Chapter 6

# Non-wires solutions

# Chapter 6. Non-wires solutions

"I was taught that the way of progress was neither swift nor easy."

– **Marie Curie**, Nobel prize winning physicist and chemist

## 6.1 Reader's guide

PGE's Distribution System Plan (DSP) takes the first step toward outlining and developing a 21st century community-centered distribution system. This system primarily uses distributed energy resources (DERs) to accelerate decarbonization and electrification and provide direct benefits to communities, especially environmental justice communities.[51] It's designed to improve safety, reliability, resilience and security, and apply an equity lens when considering fair and reasonable costs.

This chapter provides an overview of PGE's evaluation of non-wires solutions (NWS) pilot concepts. We describe the process and journey of each of the evaluated pilot concepts, describing the grid need, customers impacted, and the expected wires and non-wires solutions. We also discuss impacts to existing processes, systems and regulations, and lessons learned.

**WHAT WE WILL COVER IN THIS CHAPTER**

An overview of non-wires solutions (NWS)

PGE's proposed process to screen, model, and evaluate NWS

A case study approach to describing each of the evaluated pilot concepts

Expected evolution of NWS in the distribution planning process

**Table 27** illustrates how PGE has met OPUC's DSP guidelines under Docket UM 2005, Order 20-485.[52]

**Table 27. Distribution system overview: Guideline mapping**

| DSP guidelines | Chapter section |
|---|---|
| 5.3.d | **Section 6.2, 6.3, 6.4** |
| 5.3.d.i | **Section 2.4**, **6.3.1** |
| 5.3.d.ii | **Section 2.4**, **6.4.1.4** |
| 5.3.d.iii | **Section 2.4** |
| 5.3.d.iv | **Section 2.6** |
| 5.3.d.v | **Section 2.6**, **3.5.5.3, 6.4.1.4, 6.4.2.4** |
| 5.3.d.vi | **Section 6.4.1.8**, **6.4.2.8** |

51. PGE uses the definition of environmental communities under Oregon House Bill 2021, available at: https://olis.oregonlegislature.gov/liz/2021R1/Measures/Overview/HB2021.
52. OPUC UM 2005, Order 20-485 was issued on December 23, 2020, available at: https://apps.puc.state.or.us/orders/2020ords/20-485.pdf.

# 6.2 Introduction

The landscape of utility planning is changing. This shift is created through state policy and regulation addressing climate change, the acceleration of customer adoption of distributed energy resources (DERs), customer preferences, and the declining costs of DERs; especially rooftop photovoltaic solar units, electric vehicles and energy storage.[53] As availability of and interest in DERs increase, this influences PGE's planning processes. Our planners now need to consider more granular data and additional analysis to account for bi-directional flows (such as energy produced by customer solar panels), variable and new demand profiles (such as electric vehicle charging), and growing amounts of digital technologies, including controls (devices that enable us to communicate with a customer's thermostat or water heater).

In addition to modifying the planning approach, DERs also present themselves as a possible solution to grid constraints. Using DERs to address grid constraints is commonly called non-wires solutions (NWS). The Oregon policy landscape takes this concept one step further, focusing on how NWS can potentially address distribution system constraints reliably, resiliently, and affordably while also supporting environmental and energy justice goals, particularly for historically underrepresented communities.

PGE is focused on developing a distribution system planning approach that considers all solutions from a societal perspective when making investment decisions. We also are working to balance current policies, customer desires, and a growing number of other investment priorities as we consider alternative solutions, including customer-sited DERs.

## 6.2.1 DISTRIBUTION SYSTEM PLANNING IN TRANSITION

PGE's distribution planning process is in transition. As noted in the OPUC's Order 20-485, this is a multistage transition which will likely go through intermediate phases before the desired future state can be fully integrated into our business planning cycles. This chapter focuses on one significant element of that transition — NWS, and the steps we are taking to accelerate the transition toward the end state.

In this DSP, PGE evaluated five NWS candidates, with the goal to identify two viable NWS candidates. To do this, we did the following:

- Utilized site level adoption forecasts of several DER technologies
- Evaluated hourly impacts
- Identified and calculated system benefits from both locational and bulk power system perspective of DERs included in a NWS portfolio
- Gathered community input regarding NWS goals and equity considerations though our DSP Partnership Workshops and Community-led Workshops
- Identified key barriers and highlight future discussion areas

However, PGE is still working on key processes that will help us develop NWS that are designed to meet the goals identified in the DSP. The key processes include:

- **Forecasting** — PGE's planning process is a multi-year effort where projects submitted to our 2023 Capital Plan are based on the forecast from 2020 and updated with forecast from 2021, where feasible.
- **Modeling practices** — Large sections of the distribution system have seen relatively flat load growth for several years. To improve operational efficiency during this time, PGE instituted practices to minimize modeling time by only modeling years with significant changes over the planning horizon. However, to accommodate the expected growth in transportation and building electrification, PGE has started transitioning away from this practice.
- **Modeling tools** — PGE is undertaking a multi-year effort to obtain the next generation of planning tools. These tools will enhance our ability to analyze and model NWS among other capabilities.

53. Per OPUC Docket UM 2005, Order 20-485 "distributed energy resource" includes distributed generation resources, distributed energy storage, demand response, energy efficiency, and electric vehicles that are connected to the electric distribution power grid.

## 6.2.2 DEFINITION OF NON-WIRES SOLUTIONS

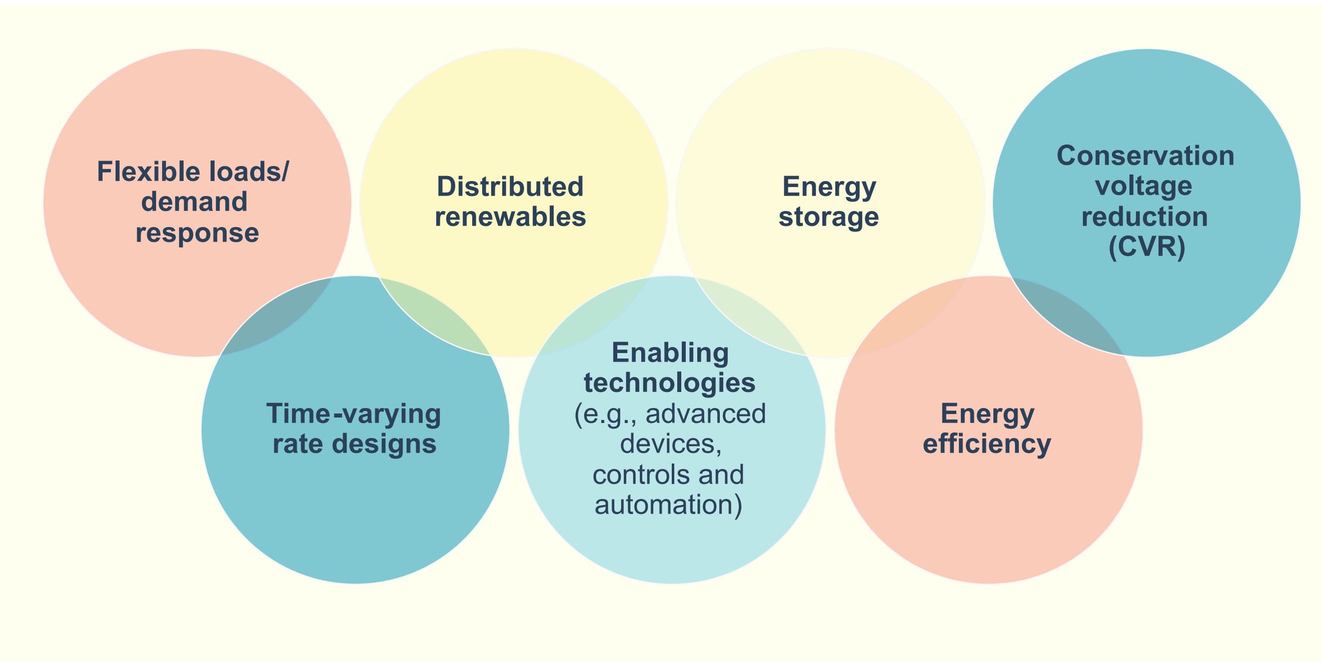
PGE defines a NWS as an investment, strategy, or action intended to defer, reduce or remove the need for a traditional utility solution (such as upgrading a substation or building a new line) in a specific geographical region to an identified distribution system need, such as managing load, generation, reliability, voltage regulation, and/or other wide-ranging distribution system needs. Most NWS are likely to include a combination of several different solution types and can range from pricing mechanisms such as time-of-use tariffs to technological solutions such as DERs or advanced controls. These solutions can be located either on the customer-side of the meter or the utility-side.

## 6.2.3 APPLICABLE TECHNOLOGIES CONSIDERED WITHIN NWS

NWS can include any action (such as energy conservation or behavioral actions), or technology (such as solar and battery storage) that meets the above definition. NWS action examples are included in **Figure 39**.

NWS projects can include these and other investments, individually or in combination, to meet the specified grid need in a cost-effective manner. In addition to the technical and cost considerations, it is also important to consider applicable state policy goals, ensure regulatory compliance, maintain safety standards, and identify any potential impacts on customer experience.

Figure 39. Example NWS actions



## 6.3 Process flow

PGE intends to complement existing solutions used to address specific types of grid needs with NWS. This requires traditional planning and regulatory processes to evolve and include NWS specific considerations (**Section 7.5**). This section details how we will evolve our planning processes to enable the evaluation of NWS. In the subsections that follow (**Figure 40**), we describe the process changes and new steps needed to integrate NWS as part of our annual planning cycle.

**Figure 40. Distribution planning process — augmented with consideration of NWS**

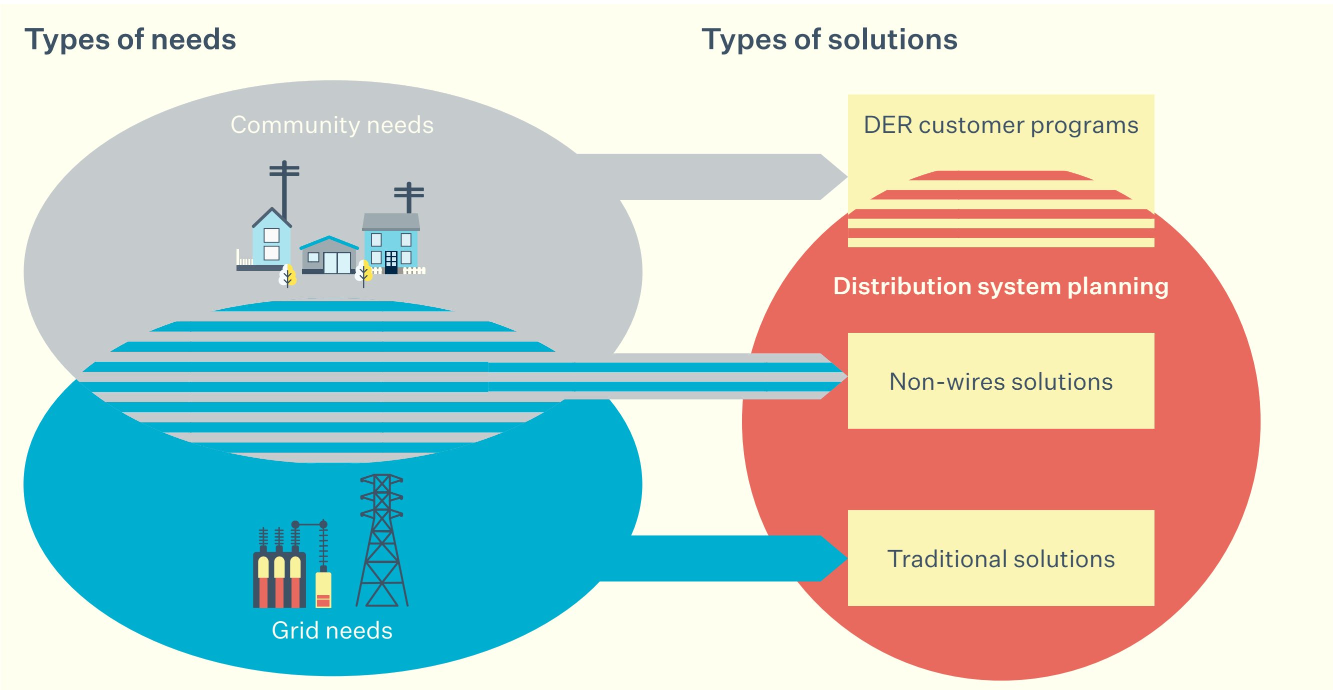
The NWS process depicted in **Figure 40** is described in further detail in **Appendix E**.

