Assessment of Proposed Energize Eastside Project

Technical review with respect to Section 18.44.052 of the City of Newcastle Municipal Code

Prepared for the City of Newcastle

June 2020 Update[1]

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[1] This core update contains data furnished by PSE in May 2020.

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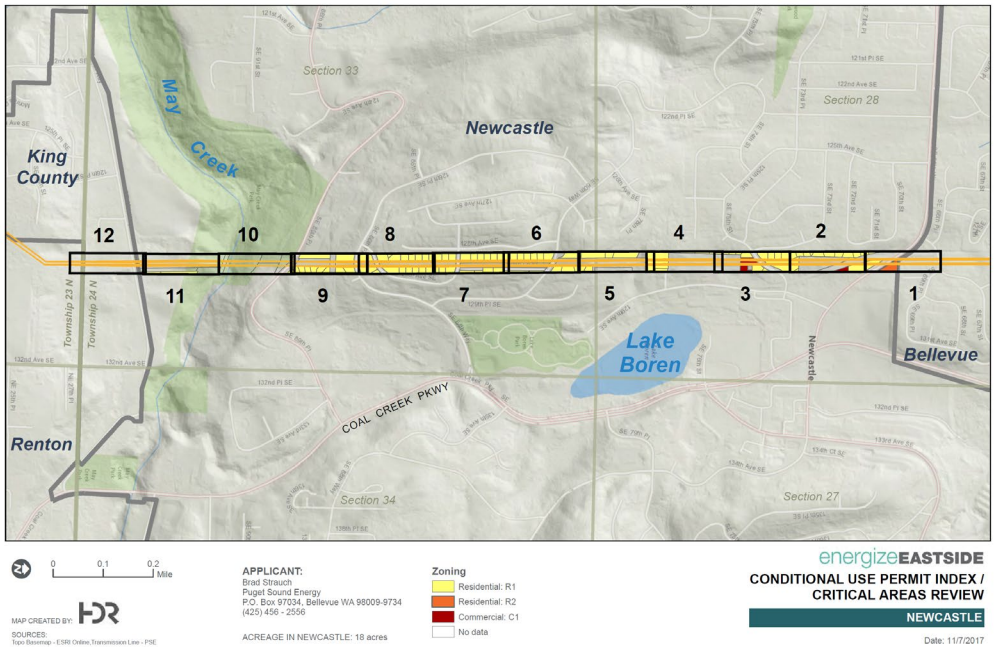
1. EXECUTIVE SUMMARY

Background

Puget Sound Energy (PSE) is projecting rapid load growth in the Eastside area near Lake Washington in Washington State. As a result, the utility identified the need to upgrade its substation and transmission infrastructure as early as 2008. To meet this need PSE proposed the Energize Eastside project in 2013, which entails building a new substation and upgrading transmission lines. PSE also investigated alternatives to building the substation, including energy conservation, batteries, and solar panels. However, the company concluded that such alternatives would not sufficiently address reliability concerns caused by the expected load growth.

As part of the Energize Eastside project, PSE applied to the City of Newcastle for a Conditional Use Permit (#CUP17-002) for a Regional Utility Facility. PSE asked to upgrade its electric transmission facilities for approximately 1.5 miles in the existing utility corridor, Willow 1, that spans approximately 1.5 miles in Newcastle; see Figure 1 below.

Figure 1. PSE proposed Energize Eastside electric transmission route, Newcastle



Source: PSE Site Plans, Energize Eastside Project, November 2017.

The upgrades in Newcastle are part of a large transmission project plan[2] that extends from the Sammamish transmission substation in Redmond to the Talbot Hill transmission substation in Renton (Figure 2). This plan was proposed to address several identified contingency[3] deficiencies in transmission capacity that PSE claims are triggered by summer and winter peak demand in King County. The proposed Energize Eastside project would build a new electric substation, the Richards Creek substation in Bellevue, and upgrade existing transmission lines in Redmond, Bellevue, Newcastle, and Renton.

In parallel with two other local communities affected by the project, the City of Newcastle is investigating PSE's Eastside filings to assess the need for the Energize Eastside project and to determine whether to provide the utility a city permit to allow PSE to upgrade its transmission infrastructure. MaxETA and Synapse Energy Economics were hired by the City of Newcastle to aid this investigation.

Figure 2. PSE proposed Energize Eastside electric transmission facilities and route

Source: Energize Eastside Project Newsletter Summer 2017

Methodology

As part of this need assessment, MaxETA and Synapse team assessed:

a) Whether PSE's load forecast methodology and assumptions, as well as forecast results, are reasonable and technically sound;

b) Whether there is a regional need for additional transmission capacity to maintain reliability;

c) Whether PSE has taken all necessary and cost-effective measures (including demand-side measures) to prevent an operational need from arising.

MaxETA and Synapse team reviewed various publicly available reports prepared by PSE as well as additional data obtained from PSE regarding historical and updated forecasted loads, conservation, and other demand-side resources.[4] The team also carried out a load flow model analysis to evaluate regional

[2] Energize Eastside, https://energizeeastside.com/.
[3] Contingency – an event where one or more electric facilities suffer an outage.
[4] See Section 4, Reviewed Material.

load conditions under contingencies, including whether the regional capacity thresholds estimated by PSE are reasonable.

Key Findings

- Our assessment of power flows finds that current or projected electric peak demand arising solely from the City of Newcastle does not trigger an operational need for the proposed transmission expansion.[5] However, our analysis shows that the current summer electric peak demand in King County has already triggered an operational need for the proposed transmission expansion to address system contingency scenarios and ensure the security of the Bulk Electric System.[6]

- Our power flow model assessment finds that the regional capacity thresholds in King County estimated by PSE are reasonable.

- The PSE load forecast approach follows a standard industry practice, although it has some limitations regarding the way it identifies and incorporates demand-side resources.

- Our review of historical summer peak loads and the capacity thresholds in King County provided by PSE shows that there is a summer transmission capacity deficiency in King County under N-1-1 contingencies even at today's peak load level. We further find that this capacity deficiency for the summer season has been 13 to 20 percent (or 200 to 300 megawatts, or MW) above the area's capacity threshold.

- Our review of historical winter peak loads and the capacity thresholds in King County shows PSE's winter peak load actually has been declining over the past several years. While we found that PSE's own winter load forecast is above the capacity threshold, we cannot conclude based on the data we analyzed whether there is a clear need for transmission capacity expansion for serving winter peak loads. PSE's past winter peak load forecasts have over-predicted winter peak loads and the current forecast does not appear to fully incorporate either the declining trend seen in winter peak over the last decade or potential emerging conservation opportunities.[7]

- PSE has adequately conducted transmission planning that seeks to prevent a facilities outage from becoming a customer interruption.

