampling just over 2,600 meters annually. As of August 2023, the total sampling requirement has decreased by about 1,000 meters, avoiding labor cost associated with each meter sample, or a total of $71,550 for labor to sample meters. PSE anticipates reaching a minimum sample rate of around 400 meters per year over the next few years. This also avoids brief outages for the respective customers as well, an estimated 32,077 customer minutes of interruption through 2037.

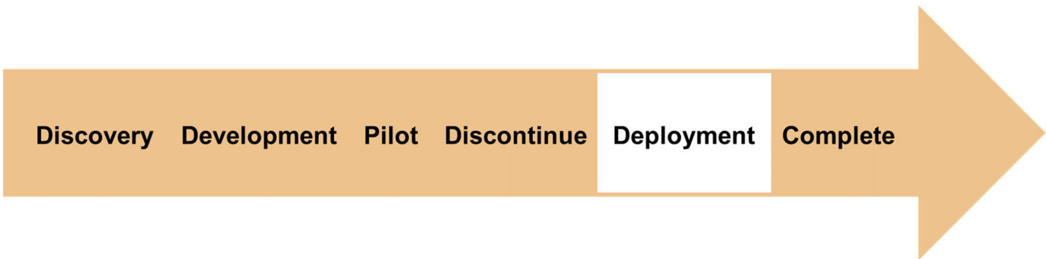
Table 102: Meter Sampling use case benefit summary (nominal)

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
METER SAMPLING REDUCTION	N/A	$2.8M	$0.07M	N/A	2021

2. ASSET UTILIZATION

With the deployment and capabilities of AMI meters, PSE is able to monitor the health of equipment that previously had little visibility. In this use case, 15-minute AMI loading data is utilized to screen PSE's distribution assets and highlight service transformers that are at risk of overload. PSE can investigate the severity of transformer overload and usage patterns over time to determine whether maintenance or replacement is necessary. This supports the prioritization of asset maintenance to avoid future risk of outages.

Progress since 2022:



PSE has built the Asset Health Dashboard using AMI data to quickly assess overloaded service transformers. During the August 2021 heat wave, PSE used this to identify transformers that needed to be replaced before failure. Since then, PSE has developed additional dashboards: the Asset Health – Overloaded Service Transformers dashboard, which presents details of usage in 15-minute intervals for the overloaded single service transformers, and the Asset Data Exception Report dashboard, which shows equipment that has the same company ID assigned to two or more grids, or same company ID in GIS but assigned to two or more different service transformers. The timeline of the use case is shown below. The owner of this use case is Delivery System Planning.