### 6.3.1 GRID NEEDS AND SOLUTIONS REVIEW

During the NWS evaluation process and based on Community input, there are two key periods where communities should be engaged within the DSP Process: Grid Needs Analysis and Solution Identification. PGE has facilitated a series of Community-led Workshops to develop capacity and share learnings with our community-based organization (CBO) partners on the technical components of our NWS process flow (see **Section 2.4**). Moving forward, we aim to use the existing monthly partner meetings as a venue to discuss our grid needs analysis and solution identification processes, while also providing additional avenues for engagement on specific projects.

As part of the review of grid needs, PGE will also review and discuss community needs. Community needs can be addressed through two channels depending on the type of need and the overlap with grid needs. Overlapping grid needs and community needs provide a unique opportunity to address multiple objectives with a single solution set. NWS, if applicable, are likely to comprehensively address these objectives. **Figure 41** shows the relationship between these needs and the types of solutions we can offer. **Section E.3.1** further describes our approach to combine community needs with NWS planning going forward.

Figure 41. Evolution and relationship between needs and solutions



# 6.4 Non-wires solution concept proposals

In PGE's initial approach to develop a minimum of two we followed the process flow outlined in **Figure 40** to the extent practicable, while accounting for overlap demographic and equity data, current staffing availability, DSP time constraints, and size of the grid need, where possible. For more information on our NWS screening process please see **Appendix E**. This process yielded five potential NWS candidates shown in **Table 28**.

Table 28. NWS candidates identified and evaluated by PGE

| PGE Substation | Target assets |
|---|---|
| Eastport | Eastport-Plaza and Eastport substation transformer (WR1) |
| Dayton | Dayton-East feeder and Dayton substation transformer (BR1) |
| Ruby | Ruby-Junction and Ruby-Carline feeders |
| Clackamas | Clackamas-Tolbert feeder |
| West Union | West Union-West Union 13, Oak Hills-Somerset, and West Union-Cornelius Pass feeders |

From these five projects, PGE then took our first step toward evaluating customer demographics at each location, as well as worked closely with our distribution engineers to better understand the grid needs and scope of a traditional solution for each project. Based on this exercise, we saw two potential candidates rise to the top as preferable sites to develop the full NWS concept proposal: Eastport and Dayton.

In the sections below, PGE has provided a detailed description of these two candidates, including results of the NWS solution development process.

### 6.4.1 EASTPORT CANDIDATE

PGE evaluated three options for the Eastport candidate: a traditional wired solution, and two non-wires solutions that feature different combinations of DERs to meet different resiliency and customer benefit objectives. This section presents the overview of the Eastport area concept proposal.

### 6.4.1.1 Summary of NWS portfolio for Eastport

PGE categorized information about the grid needs, traditional solutions, and non-wires solutions pertaining to the Eastport candidate. **Table 29** provides a high-level summary of project details for the Eastport candidate.

**Table 29. Summary of NWS candidate: Eastport-Plaza and Eastport-WR1**

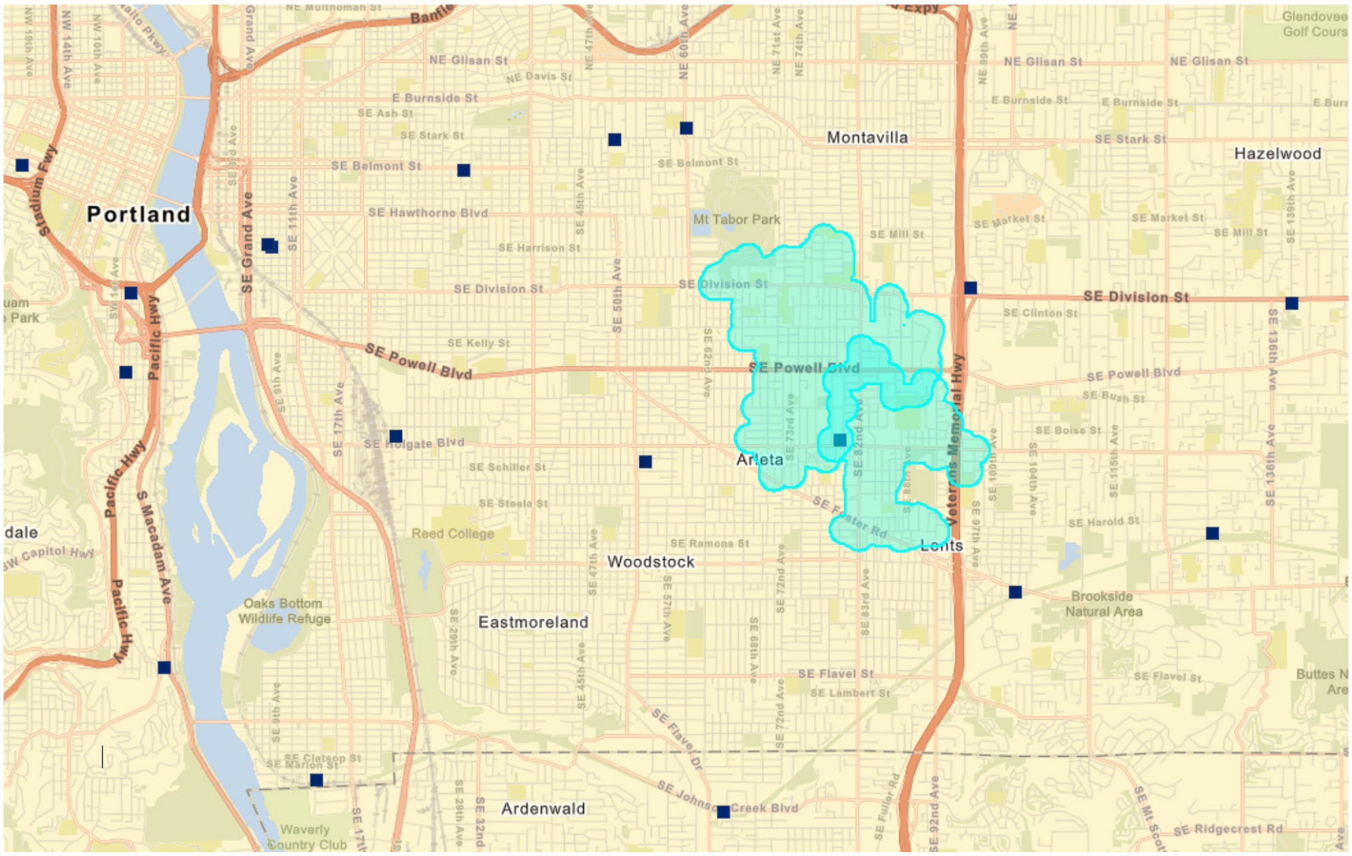
| **NWS candidate: Eastport-Plaza and Eastport WR1** | |
|---|---|
| **Scope of grid need** | Planning criteria violation on Eastport-Plaza and Eastport WR1 |
| | Violation seen on summer weekdays from 1pm-7pm |
| | Relief can be provided anywhere along the feeder and partially at the substation |
| **Traditional solution** | Substation transformer upgrade and feeder section reconductoring |
| **NWS** | Energy efficiency<br>• 5,500,000 kWh/yr annual savings by 2032 |
| | Demand response<br>• 2,166 kW of summer peak demand potential by 2032 |
| | Solar and storage<br>• 2,940 nameplate kW-dc of residential rooftop solar PV<br>• 743 nameplate kW-dc of non-residential rooftop solar PV<br>• 1,000 nameplate kW-dc of Community Solar installations |
| **Decision making metrics** | Relief can be provided anywhere along the feeder and partially at the substation |
| **Community engagement** | Performed outreach to CBOs through four Community Workshops (see **Section 2.4**) |
| | Conducted outreach to schools and government partners in the affected area to align plans with existing efforts and potential projects |
| | Going forward, will conduct detailed community needs assessment for the Eastport area by working directly with CBOs with connections and existing relationships in the area (see the community needs assessment section of **Appendix E**) |

### 6.4.1.2 Location and customer types

The Eastport substation is located within Southeast Portland and has two feeders, Eastport-76th and Eastport-Plaza, both of which are both fed from the Eastport WR1 transformer. The grid need originated at the Eastport-Plaza feeder and the transformer that feeds it, Eastport WR1. The affected equipment serves approximately 5,000 customers, of which three are critical customers and 40 are managed accounts.

Additionally, eight residential customers on the feeders have registered medical equipment. **Figure 42** highlights the customers served within the blue outline under normal conditions.[54]

Figure 42. Area served by the Eastport-Plaza Feeder




54. To see the area served by any feeder you can access PGE's Distribution Generation Evaluation map, available at: https://www.arcgis.com/apps/webappviewer/index.html?id=959db1ae628845d09b348fbf340eff03

### 6.4.1.3 Summary of grid need

The needs analyses on the Eastport substation are summarized as follows:

- The hourly load profile and the expected annual peak load growth on the Eastport-Plaza feeder and the Eastport WR1 transformer are shown in **Figure 43**.
- **Table 30** details the applicable areas for load relief to provide relief to the grid need.
- The minimum annual relief required to meet the grid need is shown in **Figure 44**.

