**EXH. CAK-7 (Apdx. B)**
**DOCKETS UE-22___/UG-22___**
**2022 PSE GENERAL RATE CASE**
**WITNESS: CATHERINE A. KOCH**

**BEFORE THE**
**WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

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

# APPENDIX B (NONCONFIDENTIAL) TO THE SIXTH EXHIBIT TO THE PREFILED DIRECT TESTIMONY OF

## CATHERINE A. KOCH

## ON BEHALF OF PUGET SOUND ENERGY

**JANUARY 31, 2022**

2020

# Advanced Metering Infrastructure Data Enablement Strategy

## Use Case Identification, Strategy, and Planning at Puget Sound Energy

GRID MODERNIZATION STRATEGY AND ENABLEMENT

# Contents

Introduction ........ 3
Background Information – Working Group Goals and Structure ........ 3
AMI Deployment at PSE and Purpose of the Working Group ........ 3
Goals of the Working Group ........ 4
Participants ........ 4
Structure and timeline: ........ 5
Meeting 1 – AMI Data Collection and Current Uses ........ 5
Meter Data Collection at PSE ........ 6
Meter Data Uses at PSE ........ 7
Meeting 2 – Example AMI Data Use Cases ........ 9
Use Case Categorization ........ 9
Meetings 3-6 – Use Case Evaluation ........ 10
Subject Matter Expert Surveys ........ 11
Use Case Evaluation Workbooks ........ 11
Subject Matter Expert Interviews ........ 15
Meetings 7-8 – Outcomes of Evaluation Process and Next Steps ........ 16
Data Requirements ........ 16
Rankings Use Cases using Evaluation Scores ........ 17
Grouping by Similar Data Needs ........ 18
Sequencing by Subject Area ........ 19
Moving from Evaluation Criteria to Decisions ........ 20
Meter Data Use Case Themes ........ 20
Selected Use Cases ........ 20
Other Ongoing Use Cases ........ 21
Use Case Summary and Current Status ........ 22
What’s next ........ 23
Business Case Development ........ 23
Gas Specific Use Cases ........ 23
Future Data Enhancements ........ 24
Appendix ........ 26

## Tables

Table 1 - Overview of Stakeholder Meetings ..... 5
Table 2 - AMI Load Profile Channels Currently Enabled at PSE ..... 6
Table 3- Natural Gas Load Profile Channels ..... 6
Table 4 – AMI Data Use Case Names, Abbreviated Names, and Subject Area ..... 9
Table 5 - Evaluation Meeting Primary Participants ..... 10
Table 6 - Evaluation Criteria ..... 13
Table 7 - Current Status of Use Cases ..... 22
Table 8 - Future AMI Data Enhancement Considerations ..... 24
Table 9 - Participant List ..... 26
Table 10 - Commercial and Industrial Meter Load Profile Channels ..... 27
Table 11 - Residential Meter Load Profile Channels ..... 28
Table 12 - Data platforms and tools overview ..... 28
Table 13 - AMI Data Use Case Descriptions ..... 30

## Figures

Figure 1 - Visual Representation of Primary PSE Meter Data Uses ..... 8
Figure 2 - Use Cases by Benefits and Feasibility ..... 17
Figure 3 - Use Cases by Data Groupings ..... 18
Figure 4 - Use Cases by Subject Area ..... 19
Figure 5 - Evaluation Flow Chart ..... 35

# Introduction

In the spring of 2020, the Grid Modernization Strategy and Enablement team ("Grid Modernization team") established the Advanced Metering Infrastructure ("AMI") Data Enablement Working Group. This document provides background information on the deployment of AMI at Puget Sound Energy ("PSE") and the working group's goals, processes, and outcomes. The first phase of the working group consisted of eight meetings from March to June 2020 to develop the framework of an AMI data use case roadmap and to identify high priority use cases for business case development. Beyond the first phase, the working group will continue to refine the use case roadmap, serve as a centralized resource and clearinghouse for AMI data use cases, and provide support and expertise in initiating AMI data use cases.

# Background Information – Working Group Goals and Structure

## AMI Deployment at PSE and Purpose of the Working Group

Puget Sound Energy initiated the meter upgrade project in March 2018, and by the end of 2023, approximately 1.1 million electric meters and 800,000 gas modules (the AMR module is being replaced with an AMI module while the physical meter remains) will be exchanged. In total, PSE will invest an estimated $473 million in AMI communication network and metering equipment. As of August 2020, ~400,000 AMI electric meters and ~270,000 AMI gas modules have been installed.

PSE views AMI as a foundational technology that enables use cases throughout the organization to benefit customers directly and indirectly as part of the broader company-wide initiatives to modernize the grid and meet the objectives of the Clean Energy Transformation Act. As part of the AMI business case, PSE recognized direct monetary benefits from Conservation Voltage Reduction ("CVR"), distribution automation utilizing the AMI network, and avoided investment to maintain the outdated AMR system. Beyond the quantified monetary benefits identified in the business case, additional benefits identified but not quantified in the business case included reduced billing exceptions (reduction of estimated bills, improved accuracy of demand billing, and improved inventory management process as part of the deployment validation process) and demand response opportunities (including time-based rates, reduced infrastructure investment needed to implement direct load control programs). The AMI deployment was also identified as a foundational step to support micro-grids and smart city attributes (e.g., smart street lighting), distributed generation integration, electric vehicle integration, and customer home-area network interface. As part of this working group, additional benefits and use cases that will utilize AMI data as will be identified and prioritized for implementation to further validate the investment in AMI technology.

One intention of this working group is to recognize the discussion within the utility industry around the challenges of fully realizing the benefits of AMI. For example, a January 2020 ACEEE report titled "Leveraging Advanced Metering Infrastructure to Save Energy" identified six areas where utilities should be utilizing AMI technology to help customers conserve energy.[1] Of the 52 utilities included in the study, only Portland General Electric was utilizing AMI technology to support all six energy conservation strategies. In some states, utility regulators have rejected utility proposals for AMI investments due to a

[1] https://www.aceee.org/research-report/u2001

lack of details around how the investment will be utilized to benefit customers such as Dominion Power in Virginia[2] and Eversource and National Grid in Massachusetts[3].

PSE conducted an internal gap analysis in 2018 that identified several potential risk areas that could prevent PSE from fully realizing the benefits of the AMI deployment. One of the primary risks identified was that PSE would not have a centralized resource to identify and prioritize AMI data use cases and to coordinate AMI capabilities and use cases across different PSE initiatives and work groups. The focus of this working group is to eliminate the identified risk in the 2018 gap analysis and strategically evaluate and coordinate AMI data use cases across PSE. The AMI Data Enablement Working Group is part of a broader joint Operations goal at PSE designed to leverage AMI capabilities for grid modernization and customer service by focusing on, in addition to AMI data enablement, topics regarding AMI metering operations, AMI network governance, and electric and gas SCADA over the AMI network. As an outcome of this joint goal, in July 2020, an AMI Alliance group was formed to address business governance involving the evolution of the foundational AMI solution capabilities and related data. The AMI Alliance recognizes that business changes will need to be governed and this process will help ensure AMI and its data value can be utilized throughout the company.

## Goals of the Working Group

The primary goal of this working group is to identify, prioritize, and initiate the development of high value AMI data use cases. As part of the process, the working group seeks opportunities to align the development of AMI data use cases to the Grid Modernization Roadmap and coordinates with the Data Enablement and Enrichment Program. Members of this working group stay informed of upcoming opportunities, internal strategies, and initiatives relevant to the AMI data enablement working group.

## Participants

In the first phase of the working group, 18 different groups from across PSE participated and provided input and expertise on different parts of the data collection process and meter data end-uses. The list of participating teams is below. Table 9 shows the complete list of participants.

- Teams at PSE providing subject matter expertise:
  - New Products, Customer Insights, Energy Efficiency, Energy Advisors, Rates & Cost of Service, Billing, Customer Solutions, Performance Quality, Asset Management, Distribution Planning, Load Forecasting, Advanced Distribution Management System ("ADMS"), System Protection, Automation, and Controls ("PAC")
- Teams at PSE providing technical expertise:
  - Meter Data Management System ("MDMS"), Data Enablement, Amazon Web Services ("AWS")/Platform of Insights ("POI"), Meter Engineering, Communications Initiatives

[2] https://www.utilitydive.com/news/virginia-rejects-dominions-752m-smart-meter-plan-other-grid-mod-proposal/575007/
[3] https://www.greentechmedia.com/articles/read/massachusetts-rejects-smart-meter-rollouts-as-competitive-energy-undermines

## Structure and timeline:

The initial formation of the working group consisted of eight meetings with stakeholders to identify, describe, and prioritize use cases. Meetings 3 through 6 were split into smaller groups by subject area including Customer Care and Billing; Asset Management, Distribution Planning, and Load Forecasting; Customer Programs and Products, and System Operations. An overview of the working session topics and goals in Table 1.

*Table 1 - Overview of Stakeholder Meetings*

| Meeting Topic | Key Question to Discuss in this Meeting | Outcome by the end of the Meeting |
|---|---|---|
| Meeting 1 – Kick-off and Introductions | What can we do with AMI (i.e., what is the current status of PSE's AMI metering capabilities and how is meter data being used)? | The group understands the basics of AMI and tools that utilize meter data at PSE. |
| Meeting 2 – Overview of Use Cases; Identify Challenges and Synergies | How has AMI been used across the industry and how would those use cases successfully translate to PSE? | The group understands how PSE could implement AMI data use cases and the strategy to help guide the process. |
| Meetings 3 - 6 Deep Dive and In-Category Prioritization | What are the top priorities and data needs for this small group and how can AMI data support this small group? | Each small group identifies small group's current uses of meter data, identifies challenges using meter data, and discusses planned and potential high value use cases of the AMI. |
| Meeting 7 – Recap Deep Dives and Begin Prioritization | What similarities and common data or operational needs were identified in the Deep Dive process? | Full working group is debriefed on the discussions that occurred in the deep dives and the group is ready to engage in the final prioritization process. |
| Meeting 8 – Prioritization Finalization | When we apply the prioritization criteria, what AMI data use cases should be the top priority for PSE to focus on implementing first and who needs to be involved in the planning? | Discuss outcomes of working group and the high priority AMI data use cases that will move onto the business case development stage. |

# Meeting 1 – AMI Data Collection and Current Uses

In the first meeting, the primary goal was to establish a common understanding of AMI technology and uses at PSE. Based on conversations with the meter technology provider (Landis+Gyr), Meter Engineering, and the MDMS teams, documentation was created to share basic information on the AMI load profile channels and data collection process

## Meter Data Collection at PSE

**Electric Meters**

Residential electric meters have 8 load profile channels and commercial and industrial electric meters have 16 load profile channels. The full list of potential load profile channels is listed in the Appendix in Table 10 for commercial and industrial meters and Table 11 for residential meters. In addition to the load profile channel data collection, meters also collect and communicate event data such as outage alerts, variance alerts, and meter errors through the AMI network.