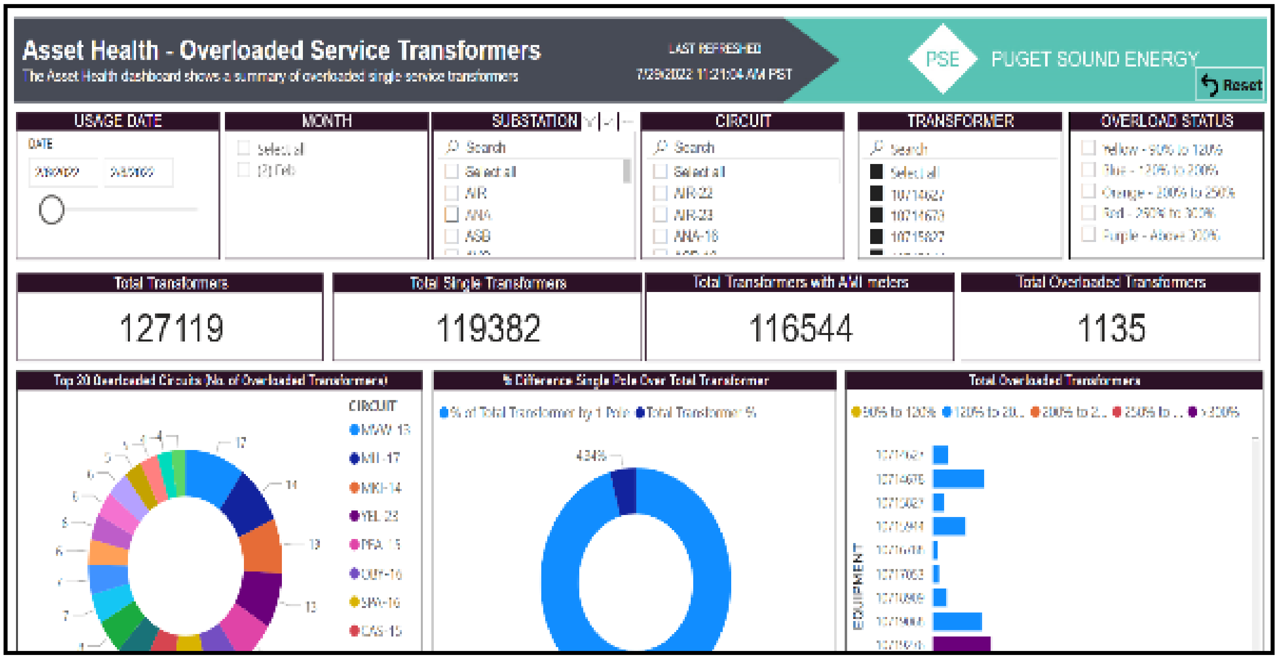


Table 103: Asset Utilization use case timeline

ASSET UTILIZATION				
2021	2022	2023	2024	2025
DEVELOP OVERLOAD SERVICE TRANSFORMER DASHBOARDS	REPLACE TRANSFORMERS	DEVELOP ADDITIONAL DASHBOARDS	BUSINESS AS USUAL INCORPORATES ASSET HEALTH CONCERNS INTO 2028 INVESTMENT PLAN OR ISSUES EMERGENCY WORK ORDER IF NECESSARY	

Benefits anticipated by the Asset Utilization use case include proactively replacing overloaded transformers which reduce outages and outage duration. PSE estimated customer benefits using the Lawrence Berkley National Labs Interruption Cost Estimator to determine the value of the reliability improvement from being able to target investment as well as lower the cost of replacement by not having to perform replacement in an emergency.

Table 104: Asset Utilization use case benefit summary

PROGRAM	ORIGINAL PROJECTED BENEFIT ESTIMATE	CURRENT PROJECTED BENEFIT ESTIMATE	BENEFITS REALIZED TO DATE	ORIGINAL BENEFIT REALIZATION SCHEDULE	CURRENT BENEFIT REALIZATION SCHEDULE
CUSTOMER INTERRUPTION COST VALUE OF RELIABILITY IMPROVEMENT	N/A	$10.6M	$0M	N/A	2024
AVOIDED CONSTRUCTION COST	N/A	$6.8M	$0M	N/A	2024

APPENDIX

ADVANCED METERING INFRASTRUCTURE METRICS						
#	METRIC	DEFINITION	CALCULATION	UNITS	2022 ACTUAL	2023 ACTUAL
40	AVERAGE CUSTOMER AMI ELECTRIC BILL READ SUCCESS RATE	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL ELECTRIC AMI METER READS	SUM THE NUMBER OF SUCCESSFUL ELECTRIC CUSTOMER AUTOMATED METER READS TO BE USED FOR BILLING PURPOSES FOR ALL BILLING CYCLES IN A MONTH DIVIDED BY THE TOTAL NUMBER OF ELECTRIC CUSTOMER METER BILLS FOR ALL BILLING CYCLES MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.	%	99.09	99.21
41	AVERAGE CUSTOMER AMI GAS BILL READ SUCCESS RATE	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL GAS AMI METER READS	SUM THE NUMBER OF SUCCESSFUL GAS CUSTOMER AUTOMATED METER READS TO BE USED FOR BILLING PURPOSES FOR ALL BILLING CYCLES IN A MONTH DIVIDED BY THE TOTAL NUMBER OF GAS CUSTOMER METER BILLS FOR ALL BILLING CYCLES MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.	%	96.89	97.56
42	AVERAGE CUSTOMER REMOTE SWITCH SUCCESS RATE	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL ELECTRIC AMI SWITCH OPERATION WHEN A COMMAND IS MADE FROM THE "COMMAND CENTER"	FOR CUSTOMER REQUESTS ONLY (MOVE IN / MOVE OUT), SUM OF THE NUMBER OF SUCCESSFUL DISCONNECTS OR RECONNECTS DIVIDED BY THE TOTAL NUMBER OF COMMANDS SENT MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE	%	95.71	97.27