[5] This finding addresses a question posed by Newcastle. It is outside the scope of this evaluation to determine if the question posed by Newcastle is consistent with municipal code requirements.
[6] An unsecured Bulk Electric System could impact the reliability of electric service in Newcastle.
[7] By its very nature, load forecasting is a forward-looking planning tool.

Conclusions

PSE has demonstrated that the proposed transmission upgrades are needed to safeguard the operational reliability of the electric system as a whole.[8] To maintain system security, power systems are operated so that overloads do not occur either in real-time or under any statistically likely contingency. Not securing the bulk electric system to operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies could affect the electric supply reliability in Newcastle. This peer review verified that under specific contingencies (N-1-1 and N-2) the as-is bulk electric system serving Newcastle is already susceptible and operationally reliant in the implementation of Corrective Action Plans (CAPs).This means that PSE's application has met the threshold for approval described in Newcastle City Code C-5 under NMC 18.44.052 Utility facilities – Regional: "[t]he applicant shall demonstrate that an operational need exists that requires the location or expansion at the proposed site."

The current transmission deficiency can be cured by upgrading one of the 115kV transmission lines between the Talbot Hill and Sammamish substations to 230kV and installing an additional 230kV/115kV 325MVA transformer at the proposed Richards Creek substation in Bellevue. Upgrading the second 115kV transmission line that currently travels through the same corridor, Willow 1, to 230kV is consistent with good system planning, particularly because the facilities to support these higher voltages will already be deployed.

[8] Electric system as a whole is also referred to as Bulk Electric System.

Recommendations

We recommend that the Conditional Use Permit to PSE to upgrade the identified approximately 1.5 miles of existing 115kV lines with 230kV lines come with a condition: PSE should conduct an independent design assessment of the overhead transmission facilities traversing Newcastle to verify compliance with the clearance safety rules for the installation and maintenance of overhead electric supply of the 2017 National Electrical Safety Code (NESC), ANSI C2 Part 2. [9] We also recommend that the City of Newcastle send field inspectors during the transmission line upgrades to ensure compliance with the 2017 NESC.

[9] https://apps.leg.wa.gov/WAC/default.aspx?cite=296-45-045

2. INTRODUCTION AND NEWCASTLE MUNICIPAL CODE REVIEW

Puget Sound Energy's (PSE) past and current load forecasts show continued growing electric load in the Eastside area near Lake Washington in Washington State. The utility examined the expected growing demand in detail and identified the need to upgrade its substation and transmission facilities as early as 2008. In 2013, the PSE proposed the Energize Eastside project to address this load growth issue, including a proposal to build a new substation and upgrade transmission lines. PSE also investigated alternatives to building new substation and transmission facilities, specifically energy conservation, demand response, batteries, and solar panels. However, PSE's studies concluded that such alternatives would not sufficiently address reliability concerns caused by the expected load growth.

In parallel with two other local communities affected by the project, the City of Newcastle is investigating PSE's Eastside filings to assess the need for the Energize Eastside project and to determine whether to provide the utility a city permit to allow PSE to upgrade its transmission infrastructure. MaxETA and Synapse Energy Economics were hired by the City of Newcastle to aid this investigation.

The City of Newcastle requires that "[p]roposals that include new or expansions to existing utility facility – regional shall demonstrate compliance with" several criteria under NMC 18.44.052 ("Utility facilities – Regional") in addition to the conditional use permit criteria listed in NMC 18.44.050. For the purposes of NMC 18.44.052, expansions include "a modification of an existing regional utility facility by an increase in the size, height, impervious coverage, floor area, or parking area of the facility by greater than 10 percent."

Among others, our review specifically investigates whether PSE as an applicant to the City of Newcastle has complied with the following criteria under NMC 18.44.052:

> C-5. The applicant shall demonstrate that an operational need exists that requires the location or expansion at the proposed site;
>
> C-6. The applicant shall demonstrate that the proposed utility facility – regional improves reliability to the customers served and reliability of the system as a whole, as certified by the applicant's licensed engineer;

To find answers to these code requirements, this independent consultant report assesses:

a) Whether PSE's load forecast methodology and assumptions, as well as forecast results, are reasonable;

b) Whether there is a regional need for additional transmission capacity to maintain reliability; and

c) Whether PSE has taken all necessary and cost-effective measures (including demand-side measures) to prevent an operational need from arising.

3. OVERVIEW OF EASTSIDE NEEDS ASSESSMENT AND EASTSIDE PROJECT

3.1. History of Eastside Needs Assessments

Since 2008, PSE has conducted numerous studies on the reliability of its transmission facilities to meet future peak load conditions and needs for transmission facility expansion. These studies identified a variety of concerns, and the studies conducted in recent years identified and examined solutions to the concerns in detail.

Earlier studies include the 2008 Initial King County Transformation Study, 2009 PSE TPL Planning Studies and Assessment, and the 2012 PSE TPL Planning Studies and Assessment.[10] These studies found that "potential thermal violations may occur on facilities from Talbot Hill Substation to Sammamish Substation," as noted in a 2013 study commissioned by PSE called the "2013 Eastside Needs Assessment."[11]

More recent studies focused on transmission facilities in the Eastside area and examined both the transmission needs as well as solutions. The studies that focused on the need for the transmission facilities are:

- 2013 Eastside Needs Assessment Report ("2013 Needs Assessment") prepared by Quanta Technology
- 2015 Supplemental Eastside Needs Assessment Report ("2015 Supplemental Needs Assessment" or "2015 Needs Assessment") prepared by Quanta Technology

Notably the 2013 Eastside Needs Assessment found that there would be a transmission deficiency in the winter of 2017–2018 and in the summer of 2018. More specifically, these key findings are as follows:

- "For the Winter peak at approximately 5,200 MW (2017–18 in the model) there are two 115 kV elements with loadings above 98% for Category B (N-1) contingencies and five 115 kV elements above 100% for Category C (N-1-1 & N-2) contingencies."
- "For the Summer peak at approximately 3,500 MW (2018 in the model), there are two 230 kV elements above 100% and two 115 kV elements above 93% loadings for Category B (N-1) Contingencies. There are also three elements above 100% loading and one above 99% loading for Category C (N-1-1) contingencies."[12]

[10] Descriptions of these studies are provided on page 23 of the 2013 Eastside Needs Assessment.
[11] Quanta Technology 2013. Eastside Needs Assessment Report – Transmission System King County.
[12] Quanta Technology 2013. Page 8.