Figure 43. Load profile and Load growth at Eastport-Plaza and Eastport WR1

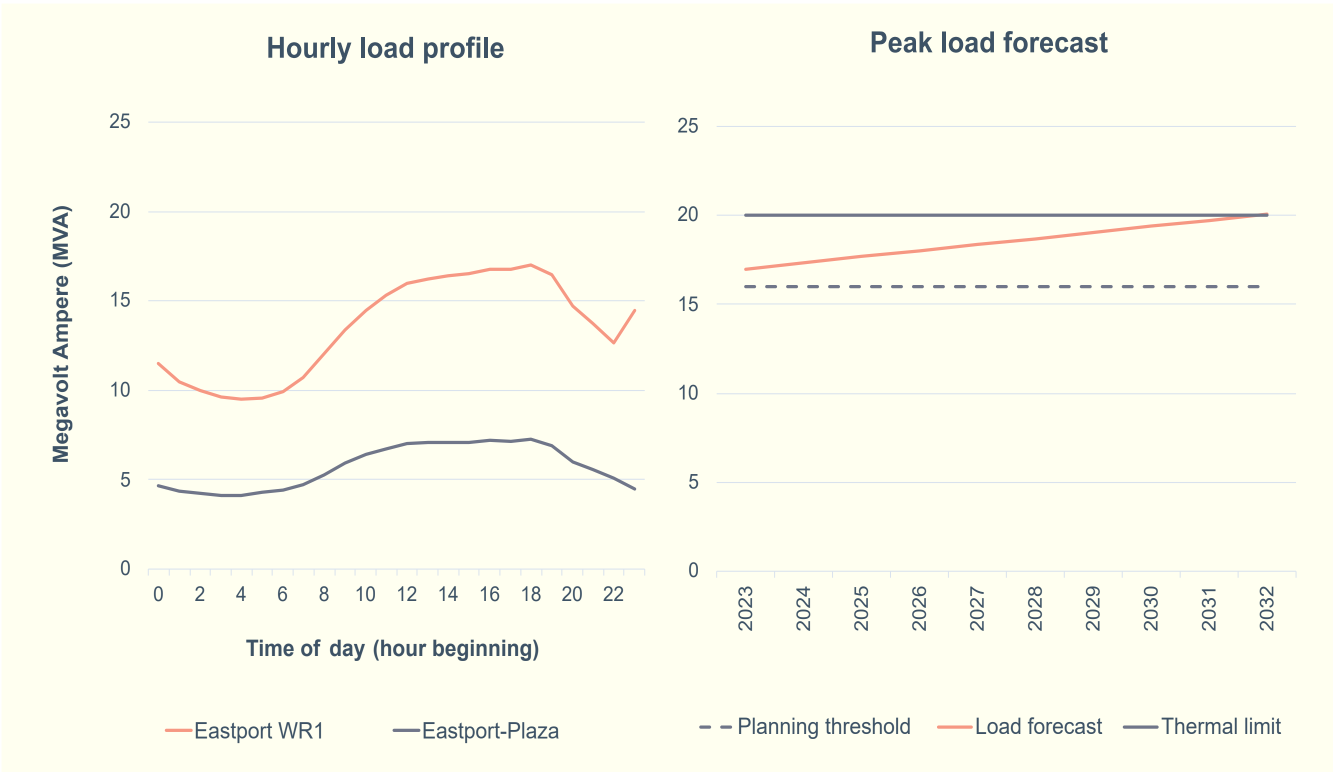
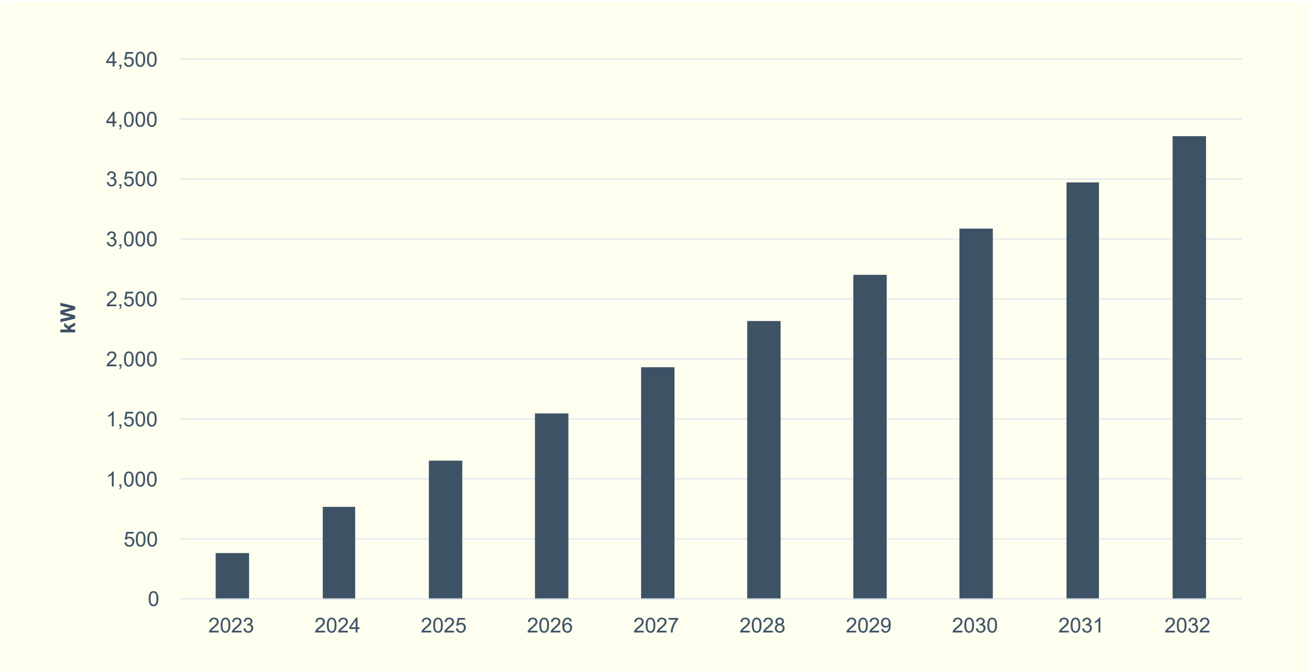



Table 30. Summary of grid need for Eastport-Plaza and Eastport WR1

| Parameter | Value under normal condition (N-0 condition) |
|---|---|
| **Violation type** | Planning criteria violation (thermal) for both the Eastport-Plaza feeder and Eastport WR1 transformer |
| **Applicable areas for load relief** | Entire scope of Eastport-Plaza and Eastport-76th feeders |
| **Violation time and duration** | 1-7 PM, Summer weekdays, non-holidays |

Figure 44. Minimum annual relief required for N-0 scenario




### 6.4.1.4 Customers and equity data

As PGE transitions to human centered planning, a key step is to understand the customers that are impacted by the grid need and consider how the customer mix can inform potential opportunities. Some key insights we learned about the customers affected by the grid need include:

- Residential customers make up 86% of all customers impacted with a split of 45% living in multifamily and 55% living in single family units. Small commercial customers represent 11% of the building stock and 2.4% is classified as large commercial.
- On an annual basis, residential customers account for 40% of total energy consumption. Small commercial accounts for 16%, large commercial accounts for 44%.
- There is a mix of building age, with just under 25% of today's building stock built in or before 1964, 10% built in 1980, and approximately 21% of the building stock built after 2000.
- Residential customers received approximately $69,000 in energy assistance payments; with renters receiving 86% of the assistance.
- Equity and demographic data of the customers on this feeder can be found on PGE's distributed generation evaluation map available on our DSP website.[55]

In addition to reviewing these datasets, PGE took additional steps to understand the customer landscape so that our solutions consider all relevant angles. We met with CBO leaders and local government representatives, engaged our Key Customer Management team and socialized concepts with select customers in the identified target areas, and leveraged our internal resources and knowledge base to better understand potential local needs and preferences. This engagement helped refine our data; including filling in data gaps such as current cooling penetration, providing insights into solution preferences such as clean energy needs and desires, and energy burden.

55. See PGE's DSP website, available at: Distribution System Planning | PGE (portlandgeneral.com)

### 6.4.1.5 Solutions

#### 6.4.1.5.1 Wired solution

PGE first evaluated and eliminated opportunities to address grid needs by permanently transferring load from the overloaded feeder/transformer to adjacent feeders/transformers. Subsequently, we developed a more detailed wired solution that included the following elements:

- The violation on the Eastport WR1 transformer can be eliminated by upgrading the substation transformer to accommodate current and future growth while improving system flexibility and resiliency.
- The violation on the Eastport-Plaza feeder can be addressed by reconductoring a 500-foot section of feeder on Southeast Holgate Boulevard.

#### 6.4.1.5.2 Non-wires solution

##### 6.4.1.5.2.1. Eastport substation locational value

To determine the locational value of the NWS, PGE employs the Present Worth Method as described in the Locational Value of Distributed Energy Resources report developed by the Lawrence Berkeley National Lab.[56] Key inputs to the locational value include the cost of the recommended wired solution, expected in-service date of the wired solution, and the deferral time.[57]

For the Eastport WR1 and Eastport-Plaza grid need, deferring the wired investment by 10 years (assuming the ramped annual relief shown **Figure 44**) yields an annualized locational value of $283.39/kW-year. This translates to an approximate twelve-fold increase in the distribution system avoided cost as compared to our current system-wide value used for energy efficiency cost-effectiveness ($24.39/kW-yr).[58]

##### 6.4.1.5.2.2. Eastport resource potential and application

PGE evaluated locational DER potential for each of the two NWS options (Option 1 – Reliability Portfolio and Option 2 – Customer Resiliency portfolio). Option 1 is a front-of-the-meter approach that relies on utility-scale battery storage with some customer adoption, while under Option 2 (Customer Resiliency) the need for a utility-scale battery is offset by more aggressive customer adoption.

We first present the annual DER adoption potential to reflect the growth in adoption over time commensurate with the identified relief needed in **Figure 44** and then discuss the hourly shape of the resources identified.[59]

56. The locational value of DERs work from LBNL, available at: https://emp.lbl.gov/publications/locational-value-distributed-energy
57. The deferral time can be determined by a combination of factors such as the asset's 'Time to Intervention' which represents the expected time until PGE must take to replace the asset, the planning horizon, and when the relief from DERs cannot overcome the peak load growth.
58. For an overview of the most recently approved T&D avoided costs used in energy efficiency resource planning, see Order No. 21-476 under Docket No. UM1893, available at: https://apps.puc.state.or.us/orders/2021ords/21-476.pdf
59. We only present the more aggressive Customer Resiliency DER buildup because the process undertook is essentially the same for each option within our NWS evaluation. The results of both are included in the summary presented in **Table 28**.

