Appendix J. Description of solutions to address grid needs

Below, PGE has outlined estimated costs for prioritized projects as described in **Chapter 5**. The actual project costs will vary as a result of changes in construction costs. Dynamic factors such as the supply chain, labor market, permitting, regulatory requirements and customer growth projections also impact project costs and timelines. PGE reviews projects after design and engineering to validate estimates prior to proceeding with construction.

J.1 Evergreen project

The Evergreen project addresses the grid need of industrial load growth in the North Hillsboro area. This project was originally conceptualized as a transmission-only project to meet NERC Compliance obligations. However, the rapid load growth in the North Hillsboro area dictates the need to add distribution infrastructure to the project. Two new 150 MVA substation transformers, two metal-clad switchgear, and new feeders will be installed to serve the load growth in the area. This project is considered a "must do" because the existing infrastructure is not capable of serving the new customers. As a result, there are no alternatives to this project.

This project started in 2018 and is planned for completion by the end of 2024.

J.2 St. Louis project

The St Louis project is part of the larger Willamette Valley Resiliency Project (WVRP), which is discussed in detail in the Resilience section of **Appendix K**. The WVRP mitigates existing loading and voltage issues on the 57 kV sub-transmission system in the Willamette Valley by rebuilding six substations, converting four of these to 115 kV, and building two new 115 kV lines. The St. Louis project rebuilds the St. Louis substation to a 115 kV ring bus configuration and replaces the existing distribution transformers with two standard 28 MVA transformers. A new commercial customer must be served by a temporary transformer starting in 2022 until the St. Louis project is complete, because there is not enough capacity to serve this new load at the existing substation. This rebuild accommodates this new commercial load growth and the rebuild combined with the rest of the Willamette Valley Resiliency Project provides for at least 50 MVA of load growth in the area.

Currently, the Willamette Valley area 57 kV sub-transmission system is at risk of experiencing overloads and even voltage collapse, which could result in PGE equipment damage and significant customer outages. Multiple options to mitigate these issues were analyzed, including a battery energy supply system (BESS) connected to the 57 kV system. However, with the loading and voltage issues that can persist even in light loading conditions, charging this BESS could contribute to the problems. In addition, the aging substation assets in the area and the potential for significant load growth (including some commercial load growth served by the St Louis substation) dictated the need to improve the reliability and resiliency of the area.

The St. Louis project is beginning in 2022 and is projected for completion in 2025.

J.3 Silverton project

A new feeder, Silverton-Oak, is required to serve a new large industrial customer in the Silverton area. The existing feeder serving the site, Silverton-North, is heavily loaded, exceeding planning criteria, and cannot accommodate the new 5.3 MW of load. Therefore, the new Oak feeder, which will split the North feeder, must be constructed.

The addition of the new 5.3 MW load causes the Silverton BR2 transformer to be heavily loaded during peak summer conditions, exceeding planning criteria. To mitigate this new loading concern, a second new feeder, the Silverton-Garden feeder will be constructed, splitting the Silverton-West feeder and moving 5.1 MW from the Silverton BR2 transformer to the Silverton BR1 transformer.

Both new feeders are low-cost options to serve the new load and mitigate loading issues. Splitting existing feeders to create new feeders is ideal, because you do not need to build new infrastructure for the entirety of the path to the customer. The option to install another feeder and shift load from one transformer to another is ideal to alleviate a heavily loaded transformer because the alternative would be to replace the transformer with a larger transformer, which by itself would exceed the combined cost of the two feeder projects.

The Silverton-Oak feeder is planning for construction in 2022 to meet the new customer timeline. The Silverton-Garden feeder is projected to be constructed before summer 2023 to mitigate the summer loading concern.

J.4 Redland project

The Redland project addresses multiple grid needs west of Oregon City: aging infrastructure, heavily-loaded equipment, and lack of SCADA telemetry. The Leland substation, which is adjacent to the Redland substation, experiences heavy loading on both its substation transformer and two of its three distribution feeders during peak loading conditions, especially during the summer. The Leland substation feeders also are in the top 10 of the AMP Risk Register for both Existing Total Risk and Existing CMI Impact. The Leland substation, however, does have SCADA, and its substation transformer was manufactured in 2001.

The adjacent Redland substation, however, has a substation transformer that was manufactured in 1971 and is shown to be due for replacement per the AMP model. In addition, the Redland substation does not have SCADA telemetry. There are only two distribution feeders served by the Redland substation, and one is heavily loaded during peak summer conditions. Rebuilding the Redland substation addresses the aging infrastructure at Redland, provides telemetry to a rural area, and adds a second distribution transformer to offload heavily loaded equipment at both the Leland and Redland substations, reducing risk and CMI.