The 2013 Needs Assessment also found that a summer load level of need (3,340 MW) could occur as early as 2014. However, the study emphasizes that the PSE summer load level where King County starts to have significant issues is at about the 3,500 MW level projected for 2018.[13]

The 2013 Eastside Needs Assessment report also indicated the need to expand the use of Corrective Action Plans ("CAPs") to manage these overloads. CAPs are implemented according to the regional entity's procedures to remedy a specific system problem using a list of actions and an associated timetable for implementation. These actions include:[14]

- Installation, modification, retirement, or removal of transmission and generation facilities and any associated equipment
- Installation, modification, or removal of Protection Systems or Special Protection Systems
- Installation or modification of automatic generation tripping as a response to a single or multiple Contingency to mitigate Stability performance violations
- Installation or modification of manual and automatic generation runback/tripping as a response to a single or multiple Contingency to mitigate steady state performance violation
- Use of Operating Procedures specifying how long they will be needed as part of the Corrective Action Plan
- Use of rate applications, Demand Side Management (DSM), new technologies, or other initiatives
- If situations arise that are beyond the Transmission Planner or Planning coordinator that prevent CAP implementation in the required timeframe:
    - Non-Consequential Load Loss
    - Curtailment of Firm Transmission Service

PSE does not advocate for the use of CAPs as a solution to an identified need.[15] As a temporary operational alternative, NERC Standard TPL-001-4 allows curtailment and loss of load for specific contingencies to meet performance requirements. However, it is best practice to avoid the use of these operating procedures.

The 2013 Needs Assessment also indicated the overloads could be more severe if peak loads were higher as a result of other factors, such as extreme cold weather conditions, higher load growth due to local economic conditions, or lower conservation achievements relative to PSE's conservation targets.

The 2015 Supplemental Needs Assessment verified that there was still an expected transmission capacity deficiency in the Eastside area in the winter of 2017–2018 and in the summer of 2018. This

[13] Quanta Technology. 2013. 2013 Eastside Needs Assessment, page 8, 9, 13 and 70; Quanta technology. 2015. 2015 Supplemental Eastside Needs Assessment Report, page 18.

[14] NERC Standard TPL-001-4 R2.7

[15] 2015 Supplemental Eastside Solutions Study Report.

study further identified that the summer capacity deficit is worse than what was identified in the 2013 Needs Assessment. The 2015 study found expected needs to use CAPs and load shedding to mitigate the system deficiency while the 2013 study found CAPs would be required, but not load shedding.[16]

To address these potential transmission deficiency problems, PSE carried out numerous studies to examine potential solutions including traditional supply-side solutions and non-wires solutions such as energy efficiency, demand response, and batteries: [17]

- 2013 Eastside Solutions Study Report (Updated February 2014), prepared by Quanta Technology
- 2014 PSE Screening Study, prepared by E3
- 2014 Eastside 230 kV Project Underground Feasibility Study, prepared by Power Engineers
- 2015 Supplemental Eastside Solutions Study Report, prepared by Quanta Technology
- 2015 Eastside System Energy Storage Alternatives Study, prepared by Strategen
- 2015 Lake Washington Submarine Cable Alternative Feasibility Study, prepared by Power Engineers
- 2018 Eastside System Energy Storage Alternatives Assessment Update, prepared by Strategen

3.2. PSE's Latest Eastside Contingency Load Threshold Analysis

The 2013 Eastside Needs Assessment Report includes a heat map that PSE claimed is a depiction of electric load density. However, we note that this map shows the most densely populated areas in and around the Eastside (see Figure 3) which do not necessarily coincide with electric demand. We conducted power flow models in the Northwest area serving the South King county zone using historical and projected peak demand for King County.[18] We ran the models employing the base cases provided by the Western Electricity Coordinating Council (WECC) and varying key sensitivities while maintaining the projected peak demand constant to evaluate regional grid conditions under various contingency events.

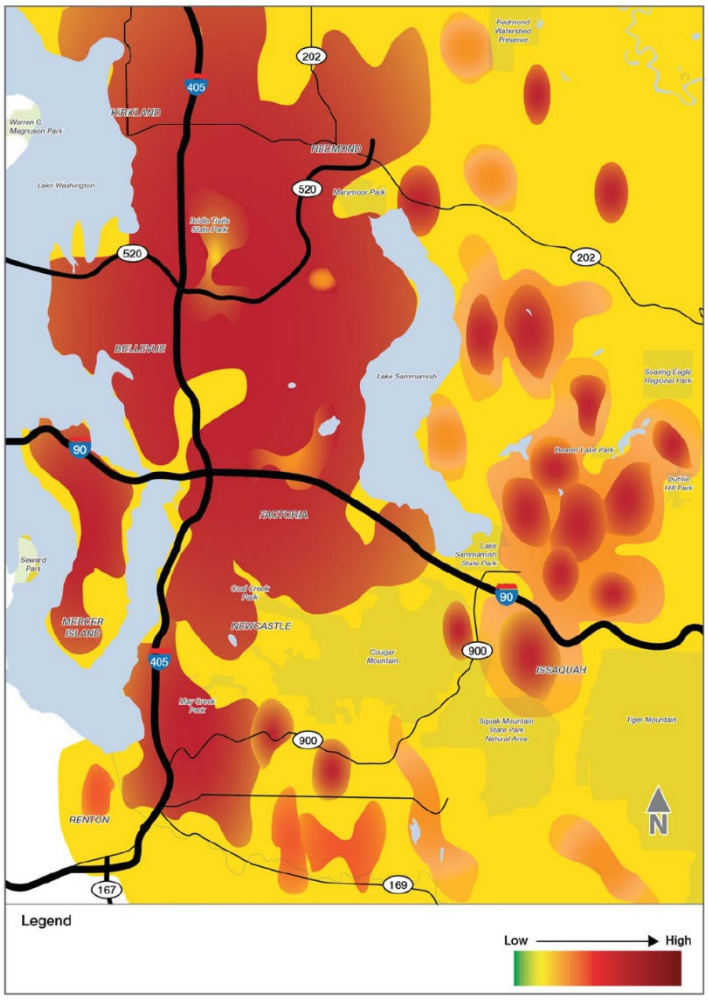
For Summer 2018, our load flow analysis verified that under N-1-1 contingencies the 230/115kV transformers at the Sammamish substation will overload when modeled using reasonable transformer series resistances and reactances and MVA operational limits. However, we also found that realistic increases in peak demand arising solely from the City of Newcastle, primarily served by the Hazelwood substation in the South King County zone, have negligible effect in the thermal transformer overloads identified for the Sammamish substation.

[16] Quanta Technology. 2015, page 4.

[17] These studies are available at https://energizeeastside.com/.

[18] An assessment of historical and projected peak demand is discussed in Section 5, for summer peak loads, see Figure 10 in Section 5.

Figure 3. Modified heat map



Source: 2013 Eastside Needs Assessment Report depicts population density.