Currently, for electric AMI meters, up to 11 channels of 15-minute interval data are collected and stored in Landis+Gyr's Command Center ("CC") including the channels and data listed in Table 2.

*Table 2 - AMI Load Profile Channels Currently Enabled at PSE*

| Channel | Data Type |
|---|---|
| 1 | kWh (delivered) |
| 101 | kWh (received) |
| 3 | kVARh (delivered) |
| 103 | kVARh (received) |
| 83 | Vh (delivered Phase A) |
| 84 | Vh (delivered Phase B) |
| 85 | Vh (delivered Phase C) |
| 86 | Ah (delivered Phase A) |
| 87 | Ah (delivered Phase B) |
| 88 | Ah (delivered Phase C) |
| 89 | Ah (delivered Neutral) |

Most meters only receive interval data from channels 1, 101, and 83. Command Center communicates data to MDMS for channels 1, 3, 101, and 103 for commercial and industrial meters and only channels 1 and 101 for residential meters.

**Natural Gas Meter Data Collection**

AMI gas modules communicate total consumption information and one load profile of data. As listed in Table 3, for residential meters, AMI modules have 15-minute load profile intervals and for commercial and industrial meters, AMI modules have 60-minute load profile intervals.

*Table 3- Natural Gas Load Profile Channels*

| Channel | Data Type |
|---|---|

| | |
|---|---|
| 33 | CCF (delivered) |
| 76 | CCF (corrected) |

**Meter Data Validation**

15-minute interval data for electric meters is sent from Command Center to MDMS four times per day (every six hours) and gas interval data is sent once per day. A PSE process to clean the data, “Data Validation, Editing, Estimation (“VEE”),” is performed on all interval data once per day; therefore, daily data for both AMI and AMR meters is not available with full VEE until the afternoon of the following day.

## Meter Data Uses at PSE

Currently at PSE, meter data is used by many groups directly and indirectly. The flow chart in Figure 1 is designed to be illustrative of the PSE meter data environment. The core meter data environment is on the left with MDMS and SAP serving as the primary data repositories and tools for essential functionality and like billing and customer service. The different colored data workflows to the right illustrate some of the different end user tools that utilize meter data across different groups including Planning, Operations, Load Forecasting, IT, Customer Insights, Revenue Protection, and Energy Efficiency.

Two new initiatives that have broad applications across at PSE, the Meter Analytics Record (“MAR”) and Meter Analytics Solution (“MAS”), should be specifically mentioned due to their foundational nature as a means to get meter data to a wide variety of teams and serve as an analytical foundation for many different AMI data use cases. Representatives from the MAS and MAR teams participated in this working group, and as AMI data becomes increasingly prevalent and data uses evolve, it will be important to continue to coordinate the AMI data applications across PSE. For more information on each data use and tool, please see Table 12 in the Appendix.

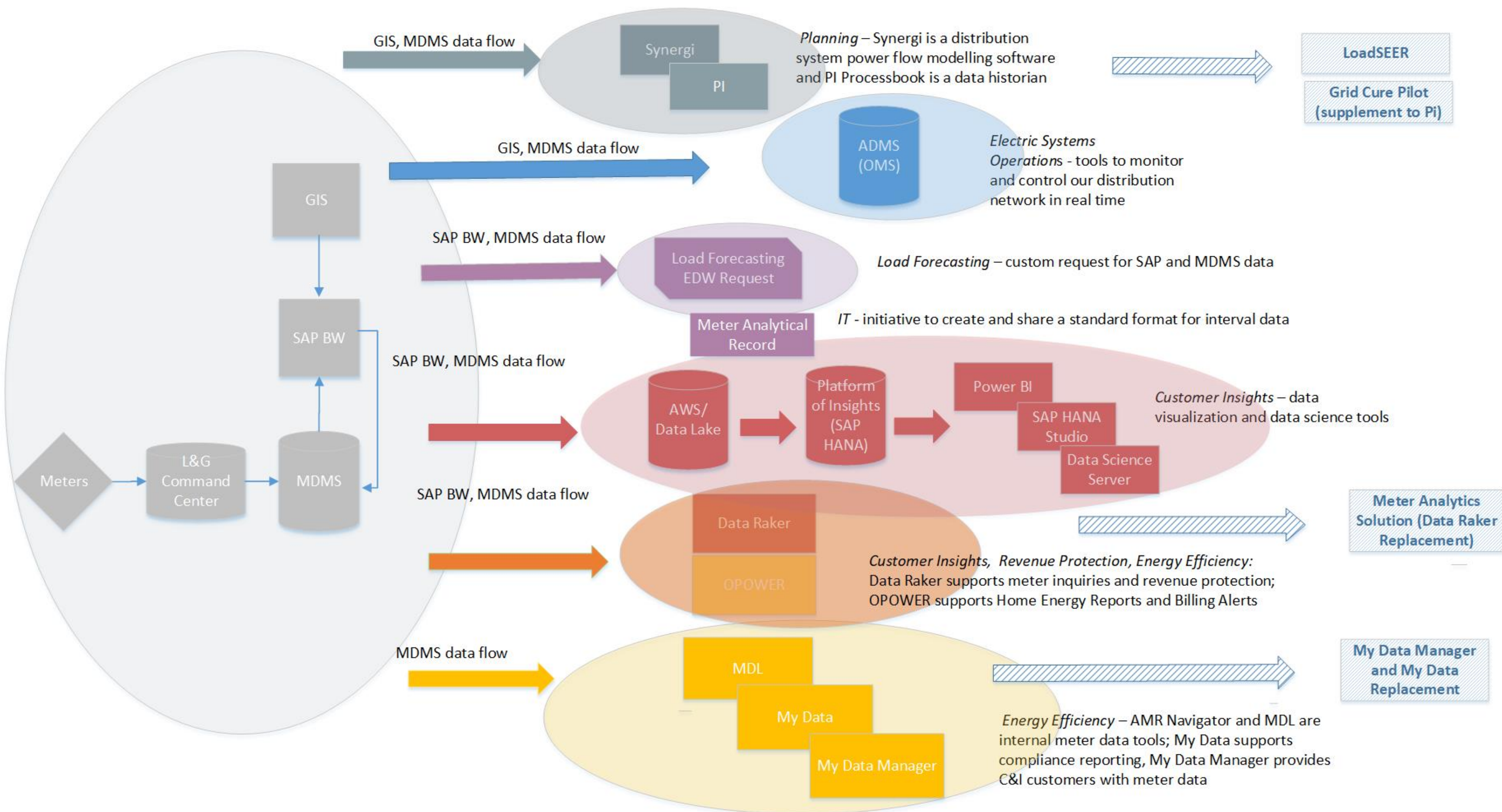


*Figure 1 - Visual Representation of Primary PSE Meter Data Uses*

## Meeting 2 – Example AMI Data Use Cases

Using industry research, white papers, and conversations with PSE stakeholders, the Grid Modernization team established a list of approximately 50 different AMI data use cases. These use cases included electric specific opportunities (e.g., Volt/VAR Optimization) and use cases that would be applicable to both electric and gas (e.g., Billing Alerts). There are a few gas specific opportunities that were not included in the use case list in Meeting 2 and the evaluation process conducted in the remaining meetings. These gas specific use cases were addressed separately with the gas teams to ensure that the few gas specific use cases were thoroughly discussed. Throughout the process, this list was refined through discussion to clarify the use case names, amend descriptions, or consolidate use cases where needed (while keeping the use cases specific enough to allow for meaningful distinctions throughout the evaluation process). The resultant list was 38 AMI data use cases in Table 4.

### Use Case Categorization

The use cases were split into subject matter areas to allow for more targeted deep discussion between groups with similar data needs and uses and to allow for easier "in subject area" comparisons and discussion rather than addressing all use cases at once. The four subject areas are Customer Care, Asset Management and Planning, Products and Programs, and Operations. The full list of use cases, abbreviations used for those use cases in documentation and graphics, and which subject area each use case was grouped with is listed in Table 4. Please note that some use cases may be relevant to multiple subject areas, but each grouping was determined as the best fit for subject area classification. For more detailed description of each use cases, please see Table 13 in the Appendix.