The alternative to rebuilding and adding capacity at the Redland substation is to add a second distribution transformer at the Leland substation. This option may mitigate the loading issues at the Leland substation, but the Redland substation will still have infrastructure past its end of life and will not have telemetry. As a result, the most prudent investment is to address all the grid needs in one project by rebuilding and adding capacity at the Redland substation.

The Redland project is beginning in 2023 and is projected for completion in 2025.

J.5 Kaster project

PGE's service territory in the St Helens area is isolated from the rest of the service territory, which means that it cannot be served from adjacent substations in the event of an outage like most of PGE's system. The only PGE-owned substation in the area is the Cascade substation, which is antiquated, past its end of life, and has arc flash concerns. This substation serves only one industrial customer and cannot reliably accommodate new load growth.

A new commercial customer has requested 7.4 MW of load service in PGE's St. Helens service territory. PGE evaluated a few options. The first option was to build a new substation, Kaster, to replace the aging Cascade substation and serve the new load. The second option was to pay CRPUD to make upgrades to serve the load and then build a new smaller substation just to replace the Cascade substation. PGE chose the first option because the St. Helens service territory still has available land for future load growth, and the second option did not allow for future expansion. Rather than pay CRPUD for a one-time solution, we determined that the best option was to build a new substation that can accommodate the existing Cascade substation load, the new 7.4 MW load addition, and have space for future equipment to serve load growth. The new substation will have the room to serve up to 100 MVA with full N-1 redundancy if load continues to grow in the area.

The Kaster project is beginning in 2023 and is projected for completion in 2025.

J.6 Glisan project

The Glisan project addresses the grid need of industrial load growth in the Gresham area. The Glisan substation is a service island to one customer, meaning that if one substation transformer is out of service, the other must be able to serve all the load at the facility. PGE has a contractual obligation to provide full N-1 redundancy to this customer at the Glisan substation.

The Glisan WR1 transformer is rated at 21 MVA nameplate, with a 23.1 MVA summer thermal rating. The Glisan WR2 transformer is rated at 28 MVA nameplate, with a 32.2 MVA summer thermal rating. The current total load served by the two transformers is 22.7 MVA. The customer will begin adding load to their facility in 2022, ultimately reaching 6 MVA of new load by Q2 or Q3 in 2023. This increases the total load served by the two transformers to 28.7 MVA. This load could be entirely served by the WR2 transformer, but not the WR1 transformer. As a result, the WR1 transformer needs to be replaced.

The Glisan WR1 transformer position used to have a 28 MVA transformer. Back in 2013, PGE swapped the Glisan WR1 28 MVA transformer with a 21 MVA transformer at the Ramapo substation to mitigate the heavy loading at the Ramapo substation. At the time, the 21 MVA transformer was sufficient to serve the total load for the customer at the Glisan substation, and PGE was able to perform a low-cost upgrade by swapping two existing transformers to increase capacity at the Ramapo substation. However, now that load is growing at the Glisan substation, the WR1 transformer must be upgraded.

The Glisan project is planned for implementation in 2023.

J.7 Waconda project

The Waconda project is also part of the larger Willamette Valley Resiliency Project, which is discussed in detail in **Appendix K** and earlier in this section under the St Louis project. The Waconda project rebuilds the Waconda substation to a ring bus configuration and replaces the existing distribution transformers with two standard 28 MVA transformers. This rebuild provides capacity for new load growth, including potential Transportation Electrification growth as part of the West Coast Clean Transit Corridor (WCCTC) initiative.

The Waconda project also includes the construction of a third 115 kV transmission source to the substation which improves reliability and resiliency.

The Waconda project is beginning in 2023 and is projected for completion in 2026.

J.8 Harrison project

The Stephens substation was decommissioned in 2020. To temporarily serve the non-standard 11 kV distribution feeders, a temporary transformer was installed at the Harrison substation. This is a service island in SE Portland, as the rest of the circuits in the area are at the standard 13 kV voltage. The Harrison project mitigates these grid needs by installing a standard 115/13 kV transformer at the Harrison substation and converts the non-standard 11 kV distribution feeders to 13 kV, served by the new transformer. This enables the removal of the temporary transformer, to be used for maintenance or other truly temporary needs as it was intended.

There are no cost-effective alternatives to this project, as the Harrison substation is the closest substation to the former Stephens substation.

The Harrison project is beginning in 2022 and is planned for completion in 2025.

J.9 Linneman project

The Linneman project addresses the grid needs of residential load growth in the Happy Valley area and the use of temporary equipment to serve this load growth. Load has been steadily increasing in the Happy Valley and Gresham areas. In June 2021, a mobile substation had to be installed at the Pleasant Valley substation to serve load during the heat wave, because existing infrastructure was heavily-loaded and at risk of exceeding its thermal limits. This mobile substation remains at the Pleasant Valley substation because the area is constrained.

