DELIVERY SYSTEM PLANNING

APPENDIX G

PUGET SOUND ENERGY

2023 Gas Utility Integrated Resource Plan – DRAFT

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1. Introduction

Puget Sound Energy's (PSE) energy delivery system is the network of distribution and transmission wires and pipelines that deliver energy from the energy source to the customer meter. We design our system to deliver energy safely, reliably, affordably, cleanly, and on-demand under all system conditions. Our system design plans include actions to meet all regulatory requirements, including North American Electric Reliability Corporation (NERC) standards that govern the bulk electric system and Pipeline and Hazardous Materials Safety Administration (PHMSA) regulations that govern pipeline safety. Crucially, we plan so we can meet our customers' future energy needs.

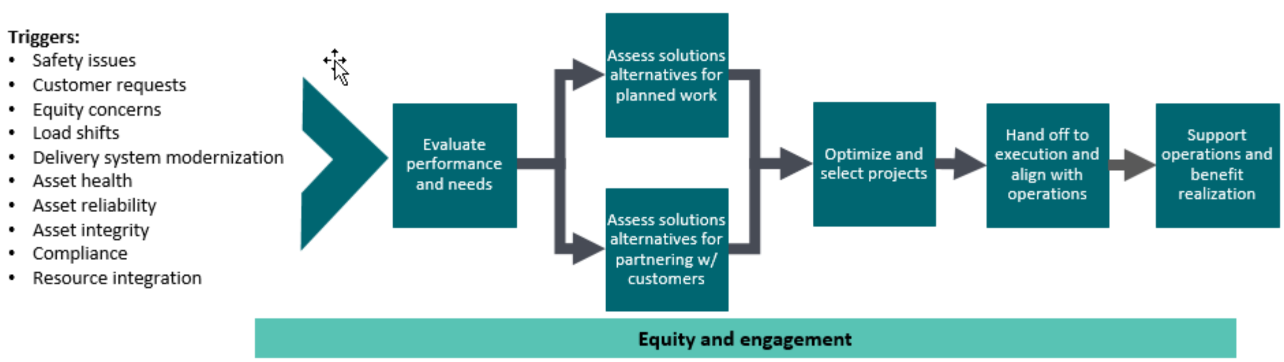
We also plan a flexible system that adapts to changes in customer use, advances in emerging technologies, and increased penetration of more diverse and distributed clean energy sources. We anticipate meeting future energy needs using a hybrid, complementary approach that balances electric, gas, and other energy sources (such as renewable natural gas and hydrogen) and delivers them optimally. We prioritize key foundational technology investments, specific asset hardening to improve reliability and resiliency to major events, intelligent demand-side management systems to optimize energy use, and backbone major infrastructure improvements. These efforts to modernize and improve our delivery system are necessary to meet regulatory requirements and future energy demand needs.

Meeting these needs and our decarbonization goals requires a flexible planning framework, a modern energy delivery system, a focus on research, and continuous improvement. Delivery System Planning (DSP) is the structured approach we use to analyze delivery system needs and potential solutions, prioritize the portfolio, ensure customer equity, and realize benefits.

2. Delivery System Planning

Pipeline and electric delivery system planners prepare 10-year plans as required for integrated resource plans (IRPs) and annual implementation plans. This section describes the current process for developing both types of plans.

Figure G.1: PSE Delivery System Planning Operating Model



We begin the PSE planning process with a needs assessment. Then we evaluate solution alternatives and recommendations. We start the needs assessment with county- and local-level load forecasts. We evaluate the system's current performance and future needs based on data analysis and modeling tools. Our planning considerations include internal inputs such as integrity indices, system performance, equity, company goals and commitments, and the root causes of historical events. External inputs include service quality indices, regulations, municipality infrastructure plans, customer complaints, and ongoing service issues. Solution assessment includes identifying alternatives to meet the need and comparing these alternatives against one another. We identify recommended alternative(s) that will proceed to project planning if approved. We also identify the portfolio of projects that will proceed based on optimized benefits and costs for a given funding level, supported by approval in the company budget. The process is the same for both long- and short-term planning

2.1. Analysis Process and Needs Assessment

Many different critical factors drive energy delivery system needs. We consider these factors to identify the right system needs, as described in the next section.

Delivery System Demand and Peak Demand Growth: Demands on the overall system increase as the population of PSE's service area grows and economic activity increases, despite the increasing role of energy-conserving demand-side resources. However, demand is uneven within the service area, with much higher demand growth in the central business districts surrounding the urban centers. Peak loads occur when the weather is the most extreme. We carefully evaluate system performance during peak load periods each year, update system models, and compare these models against future demand and growth forecasts. These steps prepare us to determine where we need additional infrastructure investment to meet peak firm (committed) loads. Customer usage patterns determine the peak conditions we must design the delivery system to accommodate.