*Table 4 – AMI Data Use Case Names, Abbreviated Names, and Subject Area*

| Use Case Name | Short Name | Subject Area |
|---|---|---|
| More information and control - Customer Aggregate Usage Data | AggregatedData | Customer Care |
| Monitor Asset Health (voltage anomalies) | AssetHealth | Asset Management and Planning |
| Battery Incentive & Management | Battery | Products and Programs |
| More information and control - Billing Alerts | BillAlerts | Customer Care |
| Improved Bill Generation | BillGen | Customer Care |
| Capacity Planning / Sizing Assets | CapacityPlan | Asset Management and Planning |
| Identify customer-owned DER | CustomerDER | Asset Management and Planning |
| Improved Customer Safety | CustomerSafety | Customer Care |
| Improved Customer Engagement with additional data | CustomerService | Customer Care |
| Customized Engagement around Products/Services | CustomizedEngagement | Products and Programs |
| Distribution Automation | DA | Operations |
| Demand Response / Demand Management | DR | Products and Programs |
| Energy Efficiency Program Optimization | EE Optimize | Products and Programs |
| EV Planning and Integration | EV | Products and Programs |
| Metering Issues -Theft and Fraud Detection; Meter Failures | FraudDetect | Customer Care |

| | | |
|---|---|---|
| Grid Reliability / renewables and DERs integration / Hosting Capacity Analysis | GridRelHCA | Asset Management and Planning |
| Identify Unsafe Working Conditions | IdentifyUnsafeConditions | Operations |
| More information and control - In Home Displays and other Smart Devices | IHD | Products and Programs |
| Customer Load Disaggregation | LoadDisagg | Products and Programs |
| Load Forecasting | LoadForecast | Asset Management and Planning |
| Meter Ping Functionality | MeterPing | Customer Care |
| Model Validation / Improved Data Quality | ModelValidation | Asset Management and Planning |
| Momentary Outages / Power Quality | MomentaryOutages | Operations |
| Outage management - Nested Outages | NestedOutages | Operations |
| Leveraging the Network / SCADA | Network | Operations |
| Support Non-Wires Solutions | NWS | Asset Management and Planning |
| Predictive Analytics for Operations | OpsAnalytics | Operations |
| Outage Management - Customer Communication | OutageComm | Customer Care |
| Outage Management - Detection | OutageDetect | Operations |
| Power Quality / Voltage Compliance / Real-time Operating Conditions | PowerQuality | Operations |
| Bill Payment - Automated or Pre-Paid | PrePay | Customer Care |
| Solar PV - Customer Billing and Utility Planning | PV | Products and Programs |
| Designing Rate Programs / Pricing | RatesPricing | Products and Programs |
| Remote Connect and Disconnect | RemoteConnect | Customer Care |
| Controllable Customer Resources / Smart Consumer Devices | SmartDevices | Products and Programs |
| Asset Health (utilization factor) - Under and Over Loaded Transformers | TransformerLoading | Asset Management and Planning |
| Transformer Mapping / Phase Identification / Switching Analysis | TransformerMapping | Asset Management and Planning |
| Volt/VAR Optimization | VVO | Operations |

## Meetings 3-6 – Use Case Evaluation

Each meeting focused on one of the four subject matter areas, and each meeting had a subset of primary participants who served as subject experts. The PSE teams that provided subject matter expertise are in Table 5 listed below. Each subject matter expert completed a pre-meeting survey, evaluation workbooks, and individual interviews with the Grid Modernization team.

*Table 5 - Evaluation Meeting Primary Participants*

| Subject Area | Team |
|---|---|
| Meeting 3 – Customer Care | Customer Solutions – Journey Management |
| | Strategic Customer Insights |

| | |
|---|---|
| | Customer Solutions – Billing and Payment |
| | Customer Care – Performance Quality |
| Meeting 4 –<br>Asset Management and Planning | System Planning – Asset Management |
| | Distribution System Planning |
| | Load Forecasting |
| Meeting 5-<br>Products and Programs | New Product Development |
| | Energy Efficiency |
| | Rates and Cost of Service |
| | Energy Advisors |
| Meeting 6-<br>Operations | Electric System Operations |
| | System Protection, Automation, Control |

The goal of each of these four meetings was to discuss current and future meter data needs and uses, review the list of AMI data use cases that this group would evaluate, and provide an overview of the evaluation process and next steps.

## Subject Matter Expert Surveys

Each set of subject matter experts completed an online survey to prepare for the meeting's topics of discussion including meter data needs and uses, and preliminary thoughts on potential AMI data use cases. The survey questions were:

- How does your team currently use meter data (e.g., to generate bills, to identify high energy consumption accounts, etc.)? Please consider secondary uses (e.g., primary use is to generate bills; secondary use is to investigate customer inquiries of bills).
- What barriers or challenges does your team currently face accessing meter data (if any)? Are there other challenges currently impacting your work with meter data (e.g., data quality, data format, etc.)?
- What is currently planned within your group that will utilize AMI data? Please include anything currently in development or included on a longer term plan/roadmap (i.e., what would be included in a future response to question 1)
- What are your top 3 use cases for your group (i.e., which use cases that you think should be a top priority for your team)?
- Are there any use cases currently categorized as part of different subject area that you would like to discuss as part of this meeting's discussion?

## Use Case Evaluation Workbooks

Beyond discussion of current and planned meter data uses, the other primary purpose of these meetings was to introduce the evaluation questions that would provide a thorough and transparent way to benchmark each use case. The evaluation framework was established in coordination with the Data Enablement and Enrichment Program, a program that had recently evaluated various data enablement use cases (including a few that were meter data related). The evaluation questions were designed to cover a wide variety of metrics and benefits. Not every evaluation question would be highly relevant for each use case (e.g., use cases that require a new program may not increase productivity of PSE employees since it would create new work, but those use case may score highly on benefits to customers and alignment to PSE strategies), and the goal was to have a holistic set of questions that would help differentiate "high value" use cases from both the operational side and also the customer facing side. A conceptual flow chart of how the evaluation questions would sequence to help guide the prioritization process is included in Figure 5 in the Appendix.

The evaluation questions that were completed for each AMI data use case on a scale of 1-5 are described in the Table 6.

*Table 6 - Evaluation Criteria*

| Scoring Questions | Score | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| **How thoroughly does the business understand benefit of the use case?** | Newly introduced | General understanding | Understood, but not in scope | Requested by business, but not in scope | Part of an active project. |
| **To what degree does the use case improve performance of SQI metrics?** | None | Indirectly | One | Two | Three or more |
| **How many customers are impacted by this use case?** | Impacts a handful of customers (e.g., EV owners) | Impacts multiple sub-groups of customers (e.g., customers with solar, EV chargers, or storage) | Impacts residential OR commercial/industrial customers | Impacts either all gas OR all electric customers | Impacts all electric AND gas customers |
| **To what degree does the use case support PSE strategic initiatives?** | None | Indirectly | One | Two | Three or more |
| **What productivity increase is expected from this use case?** | No change | Small reduction if work effort | Moderate reduction in work effort | Significant reduction in work effort | Automation/ elimination of work effort |
| **How much does the use case enhance PSE capabilities?** | One for one replacement of existing capability | Adds new feature or option | Adds multiple features or options | Significant enhancement to existing process. | Adds new process or capability |
| **Does the use case reduce risk in any of the categories identified in the Enterprise Risk Management Program for the year?** | None | Indirectly | One | Two | Three or more |
| **What regulatory hurdles exist for this use case?** | Data to support use case cannot be shared (privacy or | Data can be readily shared<br>AND | Data can be readily shared<br>AND | Data can be readily shared<br>AND | Data can be readily shared<br>AND |

| | | | | | |
|---|---|---|---|---|---|
| | transmission/generation restrictions)<br>OR<br>Unlikely to be approved by UTC | PSE would need UTC proceeding<br>Example: Time Varying Rates as part of next rate case | PSE would modify a program previously approved by UTC (i.e., may need to inform UTC and/or request updated approval) | PSE may inform UTC of utilization of data (e.g., a tool, program, platform) | Utilization of data (e.g., a tool, program, platform) does not require any regulatory component. |
| **Is the data needed to support this use case available (collected)?** | Data not available through AMI | Near real-time data<br>More granular data for bellwether meters (e.g., 5 minute interval data) | 15-minute data for new load profile channels, 1 day lag (all meters) | 15-minute data for new load profile channels, 1 day lag (bellwether meters only) | 15 minute kWh data, data sent 4x per day (electric), 1x per day gas; 1 day lag (to validate all data for the previous day) |
| **Is the supporting data for this use case easily accessible?** | Data not available through AMI | New load profile channels, new meter events | Some meter events and current/voltage data collected by meters or Command Center but not loaded to MDMS | 15-minute kWh, Voltage, and Current data stored in MDMS/AWS but access is being developed (MAR) | Daily kWh data currently collected and stored in MDMS and AWS /<br>HANA Studio (MAS) |
| **What is the availability of technical dependencies that are needed to support this use case?** | Requires new enterprise-wide technologies not currently planned to enable use case | Requires new platform (e.g., DERMS) with enterprise connections (e.g., GIS, SAP) | Requires new platform or technology that is standalone (e.g., a new tool to analyze transformer loading)<br>OR<br>Requires changes to existing enterprise connections (SAP, GIS, Web portal) | Standalone (external) tool/ product with enhancement (e.g., enhancements to OPOWER by providing more granular kWh data) | Enhancing (internal) tool/product or existing processes such as providing more granular kWh data to the Load Forecasting team for their internal analysis |

## Subject Matter Expert Interviews

Within the evaluation criteria, the questions were split into two categories. In the first category, the focus was on questions that could be categorized as the "benefits/value" set of questions, and in the second category of questions, the focus was on questions in the above table that could be categorized as the "data requirements / feasibility" set of questions. The breakdown was as follows:

- "Benefits/Value" Evaluation Areas
    - Business Maturity/Understanding
    - Corporate (SQI) Metrics
    - Customer Impact
    - Enterprise Risk Reduction
    - Enhancement of Capabilities
    - Strategic Alignment (ISP)
    - Productivity Increase
- "Data Requirements / Feasibility" Evaluation Areas
    - Regulatory Feasibility
    - Data Collection
    - Data Availability/Access
    - Technical Dependencies

Each subject matter expert completed an Excel workbook after the meeting to evaluate each use case in their subject area for the first six questions in Table 6. The evaluation criteria for "Enterprise Risk Reduction" and "Regulatory Feasibility" were evaluated by the Grid Modernization team to provide consistent scoring across these metrics since they were not specific to subject matter experts focus areas nor the technical data team's expertise. The last three questions were scored based on a combination of individual interviews conducted by the Grid Modernization team with each subject matter expert to better understand the data requirements and what the use case would look like if implemented, and with the assistance of the meter engineering and data teams to create evaluation categories that would represent the challenges of collecting or presenting this data for use cases. These interview questions with each subject matter expert focused on discussing the following questions:

- If a project has been indicated as an "ongoing" project, does this project actively include enhancements/changes as a result of AMI deployment (i.e., even though PSE has existing "Billing Alerts", only mark "ongoing" if there is ongoing work to implement AMI data to enhance/change the Billing Alerts)
- If the use case is ongoing, what is the name of the ongoing project?
- What AMI data types (e.g., 15-minute kWh data, voltage data, etc.) would be needed to support this use case?

- What data frequency (e.g., 5-minute intervals), latency (e.g., data from the previous hour), and history (e.g., 3 years of historical data) would be needed to support this use case?
- What systems other than MDMS/Command Center (e.g., GIS, SAP) would need to be coordinated/integrated for this use case?
- What would it look like to implement this use case at PSE (i.e., please provide a brief description of what this use case would like if successfully implemented)?