**Figure 45** shows the annual energy efficiency potential identified for Eastport substation.

**Figure 45. Energy efficiency resource potential for Eastport substation**

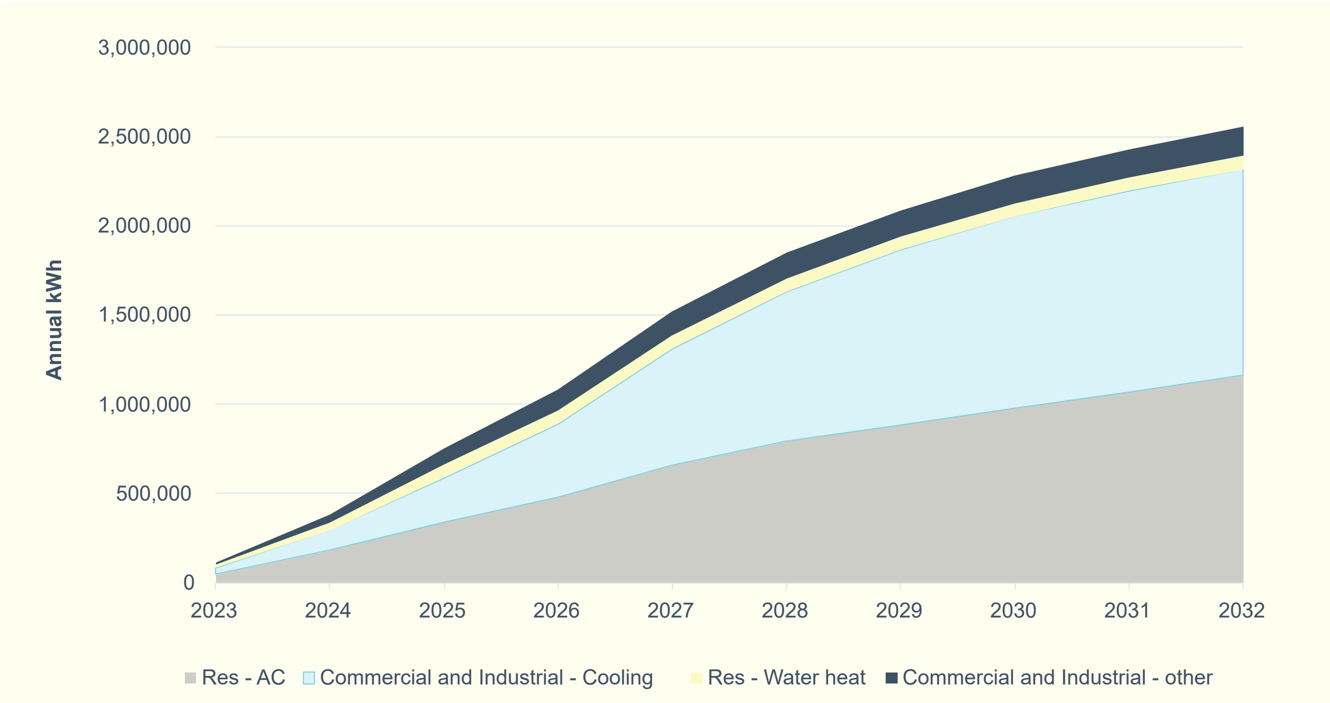
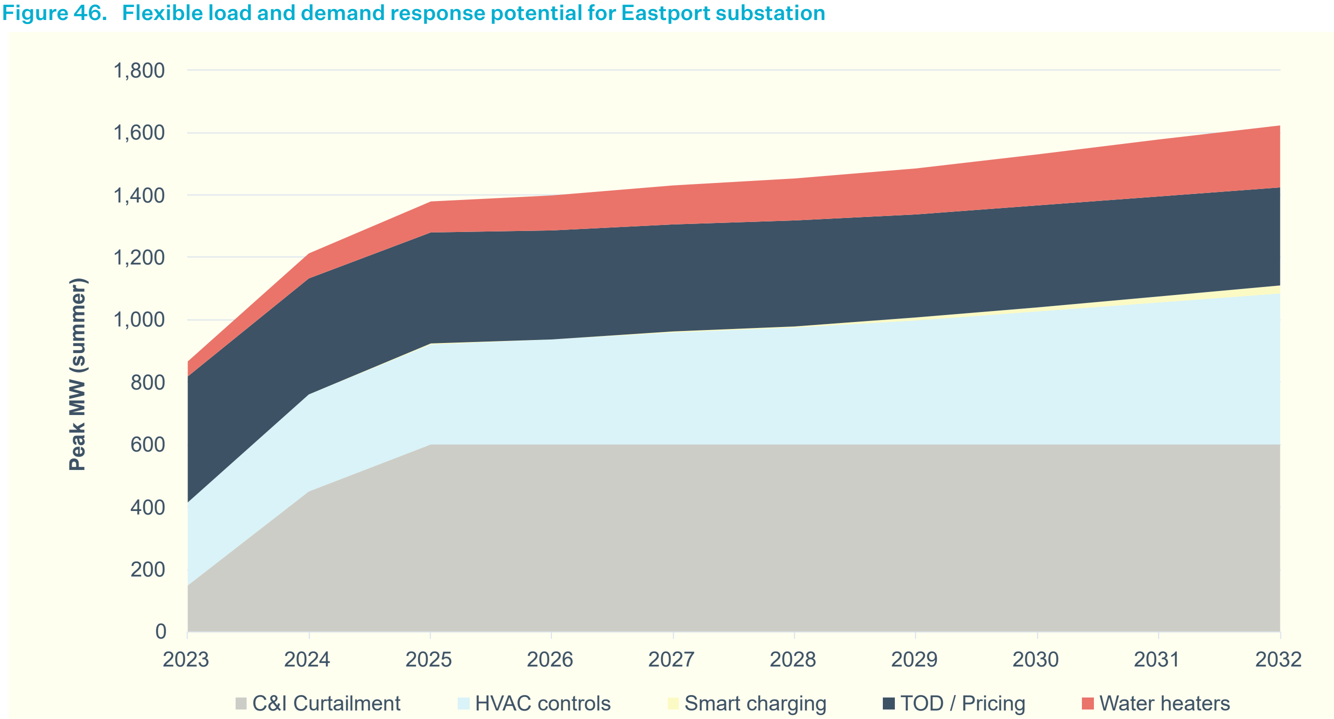


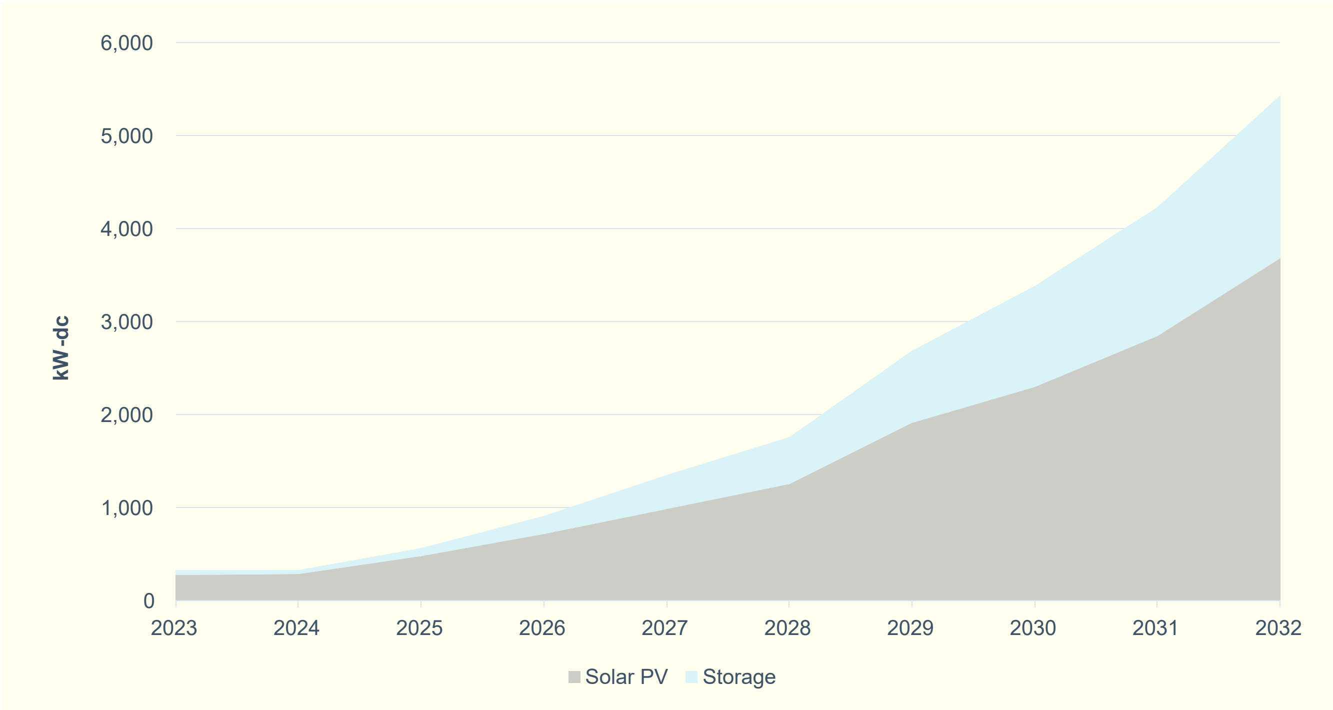

**Figure 46** shows the annual flexible load and demand response potential for Eastport substation.

**Figure 46. Flexible load and demand response potential for Eastport substation**



Finally, PGE estimated significant distributed solar photovoltaic (PV) and storage potential at the Eastport substation, as shown in **Figure 47**.

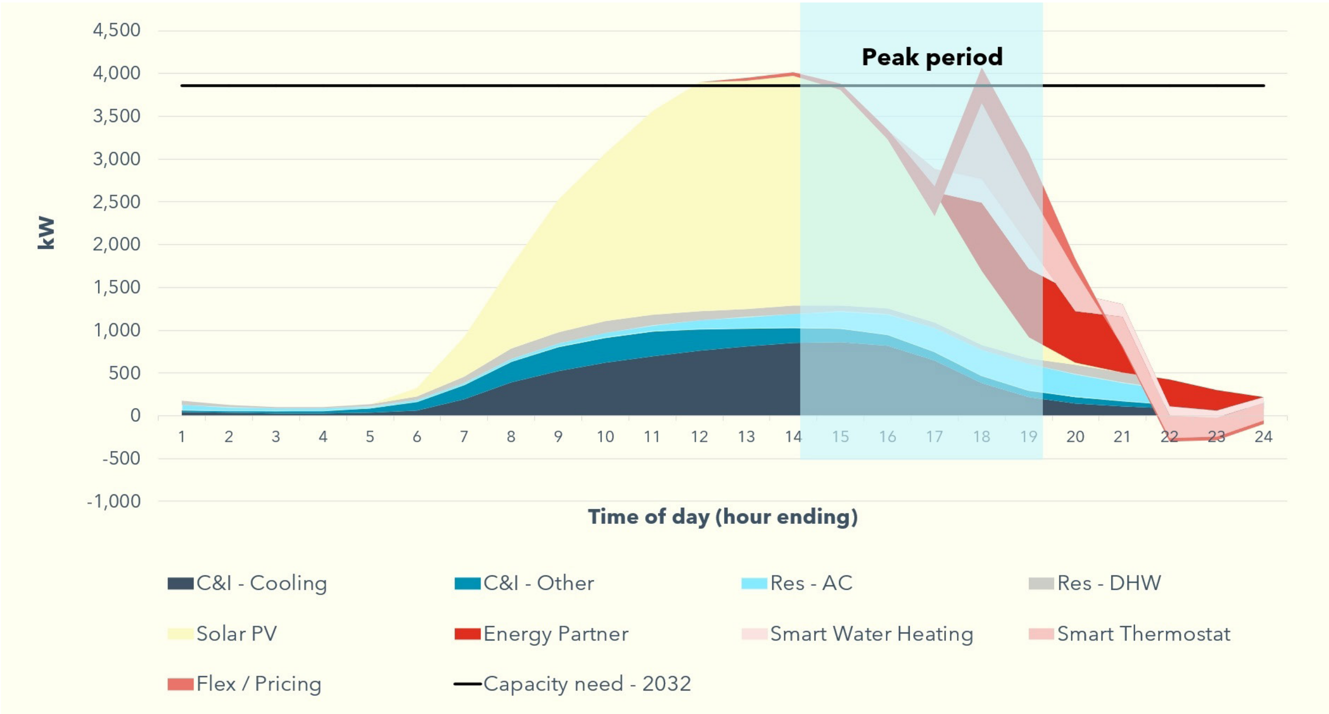
**Figure 47. Solar plus storage potential for Eastport substation (Nameplate kW-dc)**




After identifying the achievable DER potential for Eastport substation, we analyzed the hourly availability of each resource to assess ability to bring future forecasted load growth back within the planning guidelines. This is particularly important for resources like solar PV, that might only provide relief for a percentage of the identified hours (12pm-7pm).

**Figure 48** shows the hourly summer peak day shape of the combined reductions to load due to energy efficiency, solar PV, and PGE's demand response offerings, relative to the identified relief needed on the Eastport WR1 transformer in 2032. We see that the DERs work together to complement one another and provide relief during different hours of the day. In particular, as solar is reducing output in the late-afternoon and early evening, then the combined effect of our Flexible Load programs provide relief.