		BY PSE FOR CUSTOMER REQUESTED PURPOSES	IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.			
43	AVERAGE CUSTOMER REDUCED ENERGY CONSUMPTION FROM VOLTAGE REGULATION	AVERAGE CUSTOMER FIRST YEAR REDUCTION IN ENERGY CONSUMPTION, MEASURED IN KWH, WHICH RESULTS FROM LOWERING THE VOLTAGE ON A CIRCUIT AT THE SUBSTATION	SUM OF FIRST YEAR REDUCTION IN ENERGY CONSUMPTION FOR ALL FEEDERS OF ALL SUBSTATIONS THAT DISTRIBUTION EFFICIENCY OR CONSERVATION VOLTAGE PROJECTS WERE COMPLETED ON DURING THE YEAR DIVIDED BY THE SUM OF THE NUMBER OF RESIDENTIAL AND SMALL COMMERCIAL CUSTOMERS ON EACH PROJECT CIRCUIT. ENERGY CONSUMPTION SAVINGS PER FEEDER IS THE CONSERVATION VOLTAGE REDUCTION FACTOR MULTIPLIED BY THE ANNUAL ENERGY CONSUMED MULTIPLIED BY THE PERCENT CHANGE IN VOLTAGE.	KWH	186	915
44	COUNT OF PARTICIPATING CUSTOMER COMPLAINTS IN EACH OF PSE'S TVR PILOTS	ANNUAL TOTAL NUMBER OF COMPLAINTS SUBMITTED TO THE COMPANY ABOUT EACH TVR PILOT BY CUSTOMERS	SUM OF THE NUMBER OF COMPLAINTS DOCUMENTED BY THE CALL CENTER FROM CUSTOMERS PARTICIPATING IN ALL TVR PILOTS.	#	NA	3
45	LOAD REDUCTION DURING CALLED EVENTS FOR CUSTOMERS ENROLLED IN THE TIME OF USE ("TOU") + PEAK TIME REBATE ("PTR") PILOT	ANNUAL ELECTRIC ENERGY LOAD REDUCTION FOR ALL CALLED EVENTS FOR CUSTOMERS ENROLLED IN THE TIME OF USE ("TOU") OR PEAK TIME REBATE ("PTR") PILOT	SUM OF EACH EVENT CALL OF ELECTRIC ENERGY LOAD BASELINE PROFILE MINUS ENERGY LOAD FOR CUSTOMERS THAT ARE ENROLLED IN TOU OR PTR PILOT THAT COMPLIED WITH EVENT CALLS [OR USING AN AVERAGE CUSTOMER MODIFIED PROFILE] PLUS LOAD BASELINE PROFILE OF THOSE THAT DID NOT COMPLY WITH EVENT CALLS.	KW	NA	NA
46	COUNT OF CUSTOMER IMPRESSIONS WITH	ANNUAL NUMBER OF CUSTOMER EMAILS SENT ASSOCIATED WITH	SUM OF NUMBER OF EMAIL SENT FROM EMAIL CAMPAIGNS FEATURING CONTENT ON PROGRAMS THAT LEVERAGE AMI DATA.	#	589,592	2,081,509

	AMI PROGRAM MARKETING EFFORTS	PROGRAMS THAT LEVERAGE AMI DATA				
47	HIGH USAGE ALERT OPEN RATE	ANNUAL PERCENTAGE OF EMAILED HIGH USAGE ALERTS THAT WERE OPENED	SUM OF THE NUMBER OF CUSTOMERS THAT OPENED THE EMAILED HIGH BILL ALERTS DIVIDED THE NUMBER OF EMAILED HIGH BILL ALERTS SENT MULTIPLIED BY 100.	%	64	65
48	DOWNLOAD COUNT OF ENERGY DATA, IN BOTH CSV AND GREEN BUTTON FORMAT	ANNUAL NUMBER OF ALL RESIDENTIAL CUSTOMER ENERGY DATA DOWNLOADS USING GREEN BUTTON TOOL	SUM OF THE NUMBER OF RESIDENTIAL CUSTOMER ENERGY DATA DOWNLOADS USING THE GREEN BUTTON TOOL EITHER CSV OR XLM FILE TYPE.	#	21,113	27802
49	COUNT OF CUSTOMERS ENROLLED IN SMART THERMOSTAT PROGRAMS FOR SPACE HEATING	ANNUAL NUMBER OF GAS AND ELECTRIC CUSTOMERS THAT ARE ENROLLED IN SMART THERMOSTAT PROGRAMS	SUM OF ALL GAS AND ELECTRIC CUSTOMERS THAT HAVE RECEIVED SPACE HEATING THERMOSTAT INDIVIDUAL REBATES EXCLUDING THERMOSTATS INSTALLED AS PART OF A LOW-INCOME WHOLE-HOUSE PROGRAM.	#	14,879	22710