We were able to verify that under several contingencies certain facilities of the bulk electric system serving Newcastle will overload. The operational need arises from having to comply with NERC reliability standards that safeguard the security of the bulk electric system and not due to the discrete electric peak demand in Newcastle. We want to highlight that Newcastle will experience electric supply reliability issues if the bulk electric system is not secured.

Page 18 of the 2015 Supplemental Needs Assessment references 3,340 MW of area summer load as a threshold above which PSE's transmission facilities will be overloaded under extreme system contingency events. Table 6-12 from the 2013 Eastside Needs Assessment further justifies the 3,340 MW as a level of concern by demonstrating equipment is overloaded to 100 percent of emergency rating during N-1-1 contingency at 3,340 MW of area summer load. In 2017, PSE switched to Electric Power Research Institute's PTLOAD program to calculate load limits for transformers because the existing in-house software was unmaintainable. The PTLOAD program is a widely accepted tool in the industry for rating transformers. With the new software, PSE adjusted its level of concern downward to

3,125 MW in the summer. The level of concern load level difference between 2013 and 2019 is mainly due to a change to a more widely accepted method of determining the individual transformer ratings. The latest estimate of the level of concerns by PSE is provided in Table 1 below for the PSE's entire service territory and for King County. Our load flow analysis confirmed that these load thresholds are reasonable.

Table 1. PSE's revised load thresholds

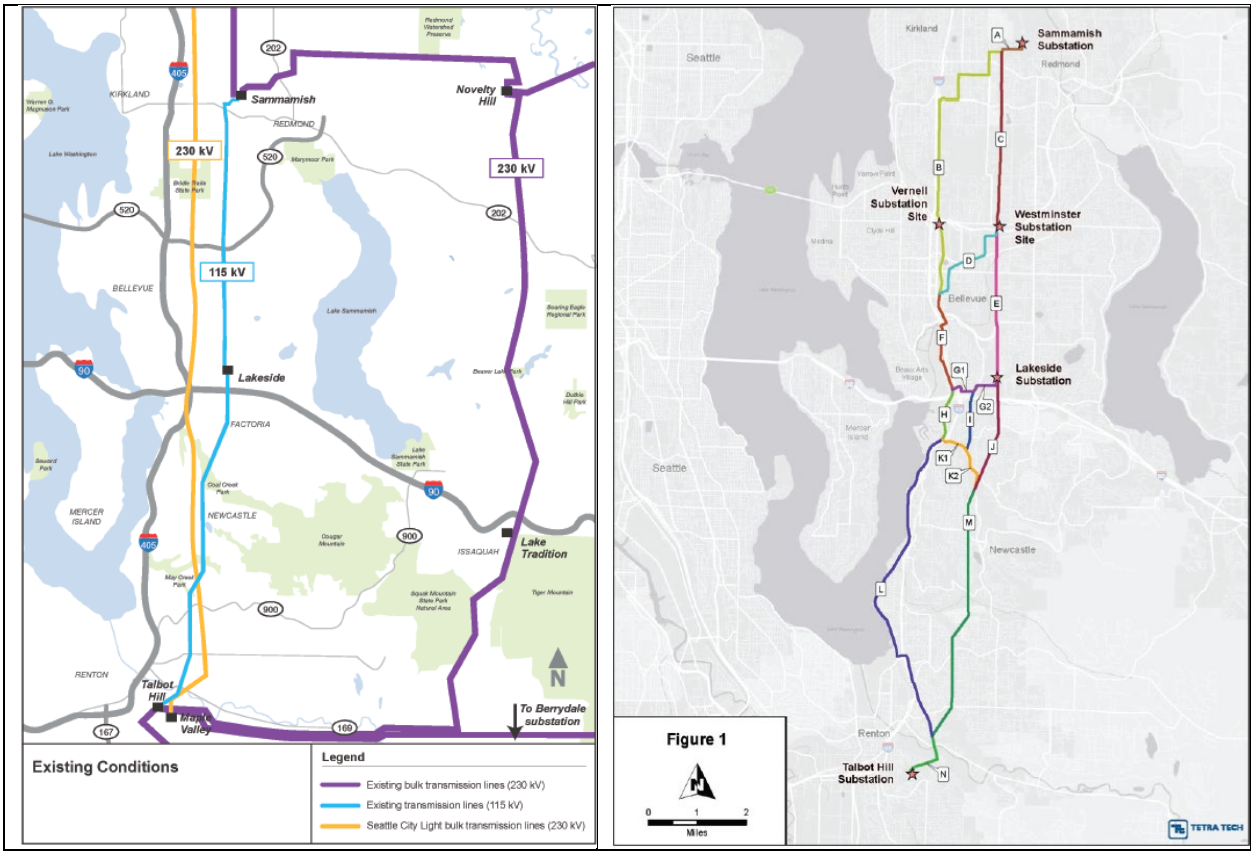
	Summer (MW)	Winter (MW)
PSE Area Load (Native + Transportation)	3125	5000
King County (Native + Transportation)	1594	2436

Source: PSE Data Request Response – September 9, 2019; Note: These load levels were calculated by scaling 2018 TPL seasonal caseloads until the emergency rating exceeded 100 percent during N-1-1 contingency.

3.3. Description of Proposed Eastside Project

PSE identified several contingency[19] deficiencies in its transmission capacity that are triggered by summer peak demand in King County. To address these deficiencies, PSE proposes a transmission expansion plan[20] that extends from the Sammamish transmission substation in Redmond to the Talbot Hill transmission substation in Renton (Figure 4). The proposed Energize Eastside project will also build a new electric substation, the Richards Creek substation in Bellevue, and upgrade existing transmission lines in Redmond, Bellevue, Newcastle, and Renton. PSE claims that these upgrades and new facilities are needed to ensure the bulk electric system continues to perform reliably under several contingencies.

Figure 4. Energize Eastside project's proposed upgrade to the Sammamish-Talbot Hill 115kV transmission line (blue line left) to 230kV and new substation, the Richards Creek substation, in Bellevue



Source: Tetra Tech (December 2013) Eastside 230kV Project Constraint and Opportunity Study for Linear Site Selection.

[19] Contingency – an event where one or more electric facilities suffer an outage.

[20] Energize Eastside, https://energizeeastside.com/.

4. LOAD FORECASTS AND NEED ASSESSMENT

4.1. PSE Load Forecast Methodology

The PSE load forecast approach follows a standard industry practice, although it has some limitations regarding the way it incorporates demand-side resources. PSE uses typical econometric models to forecast energy and peak loads over a 20-year time period. PSE's forecasting approach mainly consists of a regional economic and demographic model and a billed sales and customers model. The former uses both national- and county-level data to produce a forecast of various economic and demographic factors (*e.g.*, employment, types of employment, unemployment, personal income, population, households, building permit, etc.). The latter model takes the outputs from the former model and projects the number of customers by class as well as the energy use per customer by class. This model then multiplies the number of customers and energy use per customer to arrive at the billed sales forecast by class.