**Figure 48. Combined efficiency, flex load, and solar PV peak day shape**

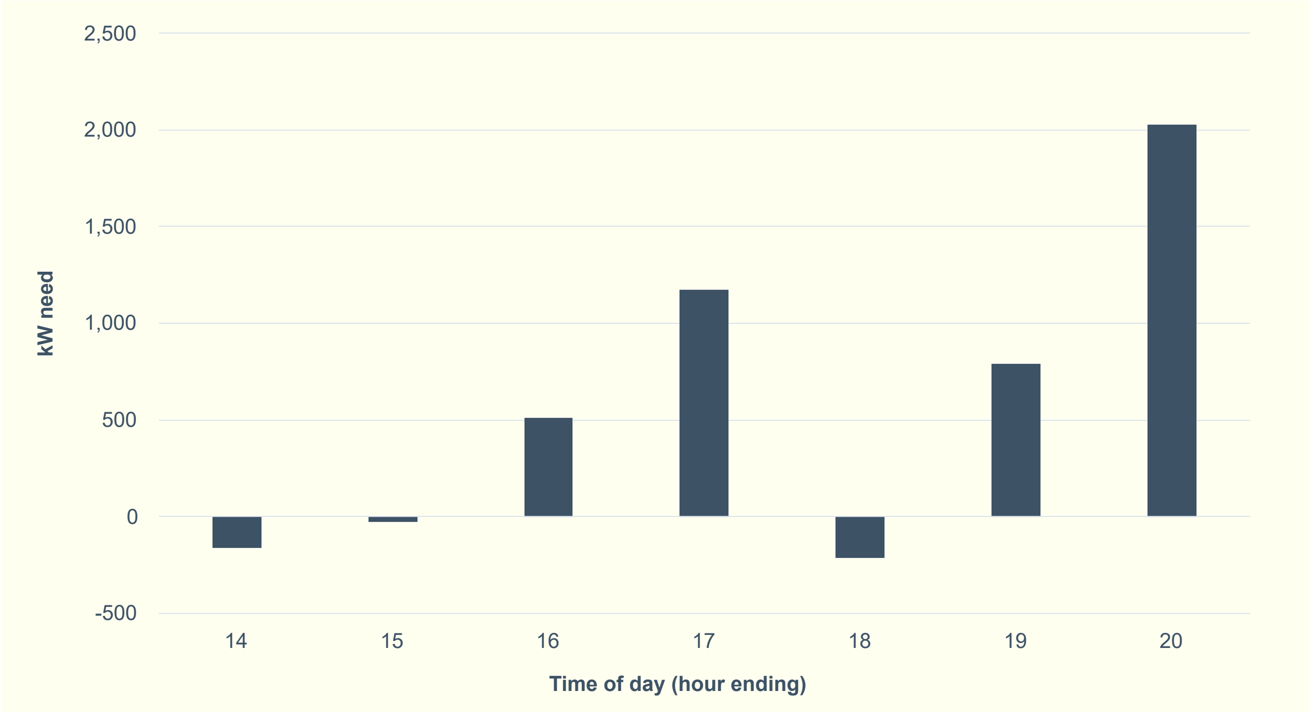



Battery storage was not shown in this chart because it is highly flexible and can be dispatched to meet almost any shape of need required. Therefore, the next step in the course of our portfolio development was to evaluate the impact of customer-sited battery storage to fill the remaining gaps (the area of the graph in shaded blue that lies above the resource stack and below the black solid line). This area reflects the remaining resource need.

The amount of remaining need by each hour during the identified window is shown in **Figure 49**. The maximum height of the need is in hour ending 20 (8pm) and is around 2 MW, and the sum of the positive bars gives PGE an energy need of 4.5 MWh. After we subtract from this our distributed storage potential (1.8 MW and 3.6 MWh from **Figure 47**) we are left with a need for a 250 kW / 1,000 kWh battery solution so that the NWS portfolio can reduce load below the planning threshold and remove all violations identified for this study area. We propose to either keep this remaining need for a front-of-the-meter solution, or consider a community resiliency microgrid.[60]

60. For example, PGE's pilot installation at Beaverton Public Safety Center is a 250 kW, 4-hr microgrid.

Figure 49. Remaining relief needed by storage for Eastport NWS




This approach minimizes cost while maximizing behind-the-meter resources that can reliably deliver both energy and capacity.

### 6.4.1.6 Eastport costs breakdown

In this section PGE provides a detailed accounting of the costs of each of the evaluated options and discusses our process for considering each in the formation of the final pilot configuration. The wired solution for resolving the identified constraint includes the following scope of work at the substation:

- Installation of temporary 115 kV/12.47 kV mobile transformer
- Removal of existing 22.4 MVA Eastport WR1 transformer
- Replacement of transformer foundation
- Installation of new 28 MVA transformer at Eastport WR1
- Removal of temporary transformer
- In addition, the wired solution includes the following scope of work at the feeder level:
- Removal and replacement of distribution poles
- Replacement of open delta banks with closed delta banks
- Upgrade of 336 KCM overhead conductors to 795 KCM

The conceptual estimate is approximately $2.8 million. This is a preliminary engineering estimate provided for the purpose of evaluating the NWS. Additional analysis will be performed and a final estimate prepared if we need to move forward with the wired solution. These costs are not included in the near-term action plan.

To assess the costs of the NWS options, PGE used a combination of EPRI's Energy Storage Cost Estimation Tool and internal bid data for potential future costs of the front-of-the-meter storage components.

**Table 31** shows the assumptions for operations and maintenance (O&M) costs required to maintain the front-of-the-meter (FTM) battery solution.

Table 31. Operations and maintenance cost assumptions for FTM storage

| Attribute | Value | Unit |
|---|---|---|
| Maintenance and warranty | 2.5% | per year |
| Capacity augmentation | $200 | per kWh |
| End of life decommissioning | $34 | per kWh |

**Table 32** shows the total capital costs and operations and maintenance (O&M) summary for the Eastport substation. The capital costs represent all costs necessary to make the storage system operational, including battery system hardware and software components, installation and contractor overhead, and site work. The O&M costs were factored in based on the size of the storage unit in each option given the inputs in **Table 31** and levelized over a 25-year period.

Table 32. Eastport NWS costs for FTM storage component of each DER portfolio

| Cost element | Option 1 - Reliability (1.5 MW / 6 MWh) | Option 2 – Customer resiliency (250 kW / 1 MWh) |
|---|---|---|
| Total turnkey EPC capital costs | $2,334,009 | $741,472 |
| Microgrid controller costs | $91,300 | $91,300 |
| O&M (annual $/yr) | $114,510 | $27,897 |

For all other DERs, PGE developed estimates for the following cost categories:

- **Admin costs** — We assumed 20% adder (applied to the total measure costs of each DER portfolio) to reflect enhanced project management needs, and any targeted marketing required to achieve greater locational adoption for NWS
- **Incentive costs** — We used past incentive data from Energy Trust of Oregon (ETO) and current incentive levels from PGE's Multi-year Plan for flexible loads
- **Participant costs** — We used past data from ETO for energy efficiency and participant cost assumptions from AdopDER for all other DERs.

PGE calculated both utility costs and participant costs in order to inform discussion around the cost impact of the NWS from various perspectives, as well as to highlight the relative amount of customer investment that can be leveraged with a more aggressive deployment of DERs.[61] **Table 33** summarizes these customer-sited DER costs for each NWS option.

61. PGE is using estimates of participant costs based on current and past data and does not reflect actual expected customer cost contributions of the NWS since that will be determined by the ultimate incentive levels set by the program delivery teams.

Table 33. DER and flex load cost summary - Option 1 Reliability Portfolio

| DER Type | Option 1 - Reliability portfolio | | |
|---|---|---|---|
| | Admin costs | Incentive costs | Participant costs |
| Energy efficiency | $177,585 | $782,312 | $5,069,632 |
| Demand response / flex load | $180,159 | $641,525 | $1,999,351 |
| Solar PV | $237,978 | $275,023 | $2,065,002 |
| Storage | $23,450 | $1,297,213 | $745,356 |

**Table 34** shows the same cost information for Option 2 – Customer Resiliency portfolio. Note, there is more aggressive deployment of DERs for Option 2.

Table 34. DER and flex load cost summary - Option 2 Customer Resiliency portfolio

| DER Type | Option 2 - Customer resiliency portfolio | | |
|---|---|---|---|
| | Admin costs | Incentive costs | Participant costs |
| Energy efficiency | $236,779 | $1,043,082 | $6,759,509 |
| Demand response / flex load | $240,211 | $855,367 | $2,665,801 |
| Solar PV | $416,179 | $437,752 | $3,594,516 |
| Storage | $35,000 | $1,936,139 | $1,061,702 |

With both the NWS options, it is important to highlight the role that both customer co-funding as well as matching local, state, and federal tax credits and other funding sources can contribute to such a robust customer-focused NWS application. Because the benefits of DERs encompass a wider range of value streams (both monetizable and non-monetizable), these costs appear higher but may be preferable depending on the decision-making lens applied. It will be important to further assess the incremental costs of deploying the pilot during the more detailed planning phase after final program and budget goals are set.

### 6.4.1.7 Eastport benefits breakdown

In this section, PGE provides a detailed accounting of the benefits of each of the evaluated options and discuss our process for considering each in the formation of the final pilot configuration. We evaluated two primary categories of benefits when comparing the wired solution with each non-wired solution option: 1) system reliability improvements, and 2) additional DER benefits stemming from complementary grid services.

In **Section 4.4**, PGE discussed our Asset Management Program's (AMP) process for evaluating asset risk and assigning outage consequences. To evaluate the reliability improvements and subsequent benefits of the wired solution and each of the NWS options, PGE utilized our traditional AMP methods of evaluating a distribution capital project for its impact on lifecycle cost of ownership, and various metrics of reliability improvements and risk reduction.

The summary of results is shown in **Table 35**.[62] The table shows reductions in key metrics like Near-Term Asset Risk (NTR) and Near-Term Customer Minutes Interrupted (CMI) expected to result from each option. It also shows a reduction in expected outage durations that would result from each outage. This is an important customer resilience metric, along with expected number of outages. Expected number of outages is excluded from this summary, as the options presented here had either negligible or zero impact. The near-term values are for the first year of the project being in-service.

**Table 35. Summary results of AMP risk reduction and lifecycle cost comparison**

| Option | LCOO | NTR | CMI |
|---|---|---|---|
| Wired solution | $2,182,255 | $323,259 | 250,917 |
| NWS Option 1 | $1,609,442 | $140,620 | 40,394 |
| NWS Option 2 | $2,963,357 | $190,989 | 49,277 |

PGE present these results for informational purposes only, since they show how DERs under a NWS would compare to a traditional wired solution all else being equal. However, we took the NTR as a proxy for resiliency value of DERs and used this value as an input into our evaluation of the full stacked value of DERs. This is necessary because DERs can provide system value in times other than during peak load conditions, and we must quantify the NPV of each of these value streams to round out our evaluation of potential benefits from a NWS. **Table 36** shows the system avoided costs that result from the energy efficiency and flexible load portion of the Eastport NWS portfolios.[63]

**Table 36. Overall system benefits from energy efficiency and flexible loads**

| DER Type | Option 1 - Reliability portfolio | Option 2 - Customer resiliency portfolio |
|---|---|---|
| Energy efficiency | $2,915,519 | $3,887,000 |
| Customer-sited storage | $888,457 | $1,265,761 |
| Demand response / flexible load | $2,629,454 | $3,505,939 |

NWS provide an opportunity to accelerate customer DER adoption and achieve significant benefits for customers and communities. The system benefits shown in Table 35 represent traditional evaluation of system avoided costs for both EE and DR. However, there are other potential benefits that have yet to be quantified that PGE highlights here, as it factored into the decision making when evaluating the various NWS options.