Our gas load is primarily residential. Therefore, peak conditions align with cold-temperature weather events that occur each year during the winter months, November–March. Every day, the greatest draw on the system occurs between 5 a.m. and 9 a.m., when most households begin their morning routine of waking up in a warm house, taking hot showers, and cooking morning meals. During these high-demand periods, the lowest pressures in the system occur. A system failure to meet these peak demands will result in low system pressures that cannot support the proper operation of customer equipment, affecting comfort and introducing safety risks. This situation requires the pipeline system operator to manually close each customer meter until proper delivery system pressures are reestablished, then subsequently perform a safety check and relight each appliance, further inconveniencing the customer. As a result, pipeline planning criteria are conservative to ensure the minimum pressures are maintained even during cold weather extremes.

Energy efficiency consists of measures and programs that upgrade or replace existing building components that affect energy use, such as heating, ventilation, water heating, insulation, and appliances with more energy-efficient options. These replacements can reduce peak demand and overall energy consumption for residential and commercial customers. Customers who agree to reduce their energy use during periods of system stress from peak loading, system imbalance, or in response to market prices participate in demand response (DR). Interruptible rates, which offer reduced costs for energy delivery to customers who agree to curtail use when requested, are a subset of demand response. When we use DR to relieve loading at critical times, it can reduce the need for increasing the capacity of traditional delivery infrastructure. We use interruptible rates in PSE's service area and depend significantly on curtailing these customers to meet demand.

Aging Infrastructure: Refreshing aging infrastructure is essential to modernizing the delivery system. Equipment that has reached the end of life creates integrity issues, potentially causing leaks or failure to operate when needed.

System Integrity: The Pipeline and Hazardous Materials Safety Administration (PHMSA) requires PSE to monitor and remediate pipeline transmission and distribution systems risks.

Operational Flexibility: The ability to isolate pipelines and transfer load is important when responding to unplanned and planned outages and performing necessary equipment maintenance.

Safety and Regulatory Requirements: These contractual and legal requirements drive action for immediate mitigation, and as a result, we identify and resolve them outside of this long-term planning process.

We review PSE's delivery system annually to ensure pipeline integrity and mitigate risk. Past leaks, equipment inspection, maintenance records, customer feedback, employee knowledge, and analytic tools identify areas where improvements are likely required and where such improvements mitigate risks to the public and PSE's customers. We collect system performance information from field charts, remote telemetry units, SCADA, employees, and customers. Per regulation, PSE has a robust distribution integrity management program and a transmission integrity management program that requires a risk-based approach to identify and mitigate integrity concerns. We implement programs to address these risks, which often result in the replacement of assets or increased monitoring. Programs are also in place to manage aging infrastructure by replacing pipelines nearing the end of their useful life.

We included external inputs, such as new regulations, municipal and utility improvement plans, customer feedback, and company objectives, such as PSE's asset management strategy in the system evaluation. These inputs help us understand commitments and evaluate opportunities to mitigate impact and improve service at least cost. For example, the Washington Utility and Transportation Commission (Commission) issued a policy statement in 2012 allowing gas utilities to file a plan to replace pipes with a higher risk of failure. We considered PSE's commitment to this plan in the evaluation. In 2016, the National Transportation Safety Board (NTSB) recommended the pipeline industry develop guidance on safe pipeline operations to protect communities and the environment. The Pipeline Safety Management System (PSMS) helps operators understand, manage, and continuously improve safety efforts at any stage of their safety programs through a Plan-Do-Check-Act cycle. The PSMS provides tools needed to track and improve safety performance continuously and comprehensively. We obtain annual updates to local jurisdiction six-year Transportation Improvement Plans to gain a long-term planning perspective on upcoming public improvement projects. As transportation projects develop through design, engineering, and construction, we work with local jurisdictions to identify and minimize potential utility conflicts and seek opportunities to address system deficiencies and needs.

We rely on several tools to help identify needs and operational concerns and to weigh the benefits of alternative actions to address them. Table G.1 summarizes these tools, the planning considerations (inputs) that go into each, and the results (outputs) they produce. We use each tool to provide data independently and then put it in our investment decision optimization tool (iDOT), which creates an understanding of the benefits and risks.

Table G.1: Natural Gas Delivery System Planning Tools

Tool	Use	Inputs	Outputs
Synergi®	Pipeline and Electric network modeling	Pipeline and electric distribution infrastructure from GIS and load characteristics from CIS; load approvals; load forecast	Predicted system performance
Pipeline Outage Spreadsheet	Pipeline outage predictive analysis	Pipeline Synergi system performance data for future capacity	Predicted outage reductions
Distribution / Transmission Integrity Management and Risk Assessment	Pipeline risk analysis	Pipeline infrastructure operating or maintenance concerns from various databases	Program funding options to mitigate higher-risk facilities
Investment Decision Optimization Tool (iDOT) (We input data collected by the tools above into iDOT)	Pipeline and electric project data storage and portfolio optimization	Project scope, budget, justification, alternatives, and benefit/risk data collected from tools and in iDOT; resources/financial constraints	Optimized project portfolio; the benefit-cost ratio for each project; project scoping document

Note: PSE's pipeline system model is a large integrated model of the entire delivery system using a software application (Synergi® Gas) that is updated to reflect customer loads and system and operational changes. This modeling tool predicts capacity constraints and system performance in various temperatures and under different load or gas blend scenarios. We compare results to actual system performance data to assess the model's accuracy.