PSE uses another regression model to estimate electric peak loads based on observed monthly peak system demand and monthly weather normalized delivered demand.[21] It is not clear how much historical data are used in PSE's load forecast models, but one report produced by a consultant for Bellevue (Bellevue Consultant report) stated that key historical statistics are available for the entire system from 2000 and for King County and Eastside area from 2006.[22]

PSE's current forecasts are produced for each county. However, PSE also produced a forecast specific to the Eastside area in the 2013 and 2015 Eastside Needs Assessment studies. The Bellevue Consultant report noted that PSE started to produce county-by-county forecasts starting in 2015. The report also noted that for the 2013 and 2015 Eastside Needs Assessment studies, PSE produced the Eastside-specific forecast from the King County forecast using census tract data.[23] However, our data request to PSE revealed that PSE has not updated its forecast for the Eastside area since then, despite the fact that the Eastside was the most critical area of the Needs Assessment studies.[24]

PSE also makes some further adjustments to its load forecasts. Most notably, PSE reduces annual energy and peak load demands to account for the cost-effective amount of energy conservation (also called demand-side resources) identified in PSE's integrated resource plan (IRP) process.[25] The 2013 and 2015 Eastside Needs Assessment studies included several conservation scenarios, including one scenario called 100% Conservation (including 100 percent of the conservation potential estimated in the most recent IRP) and a 75% Conservation scenario. PSE has been including the impacts of electric vehicles in

[21] PSE. 2017. 2017 PSE Integrated Resource Plan, Chapter 5.

[22] Utility System Efficiencies, Inc. 2015. Independent Technical Analysis of Energize Eastside, prepared for the City of Bellevue, Page 19.

[23] Utility System Efficiencies, Inc. 2015. Page 15.

[24] PSE response on June 14, 2019 to Newcastle Consultants' data request on May 15, 2019.

[25] PSE. 2017. 2017 PSE Integrated Resource Plan, Chapter 5, page 5-2.

its load forecast since its 2017 IRP.[26] PSE also includes the impacts of specific new construction projects in its near-term load forecasts, but correctly transitions those projects out of the forecast over several years to reflect the fact that new construction is included in the econometric projections of the base load forecast.

4.2. PSE Evaluation of Conservation and Other Demand-Side Resources

As mentioned above, PSE commissioned several studies to examine the potential of energy conservation and other demand-side resources as NWAs to the Energize Eastside project. These studies specifically examined whether there are sufficient demand-side resources available to reduce peak loads to the levels below critical thresholds under transmission contingency events (*e.g.*, N-1-1 conditions). Below we briefly summarize each of the key studies. Appendix A lists these studies as well as other studies we reviewed.

- **2013 Eastside Needs Assessment by Quanta Technology**: As mentioned above, in order to examine the need for transmission expansion, this study analyzed the impact of energy conservation measures on peak load forecasts based on the most recent IRP. The study assessed the capacity overloads for the entire PSE system and for the Eastside area with various conservation levels including a 100% Conservation scenario. The study identified system overloads by 2017–2018 for winter peak and as early as 2014 for summer peak under normal weather conditions, assuming 100 percent of the energy conservation estimated in the recent IRP. The study is not clear regarding which version of the IRP was used to develop conservation estimates, but it is likely that the study used PSE's 2013 IRP given the timing of the study.

- **2015 Supplemental Eastside Needs Assessment by Quanta Technology**: This report updated the load forecasts and reassessed the need for transmission capacity expansion in the Eastside area. The report indicates no changes to its energy conservation assumptions or methodologies. Unlike the 2013 study, this report clearly indicates that it used conservation targets from the 2013 IRP, although Quanta did not include the active demand response from that IRP because PSE did not implement active demand response following the IRP's publication.[27]

- **E3 study**: In early 2014, E3 assessed the potential for NWAs in King County to defer the proposed transmission upgrades in the Eastside area, including energy efficiency, demand response, and distributed generation.[28] Using additional avoided benefits of deferring the transmission upgrades, the study assessed as NWAs incremental amounts of cost-effective demand-side resources beyond the level of resources selected in PSE's 2013 IRP. The study found a total of 56 MW of incremental demand-side resource potential (30 MW from energy efficiency, 25 MW from demand response, and 1 MW from distributed generation) in King County. The study concluded that these demand-

[26] PSE. 2017. 2017 PSE Integrated Resource Plan, Chapter 5, page 5-37.

[27] Quanta Technology. 2015. Page 7.

[28] E3. 2014. 2014 PSE Screening Study.

side resources are not sufficient to defer the transmission need because the region will be 75 MW short with PSE's 100% Conservation scenario or 100 MW short with its 75% Conservation scenario (which also acts a proxy for the higher load growth scenario or extreme winter conditions). The study focused on winter peak loads, apparently because winter peak is the main focus of the 2013 Needs Assessment. Detailed examination of this study is outside of the scope of our analysis. However, it is not clear to us whether the amount of demand-side resources identified in this study is still valid today, mainly because the study is more than six years old and because potential amounts likely have changed since then.

- **Strategen 2015:** PSE commissioned Strategen to evaluate the feasibility of electric battery storage as an incremental measure to the additional demand-side resources identified by the E3 study.[29] The study examined annual hourly load data and determined that Talbot Hill substation was the substation with the most significant normal and emergency overloads that occur during the winter period. Assuming the demand-side resource results from the E3 study, the study examined load flows of the network transmission system and determined the battery sizes necessary to resolve normal overload reductions in the short term (Baseline), emergency overload elimination (Alternative #1), and normal overload elimination in the long term (Alternative #2). The resulting battery sizes are 328 MW, 121 MW, and 544 MW respectively.[30] The study also examined the technical feasibility and cost-effectiveness of large-scale batteries and concluded that batteries are not technically feasible under the Baseline and the Alternative #2 scenarios due to the excessive size of the batteries, siting limitations, long project timeline, and limited transmission system capacity to charge the batteries. The study then found that while the Alternative #1 (121 MW battery for resolving 34 MW of emergency overload) is technically feasible and cost-effective with a benefit-cost ratio of 1.13 and a $264 million net present value cost estimate, this scenario does not meet PSE's reliability requirements. However, we note it is likely that the estimated battery sizes are overestimated for addressing winter peak loads because the historical winter peak loads have been substantially lower than projected in the past. Nevertheless, the study's results for addressing the summer peak overloads are likely still applicable.