The customer- or community-sited DER portions of a NWS can provide multiple potential sources of community benefits, including:

- Local employment impacts, especially if installation work is carried out by local contractors
- Reduced air pollution and subsequent public health impacts
- Resiliency to outages and impacts on vulnerable customers and business processes
- Bill savings from reductions in energy use or rebates from program participation

62. See detailed discussion about the AMP results for Eastport presented in **Appendix E**.
63. We show here the avoided costs associated with energy efficiency and demand response programs because these have readily available and accepted methods for assessing system benefits of such programs. For solar and storage, we note that these have system benefits, but they have yet to be included due to the uncertain impact they can have on the distribution grid. We will explore this further in the more detailed planning phase of the pilot should it move forward.

PGE expects that methodologies to quantify these important benefits will be advanced through development of the CEP, with significant input from community groups via the Community Benefits and Impacts Advisory Group (CBIAG) and other ongoing engagement venues. In the meantime, we considered these qualitatively while considering the different NWS options.

### 6.4.1.8 Greenhouse gas reductions due to NWS

Both option 1 and option 2 NWS portfolios for Eastport contain significant amounts of energy efficiency, demand response, solar PV, and battery storage. Each of these DER types have different implications for quantifying greenhouse gas (GHG) reductions associated with implementing these projects as a potential NWS.[64]

PGE's approach to quantifying GHG associated with each DER type included in the NWS portfolios for Eastport is as follows:

- Energy efficiency potential is quantified as annual energy savings (MWh) and are translated to GHG reductions using PGE's reported emissions intensity per MWh of PGE's electricity delivered to Oregon retail customers for 2021. This has the benefit of being straightforward and in line with ETO's common reporting regarding the GHG impacts of past installations.
- Demand response / flexible loads primarily shift load, rather than reduce it outright. This load shifting may be associated with GHG reductions depending on the state of the grid. Disentangling marginal emissions rates and assessing how different dispatch considerations of flexible loads remains a large and complex undertaking and we do not attempt that here given the interdependencies with both emerging policy guidance and IRP and CEP modeling. In the interim, we have relied on GHG reduction estimates derived from the U.S. Environmental Protection Agency's Avoided Emissions and geneRation Tool (AVERT) to develop a more static estimate of GHG reductions from demand response and flexible loads.[65]
- Solar PV is a clean generation source measured in annual energy (kWh) that directly reduces the amount of electricity consumed from the grid, and therefore we use PGE's emissions intensity per MWh of PGE's electricity delivered to Oregon retail customers for 2021, as we do with energy efficiency.
- Storage resources provide valuable flexibility and non-emitting capacity to the system but incur an energy penalty due to their round-trip efficiency losses. However, storage acts similarly to demand response in that you can shift load and generation to yield incremental GHG reductions. This can be achieved by charging the battery either from a paired rooftop solar system or when the grid's relative carbon intensity is lower and discharging during peak periods which tend to be more GHG intensive.

The 2021 emissions intensity for PGE retail load as reported to Oregon Department of Environmental Quality (DEQ) was 0.32 MT CO2e/MWh.[66]

Using this as a baseline, we calculated the cumulative MWh reductions associated with each of the NWS portfolio options based on the amount of energy efficiency and solar PV production in each over the 10-year pilot window (**Table 37**).[67]

64. An important consideration is how the relative change in DER procurement would change PGE's future emissions profiles. Carbon dioxide emissions associated with PGE's thermal generating resources are evaluated in the IRP, and the DER forecast presented in **Section 3.5** is an input to IRP modeling that ultimately impacts the dispatch decisions of the portfolio and subsequent GHG intensity across a variety of scenarios. The impact of DER adoption on emissions will be further elaborated in IRP and CEP analyses.
65. U.S. Environmental Protection Agency. Last updated October 6, 2021. "AVERT Web Edition" available at: https://www.epa.gov/avert/avert-web-edition
66. Emissions intensity is calculated based on the Oregon Department of Environmental Quality (ODEQ) Investor-Owned Utility GHG report. The ODEQ report shows greenhouse gas emissions associated with power provided to PGE customers and does not account for emissions associated with power delivered outside of PGE service territory.
67. We use historical emissions factors for this analysis primarily due to the complexity of forecasting reductions in GHG over time, given that the actual GHG intensity of a given dispatch mix will be altered by the successful completion of NWS projects. As such, we expect this topic to be a subject of interest as we continue to discuss HB2021 emissions requirements under the IRP and CEP efforts.

**Table 37. Cumulative GHG reductions from NWS portfolios**

| Metric | Option 1 - Reliability portfolio | Option 2 - Customer resiliency portfolio |
|---|---|---|
| MWh from EE and PV | 34,726 | 50,874 |
| MT CO2e/MWh | 0.32 | 0.32 |
| MT CO2e reduced | 11,112 | 16,280 |

### 6.4.2 DAYTON CANDIDATE

PGE evaluated three options for the Dayton candidate: a traditional wired solution, and two non-wires solutions that feature different combinations of DERs to meet different resiliency and customer benefit objectives. This section presents the overview of the Dayton area concept proposal.

#### 6.4.2.1 Summary of NWS portfolio for Dayton

PGE categorized information about the grid needs, traditional solutions, and non-wires solutions pertaining to the Dayton candidate. **Table 38** provides a high-level summary of project details for the Dayton candidate.

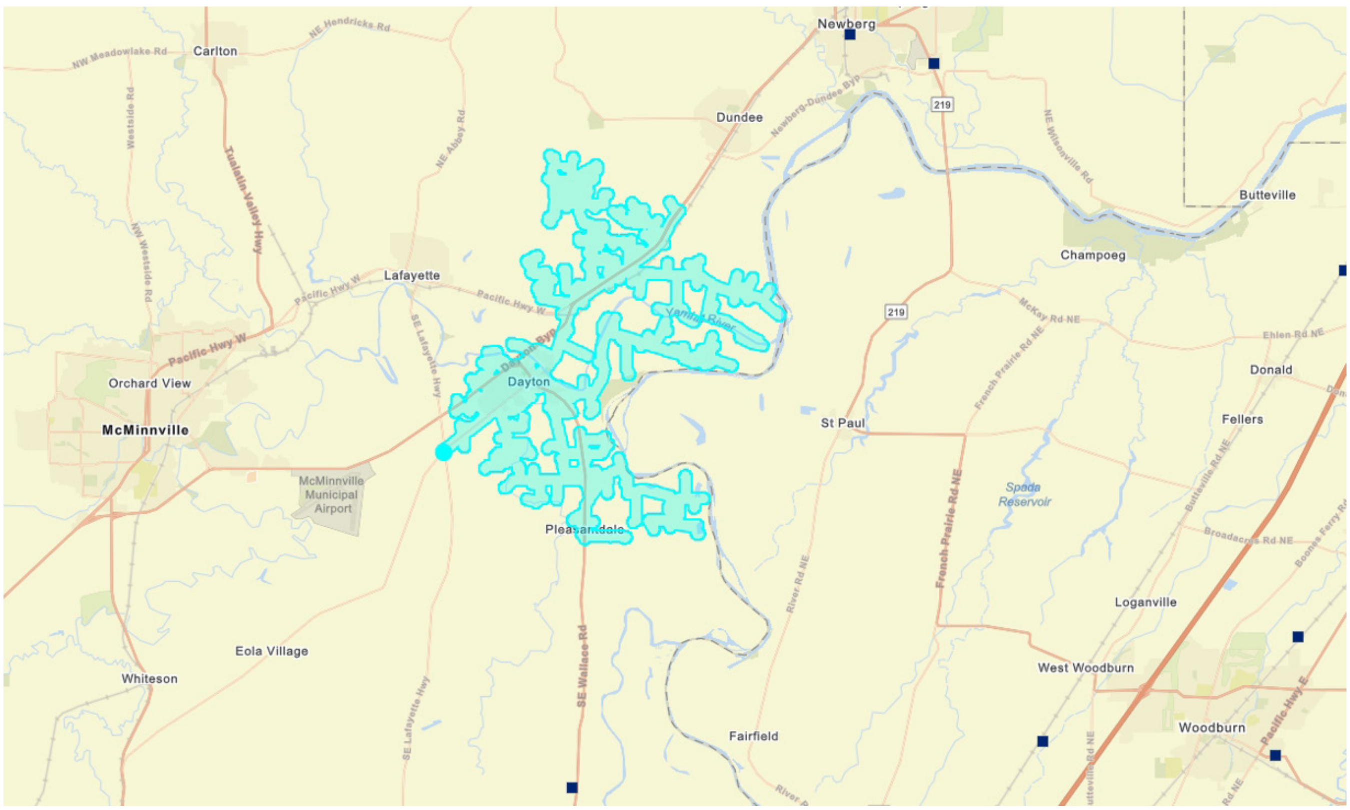
**Table 38. NWS candidate: Dayton-East and Dayton BR1**

| NWS candidate: Dayton-East and Dayton BR1 | |
|---|---|
| **Scope of grid need** | • Planning criteria violation on Dayton-East and Dayton BR1<br>• Violation seen on summer weekdays from 1pm-7pm<br>• Relief can be provided anywhere along the feeder and partially at the substation |
| **Traditional solution** | • Substation transformer upgrade and feeder section reconductoring |
| **NWS** | • Energy efficiency: 1,700,000 kWh/yr annual savings by 2032<br>• Demand response: 1,500 kW of summer peak demand potential by 2032<br>• Solar and storage: 563 nameplate kW-dc of rooftop solar |
| **Decision making metrics** | • Relief for Dayton-East must be located downstream (to the northeast) of the 8th St. and Ferry St. intersection.<br>• Relief for the Dayton BR1 transformer can be located anywhere throughout the footprint |
| **Community engagement** | • Insights regarding community needs were applied to the Dayton NWS primarily from the Community Workshops (see **Section 2.4**) in terms of general principles<br>• Due to timing constraints, we did not engage customers and community partners to the same extent as we did for Eastport NWS<br>• Going forward, we will leverage the same community outreach principles and processes for each individual NWS depending on the level of effort required. For this case, our decision was also informed by the desire to explore more front-of-the-meter solutions in Dayton, given the greater need for installing the NWS in a specific location to mitigate the Dayton-East constraint. |

### 6.4.2.2 Location and customer types

Dayton substation is located in Dayton, OR and has just one feeder: Dayton-East. The Dayton BR1 transformer serves only one feeder, Dayton-East. The feeder serves 1,600 customers and is considered a rural feeder, of which 75% are residential and 25% are non-residential. There are 13 managed accounts in the impacted area and 8 residential customers have registered medical equipment. **Figure 50** highlights the customers served within the blue outline under normal conditions.[68]

**Figure 50. Area served by the Dayton BR1 transformer**




68. To see the area served by any feeder you can access PGE's Distribution Generation Evaluation map, available at: https://www.arcgis.com/apps/webappviewer/index.html?id=959db1ae628845d09b348fbf340eff03

### 6.4.2.3 Summary of grid need

The needs analyses on the Dayton NWS candidate are summarized as follows:

- The hourly load profile and the expected annual peak load growth on the Dayton-East feeder and the Dayton BR1 transformer are shown in **Figure 51**.
- **Table 39** details the applicable location to provide relief to the grid need.

The minimum annual relief required to meet the grid need is shown in **Figure 52**.