Modeling is a three-step process. First, we build a map of the infrastructure and its operational characteristics using geographic information (GIS) and asset management systems. For pipelines, these details include the diameter, roughness, and length of the pipe, connecting equipment, regulating station equipment, and operating pressure. Next, we identify customer loads, specifically (for large customers) or as block loads for address ranges. Existing customer loads come from PSE's customer information system (CIS) or telemetry readings. Finally, we take into consideration seasonal variations, types of customers (interruptible vs. firm), time of daily peak usage, the heat content of the fuel, the status of components (valves or switches closed or open), and forecast future loads to model scenarios of infrastructure or operational adjustments.

Our goal is to find the optimal solution to a given issue. Where issues surface, we use the model to evaluate alternatives and their effectiveness. We augment potential options with cost estimates and feasibility analysis to identify the lowest reasonable cost solution for current and future loads.

The performance criteria at the heart of PSE's infrastructure improvement planning process are:

- Safety and compliance with all regulations and contractual requirements (100 percent compliance).
- The ability to remove equipment from service for maintenance and provide flexibility for emergency response.
- The heat content of the fuels to meet tariff requirements (985 BTU per cubic foot)
- The historical or future pipeline integrity performance indicators that elevate risk relative to safety or methane release, which may be caused by aging infrastructure, third-party damage, or equipment location or condition.
- The maximum pressure acceptable in the system (defined by CFR 192.623 and WAC-480-93-020).
- The minimum pressure that must be maintained in the system (the level at which appliances fail to operate).
- The nature of service each type of customer has contracted for (firm or interruptible).
- The temperature at which the system is expected to perform (52 DD Peak Hour).

We begin our evaluation by reviewing existing operational challenges, load forecasts, demand-side management (DSM), commitments, obligations, and opportunities. Planning triggers are specific performance criteria that indicate the need for a delivery system study. There are different triggers or thresholds for transmission, bulk distribution (high pressure) and distribution (intermediate pressure), capacity, and reliability. We identify a need when performance criteria are not met.

We expect the planning assumptions, guidelines, and performance criteria to change over time due to the evolving policies pursuing electrification, demand-side resources at the local neighborhood level, and deferral of traditional infrastructure investments in favor of new technologies. We expect delivery system planning margins to increase to account for greater uncertainty of loads due to variability of participation in behavior-based conservation and demand response programs. Puget Sound Energy's delivery system planning assumptions relative to conservation and demand response have historically incorporated outputs generically at a high level, but these assumptions, while appropriate for resource planning, may not be suitable for local neighborhood decisions and reliability until such programs reach greater maturity. Higher cost conservation is likely customer-type specific, and as a result, greater study and specific application of targeted conservation programs are necessary for conservation to be reliable. We may also need to develop assumptions regarding demand response program participation, as customer adoption may change as home occupancy changes over time.

We engage with Commission pipeline safety staff in various forums, such as annual audits and quarterly roundtable discussions that also inform our planning considerations.

2.2. Solutions Assessment and Criteria

We list the alternatives available to address delivery system capacity, integrity, aging infrastructure, and operational flexibility in Table G.2. Each option has its costs, benefits, challenges, and risks. We included traditional pipeline solutions and non-pipe alternatives in the analysis.

Table G.2: Alternatives to Address Delivery System Capacity and Reliability

Alternatives	Pipeline System
Add energy source	City-gate station, district regulator, alternate fuels like renewable natural gas and hydrogen blended gas
Strengthen feed to the local area	New high-pressure main, new intermediate pressure main, replace main
Improve existing facility	Regulation equipment modification, uprate system
Load reduction	Conservation, load control equipment, possible new tariffs

We also manage short-term issues like peaking events or temporary conditions created by a pipeline construction project through deployment of temporary sources or operational actions such as the following:

- Temporary adjustment of regulator station operating pressure as executed through PSE's Cold Weather Action Plan
- Temporary siting of mobile equipment such as compressed natural gas injection vehicles and liquid natural gas injection vehicles

2.2.1. Non-pipe Alternative Analysis

Our non-pipe alternative analysis is a screening process that breaks down evaluation of utilizing existing resources, applying emerging technologies like renewable natural gas injection and hydrogen blending, or reducing customer demand. We perform an economic and feasibility analysis whose results provided a recommended solution. The planning process compares alternatives, seeking the least-cost solution that maximizes value for customers and interested parties. We evaluated a traditional pipeline solution, a full non-pipe solution, and any potential hybrid options that fit the program.