- **Strategen 2018**: PSE commissioned Strategen to conduct a new study updating the Strategen 2015 study to consider changes to substation equipment ratings, PSE's updated load forecasts in 2017, and recent advancements in the energy storage market.[31] This study analyzed the feasibility of two scenarios: (a) the Interim Solutions that meet the Winter 2018/2019 and Summer 2019 overload constraints and (b) the Complete Solution that meets PSE's 2027 forecasted need. The conclusions of this study are mostly consistent with the findings of the Strategen 2015 study. The 2018 Strategen Study found that energy storage is still not a practical solution to meet the expected

[29] Strategen. 2015. Eastside System Energy Storage Alternatives Screening Study.

[30] These estimates take into account battery degradation factors and the study's finding that only 20 percent of the battery capacity is effective in reducing load at the substation and the rest of the battery outputs are expected to affect loads in other substations due to the interconnected nature of the network transmission system.

[31] Strategen. 2018. Eastside System Energy Storage Alternatives Assessment - Report Update.

Eastside transmission overloads. The study found that required battery systems would be substantially more expensive than the proposed transmission upgrades and would require large land areas (*e.g.*, 19 times the size of Tesla's Hornsdale facility in Australia, the world's largest currently installed system). The study also found that the largest system constraints have shifted from Talbot Hill substation for the winter peak period to Sammamish substation for the summer peak period. The required system size for the Complete Solution is 549 MW to serve the expected summer peak load in 2027. However, our review of PSE's latest load forecasts (discussed in the following section) reveals that the summer peak gap is about 460 MW in 2027 without demand response, solar PV, and other distributed generation (See Figure 10 in this section). Thus, it is likely the Strategen 2018 study overestimated the size and cost of battery options.

- **Latest conservation estimate**: PSE's latest load forecasts include the impacts of the 100% Conservation scenario that is consistent with the latest Conservation Potential Assessment included as Appendix J to the 2017 IRP, with the exception of demand response and distributed generation. This conservation potential includes PSE's energy efficiency programs, distribution efficiency (*e.g.*, conservation voltage reduction) and savings from codes and standards. Based on data from PSE, we found that PSE assumes 361 MW of winter conservation potential for 2023 (224 MW from energy efficiency programs, 132 MW from codes and standards, and 4 MW from distribution efficiency) while PSE's IRP selected 374 MW of conservation for the same year.[32]

[32] PSE. 2017. 2017 PSE Integrated Resource Plan, Chapter 1, Figure 1-4; File "Newcastle DR Q1 partG.xlsx" obtained from PSE data response on September 10, 2019 to Newcastle Consultants' data request on August 8, 2019.

4.3. PSE Winter Peak Load and Needs Assessment

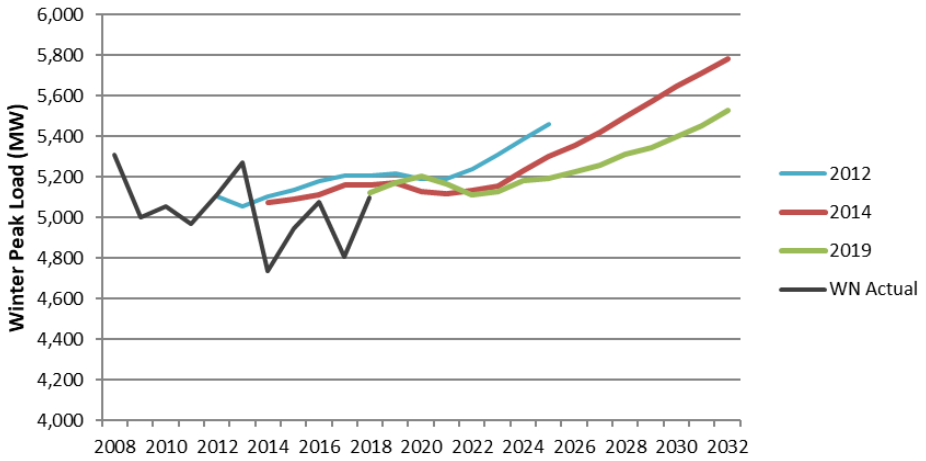
We conducted a review of historical winter and summer peak loads and the winter and summer peak load forecasts that PSE has made over the last several years. We obtained PSE's latest historical load data and load forecast through the data request process and compared them with PSE's previous analyses provided in the 2013 and 2015 Needs Assessment report. This sub-section focuses on our assessment of PSE's winter peak load estimates.

Figure 5 presents PSE's load forecasts for its service territory made in 2012, 2014, and 2019 along with weather-normalized actual winter peak loads (*i.e.*, loads adjusted for the specific weather impacts seen each year). These loads represent loads including the demand-side resource potential estimated in PSE's IRPs except peak load impacts from any demand response or distributed generation. These load data are also adjusted for PSE's transmission-level customers that are not included in PSE's corporate load forecasts.[33] This figure shows that the historical winter peak loads have been lower than what PSE's load forecasts have projected in the past, except in 2012.[34] It is also important to note that there has been a slight declining trend in the historical weather-normalized peak loads over the past 10 years. The annual average growth rate over the past 10 years is -0.4 percent. PSE did not project this decline. In fact, PSE's forecasts show increasing loads into the future years, and past forecasts showed increasing load during the time period when actual loads have declined. In addition, newer forecasts show lower peak loads than previous forecasts, and the time at which peak loads are projected to rise substantially appears to be shifting into the future with each forecast.

[33] We assume 270 MW of peak load for transmission-service customers per page 8 in the 2015 Supplemental Needs Assessment.

[34] This finding reflects updated weather normalized winter peak demand of PSE entire service territory furnished by PSE in May 2020.

Figure 5. PSE entire service territory: winter peak load forecasts and actual peak load



Source: Compiled from PSE load forecast documents and discovery responses—WN Actual is weather-normalized actual peak load.

PSE's load forecasts have historically over-projected loads relative to actual loads. This was noted by Washington Utilities and Transportation Commission (WUTC) in its "Acknowledgement letter attachment" to PSE's 2017 IRP. In this letter WUTC noted, "historically, PSE's load forecasts have been overly optimistic" and included an assessment of PSE's load forecasts by the Lawrence Berkeley National Laboratory in terms of average annual growth rate of energy (AAGR) as shown in Table 2 below.[35]

Table 2. PSE's projected and actual average annual growth rate of electric energy

Period	LSE-Projected AAGR	Actual AAGR
2006-2014	1.75%	-0.19%
2012-2014	1.90%	-1.19%

Source: WUTC Acknowledgement letter to PSE's 2017 IRP.