Figure 51. Load profile and Load growth at Dayton-East and Dayton BR1

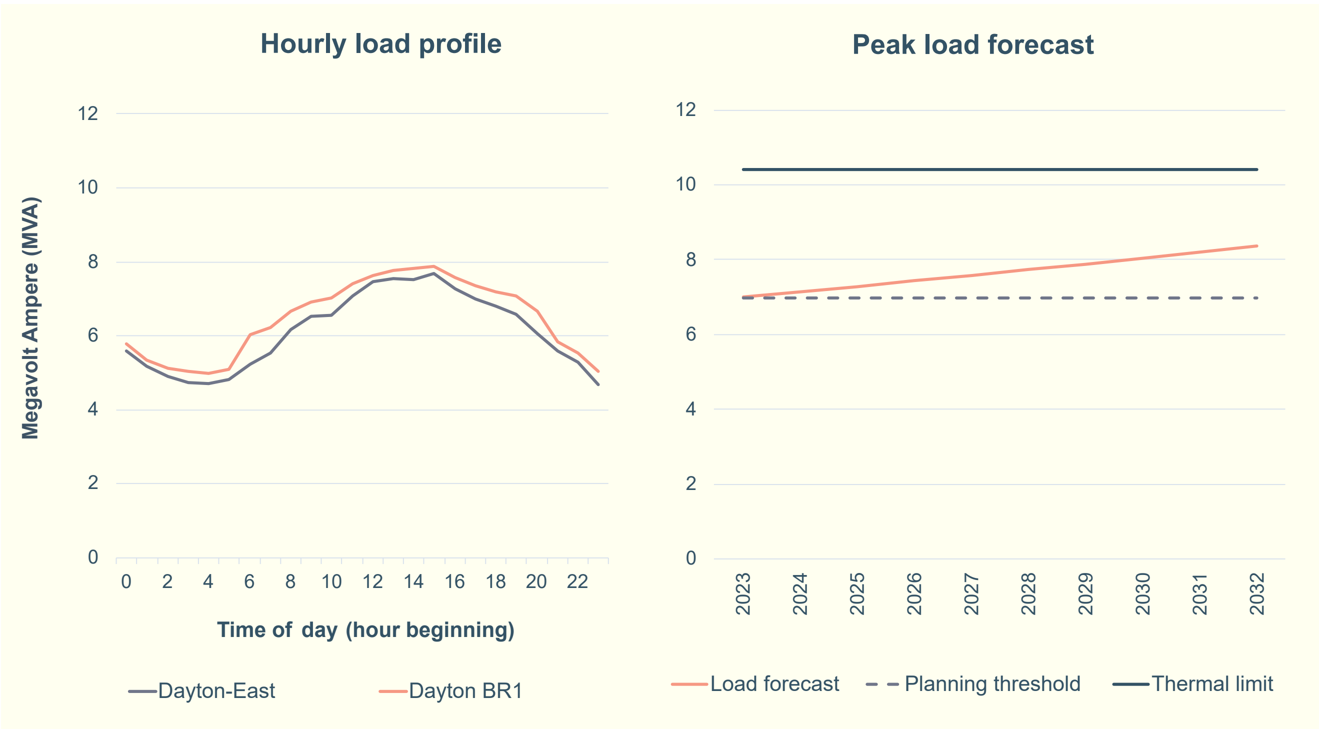
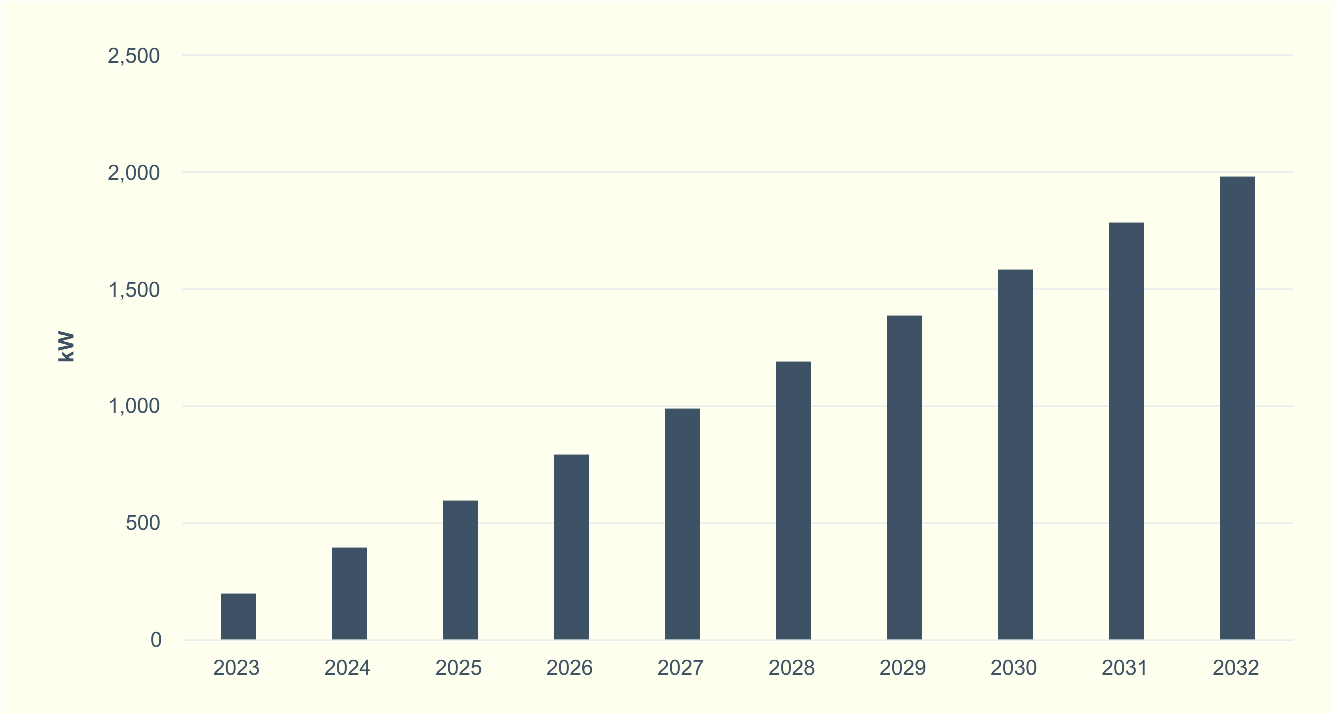



Table 39. Summary of grid needs for Dayton-East and Dayton BR1

| Parameter | Value under normal condition (N-0 condition) |
|---|---|
| Violation type | Planning criteria violation (thermal) for both the Dayton-East feeder and Dayton BR1 transformer |
| Applicable areas for load relief | • Relief for Dayton-East must be located downstream (to the northeast) of the 8th St. and Ferry St. intersection.<br>• Relief for the Dayton BR1 transformer can be located anywhere throughout the footprint |
| Violation time and duration | 12-6 PM, Summer weekdays, non-holidays |

Figure 52. Dayton NWS - minimum annual relief required for N-0 scenario




### 6.4.2.4 Customer and equity data

Dayton presents an opportunity to investigate potential benefits and challenges of delivering a NWS in a more rural part of the service area. Key highlights of the customers served by Dayton-East are as follows:

- Of the 1,200 residential customers on the feeder, 79% dwell in single family residences, 14% in manufactured homes, and 7% in multifamily buildings. The relatively high percentage of manufactured homes provides opportunity to leverage innovative delivery mechanisms such as Energy Trust's manufactured home replacement pilot.[69]
- 57% of residential customers own their homes, while 43% are renters.
- Of the 377 business customers, nearly 40% are categorized as agricultural and mining, indicating good potential for irrigation measures as part of the solution set.
- Customers received over $52,000 in energy assistance payments over the last 12 months, with renters receiving 73% of the assistance.

69. Energy Trust's blog, available at: https://blog.energytrust.org/energy-trust-scales-up-work-to-replace-inefficient-manufactured-homes/

### 6.4.2.5 Solutions

#### 6.4.2.5.1 Wired solution

The load on Dayton-East creates two grid needs: load growth-driven thermal capacity upgrade N-0 projects for the Dayton BR1 transformer and the Dayton-East feeder mainline conductor. The N-1 scenarios do not introduce any further needs. If a NWS project can reduce load northeast of the feeder constraint, it can potentially defer both thermal capacity constraints (Dayton BR1 and Dayton-East).

The traditional, wired solution to the constraints on Dayton BR1 and Dayton-East would be to replace the Dayton BR1 7.5 MVA transformer and its associated voltage regulator with a standard 28 MVA transformer, and to reconductor the approximately 6,000 feet of distribution feeder conductor along Southeast Amity Dayton highway from 336 KCM AAC to 795 KCM AAC conductor. Additional substation work would include replacement of the transformer relays and replacement of the transformer high-side fuse with a circuit switcher. The substation work would also require the use of a mobile substation.

#### 6.4.2.5.2 Non-wires solutions

For Dayton, PGE simplified the development of the NWS because of the nature of the grid need and available customer base within which to deploy DERs (Dayton has only one impacted feeder compared to two, larger feeders in Eastport). Similar to Eastport, we developed two options for the NWS to compare against the wired solution: Option 1 (Front-of-the-meter) contained only a single installation of a utility-scale battery storage option, while under Option 2 (Customer Resiliency) the need for a utility-scale battery is reduced by more aggressive customer adoption.

##### 6.4.2.5.2.1. Dayton substation locational value

PGE used the same present worth method developed by Lawrence Berkeley National Laboratory (LBNL) to evaluate the locational distribution-system avoided cost from deferring the identified grid need with a NWS. For the Dayton BR1 and Dayton-East grid needs, deferring the wired investment by 10 years yields an annualized value of $650.53/kW-yr.

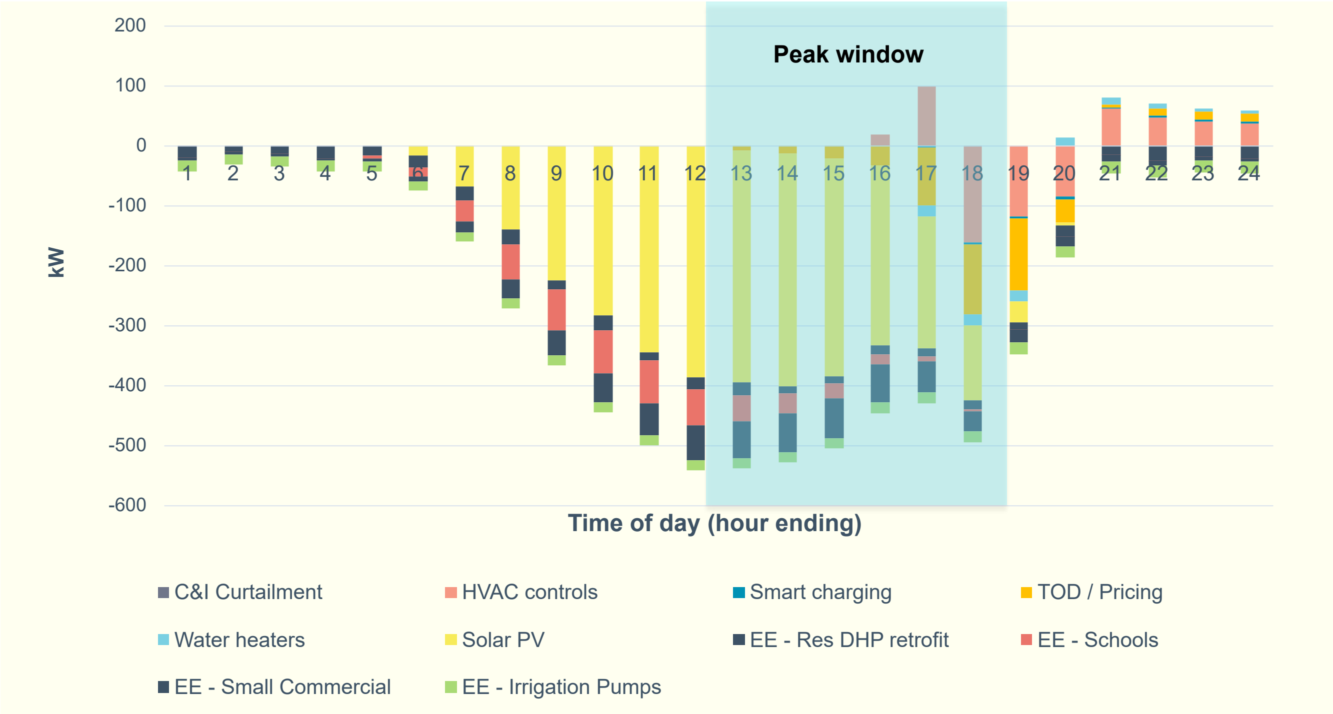
##### 6.4.2.5.2.2. Dayton resource potential and applicability