Through the interviews discussing these questions, a list of basic data requirements and integrations were documented for each use case. The common framework for scoring (e.g., if a use case requires new load profile channels then it should be scored as a “4” relative to a “5” for use cases that utilize existing load profile channels) that was established with the support of the technical teams, could then be applied to each of these use cases. For criteria that was evaluated by multiple subject matter experts, scores were averaged across the use cases and compiled for discussion in the final two meetings.

## Meetings 7-8 – Outcomes of Evaluation Process and Next Steps

### Data Requirements

After the scoring was completed, the results were consolidated and summarized. The final two meetings focused on sharing findings and discussing the evaluation process. One of the goals of this working group evaluation process was to identify what AMI data use cases can be implemented using the data that is currently available from PSE’s AMI system and which uses cases would require an enhancement or modification. The majority of AMI data use cases that were evaluated would utilize data that is currently available. Some of the high-level data requirements for the use cases are summarized below:

- **27** Use cases  will utilize data currently collected from the meters
- **14** Use cases will utilize existing 15-minute kWh data (or hourly/daily data is sufficient)
- **10** Use cases will utilize 15-minute voltage or current data
- **7** Use cases would require “near real time data”
- **6** Use cases could utilize new meter events or load profile channels
- **5** Use cases require meter events (power up/down)

Please note that the counts above are not mutually exclusive and do not sum to the total number of use cases evaluated since some use cases may utilize multiple data types and have different data latency requirements

Given the subjective nature of the evaluation process, we created several visualizations to help identify high value use cases and to organize all the input received throughout the process. Each of the following figures uses colors to indicate which subject area the use case is from (blue – Asset Management and Planning, yellow – Customer Care, orange – Products and Programs, green – Operations). Use cases in bold ovals have been identified as “ongoing” or “in development.”

## Rankings Use Cases using Evaluation Scores

The chart below shows the rankings for each use case for the “benefits/value” criteria along the x-axis and the rankings for “data requirements / feasibility” criteria along the y-axis. This graphic helps identify the “high value”, “easy to implement”, and “high value and easy to implement” use cases. Use cases in the top right quadrant ranked highly for value and benefits (i.e., higher value use cases) and feasibility (i.e., easier to implement). Please note that small differences in scores can result in large differences in ranks (e.g., if the top 10 use cases scored between 18 and 19 for data requirements and feasibility and the next highest ranked use case scored 17.5, then it could look much lower (e.g., rank of 11 vs. 1) than the difference in raw scores between #1 and #11.

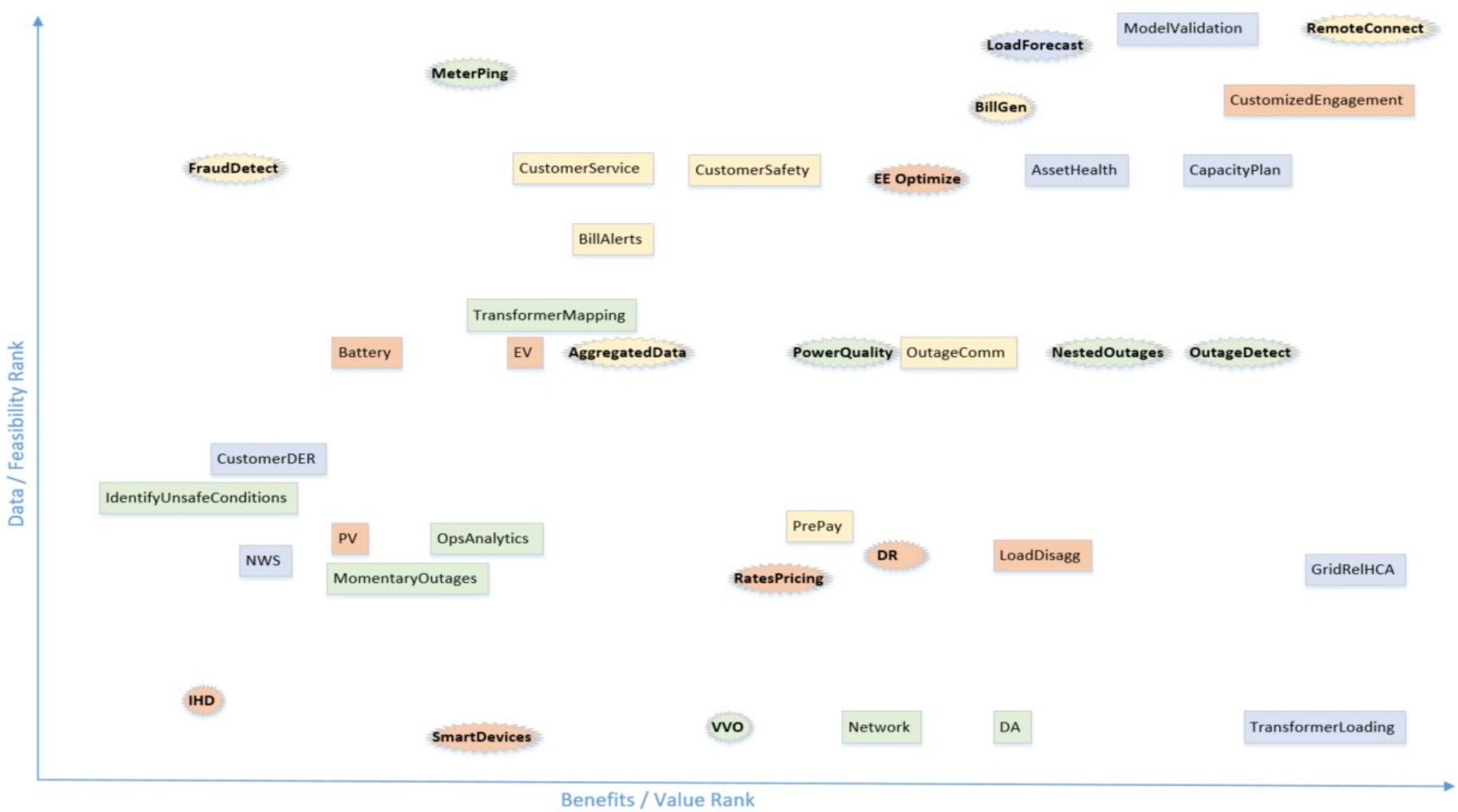


*Figure 2 - Use Cases by Benefits and Feasibility*

## Grouping by Similar Data Needs

Figure 3 shows use cases grouped by data needs and integration considerations. As the use cases move from left to right, they progress from "crawl" to "walk" to "run" to show where PSE might want to start. This visualization is one way to look at sequencing the use cases to gauge relative complexity and also recognizing the similar data requirements for many use cases. While the initial focus may be on a handful of use cases, the data enablement process (e.g., collecting, cleaning, and staging data) for one use case could then be adapted to support additional use cases with the same data needs. Please note that this visualization is a simplification of data needs and feasibility, and that this analysis only uses the scores as a guide, but each use case is not placed precisely based on score.

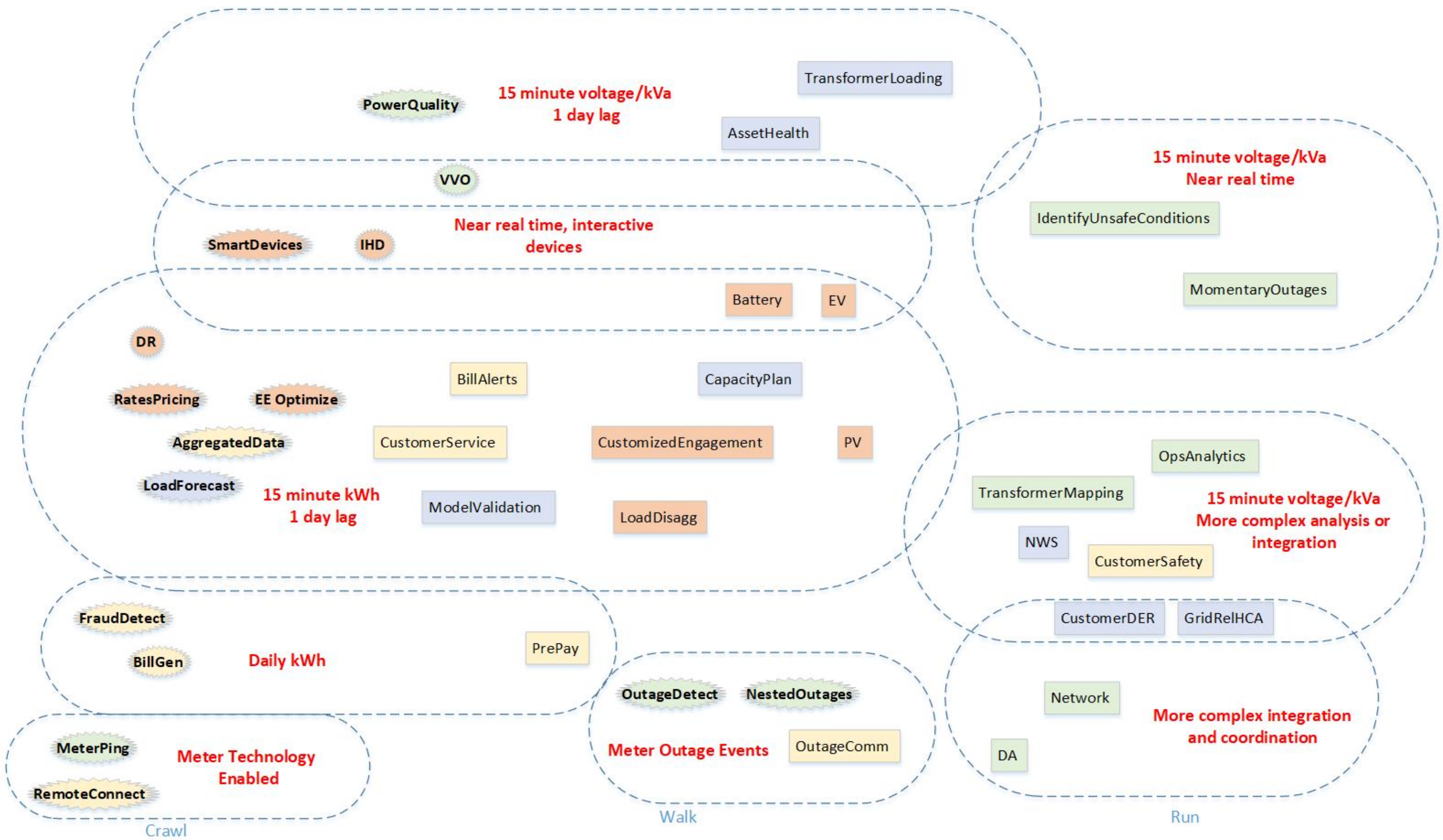


*Figure 3 - Use Cases by Data Groupings*

## Sequencing by Subject Area

Figure 4 shows a potential progression of use case development within an area and the interconnectedness of the use cases. Similarly to Figure 3, it progresses through a "crawl" to "walk" to "run" to show where PSE might want to start along the x-axis. The progression along the y-axis is not relevant since the groupings are by subject area. The dashed lines indicate where use cases can support or improve related use cases, and the solid lines indicate a dependency. For example, while Load Forecasting does not require Load Disaggregation, it could be improved with a fully implemented Load Disaggregation use case. A direct example would be Improved Outage Communications to customers being directly dependent on the Outage Detection use case. Please note that this figure does not prioritize coordinating similar data needs and that each use case is not placed precisely based on score.