We are monitoring and investigating technologies that will be beneficial low-carbon alternatives in the future, including renewable natural gas injection or hydrogen blending into the supply to meet a localized need. Additionally, we are advancing the load reduction alternatives. Such options may depend on customer participation for siting, control, or actionable behavior, and seek to continue developing our understanding and confidence in these as permanent solution alternatives. These alternatives include greater use of demand response through smart thermostat technologies, and higher efficiency and hybrid or dual-fuel customer heating equipment.

In 2018–2019, we piloted a gas demand-response program to determine the potential for peak capacity reductions using smart thermostats. We have a small pilot in the Duvall area to address a system need in 2022–2023. Pilot results allow us to evaluate the potential for using demand response as an NPA to delay supply and distribution investments. We will continue to build on our demand response experience to help determine what role this new tool can play in alternatives to pipeline infrastructure. We will also leverage demand-side resources through reliable local programmatic energy efficiency offerings. Lessons from our pilot will benefit local applications we use to manage loads and defer infrastructure investments. We anticipate leveraging energy-saving technologies will address some local delivery system constraints, but not all, with effectiveness subject to local characteristics of each area.

2.2.2. Criteria and Evaluation

We establish technical and non-technical solution criteria to ensure implemented solutions fully address the needs. Based on the needs identified, we perform a solutions study where we develop project alternatives. Solutions studies consider opportunities to partner with customers, PSE programs, or a PSE pilot. We vet the solution alternatives and evaluate them against specific solution criteria. Technical solutions must meet all performance criteria as we described. We also assess how to avoid adverse impacts on system integrity or operating characteristics, how long the solution will last, and whether it will delay the need for additional investments for a specified time. We also consider our customers' rate burden as PSE recovers investments. Non-technical solution criteria include permitting feasibility, environmental and community acceptance as facilitated through permitting processes, reasonable project cost, the maturity of technology, and constructability within a reasonable timeframe.

To evaluate alternatives, we compare the relative costs and benefits of various solutions (projects) using iDOT, a project portfolio optimization process and tool. Based on PowerPlan's Asset Investment Optimization (AIO) software, iDOT allows us to capture project and program criteria and benefits and score them across 13 factors associated with five categories. These include meeting required compliance with codes and regulations, net present value of the project, improvement to integrity, reliability, and safety, future possible customer/load additions, deferral or elimination of future costs, customer satisfaction, alignment with interested parties, and opportunities for future success gained by increasing system flexibility or learning about new technologies and methods or drivers of specific company objectives. iDOT makes it easier to conduct side-by-side comparisons of projects and programs of different types to help us evaluate infrastructure solutions.

We calculate project costs using various tools, including historical cost analysis and unit pricing models based on estimated engineering costs and service provider contracts. We refine cost estimates as projects move through detailed scoping. Through this process, we review alternatives and vet recommended solutions through an internal peer review process. Projects that address routine infrastructure replacement are proposed at a program level and incorporated into a parallel path in the iDOT process. We use risk assessment tools to prioritize projects within these programs; for example, we prioritize vintages of wrapped steel and polyethylene facilities for replacement based on known risks such as leak history, pipe condition, and the pipe's proximity to certain structures.

The iDOT tool also helps us examine projects in greater detail than a simple cost/benefit analysis. The iDOT software includes health and safety improvements, environmental impact, sustainability, customer value, and interested party. As a result, projects that contribute intangible value receive due consideration in iDOT.

Using project-specific information, iDOT optimizes total value across the entire portfolio of non-mandated or discretionary natural gas system infrastructure projects, which results in a set of capital projects that provide maximum value to customers, interested parties, and PSE relative to given financial constraints. We make additional minor adjustments to ensure the portfolio addresses resource planning and other applicable constraints or issues, such as known permitting or environmental process concerns. We have periodically reviewed this process, the optimization tool, and the resulting portfolio with Commission staff.

iDOT builds a hierarchy of the value these benefits against the project cost. The benefits are reviewed and reassessed periodically with senior management to ensure we assign proper weight and priority throughout the evaluation process. In 2022, we changed the underlying tools that enable the iDOT process from Price Waterhouse Cooper's (PWC) Folio to PowerPlan's Asset Investment Optimization tool. In 2023, we will update the benefits to include equity considerations and a specific carbon emissions reduction or methane emissions reduction benefits. In 2023, we will also determine how best to incorporate interested party input into the benefit review and weighting process.