The Linneman substation site used to be a transmission-only substation and was decommissioned in 2020. PGE now wants to use this property to install distribution infrastructure to help serve load in the Happy Valley area and alleviate heavily-loaded equipment. This will enable the removal of the mobile transformer at the Pleasant Valley substation so it can be used for its intended purpose, maintenance and emergency situations. Using an existing PGE-owned property is the least-cost

alternative because PGE does not need to purchase property for a new substation elsewhere.

The Linneman project will begin in 2023 and is projected for completion in 2025.

J.10 Boring project

The Boring project addresses multiple grid needs in the area of the City of Boring, OR, specifically heavily loaded equipment and aging infrastructure. The Boring BR1 transformer was removed from service in 2019 due the threat of imminent failure. PGE's operations team detected increased gassing which could have caused a catastrophic failure of the transformer and damage to other equipment and a significant safety risk to personnel, if left in service. As a result, the load from that transformer was transferred to other facilities in the area. This has resulted in heavily loaded transformers at both Boring and Dunns Corner, as well as voltage problems because the distribution feeders serving the load that was served by Boring BR1 are now much longer.

In addition, the Boring BR2 transformer was manufactured in 1957 and is nearing the end of its economic life per the AMP models. Numerous other pieces of equipment at the Boring substation are also at their end of life, including the SCADA telemetry system. The complete rebuild of the substation is the recommended option to address aging infrastructure and add capacity with a second transformer.

One alternative is to rebuild the substation with only one 28 MVA substation transformer. However, this does not provide the full N-1 redundancy that two 28 MVA transformers provide. Loading and voltage issues could still occur if there was an outage to the one Boring substation transformer.

The Boring project is beginning in 2023 and is projected for completion in 2025.

J.11 Glencullen project

The Glencullen project addresses multiple grid needs in SW Portland: heavily-loaded equipment at adjacent substations, lack of SCADA telemetry, and multiple tree-related outages on distribution feeders. The Sylvan substation is heavily loaded during peak summer conditions on both the substation transformer and one of the distribution feeders. When PGE rebuilds a substation and equipment is taken out of service for many months, the load served by that substation must be either transferred to a temporary transformer or to adjacent substations. Unfortunately, there is not enough room at the Sylvan substation to install a temporary transformer and have enough room to construct the new facilities. Some of the load at Sylvan can be transferred to the Cedar Hills substation, but this still leaves significant load unserved. Installing additional capacity with a second transformer at the Glencullen substation provides the capacity to pick up the load from the Sylvan substation for the rebuild. This second transformer enables full N-1 transformer redundancy for both the Sylvan substation and the Glencullen substation in the event of future maintenance or unplanned outages. The Glencullen substation also lacks SCADA telemetry, so the rebuild will include the installation of a SCADA system. In addition, the Glencullen distribution feeder's route goes through some heavily treed areas and has experienced multiple tree-related outages. This project will address these outages by installing tree wire.

The rebuild and capacity additions for both Glencullen and Sylvan substations provides capacity for a future rebuild of the Canyon substation, which carries the 4th-most risk of all of PGE's substations.

The Glencullen project is beginning in 2023 and is projected for completion in 2026.

J.12 Scholls Ferry project

The Scholls Ferry project addresses the grid needs of existing heavily loaded equipment and significant residential load growth. The Murrayhill WR2 substation transformer and the Scholls Ferry WR1 substation transformer both exceed planning criteria during peak summer conditions. In addition, three of the five Murrayhill substation distribution feeders exceed Planning Criteria during peak summer conditions. The Murrayhill-Kinton feeder can exceed its summer thermal rating during peak summer loading conditions. As a result, load on this feeder must be shifted to adjacent distribution feeders, which constrains these distribution feeders.

There are multiple residential developments in various stages of construction around the Scholls Ferry substation. Approximately 16,700 new homes are planned and new infrastructure is required to serve these new developments, as the existing infrastructure is already constrained. The Scholls Ferry project installs a second transformer at the Scholls Ferry substation, a 50 MVA transformer, to both have enough capacity to serve the new load and provide redundancy on the system in the event of an outage. Five new distribution feeders will be installed to be served by this new transformer.

An alternative was analyzed with a 28 MVA transformer installed at Scholls Ferry substation instead of a 50 MVA transformer. This option does not have enough capacity to offload the heavily loaded Murrayhill substation while also serving the projected new load. As a result, an additional capacity addition to alleviate loading at the Murrayhill substation would need to be completed, which is not as cost effective as the recommendation to install a 50 MVA transformer at the Scholls Ferry substation.

The Scholls Ferry project is beginning in 2023 and is projected for completion in 2025.