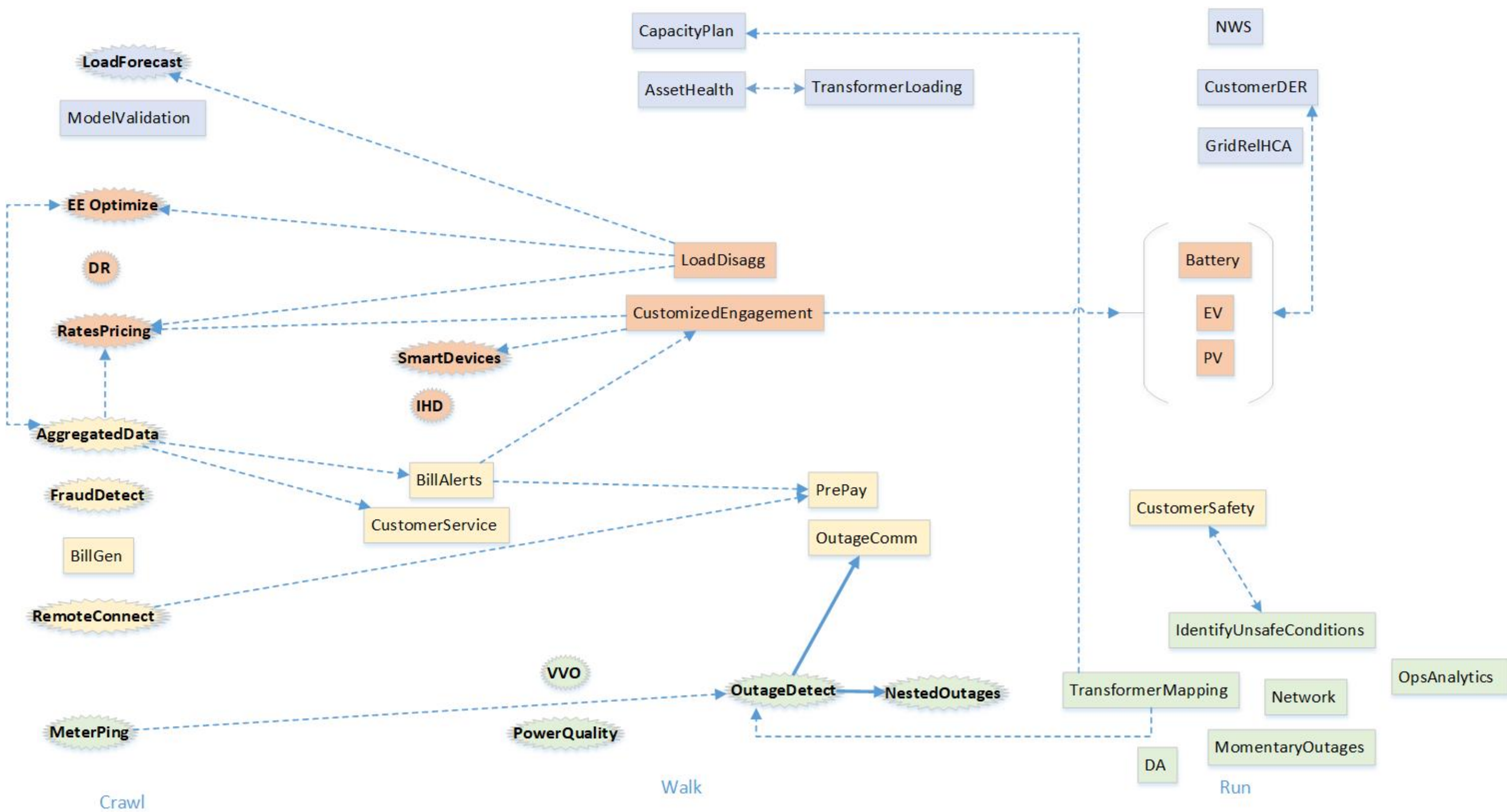


*Figure 4 - Use Cases by Subject Area*

# Moving from Evaluation Criteria to Decisions

## Meter Data Use Case Themes

With a thorough evaluation process soliciting input and expertise from stakeholders across PSE, several key themes emerged:

1) Previous AMR data uses and tools were frequently specific to an individual team and created as a one-off solution.
2) Several use cases that will utilize AMI data are already in development or have initiated planning.
3) The majority of use cases can be initiated with the existing data collection and presentment processes, but several high-value use cases would necessitate enhancements.
4) Several use cases will enable other use cases with dependencies on the underlying data collection or implementation of a related use case.
5) Several use cases have interest or support from teams not directly "owning" the underlying data or application of a use case.

## Selected Use Cases

Based on the rankings and evaluation scores, interviews that confirmed relative levels of interest in use cases, and new insights on dependencies and cross-organizational interests, the group selected and vetted four use cases. The selected use cases were all evaluated as high value with moderate to easy feasibility and implementation, and an emphasis was placed on use cases that are intersectional and will leverage the collaborative set of stakeholders who participated in this process. Each of the selected use cases will require input and coordination from at least two functionally different teams (e.g., Energy Efficiency and Customer Care / Customer Experience teams). The selected use cases would not be initiated in the near-term without the support of this working group.

- **Outage Detection - Operations** – incorporating meter power up/down events and voltage data in near-real time into ADMS/OMS
  - **Why was this specific use case selected**: Improved outage detection was a core benefit cited in the AMI Business Case and is one of the most widely cited benefits of AMI. Implementing this use case would have a direct impact on SQI metrics (SAIDI and SAIFI times) and would be foundational to dependent use cases such as improved outage communication to customers and identifying nested outages.

- **Asset Health - Asset Management and Planning** – using AMI data to support asset monitoring/awareness (e.g., this transformer is trending towards failure) and help groups make operational or design decisions
  - **Why was this specific use case selected**: Asset Health scored highly in terms of benefits and this use case will leverage existing kWh and voltage interval data being collected by the meters. This use case has a well-defined scope, and implementing this use case will help enable future use cases like transformer loading analysis. Peer utilities have

successfully implemented preventative or mitigation related to asset healthy utilizing AMI data.[4]

- **Load Disaggregation - Customer Programs and Products –** identifying discrete energy loads within homes or businesses
    - **Why was this specific use case selected**: Load disaggregation is becoming increasingly discussed by utilities as customers continue to add new devices to homes (e.g., EVs, batteries, heat pumps, etc.) and seek more insight and control of their energy use. Not only will load disaggregation provide customers with more insight into their energy consumption, but the development of this use case will support the Load Forecasting, Rates and Cost of Service, Energy Efficiency, and New Product Development teams.

- **Customer Usage Data (Aggregated Data) - Customer Care –** providing customers more granular and timely usage data from the meter (i.e., not load disaggregation) to help them better understand and manage their energy consumption
    - **Why was this specific use case selected**: One of the primary components of any AMI business case is providing customers with more granular and timely meter data. This is a foundational use case to support any use case related to customer pricing and billing (e.g., time varying rates, demand response, EV charging incentives, bill pre-payment, etc.) and the baseline expectation for utilities is increasingly becoming that customers will be able to view their interval data throughout the billing cycle. Developing this use case at PSE will facilitate discussions between the Energy Efficiency teams that work with Home Energy Reports and OPOWER billing alerts and the Customer Care, Billing, and Customer Experience teams that generate customer bills, provide customer support, and also send high bill alerts.

The four selected use cases were all chosen with the intent to avoid the most complicated or least feasible use case in the initial round; however, use cases that have high value to PSE but may have scored lower in terms of feasibility will be considered in the near-term to identify ways to support these use cases. This will be done by initiating the prerequisite requirements or enabling the foundational data needs and coordination. For example, a use case that will require data changes (e.g., near-real time data or new load profile channels) will be included as part of the near-term planning discussion regarding potential longer-term AMI data enhancements.

## Other Ongoing Use Cases

In addition to the four priority use cases, several use cases were identified as ongoing or in development throughout the meetings, evaluation process, and interviews. One important outcome of this working group is the discussion and documentation of ongoing activities using AMI data between teams that may not have otherwise coordinated. By documenting these use cases, identifying opportunities to collaborate on use cases, and recognizing potential redundancies, this working group will help facilitate strategic planning across PSE. As related or foundational use cases are completed, PSE will be better positioned to make sure that holistic solutions are implemented and opportunities for quick follow-on

[4] https://smartenergycc.org/wp-content/uploads/2019/05/VOEAMI-2019-Final.pdf, pg. 20

wins to existing use cases are shared. Several ongoing or in-development use cases were identified including:

- **Fraud Detection** – Use case that will be supported by the development of the Meter Analytics Solution
- **Demand Response, Rates and Pricing, Energy Efficiency Optimization, Aggregated Data (via the Energy Efficiency team), and Load Forecasting, Power Quality, VVO –** Use cases that will be supported by the development of the Meter Analytical Record providing better access to 15-minute kWh and voltage data
- **Smart Devices and In-Home Display –** Use cases that are being evaluated by the Energy Efficiency teams for pilot projects

## Use Case Summary and Current Status

The complete list of use cases and their current status are outlined in Table 7 - Current Status of Use Cases. Use cases with a status of "AMI Data Enablement Roadmap" are not currently in development or part of a different group's roadmap.