ADVANCED METERING INFRASTRUCTURE – EQUITY METRICS										
#	METRIC	DEFINITION	CALCULATION	UNITS	2022 ACTUAL HIC+HIGH VP	2022 ACTUAL HIC+MED VP	2022 ACTUAL HIC+LOW VP	2023 ACTUAL HIC+HIGH VP	2023 ACTUAL HIC+MED VP	2023 ACTUAL HIC+LOW VP
88	AMI ELECTRIC BILL READ SUCCESS RATE FOR HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL ELECTRIC AMI METER READS FOR CUSTOMERS FROM HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	SUM THE NUMBER OF SUCCESSFUL ELECTRIC CUSTOMER AUTOMATED METER READS TO BE USED FOR BILLING CUSTOMERS FROM BOTH HIC AND HIGH VP, BOTH HIC AND MEDIUM VP, OR BOTH HIC AND LOW VP, SEPARATELY, FOR ALL BILLING CYCLES IN A MONTH DIVIDED BY THE TOTAL NUMBER OF ELECTRIC CUSTOMER METER BILLS FOR EACH OF	%	99.26	99.3	99.07	99.25	99.28	99.31

PSE PUGET SOUND ENERGY

			THESE THREE GROUPINGS FOR ALL BILLING CYCLES MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.							
89	AMI GAS BILL READ SUCCESS RATE FOR HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL GAS AMI METER READS FOR CUSTOMERS FROM HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	SUM THE NUMBER OF SUCCESSFUL GAS CUSTOMER AUTOMATED METER READS TO BE USED FOR BILLING CUSTOMERS FROM BOTH HIC AND HIGH VP, BOTH HIC AND MEDIUM VP, OR BOTH HIC AND LOW VP, SEPARATELY FOR ALL BILLING CYCLES IN A MONTH DIVIDED BY THE TOTAL NUMBER OF GAS CUSTOMER	%	97.01	94.37	96.15	97.72	96.45	95.85

			METER BILLS FOR EACH OF THESE THREE GROUPINGS FOR ALL BILLING CYCLES MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.							
90	REMOTE SWITCH SUCCESS RATE FOR HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	ANNUAL CUSTOMER AVERAGE PERCENTAGE OF SUCCESSFUL ELECTRIC AMI SWITCH OPERATION WHEN A COMMAND IS MADE FROM THE “COMMAND CENTER” BY PSE FOR HIGHLY IMPACTED COMMUNITIES AND VULNERABLE	FOR CUSTOMER REQUESTS ONLY (MOVE IN / MOVE OUT), SUM OF THE NUMBER OF SUCCESSFUL DISCONNECTS OR RECONNECTS FOR CUSTOMERS FROM BOTH HIC AND HIGH VP, BOTH HIC AND MEDIUM VP, OR BOTH HIC AND LOW VP, SEPARATELY, DIVIDED BY THE TOTAL NUMBER OF COMMANDS SENT FOR EACH	%	95.68	96.11	96.09	97.24	97.48	96.19

PUGET SOUND ENERGY

		POPULATION CUSTOMER REQUESTS	OF THESE THREE GROUPINGS MULTIPLIED BY 100. AVERAGE ANNUAL SUCCESS RATE IS THE SUM OF MONTHLY PERCENTAGE DIVIDED BY 12 MONTHS.							
91	REDUCED ENERGY CONSUMPTION FROM VOLTAGE REGULATION FOR HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS[i]	AVERAGE CUSTOMER FIRST YEAR REDUCTION IN ENERGY CONSUMPTION, MEASURED IN KWH, WHICH RESULTS FROM LOWERING THE VOLTAGE ON A CIRCUIT AT THE SUBSTATION THAT SERVES HIGHLY IMPACTED COMMUNITIES AND VULNERABLE POPULATIONS	SUM OF FIRST YEAR REDUCTION IN ENERGY CONSUMPTION FOR ALL FEEDERS OF ALL SUBSTATIONS THAT DISTRIBUTION EFFICIENCY OR CONSERVATION VOLTAGE PROJECTS THAT WERE COMPLETED DURING THE YEAR THAT SERVE BOTH HIC AND HIGH VP, BOTH HIC AND MEDIUM VP, OR BOTH HIC AND LOW VP,	KWH	0	186	186	209	70	11

PUGET SOUND ENERGY

			SEPARATELY, DIVIDED BY THE SUM OF THE NUMBER OF RESIDENTIAL AND SMALL COMMERCIAL CUSTOMERS ON EACH PROJECT CIRCUIT. ENERGY CONSUMPTION SAVINGS PER FEEDER IS THE CONSERVATION VOLTAGE REDUCTION FACTOR MULTIPLIED BY THE ANNUAL ENERGY CONSUMED MULTIPLIED BY THE PERCENT CHANGE IN VOLTAGE.							

[i] This metric calculation for all high vulnerable populations (those in HIC and not) is 611 KWh for 2023.