Our delivery system planning process will mature as we better understand the customer benefit assessment process prescribed in CETA. The CETA-required advisory group engagements will help us further refine the definitions of energy security and resilience and guide how we consider and apply energy and non-energy benefits relative to vulnerable populations and highly impacted communities. We will also participate in a commission led Distributional Equity Analysis that will continue our methodology

2.3. Project Planning and Implementation Phase

Once we complete the described process for a particular project and portfolio and senior management reviews and approves it for funding, the initiation phase is complete, and we start the project planning phase. The outcome of project initiation is a needs assessment and solutions assessment document. For small projects, we may capture this in our SAP software system through a notification process or supported by a business case that addresses needs with programs. The project planning phase involves developing detailed engineering and technical specifications, pursuing real estate rights-of-way, planning communications, and considering potential coordination with other projects in the area. We assess implementation risks and develop mitigation plans. Puget Sound Energy's 10-year plan, included in Section 3 of this document, reflects the projects we are initiating. Once we move a project to the project planning phase, we have established the need; IRP engagement ends, and community engagement begins.

Once we have reviewed the project need and initiation recommendations, we develop annual and two-year work plans for project planning and implementation feasibility. We coordinate work plans with other internal and external work and resource plans. We make final adjustments when we compare the system portfolio with other company objectives, such as necessary generator, dam work, or customer initiatives. Although we consider annual plans final, we adjust them through the year based on changing factors such as public improvement projects that arise or are deferred, changing forecasts of new customer connections, or project permitting delays so that the total portfolio financial forecast remains within established parameters. As plans and projects develop through the design and permitting phases, cost and benefit are routinely evaluated and confirmed before progressing. We may review alternatives through project lifecycle phase gates and detailed routing and siting discussions.

We communicate long-range plans to the public through local jurisdictional tools such as the city and county comprehensive plans required by the Washington State Growth Management Act. This information often demonstrates to local jurisdictions, residents, and businesses the need for improvements well before a project is in the project planning, design, permitting, and construction process. We post updated project maps and details on PSE.com.

3. Pipeline Delivery System

Puget Sound Energy delivers gas with pipes and pressure regulating stations. Puget Sound Energy's pipeline delivery system is responsible for providing gas safely, reliably, and on demand. We must also meet all regulatory requirements that govern the system. To accomplish this, PSE must do the following:

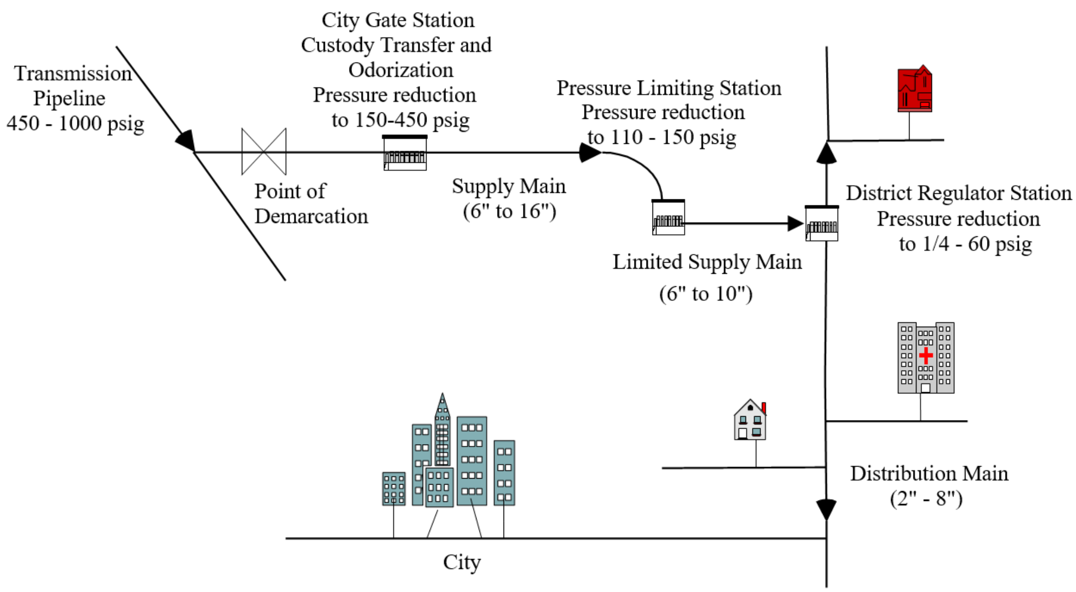
- Address reliability performance and system integrity concerns
- Integrate gas supply resources owned by PSE or others
- Meet both peak demands and day-to-day demands at the local and system levels
- Meet state and federal regulations and complete compliance-driven system work
- Monitor and improve processes to meet future needs, including customer and system trends and customer desires, so infrastructure will be in place when the need arrives
- Operate and maintain the system safely and efficiently on an annual, daily, and real-time basis

Our goal for the planning process is to fulfill these responsibilities as cost-effectively and equitably as possible. We use this process to evaluate system performance to bring issues to the surface, identify and evaluate possible solutions, understand impacted customers, and explore potential alternatives' costs and consequences. This information helps us make the most effective and cost-effective decisions.