*Table 7 - Current Status of Use Cases*

| Use Case Name | Status |
|---|---|
| **Asset Health (utilization factor) - Under and Over Loaded Transformers** | **Top 4 - Initiating Development – AMI Data Enablement Roadmap** |
| Battery Incentive & Management | AMI Data Enablement Roadmap |
| Bill Payment - Automated or Pre-Paid | Planned - Customer Care Roadmap |
| Capacity Planning / Sizing Assets | AMI Data Enablement Roadmap |
| *Controllable Customer Resources / Smart Consumer Devices* | *Ongoing - Energy Efficiency* |
| **Customer Load Disaggregation** | **Top 4 - Initiating Development – AMI Data Enablement Roadmap** |
| Customized Engagement around Products/Services | AMI Data Enablement Roadmap |
| *Demand Response / Demand Management* | *Ongoing - Bainbridge and Duvall* |
| *Designing Rate Programs / Pricing* | *Ongoing - Pricing Pilots* |
| Distribution Automation | Planned - Grid Mod Roadmap |
| *Energy Efficiency Program Optimization* | *Ongoing - Energy Efficiency* |
| EV Planning and Integration | AMI Data Enablement Roadmap |
| Grid Reliability / DERs integration / Hosting Capacity Analysis | Planned - Grid Mod Roadmap |
| Identify customer-owned DER | AMI Data Enablement Roadmap |
| Identify Unsafe Working Conditions | AMI Data Enablement Roadmap |
| Improved Bill Generation | Technical Functionality Complete |
| Improved Customer Engagement with Additional Data | AMI Data Enablement Roadmap |
| Improved Customer Safety | AMI Data Enablement Roadmap |
| Leveraging the Network / SCADA | AMI Data Enablement Roadmap |
| *Load Forecasting* | *Ongoing - MAR* |
| Meter Ping Functionality | Technical Functionality Complete |
| *Metering Issues -Theft and Fraud Detection / Meter Failures* | *Ongoing - MAS* |
| Model Validation / Improved Data Quality | AMI Data Enablement Roadmap |
| Momentary Outages / Power Quality | AMI Data Enablement Roadmap |

| | |
|---|---|
| Monitor Asset Health (voltage anomalies) | AMI Data Enablement Roadmap |
| More information and control - Billing Alerts | AMI Data Enablement Roadmap |
| **More information and control - Customer Usage Data** | **Top 4 - Initiating Development – AMI Data Enablement Roadmap** |
| *More information and control - In Home Displays and Smart Devices* | *Ongoing - Energy Efficiency* |
| Outage Management - Customer Communication | AMI Data Enablement Roadmap |
| **Outage Management - Detection** | **Top 4 - Initiating Development – AMI Data Enablement Roadmap** |
| Outage management - Nested Outages | AMI Data Enablement Roadmap |
| *Power Quality / Voltage Compliance / Real-time Operating Conditions* | *Ongoing - ADMS* |
| Predictive Analytics for Operations | AMI Data Enablement Roadmap |
| Remote Connect and Disconnect | Technical Functionality Complete |
| Solar PV - Customer Billing and Utility Planning | AMI Data Enablement Roadmap |
| Support Non-Wires Solutions | AMI Data Enablement Roadmap |
| Transformer Mapping / Phase Identification / Switching Analysis | AMI Data Enablement Roadmap |
| *Volt/VAR Optimization* | *Ongoing - Grid Mod Roadmap* |

# What's next

## Business Case Development

The Grid Modernization team will work with stakeholders from the working group, in addition to new use case specific subject experts, throughout the summer and fall 2020 to develop business cases for the four high priority use cases. Subject matter experts will provide input to refine the use cases and the Grid Modernization team will help facilitate the requirements gathering process and document the outcomes. The business case development process will help determine a path forward for each of these use cases through discussion of the following topics: refining the definition of and scope of the use case, documenting the need and benefits, estimating costs and timeline, and identifying risks and alternatives.

In addition, there will be ongoing coordination with the groups that are working on the ongoing and in-development use cases independently of this group. Throughout the process the Grid Modernization team will share updates with the larger working group as use cases are developed and as the AMI Data Enablement road map evolves.

## Gas Specific Use Cases

Following the identification of the four priority AMI data use cases, the Grid Modernization team discussed gas specific AMI data opportunities with the Gas Operations and Gas System Integrity ("GSI") teams. In the broader AMI and natural gas discussion, most of the gas specific opportunities are equipment or network dependent. One of the more commonly cited opportunities is the installation of methane detectors or leak detectors that can utilize the AMI network for communication. One other area of interest from the Gas Operations side was overall consolidation of communication devices that could potentially utilize the AMI network. Both of these opportunities are not AMI data specific (rather hardware and network specific) and were not considered near-term high priority uses by the Gas Operations team. Moving forward, they will be coordinated in conjunction with the AMI Data Use Case Roadmap.

The GSI team is primarily interested in the increased granularity of data and also the potential for new data types to such as temperature or pressure to support gas quality, demand response, and planning models. Moving forward, the Grid Modernization team will continue to support the GSI team's efforts to analyze and utilize the AMI gas data. As the GSI team participates in the MAR development process and has improved access to AMI gas data, the Grid Modernization team will help document, roadmap, and support any gas specific AMI data use cases that are identified.

## Future Data Enhancements

For the use case evaluation process, the "minimum viable data" to support any given use case was assumed to simplify the scoring process and establish baseline data requirements to initiate AMI data use cases. Use cases that have a wide range of implementation options (i.e., simple vs. advanced) were scored based on the most straightforward implementation scenario. For example, Electric Vehicle Planning and Integration was scored under the assumption that 15-minute interval data with a 1 day lag can support better planning and incentive development. More advanced options (e.g., providing near real time data to customers or managed charging) should be considered as a future state of this use case, but this more advanced application of AMI data to support EV programs was not the basis for scoring at this time. Table 8 outlines use cases that had distinct future data needs that were identified in the stakeholder interviews. Most of the future data enhancements identified make use of "near real time" data even if it is not required today.

*Table 8 - Future AMI Data Enhancement Considerations*

| Use Case | Minimum Data Collection | Minimum Data Loading Frequency | Future Data Needs |
|---|---|---|---|
| **DR** | 15-minute kWh | 1 day lag ok | near-real time |
| **PV** | 15-minute kWh - consumption and production | Monthly | near-real time |
| **CapacityPlan** | 15-minute kWh | Monthly | kVa data |
| **OpsAnalytics** | 15-minute voltage | 1 day lag ok | near-real time |
| **CustomerUsageData** | 15-minute kWh | 1 day lag ok | near-real time |
| **AssetHealth** | 15 minute voltage | 1 day lag ok | near-real time |
| **EV** | 15-minute kWh | Monthly | near-real time |
| **CustomizedEngagement** | 15-minute kWh | 1 day lag ok | near-real time data; potentially 5-minute data and voltage/current |

| | | | |
|---|---|---|---|
| **LoadDisagg** | 15-minute kWh | 1 day lag ok | near-real time; potentially in-device connection to AMI network (Zigbee) |
| **Battery** | 15-minute kwh | Monthly | near-real time; potentially voltage/current data |
| **RatesPricing** | 15-minute kWh | 1 day lag ok | near-real time |
| **PowerQuality** | 15-minute data | 1 day lag ok | near-real time; kVa data |
| **FraudDetect** | Daily kWh (in the future 15-minute kWh), meter events/flags (power up/down events) | 1 day lag ok | tilt/tamper meter events |

The potential data enhancements will be discussed as part of the ongoing AMI Alliance, which acts as a clearing house for proposed changes related to business impacts. This collective alliance of business and information technology members meets regularly to discuss business requests for changes of the AMI solution and safeguards and grows the value of the AMI program at PSE.

The AMI Data Enablement roadmap will continue refinement and the above documentation serves as a living document that will be updated to reflect changing technologies, tools, priorities, and needs at PSE.

# Appendix

*Table 9 - Participant List*

| Name | Role | Team |
|---|---|---|
| Jay Creech | Group Lead | Grid Modernization Strategy and Enablement |
| Elaine Markham | Group Advisor | Grid Modernization Strategy and Enablement |
| Kindra Bregg | Participant, Completed Use Case Evaluations | Customer Solutions – Billing and Payment |
| Theresa Burch | Completed Use Case Evaluations | Customer Solutions – Billing and Payment |
| Sue Cagampang | Participant, Completed Use Case Evaluations | Distribution System Planning |
| Gamze Cetken | Participant | Data Enablement and Enrichment |
| Chakri Damidi | Participant | Data Enablement and Enrichment |
| Chhandita Das | Participant | Rates and Cost of Service |
| Rachelle Dillard | Participant, Completed Use Case Evaluations | Energy Efficiency – Residential Energy Management |
| Kevin Gowan | Participant, Completed Use Case Evaluations | System Planning - Asset Management |
| Sarah Haroldsen | Participant, Completed Use Case Evaluations | Electric System Operations - ADMS |
| Adam Harrison | Participant, Completed Use Case Evaluations | Electric System Operations - ADMS IT |
| Birud Jhaveri | Participant | Rates & Regulatory Affairs |
| Paul Johnson | Participant | Amazon Web Services/Platform of Insights IT Architecture |
| Srini Kalmikonda | Participant | Data Enablement and Enrichment |
| Karen Koch | Participant | Communications Initiatives |
| Chad Larson | Participant, Completed Use Case Evaluations | Electric System Operations |
| Claire Locke | Participant, Completed Use Case Evaluations | Strategic Customer Insights |
| Therese Miranda-Blackney | Participant, Completed Use Case Evaluations | New Product Development |
| Lorin Molander | Participant, Completed Use Case Evaluations | Load Forecasting |
| Patrick Moore | Participant, Completed Use Case Evaluations | Customer Care - Performance Quality |
| Ani Mukhopadhyay | Participant | Data Enablement and Enrichment |
| Brian Nguyen | Participant | Meter Engineering |
| Ben Pelkey | Participant, Completed Use Case Evaluations | Energy Advisors |
| Taylor Pitts | Participant, Completed Use Case Evaluations | Energy Efficiency – Business Energy Management |

| | | |
|---|---|---|
| Valerie Poole | Participant | Meter Data Management System |
| Allison Sains | Participant | Meter Data Management System |
| Will Spencer | Participant | Data Enablement and Enrichment |
| Louis Tibbs | Participant, Completed Use Case Evaluations | System Protection, Automation, Control |
| Adam Van Assche | Participant, Completed Use Case Evaluations | Customer Solutions – Journey Management |
| Patrick Weaver | Participant | Energy Efficiency – Residential Energy Management |