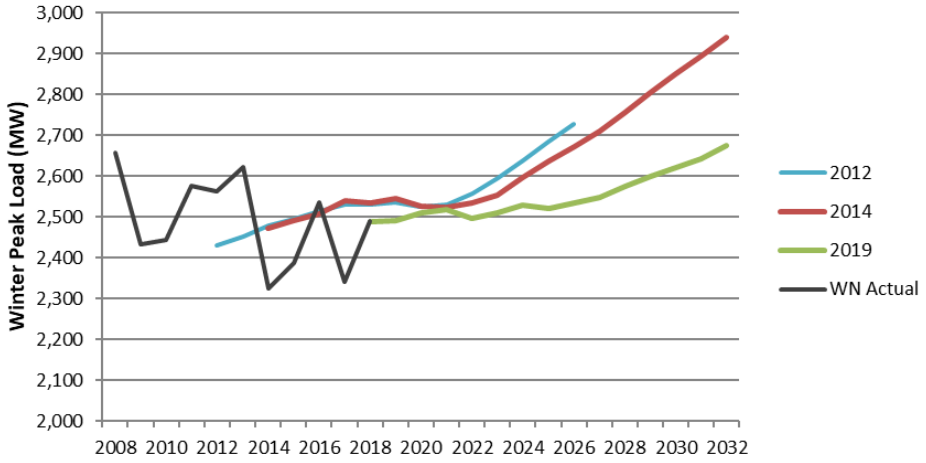
Historical loads and PSE's peak load forecasts for King County also show similar trends to what we have observed in PSE's entire jurisdiction, as shown in Figure 6. Both the historical loads and projected loads in this figure include additional peak loads expected from transmission-level customers.[36] Historical

[35] Washington Utilities and Transportation Commission (WUTC). 2018. Acknowledgement letter attachment: Puget Sound Energy's 2017 Electric and Natural Gas Integrated Resource Plan, Dockets UE-160918 and UG-160919. Page 11. Available at https://www.utc.wa.gov/_layouts/15/CasesPublicWebsite/GetDocument.ashx?docID=1743&year=2016&docketNumber=160918.

[36] We assumed 81 MW of peak loads from those customers per PSE's data response on September 9, 2019 to our data request on August 8, 2019.

weather-normalized peak loads have been lower than forecasted weather-normalized peaks in four of the five most recent years (from 2014 to 2018 except 2016).[37]

Figure 6. PSE King County: winter peak load forecasts and actual peak load



Source: Compiled from PSE load forecast documents and discovery responses. WN Actual is weather-normalized actual peak load.

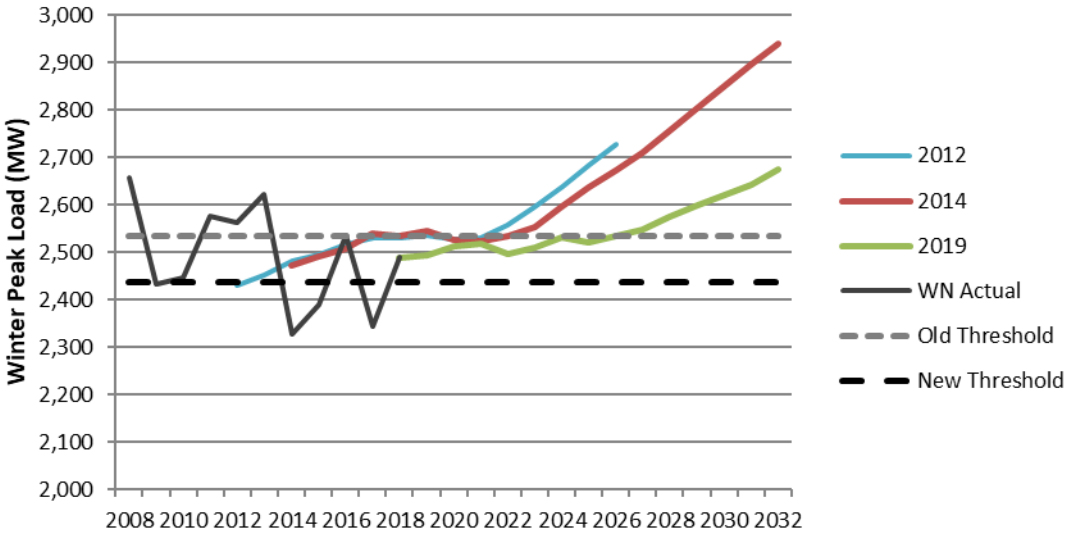
Finally, we examined the potential for winter transmission capacity constraints in King County—that is, whether and to what extent King County currently has or is expected to have any transmission capacity deficiency based on PSE's projections. We compared King County's current and projected winter peak loads with PSE's estimates for peak load thresholds. In other words, we examined the load levels of concern above which PSE's transmission facilities (*i.e.*, Talbot substation for the winter peak) are expected to experience capacity deficiency under contingency events (*i.e.*, N-1-1 conditions). This analysis is presented in Figure 7. Our analysis focuses on King County because PSE identified load constraints in the Eastside area and because PSE has not produced any updated historical loads or forecasts for the Eastside area since the 2015 Supplemental Needs Assessment, despite the fact that the Eastside was the most critical area of the Needs Assessment studies.

Figure 7 includes two separate estimates for load thresholds, labeled as "Old Threshold" and "New Threshold." The "Old Threshold" represents a load threshold (or a level of concern) that was estimated in the 2013 and 2015 Eastside Needs Assessment report, scaled from the full PSE service territory to King County. During our investigation of the needs for the Eastside, we learned that PSE switched to EPRI's PTLOAD software to characterize its transformers. This change resulted in a reduction in the MW threshold, primarily due to different assumptions regarding the performance of grid components that are built into the PTLOAD model. The "New Threshold" in Figure 7 reflects this new estimate. For the PSE service territory, the thresholds were reduced from 5,200 MW to 5,000 MW for the winter period

[37] This finding reflects updated weather normalized winter peak demand of PSE King County service territory furnished by PSE in May 2020.

(representing a 4 percent reduction) and from 3,340 MW to 3,125 MW for the summer period (representing a 6 percent reduction).[38] For King County, the new peak load thresholds are 2,436 MW for the winter and 1,594 MW for the summer. Because the 2013 and 2015 Needs Assessment reports did not provide any load threshold for King County, we estimated the "Old Threshold" for King County by taking the ratio of load threshold changes at the level of PSE's service territory.

Figure 7. PSE King County: winter peak load estimates vs. peak load thresholds



Source: Compiled from PSE load forecast documents and discovery responses. WN Actual is weather-normalized actual peak load.