3.1. How the Pipeline Delivery System Works

Utilities transport gas at a variety of pressures through pipes of various sizes (see Figure G.1). Interstate transmission pipelines deliver gas under high pressures (generally 450 to 1,000 pounds per square inch gauge (psig) to city gate stations. City gate stations reduce pressure to 150 and 450 psig for travel through supply main pipelines. Then district regulator stations reduce pressure to less than 60 psig. The gas then flows through a network of piping (mains and services) to a meter assembly at the customer’s site, where pressure is reduced to what is appropriate for the operation of the customer’s equipment (0.25 psig for a stove or furnace). A meter tracks how much the customer uses.

Figure G.2: Illustration of Pipeline Delivery System



The gas pipeline system in the United States was first built in the late 1800s and eventually expanded into a networked, two-way flow. Pipeline materials and operating pressures have changed over time. Gas was not introduced to the Puget Sound region until 1956, using higher pressures and smaller diameter pipes because of changing technologies. Now, new plastic pipes replace older cast iron pipes to cost-effectively renew existing infrastructure in urban areas. Although the energy qualities and pipeline materials have changed, the technology used to operate the system has not. Because gas pipelines are often located in increasingly congested rights-of-way, protecting pipelines from damage is even more critical than ever.

3.2. 10-year Pipeline Delivery System Plan

The gas resource planning process focuses on conservation and demand-side resources and the future of low-carbon alternative fuels. In the next decade, we will modernize the pipeline system to:

- Address major backbone infrastructure needs
- Ensure pipeline safety
- Reduce greenhouse gas emissions

Puget Sound Energy's modernization of the pipeline system and focus on safety will provide more opportunities for programs such as demand response and position the pipeline system to be agnostic to fuel type as alternative fuel supply chains mature, supply increases, and costs decrease. The 10-year pipeline infrastructure plan includes vital investments in multiple areas.

The key investment areas discussed in the following pages are interrelated. Our 10-year plan addresses needs that are either existing or predicted based on the processes described in section two of this document. We conduct delivery system studies yearly, which surface new needs or constraints in future 10-year plans. In addition, the latter years of the plan may change substantially in this time of energy and load evolution. This 10-year plan provides direction to inform decisions about specifically funded actions and plans.

3.2.1. Improve Visibility, Analysis, and Control

Advanced Metering Infrastructure (AMI): Puget Sound Energy is in year four of replacing the current aging and obsolete Automated Meter Reading (AMR) system and gas customer modules with Advanced Metering Infrastructure (AMI) technology. This new AMI technology is an integrated system of smart modules, communications networks, and data management systems that give PSE and our customers greater visibility into customer use and load information. It enables two-way metering between PSE and its customers.

Data and Control: We have modernized its monitoring tools, replacing manual field charts with digital equipment, and will continue to evaluate the greater use of automated valves to provide control where needed.

3.2.2. Reduce Greenhouse Gas Emissions

Eliminating Leaks and Methane Release: We will continue to eliminate leaks from the pipeline system, eliminating all non-hazardous[1] leaks as we find them by the end of 2022. We will continue to evaluate operating practices and methods to further minimize methane releases, for example, by increasing contractor awareness when working around pipelines to prevent damage during construction, repairing leaks more quickly than regulations require, or capturing gas when construction work requires pipelines to be depressurized and purged.

Cleaner Fuels: Puget Sound Energy has integrated some renewable natural gas (RNG) into the delivery system to decrease carbon emissions, and we will continue to look for innovative ways to harvest more RNG, streamline interconnection, and remove obstacles.

Over the last few years, we have evaluated the advantages of mixing various renewable, zero/lower carbon fuels (including hydrogen) into our existing natural gas. These evaluations have aimed to assess options to reduce our carbon emissions. During this research and learning phase, it has become evident that it will be necessary to extend our knowledge and practical experience of mixing renewable, zero/lower carbon fuels into our existing natural gas stream. We are currently accomplishing this in a limited manner by combining bio-methane and waste-based renewable natural gas with our natural gas in limited locations on our gas system. As we continue this research into renewable, zero/lower carbon fuels, it is apparent that the next logical step is to obtain additional first-hand experience with these fuels by completing demonstration and pilot projects especially related to hydrogen blending.

Demonstrations and pilot projects are the best way to obtain the experience, technical skills, and operations experience needed to safely blend these fuels with minimal impact on customer end-use applications. This demonstration and pilot project approach leverages current industry research and experience and allows us to seek partnership opportunities where necessary. We can also perform PSE-led demonstrations and functional pilot projects to begin answering outstanding questions and increase confidence, skills, and the training required to move to

[1] Hazardous leaks require immediate repair or repair within defined timeframes.

hydrogen mixing as quickly and efficiently as possible. The focus of these demonstration and pilot projects concerning hydrogen mixing in the near term include but are not limited to confirming the following areas:

- A blend of 10 percent to 20 percent of hydrogen (by volume), supported by PSE's existing gas system piping, customers, and natural gas supplies
- Impact on commercial/industrial customer equipment
- Pipeline integrity
- Residential and commercial customer appliances can use a low-level blend with minimal impact on equipment
- Safety protocols with hydrogen blends, including odorant, leak detection, and response

The scope listed above would also help inform additional future hydrogen mix strategy demonstrations and pilot projects as we progress toward reducing carbon emissions.