*Table 10 - Commercial and Industrial Meter Load Profile Channels*

| | | | |
|---|---|---|---|
| Delivered kWh | Total kVAh Phasor | Voltage Sag Phase A | Delivered dVA RMS |
| Received kWh | Q1 kVAh Phasor | Voltage Sag Phase B | Received dVA RMS |
| Total kWh | Q2 kVAh Phasor | Voltage Sag Phase C | Total kVA RMS |
| Q1 kWh | Q3 kVAh Phasor | Voltage Sag Any Phase | Q1 kVA RMS |
| Q2 kWh | Q4 kVAh Phasor | Voltage Swell Phase A | Q2 kVA RMS |
| Q3 kWh | Delivered kVArh Phasor | Voltage Swell Phase B | Q3 kVA RMS |
| Q4 kWh | Received kVArh Phasor | Voltage Swell Phase C | Q4 kVA RMS |
| Delivered kVarh | Total kVArh Phasor | Voltage Swell Any Phase | Delivered kVA Phasor |
| Received kVarh | Q1 kVArh Phasor | Temperature (Degrees C) | Received kVA Phasor |
| Total kVarh | Q2 kVArh Phasor | Delivered kW | Total kVA Phasor |
| Q1 kVarh RMS | Q3 kVArh Phasor | Received kW | Q1 kVA Phasor |
| Q2 kVarh RMS | Q4 kVArh Phasor | Total kW | Q2 kVA Phasor |
| Q3 kVarh RMS | Phase A RMS Volts | Q1 kW | Q3 kVA Phasor |
| Q4 kVarh RMS | Phase B RMS Volts | Q2 kW | Q4 kVA Phasor |
| Delivered kVAh RMS | Phase C RMS Volts | Q3 kW | Delivered kVAr Phasor |
| Received kVAh RMS | Phase A RMS Amps | Q4 kW | Received kVAr Phasor |
| Total kVAh RMS | Phase B RMS Amps | Delivered kVAr | Total kVAr Phasor |
| Q1 kVAh RMS | Phase C RMS Amps | Received kVAr | Q1 kVAr Phasor |
| Q2 kVAh RMS | Phase Neutral RMS Amps | Total kVAr | Q2 kVAr Phasor |
| Q3 kVAh RMS | Average Power Factor | Q1 kVAr RMS | Q3 kVAr Phasor |
| Q4 kVAh RMS | Frequency | Q2 kVAr RMS | Q4 kVAr Phasor |
| Delivered kVAh Phasor | External Input 1 | Q3 kVAr RMS | |
| Received kVAh Phasor | External Input 2 | Q4 kVAr RMS | |

*Table 11 - Residential Meter Load Profile Channels*

| FOCUS AX and AXe Channels | |
|---|---|
| +kWh | -kWh |
| V2h/Vh Ph. A | V2h/Vh Ph. B |
| V2h/Vh Ph. C | I2/Ih Ph. A |
| I2/Ih Ph. B | I2/Ih Ph. C |
| Sag V Ph. A* | Sag V Ph. B* |
| Sag V Ph. C* | Swell V Ph. A* |
| Swell V Ph. B* | Swell V Ph. C* |
| Sag V Any Ph. * | Swell V Any Ph* |
| Delta Temperature | Temperature |
| Frequency | Delivered kVARh |
| Received kVARh | Delivered kVAh |
| Received kVAh | |

*Voltage Sags and Swells for each phase use selectable thresholds.

*Table 12 - Data platforms and tools overview*

| Platform or Tool | Used By | Used For | Status |
|---|---|---|---|
| **Synergi** | Distribution Planning | To support power flow modeling | In use |
| **PI ProcessBook** | Distribution Planning, Plant Technical Services | To view electric distribution system data for operational areas; Playback data to analyze events | In use, could be supplemented or replaced by GridCure |
| **LoadSEER** | Distribution Planning, Grid Modernization | To provide distribution planning and DER tools with automated circuit planning scenario capabilities and load shape forecasts | In procurement process |
| **GridCure** | Asset Management, Plant Technical Services | To produce interactive asset health dashboards and actionable insights for the transformer population | In pilot evaluation phase |
| **ADMS** | Electric System Operations | To provide tools to monitor and control our distribution network in real time | In development |

| | | | |
|---|---|---|---|
| **Load Forecasting Daily Requirements EDW Request** | Load Forecasting and Energy Efficiency | To provide a database of daily usage data by meter | In use; Ad-hoc solution |
| **Meter Analytical Record ("MAR")** | All PSE | To provide 15-minute electric and gas interval data in an consistent and easy to use format | In Development |
| **Platform or Tool** | Used By | End Use | Status |
| **AWS/Data Lake** | IT | To store unstructured and structured data in the cloud | In use |
| **Platform of Insights/SAP HANA** | All PSE (primarily Customer Insights currently) | To serve as the data virtualization platform that connects data sources from across PSE | In use with additional enhancements planned |
| **Power BI/SAP Hana Studio/Data Science Server** | All PSE (primarily Customer Insights currently) | To provide end-user tools to analyze and present data in the Platform of Insights | In use with additional enhancements planned |
| **Data Raker** | Revenue Protection, Billing Performance, Customer Insights, Load Forecasting | To provide an internally platform to view, research and analyze meter data | In use with internal replacement in development |
| **Meter Analytics Solution ("MAS")** | All PSE | To replace Data Raker with an in-house solution that integrates meter data and leverages new analytical capabilities established in the Platform of Insights | In development |
| **OPOWER** | Energy Efficiency | To support customer communications including Home Energy Reports and usage variation alerts | In use, contract expires fall 2020 |

| | | | |
|---|---|---|---|
| **MDL ("Meter Data Link")** | Energy Efficiency | To serve as an internal meter data tool to view and research meter history | In use |
| **My Data** | Energy Efficiency | To provide a customer-facing tool for compliance for Energy Star Portfolio Manager | In use, replacement planned |
| **My Data Manager** | Energy Efficiency | To provide a customer-facing data platform for commercial/industrial customers to view usage and billing data | In use, replacement planned |

*Table 13 - AMI Data Use Case Descriptions*

| | |
|---|---|
| **Asset Health (utilization factor) - Under and Over Loaded Transformers** | Transformer Load Management can use additional AMR/AMI system data to estimate the load on service transformers with much greater precision. TLM will be able to identify transformers that are at risk of failure due to overload, and the secondary division of a distribution transformer. |
| **Battery Incentive & Management** | During the EMI Consulting-led ideation workshop, participants noted how important backup generation is to PSE customers, how PSE lacks visibility into whether customers have onsite backup generation such as a generator or an electric battery, and how useful it would be if PSE could control batteries. |
| **Bill Payment - Automated or Pre-Paid** | Pre-pay billing programs reduce billing fluctuations, unanticipated high electric bills, and service disruptions for customers on pre-pay programs by communicating usage on regular intervals |
| **Capacity Planning / Sizing Assets** | With AMI, utilities can collect specific customer usage data at the daily, hourly, 15-minute level with high levels of accuracy to improve previously used general monthly load profiles to forecast future load and plan future capacity. |
| **Controllable Customer Resources / Smart Consumer Devices** | Control technologies include devices such as programmable communicating thermostats (PCTs) and direct load control (DLC) devices that utilities and customers use to automatically control customers' heating and cooling systems or other energy-intensive devices. In addition, home area networks (HAN) and energy management systems can be installed to automatically control appliances in response to price signals, load conditions, or pre-set preferences. |
| **Customer Load Disaggregation** | AMI can help utilities identify discrete (behind the meter) energy loads within homes or businesses. There are several new approaches to energy disaggregation and behind the |

| | |
|---|---|
| | meter data analytics that vary based on the granularity of the data that is accessible, how quickly the data can be analyzed, and the depth of historical records to draw from: Landis+Gyr and Sense utilize real-time and high-resolution disaggregation; Itron and Bidgely mine historical data for personalized insights. |
| **Customized Engagement around Products/Services** | AMI data enables utilities to customize and target solutions to groups of residential and business customers based on their energy usage, behaviors, and preferences. |
| **Demand Response / Demand Management** | Analysis of AMI data can support demand management programs throughout their lifecycle. The analysis becomes a part of program planning, implementation, and evaluation. AMI meters could support real time energy consumption data sharing or on-demand meter readings to support customer participation. |
| **Designing Rate Programs / Pricing** | Time-based rates and incentive programs encourage customers to reduce electricity use during times of peak demand through price signals or rebates. These programs should be easy for customers to understand and compare pricing options while meeting current and future utility needs. |
| **Distribution Automation** | From a network perspective, when utilities are evaluating AMI and plan to leverage the AMI for distribution automation application, they also must evaluate the suitability of the communications architecture for current and emerging applications. Please note this is being considered as part of a separate initiative. **This working group is focused on AMI Data Enablement - The implications for our group are focused on how much of the network bandwidth (if any) should be reserved for this use case.** |
| **Energy Efficiency Program Optimization** | AMI data can support energy efficiency program planning, implementation, and evaluation to help utilities and program implementers to easily and efficiently maximize the effectiveness of their programs. |
| **EV Planning and Integration** | AMI provides accurate time-stamping of energy consumption information that can help utilities better integrate EVs that will have large impacts on the size and timing of electricity demand as the market for EVs continues to grow. |
| **Grid Reliability / renewables and DERs integration / Hosting Capacity Analysis** | Real-time visibility and granular data help utilities manage the challenge of increasingly complex power flows as more intermittent generation is added and the integration of EVs and DERs such as rooftop solar and energy storage systems |
| **Identify customer-owned DER** | AMI meters can help utilities identify customer-owned DERs (e.g., EV's, Storage, Solar PV systems) and understand the impacts of customer-owned systems |
| **Identify Unsafe Working Conditions** | AMI can help identify downed live conductors and unregistered PV installations/code violations |