Given the higher focus on the Dayton NWS toward the utility-scale solution, PGE did not develop as detailed of annual forecasts of DER potential as done for Eastport. Instead, PGE focused on right-sizing the storage solution to mitigate the grid need. To estimate the size of the storage solution, we first compiled the hourly historical SCADA measurements of load on both the Dayton-East feeder and Dayton BR1 transformer during the summer 2021 June heat wave. Using this information, we calculated the max energy and capacity needs to bring the feeder load back under acceptable levels. This method allowed for consideration of potential constraints to charging the battery from the grid up to its max capacity during a multi-day heat wave as experienced in June 2021.

Once PGE sized the system for Option 1, we ran the cost estimates and AMP analysis on the utility-scale solution. For Option 2 – Community Resiliency option, we first layered in the hourly contributions of the distributed customer potential (energy efficiency, solar, storage, and demand response)[70] to reduce the loading described for Option 1. Then with the new, lower loading we sized the max energy and capacity of the front of meter storage requirement. **Figure 53** shows the total hourly profile from the DERs included in Option 2 that were used to adjust the expected future load downward.

70. For developing the DER potential for Dayton NWS - Option 2, we followed the same method described for Eastport.

Figure 53. Dayton NWS Option 2 - Customer resiliency




The addition of the DERs again greatly reduced the capacity and energy need from the utility-scale storage solution but did not eliminate it. **Table 40** shows the final composition of each of the two evaluated NWS options for Dayton.

Table 40. Dayton NWS options - DER portfolio contributions

| NWS element | Option 1 - Reliability focused | Option 2 - Customer resiliency focused |
|---|---|---|
| EE potential | N/A | 1,732,626 kWh/yr |
| DR / Flex potential | N/A | 1.5 MW |
| Solar potential | N/A | 563 kW nameplate |
| Distributed customer storage | N/A | 1.2 MW / 2.4 MWh (2-hr) |
| Utility-scale storage | 2 MW / 12 MWh (6-hr) | 1.5 MW / 6 MWh (4-hr) |

### 6.4.2.6 Dayton costs breakdown

In this section PGE provides a detailed accounting of the costs of each of the evaluated options and discuss our process for considering each in the formation of the final pilot configuration.

The wired solution for resolving the identified constraints involves the following scope of work:

- Installation of temporary 115 kV/12.47 kV mobile transformer
- Removal of existing 7.5 MVA Dayton BR1 transformer and its associated voltage regulator
- Replacement of transformer foundation
- Installation of a new standard 28 MVA transformer
- Replacement of the transformer relays and replacement of the transformer high-side fuse with a circuit switcher
- Removal of temporary mobile transformer
- In addition, the wired solution includes the following scope of work at the feeder level
- Upgrade approximately 6,000 ft. of transmission under-build mainline from 336KCM AAC to 795KCM AAC conductor

The conceptual estimate is approximately $3.3 million. This is a preliminary engineering estimate provided for the purpose of evaluating the NWS. Additional analysis will be performed and a final estimate prepared if we need to move forward with the wired solution. These costs are not included in the near-term action plan.

For the Dayton NWS, Option 1 – Reliability Focused only includes a front-of-the-meter battery. For simplicity, Table 41 shows the cost estimates for the front-of-the-meter storage component of both Option 1 and Option 2 using the same assumptions about capital costs and O&M as used for the Eastport NWS from **Table 32**.

**Table 41. Dayton NWS costs for FTM storage component of each DER portfolio**

| Cost element | NWS Option 1 (2 MW / 12 MWh) | NWS Option 2 (1.5 MW / 6 MWh) |
|---|---|---|
| Total turnkey EPC capital costs | $3,579,096 | $2,160,692 |
| Microgrid controller costs | $91,300 | $91,300 |
| O&M (annual $/yr) | $201,797 | $110,177 |

For all other DERs, PGE developed estimates for the following cost categories:

- **Admin costs** — We assumed 20% adder (applied to the total measure costs of each DER portfolio) to reflect enhanced project management needs, and any targeted marketing required to achieve greater locational adoption for NWS
- **Incentive costs** — We used past incentive data from Energy Trust of Oregon (ETO) and current incentive levels from PGE's Multi-year Plan for flexible loads
- **Participant costs** — We used past data from ETO for energy efficiency and participant cost assumptions from AdopDER for all other DERs.

To assess the DER costs for each portfolio option, PGE took the total expected contributions in Option 2 – Customer Resiliency Focused and used the same cost assumptions as when assessing the Eastport NWS concept.[71] **Table 42** shows the final cost breakdown of Option 2 – Customer Resiliency focused DER portfolio.

71. It should be noted however that there are more current matching funding opportunities in the Portland area due to the availability of the Portland Clean Energy Fund. However, we did not explicitly assume any matching funds for Eastport or Dayton but simply highlight the potential to influence the cost structure of the pilots.

Table 42. Dayton cost summary - Option 2 - Customer resiliency focused

| DER Type | Option 2 - Customer resiliency portfolio | | |
|---|---|---|---|
| | Admin costs | Incentive costs | Participant costs |
| Energy efficiency | $75,055 | $330,640 | $2,142,656 |
| Demand response / flexible load | $169,063 | $602,014 | $309,875 |
| Solar PV | $63,623 | $66,921 | $549,513 |
| Storage | $23,333 | $1,290,759 | $395,970 |

### 6.4.2.7 Dayton benefits breakdown

In this section PGE, provides a detailed accounting of the benefits of each of the evaluated options and discuss our process for considering each in the formation of the final pilot configuration. Similar to Eastport, PGE followed the AMP procedures for assessing the change to reliability and risk from each the wired solution and the two evaluated NWS options in Dayton.

The summary of the AMP analysis is shown in **Table 43**. The table shows reductions in key metrics like NTR and CMI expected to result from each option. It also shows a reduction in expected outage durations that would result from each outage. This is an important customer resilience metric, along with expected number of outages. Expected number of outages is excluded from this summary, as the options presented here had either negligible or zero impact. The near-term values are for the first year of the project being in-service.

Table 43. AMP benefits summary of Dayton wired solution and NWS options

| Scenario | LCOO | NTR | CMI |
|---|---|---|---|
| Wired solution | $2,035,395 | $472,350 | 139,551 |
| NWS Option 1 | -$8,030 | $70,184 | 19,767 |
| NWS Option 2 | $3,083,061 | $252,412 | 54,819 |

**Table 44** shows the system avoided costs that result from the energy efficiency and flexible load portion of the Dayton NWS portfolios.

Table 44. Overall system benefits from energy efficiency and flexible loads

| DER Type | Option 1 - Reliability portfolio | Option 2 - Customer resiliency portfolio |
|---|---|---|
| Energy efficiency | N/A | $1,684,564 |
| Customer-sited storage | N/A | $1,265,761 |
| Demand response / flexible load | N/A | $849,979 |

As discussed for Eastport, NWS provide an opportunity to accelerate customer DER adoption and achieve significant benefits for customers and communities. For Dayton, since we evaluated a slightly different combination of NWS options (with Option 1 comprised of solely a utility-scale battery) these community benefits mainly pertain to Option 2, though certain benefits may accrue as well under the utility-scale battery option.

The customer- or community-sited DER portions of a NWS can provide multiple potential sources of community benefits, including:

- Local employment impacts, especially if installation work is carried out by local contractors
- Reduced air pollution and subsequent public health impacts
- Resiliency to outages and impacts on vulnerable customers and business processes
- Bill savings from reductions in energy use or rebates from program participation

For Dayton there may be an additional potential to derive significant water savings as part of the energy efficiency components of the NWS portfolio (under Option 2) due to the high amount of agricultural activity on the impacted feeder. PGE expects that future collaboration through the CBIAG under the CEP will continue to evolve the quantification of these important benefits. In the meantime, we considered these qualitatively while considering the different NWS options.

#### 6.4.2.8 Greenhouse gas reductions due to NWS

Applying the same methodology was used for Eastport, PGE estimates that the NWS – Option 2 portfolio for Dayton will result in retail electricity demand reductions of 15,476 MWh over the cumulative 10-year deferral period from EE and solar PV installations, resulting in emissions reductions of 4,952 MT CO2e.

### 6.4.3 OUTCOMES AND NEXT STEPS

NWS are inherently a question of trade-offs between competing goals. In most cases, traditional wired solutions will provide greater reliability improvements at lower cost, given their ability to provide for longer-duration support and reach a greater number of customers given their scale. However, important considerations must be factored into decision making surrounding when to invest in a NWS such as the potential value of customer resiliency to withstand grid outages without experiencing interruption of service (which might be particularly beneficial for vulnerable customers and critical public facilities), the additive impact of operating DERs to capture diverse grid benefits (which is not typically possible with traditional wired solutions), and a variety of non-energy considerations such as local employment impacts, environmental and public health benefits, and policy objectives.

PGE demonstrated that as a concept these representative DERs can meet the identified requirements for providing capacity relief on the Eastport NWS location. We have also outlined the potential costs and benefits of implementing each NWS option and the traditional wired solution. Our recommendation is to move forward with Option 2 – Customer Bill relief for both Eastport and Dayton, based on both a quantitative and qualitative examination of the relative strengths of each. Part of our reasoning is that the NWS option with more aggressive DER deployment maximizes the type of customer and community engagement potential that is highlighted throughout our DSP and is also strongly indicated in the UM2005 Guidelines. Targeted deployment of existing customer programs will contribute strongly to NWS project implementation, but new dedicated investments will also be necessary for project success. These investments will need to be aligned with resource planning activities and the evolving regulatory framework.

As we move forward with implementing this pilot concept, a more detailed round of DER planning will need to take place, including more concrete considerations or risk, customer acceptance, and budget impacts. After this more detailed planning round, the final detailed pilot designs would need to be compared the DER portfolios assessed here and examined for any key variances. The planning approach should be validated by PGE program teams and Energy Trust through detailed program planning, as well as other partners contributing to delivery of the DER solutions. In addition, PGE distribution planning engineers will need to validate the final portfolio with a CYME power flow analysis to confirm that the solution addresses all thermal and voltage violations and no new issues arise, such as excess solar generation during the spring or fall due to changing daytime minimum load conditions.