3.2.3. Ensure Pipeline Safety and Reliability

Ensuring a Healthy System: To provide overall reliability and safe operations, we expect to replace or upgrade the following system components in the next 10 years. Other steps we will implement to ensure a healthy system include:

- Continuing PSE's industry leadership in mitigating sewer cross bores[2]
- Deploying 34 programs to address pipeline safety risks associated with pipelines, pressure regulation equipment, and meters
- Investing more in risk mitigation programs under the recently passed Pipeline Reauthorization Act Rules
- Pipeline and Hazardous Materials Safety Administration (PHMSA) new requirements for transmission pipelines
- Remediating buried customer meter set equipment
- Replacing 200 to 300 miles of gas main (for example, DuPont pipelines that are prone to catastrophic failure)

Maintaining System Reliability: With real possibilities to reduce carbon emissions by increasing the use of renewable natural gas and blending alternative fuels such as hydrogen with gas, we will continue to address system needs to meet customer choice expectations. We will continue to develop and deploy non-pipe alternatives (NPA) like demand response technologies and targeted electrification that help offset increased loads because of customer growth or changes in fuel heat content.

3.2.4. Maintain Strong Security, Cyber Security, and Privacy

As critical infrastructure becomes more technologically complex, it is even more crucial for PSE to adapt and mature the physical security of critical assets and cybersecurity practices and programs to take advantage of new technology opportunities such as Internet of Things (IoT) devices. To ensure risks are consistently addressed and mitigated in alignment with the rapidly changing security landscape, we utilize a variety of industry standards to measure maturity. We also foster strong working relationships with technology vendors to ensure their approach to cybersecurity

[2] Sewer cross bores occur when gas pipe, installed by bore technologies, crosses through unlocatable sewer pipes.

matches our expectations and needs. Puget Sound Energy's telecommunications strategy will evolve to support required security and reliability, leveraging existing communication networks such as the AMI communication mesh network.

3.2.5. Major Backbone Infrastructure Projects

Major infrastructure projects are driven by reliability needs and proceed in two phases. The initiation phase includes developing the need, evaluating alternatives, and identifying a proposed solution. The implementation phase includes project planning, for which we test the need and proposed solution, and then design, permitting, and construction begin. Once a project is in implementation, location-specific activities begin, including engagement with the local community. We provide informational updates to customers through the IRP process for projects in this phase. We are working to develop more detail and engagement with the customers when a project is in the initiation phase.

Lessons learned from the PSE demand response pilot support the 2023 Gas Utility IRP preferred portfolio that identifies the opportunity to meet increasing resource needs using conservation, demand-side management, and targeted electrification programs. As we learn more, we will continue to screen new needs for NPA potential to support this forecast and refine data and tools.

We currently have no major backbone projects in the implementation phase.

➔ See Chapter Six: Gas Analysis for NPA analysis process.

3.3. Major Pipeline Projects Planning Process

We begin studying an area with a needs assessment when specific study triggers affect system reliability, including critical gas pipeline pressures and flows, load/customer growth projections, gas supply contracts, excessive cold weather actions (CWAs), and other information.

We gather data and make assumptions with the following guidance.

Planning Study Triggers:

- Gas customer outages
- Increased CWAs
- Maximum flow guidelines are reached
- Minimum pressure guidelines are crossed
- Safety or risk mitigation

Modeling Assumptions:

- The latest PSE load forecasts factor in localized system performance and growth.
- The loads in the model contain no interruptible loads for these studies.

- The projected heat content for the models includes the resource plan results.
- We baselined all models against actual flows, loads, and pressures to ensure accuracy.
- We used the latest PSE gas models that contain all pipes down to the service level and the latest gas load files. We calculated gas loads for every gas customer on our system based on their history and then temperature-compensated this and applied it to the models.

Solution criteria include technical and non-technical measures that must be met. We developed solutions criteria for system performance in reliability, cost, and constructability.

Technical Solution Criteria:

- Must address all relevant needs identified in the needs assessment report
- Must be able to meet a 25-year planning horizon — staging (phased approach) is acceptable
- Must be safe
- Must meet all performance criteria for supply and distribution system requirements, including reliability
- Must not cause any adverse impacts on the reliability or operating characteristics of PSE's system

Non-Technical Solution Criteria:

- Constructible to meet capacity need dates, both current and future
- Meet environmental impacts and permitting requirements
- Must assess and account for community and transportation impacts
- Reasonable, prudent project costs
- Utilize proven/mature technology

3.4. Major Pipeline Projects in Initiation Phase

We have three projects in the initiation phase summarized in Table G.3. We also include specific project descriptions in the following pages with summaries of the need and potential solutions evaluated, including NPAs.