| | |
|---|---|
| **Improved Bill Generation** | AMI and billing systems generate more consistent and accurate bills automatically, with fewer recording errors and customer complaints |
| **Improved Customer Engagement with Additional Data** | AMI Data helps utilities personalize communications and the products and services, and with more information for customer service reps, utilities can better resolve calls and improve customer satisfaction. |
| **Improved Customer Safety** | AMI data can help improve customer safety by helping identify unregistered PV installations/code violations, downed live conductors, heated customer panels/sockets using temperature data to help with fire prevention, and help determine fire-caused outages using temperature data |
| **Leveraging the Network / SCADA** | The AMI communication network can be leveraged to provide two-way communication between control center and distributed sensors, controllers and switches. Often times these networks can be used for communicating with substations and feeder devices. This could also include communicating with smart inverters, smart street lighting, integrating water meters **This working group is focused on AMI Data Enablement - The implications for our group are focused on how much of the network bandwidth (if any) should be reserved for this use case.** |
| **Load Forecasting** | Granular interval data improves load modeling / load forecasting, projected load growth, and helps better predict risk areas, and adjust distribution plans. Enables PSE to track actual energy consumption for sub-groups of customers (e.g., customer class and rate schedule) to estimate impacts of weather patterns, fluctuations in the economy, and any other policy or phenomenon (e.g., COVID-19) that impact the Company’s financial outlook. |
| **Meter Ping Functionality** | The meter ping functionality can determine the energized status of the meter. Utilities can use it in response to a customer call to determine if an outage is a customer issue (i.e., a tripped breaker) or system issue. |
| **Metering Issues -Theft and Fraud Detection / Meter Failures** | AMI meters can help detect instances of meter tampering, which indicate potential cases of electricity theft. Many utilities have systems that issue alarms or notifications when irregularities in consumption activity are identified. |
| **Model Validation / Improved Data Quality** | Smart meters provide information (i.e., usage, voltage, temperature, etc.) on the operational parameters of the distribution grid. Voltage data is being used in many activities including validating primary circuit models, sizing transformers, identifying over or under loaded transformers, validating demand response participation, improving power quality and increasing system reliability. With AMI, estimated reads have virtually disappeared. Experienced utilities advise that you |

| | |
|---|---|
| | collect as much data as you can from the start—even if you are not planning to use it. |
| **Momentary Outages / Power Quality** | AMI integrated with OMS can help operators gain advanced visibility to certain outage conditions and enable better identification and tracking of momentary outages and power quality issues |
| **Monitor Asset Health (voltage anomalies)** | Analyzing the meter data, pairing it with other data, and using analytics to find anomalies in the data that might otherwise be "hidden" is allowing utilities to diagnose system issues and proactively fix problems before an outage occurs or the customer notices an issue. Utilities are also able to use the data to look at recurring problems and better determine the cause |
| **More information and control - Billing Alerts** | High bill alerts help customers track their energy usage and costs and additional data for high bill research that helps customers tie behavior to costs and make changes that can lower their bill. |
| **More information and control - Customer Aggregate Usage Data** | Web portals and apps can provide AMI meter data to empower customers to understand their usage patterns and find opportunities to lower their energy costs. |
| **More information and control - In Home Displays and other Smart Devices** | In home displays can provide real-time curated data for measurement and verification along with energy-focused customer engagement. The functionality of IHDs can be supplemented or replaced by customer portals and custom energy apps. |
| **Outage Management - Customer Communication** | AMI systems can utilities proactively communicate with customers so they do not have to call in to report an outage. Utilities can more accurately determine the location of outages and dispatch crews more efficiently. Utilities can also provide updates and provide more complete restorations as crews can verify that the restoration is complete before moving to another area including detecting "nested" outages. |
| **Outage Management - Detection** | AMI's last gasp functionality can let the utility know there is an outage and utilities can verify outages through meter pings. Utilities can provide outage updates and proactive outage notifications to customers; Pairing AMI data with other data from the outage management system (OMS) can help utilities predict the location of the failure so they can send the crew to the location, helping to minimize the outage duration. |
| **Outage management - Nested Outages** | Utilities can ping to all the meters or to meters in a given area. This is especially helpful in identifying smaller outages nested within larger outages so crews can verify restoration is complete before leaving an area more complete restorations. Crews can verify that the restoration is complete before moving to another area including detecting "nested" outages. |
| **Power Quality / Voltage Compliance / Real-time Operating Conditions** | The accurate voltage information along a circuit that AMI provides gives utilities data that can help them to more precisely manage distribution voltages, troubleshoot power |

| | |
|---|---|
| | quality issues, and evaluate switching scenarios. AMI can also be used as a system-wide voltage monitoring program to validate secondary voltage range compliance or evaluate the impact of DERs |
| **Predictive Analytics for Operations** | Using outage data (data, time, momentary/sustained, cause, location) and weather/storm data models to predictively analyze expected systems and customer impacts. |
| **Remote Connect and Disconnect** | AMI also enables remote connections and disconnections and on-demand, out-of-cycle meter readings. This functionality helps support changes in occupancy, reoccurring non-payment issues, and prepaid service offerings. In cases of emergency, the remote service switch may be used to support firefighters and other first responders. |
| **Solar PV - Customer Billing and Utility Planning** | Utilities can utilize AMI data to help customers evaluate rooftop solar options by providing tools that analyze AMI recorded energy usage history and rate information. Utilities can also utilize AMI to help track data for electricity delivered to local distribution grids through net metering mechanisms. |
| **Support Non-Wires Solutions** | Better data and improved models for assessing system conditions and predicting demand impacts and energy savings levels can help identify where customer DER programs and demand-side solutions can support non-wires solutions |
| **Transformer Mapping / Phase Identification / Switching Analysis** | The accurate voltage information along a circuit that AMI provides gives utilities data that can help them to more precisely manage distribution voltages, troubleshoot power quality issues, and evaluate switching scenarios. With AMI voltage data, utilities have actual voltage measurements to validate the primary circuit models. |
| **Volt/VAR Optimization** | Managing voltages to save energy and reduce peak-driven strains on the grid isn't a new idea. With the ability to measure voltage at all of the endpoints, smart meters can be a key tool in the process. |

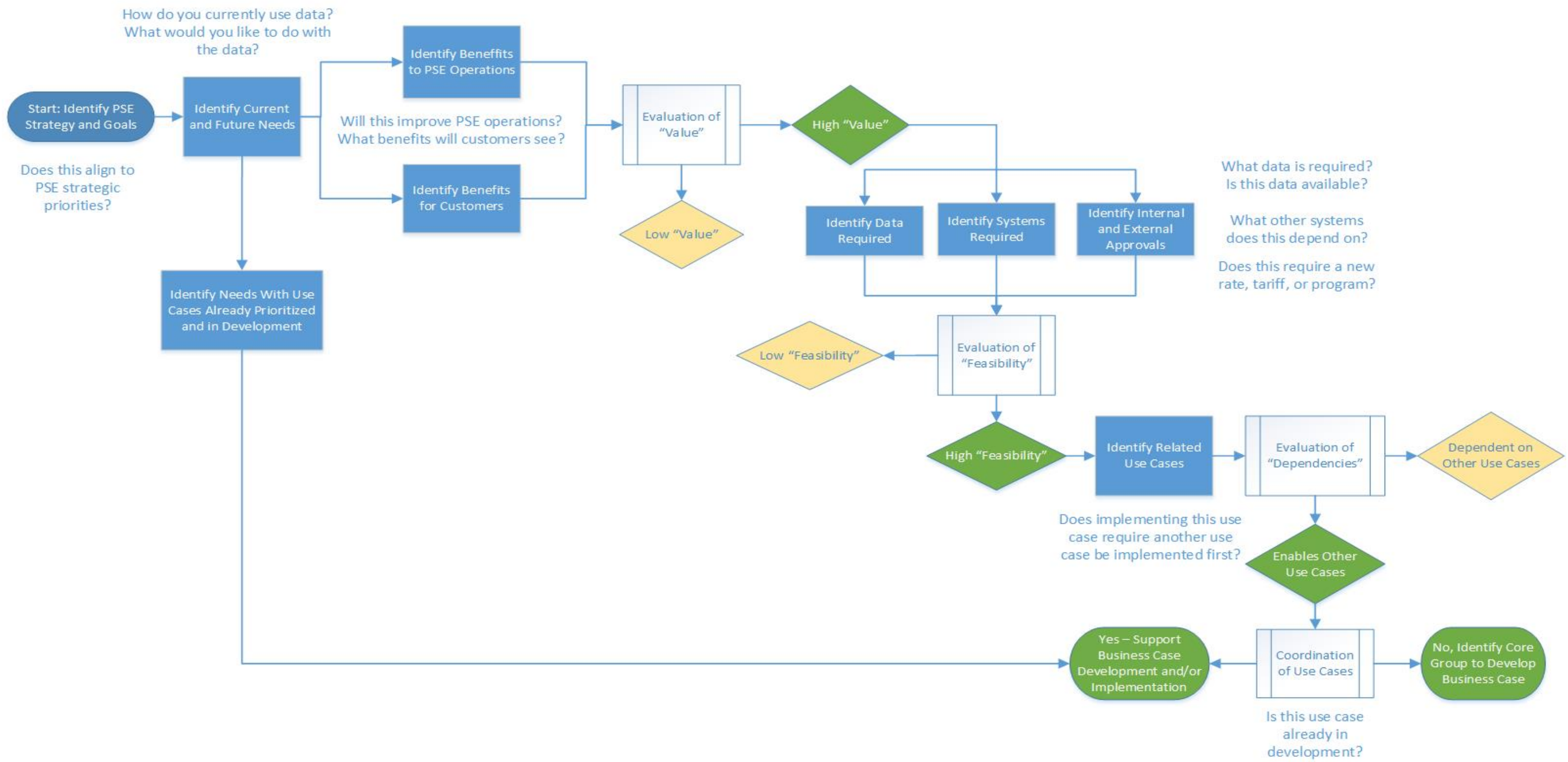


*Figure 5 - Evaluation Flow Chart*