Table G.3: Summary of 10-year Major Pipeline Implementation Projects

Summary Of Major Pipeline Projects in Initiation	Date Needed	Need Driver
Bonney Lake Reinforcement Project	Existing	Reliability and Operational Flexibility
North Lacey Reinforcement Project	Existing	Reliability and Operational Flexibility
Gas Reliability Marine Crossing	Existing	Reliability, Operational Flexibility, and Aging Infrastructure

3.4.1. Bonney Lake Reinforcement

The Bonney Lake study area includes the Lake Tapps and South Prairie areas, with approximately 20,000 residential and commercial gas customers.

Estimated need date: Existing

Date need identified: 2008

Needs assessment: A high-pressure gas supply system needs assessment was performed for the Bonney Lake Study area. This needs assessment determined that a long-term supply solution should be developed for the area while continuing to deploy CWAs to address immediate reliability concerns.

Needs identified: The current high-pressure supply system is undersized and falls below current design requirements during a peak demand event for existing gas loads.

- **Operational flexibility:** Three CWAs are scheduled for this area along with 100 percent curtailments; actions markedly insufficient to address the reliability concerns. Manual operations carry an inherent operational risk that an action may not be possible when needed due to weather and road conditions and/or equipment and personnel issues. There are limitations to manual operations based on location and availability of sufficient equipment and trained personnel.
- **Reliability:** The growth in the Bonney Lake area since 2013 has averaged four percent per year. The system cannot meet minimum design requirements without manual operations (see operational flexibility in the next bullet). The potential for gas customer outages exists.

Current Status: The needs assessment is completed, and we expect the study process for traditional pipeline solutions and NPAs to be completed in early 2023.

3.4.2. North Lacey Reinforcement

The North Lacey area includes Lacey and the north and east Olympia areas and serves approximately 21,000 customers. The project will reinforce the Olympia system.

Estimated need date: Existing

Date need identified: 2009

Needs assessment: The supply system needs reinforcement to serve recent customer loads. The models show significant low-pressure issues when we consider pipeline restrictions.

Needs identified: The current high-pressure supply system is undersized and falls below current design requirements during a peak demand event for existing gas loads.

- **Operational flexibility:** We have two CWAs scheduled for this area with 100 percent curtailments. These actions are markedly insufficient to address the reliability concerns. Manual operations carry an inherent operational risk that an action may not be possible when needed due to weather and road conditions and/or equipment and personnel issues. There are limitations to manual operations based on location and availability of sufficient equipment and trained personnel.
- **Reliability:** The supply system cannot meet minimum design requirements without manual operations. The downstream distribution system cannot maintain adequate system reliability when the upstream supply system cannot maintain itself.

Current Status: We expect to complete the detailed needs assessment and alternatives review in 2023.

3.4.3. Gas Reliability Marine Crossing

The marine crossing in King County serves roughly 13,000 customers on the Gig Harbor peninsula and Vashon/Maury Island.

Estimated need date: Current

Date need identified: 2018

Needs assessment: A high-pressure gas supply system needs assessment was performed for the Gig Harbor peninsula, Vashon Island, and Maury Island area. This needs assessment determined that a long-term supply solution should be developed while creating a backup supply solution for the area.

Needs identified: The dynamic marine environment in which this crossing has operated for more than 50 years has resulted in the need for reinforcement or replacement of parallel 8-inch undersea high-pressure laterals. Seafloor movement and fatigue induced by ocean currents have resulted in the crossing nearing the end of its service life.

- **Aging infrastructure:** Segments of the undersea pipeline infrastructure have maintenance concerns requiring mitigation.
- **Operational flexibility:** The existing marine crossing is the only gas pipeline supply to roughly 13,000 customers on the Gig Harbor peninsula and Vashon/Maury Island. Although PSE's Gig Harbor liquid natural gas (LNG) facility augments the supply to meet system peak loads, a pipeline connection is required to maintain gas service to all customers in the area.
- **Reliability:** The supply system cannot meet minimum design requirements should the lateral exceed fatigue limitations. As a result, the downstream supply and distribution systems cannot maintain adequate system pressures when the upstream supply system cannot maintain its system pressure.

Solution assessment: We developed solutions criteria in capacity, reliability, cost, constructability, and customer impact.

Solution criteria:

- Must be able to be constructed and permitted within a reasonable timeframe
- Must have reasonable project costs
- Must have the most negligible customer impact
- Must meet all technical criteria
- Must use mature technology

Evaluation of solution alternatives: We are completing a thorough alternative analysis that includes analyzing pipeline and non-pipeline solutions to determine the most cost-effective solution for this area's need.

Current Status: Project initiation to review alternative solutions is in progress, and we expect to complete it in 2023. We expect to complete system modifications to enable the operation of an emergency backup supply plan in 2023; this will ensure we meet customers' needs should the marine crossing experience a failure before the project is completed.