A comparison of the loads in Figure 7 reveals that the recent actual winter peak loads have been lower than the Old Threshold, but were above the New Threshold in 2016 and 2018.[39] PSE's latest load forecast developed in 2019 shows projected load levels above the new load threshold starting in 2018, although only by about 50 to 80 MW (or 2 to 3 percent) over the next few years. The average annual growth rate over the past decade is -0.65 percent. As with the case of the system-wide peak load forecasts, PSE did not project this declining peak load in its past forecasts. PSE's latest forecast still shows an increasing winter peak trend. While the 2018 peak load is above the New Threshold, we are not convinced that the loads will remain above the New Threshold because PSE's winter peak load forecasts have historically over-projected winter peak loads. The current forecast may have a bias in projecting higher peak loads and not fully reflecting historical winter peak trends, just like the gap the WUTC identified between the annual electric sales forecasts and actual sales from 2006 to 2014 as mentioned above. Further, there is a possibility that future loads may not increase as much as PSE is projecting or even could be lower than the New Threshold if PSE follows the WUTC's recommendation

[38] PSE data response on September 10th to Newcastle's August 8th data request 4(b).

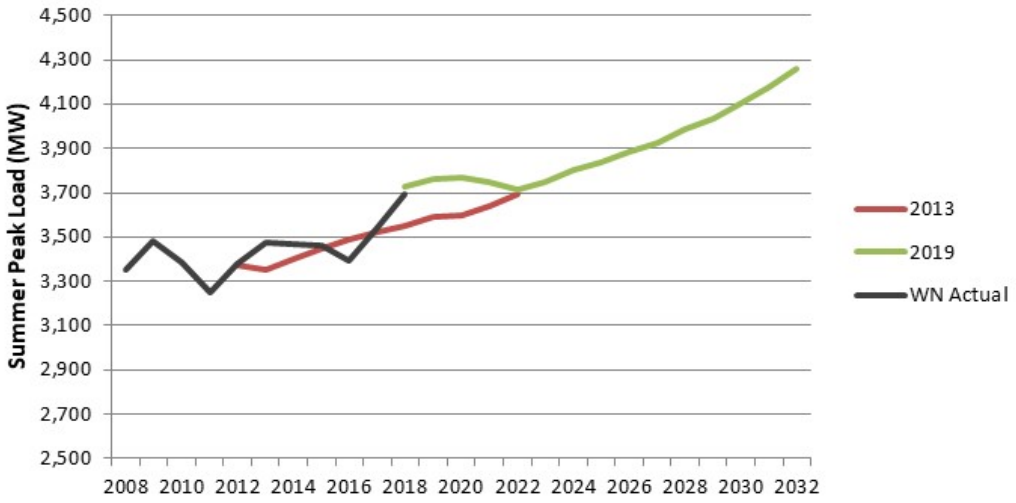
[39] This finding reflects updated weather normalized winter peak demand furnished by PSE in May 2020.

that "PSE should assume in years 11 through 20 that a reasonable level of emerging retrofit conservation measures will be available in the market at cost-effective rates even though they cannot be accurately identified or predicted now."[40]

4.4. PSE Summer Peak Load and Needs Assessment

PSE's summer peak loads present a very different story than the winter peak loads. Figure 8 presents PSE's load forecasts for its entire service territory made in 2013 and 2019, along with weather-normalized actual, historical summer peak loads through 2018 (*i.e.*, loads adjusted for annual specific weather impacts). As with the winter peak load estimates, the summer peak load estimates include loads for PSE's transmission level customers.[41] The load forecasts also represent loads adjusted for 100 percent of the demand-side resource potential estimated in PSE's IRPs. This figure shows that, unlike the historical winter peak loads, the historical summer peak loads have been increasing over the past several years, as forecast by PSE in 2013. Further, unlike PSE's winter peak forecast, the load for the first year for each forecast matches closely with the weather-normalized actual, historical loads (*i.e.*, year 2012 and 2018).

Figure 8. PSE service territory: summer peak load forecasts and actual peak



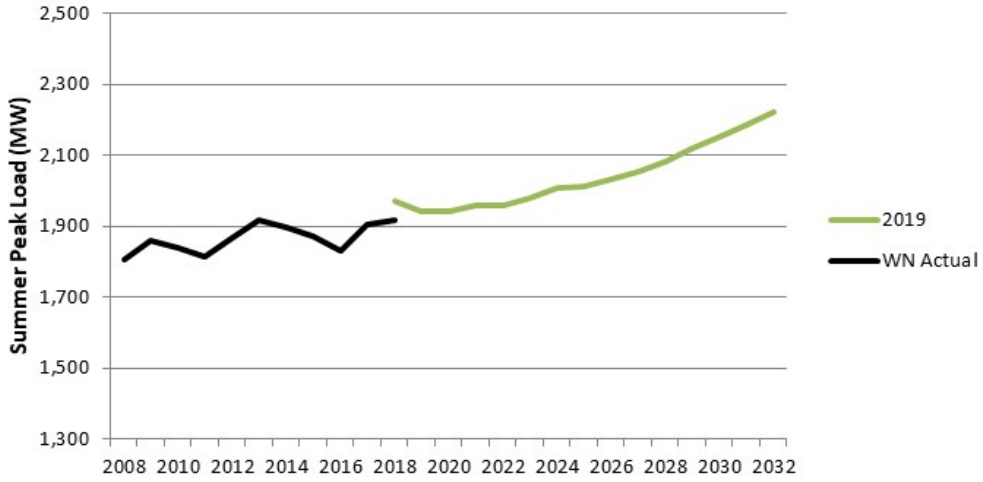
Source: Compiled from PSE load forecast documents and discovery responses. WN Actual is weather-normalized actual peak.

[40] WUTC. 2018. Page 11.

[41] We assume 270 MW of peak load for transmission-service customers per page 8 in the 2015 Supplemental Needs Assessment.

Historical and forecasted summer peak loads for King County show similar trends to the loads for PSE's entire service area, as shown in Figure 9.[42] Summer peak loads have been gradually increasing over the past several years, and PSE's forecast shows a growing peak load trend into the future. This figure includes just one forecast (made in 2019) because PSE's Eastside Needs Assessment studies did not analyze summer peak loads at the King County level, but instead focused on winter peak loads for the Eastside area as well as for the entire service territory.[43]

Figure 9. PSE King County: summer peak load forecasts and actual peak load



Source: Compiled from PSE load forecast documents and discovery responses. WN Actual is weather-normalized actual peak load.

Finally, we examined the potential of summer capacity constraints in King County. Figure 10 presents this review by providing a comparison of the summer peak loads with peak load thresholds (the load levels of concern in King County at which key transmission facilities will be overloaded under contingencies (*i.e.*, N-1-1)). As mentioned above in the winter peak load discussion, PSE revised its previous load threshold calculation methodology. Its new estimate is shown as "New Threshold" (1,594 MW) in Figure 10. Because the 2013 and 2015 Needs Assessment reports did not provide any load threshold for King County, we estimated the "Old Threshold" for King County based on the ratio of load threshold changes at the PSE's service territory level. At the total system level, the 2013 and 2015 Needs Assessment reports found system overloads could occur as early as 2014 and become more serious by Summer 2018.[44]

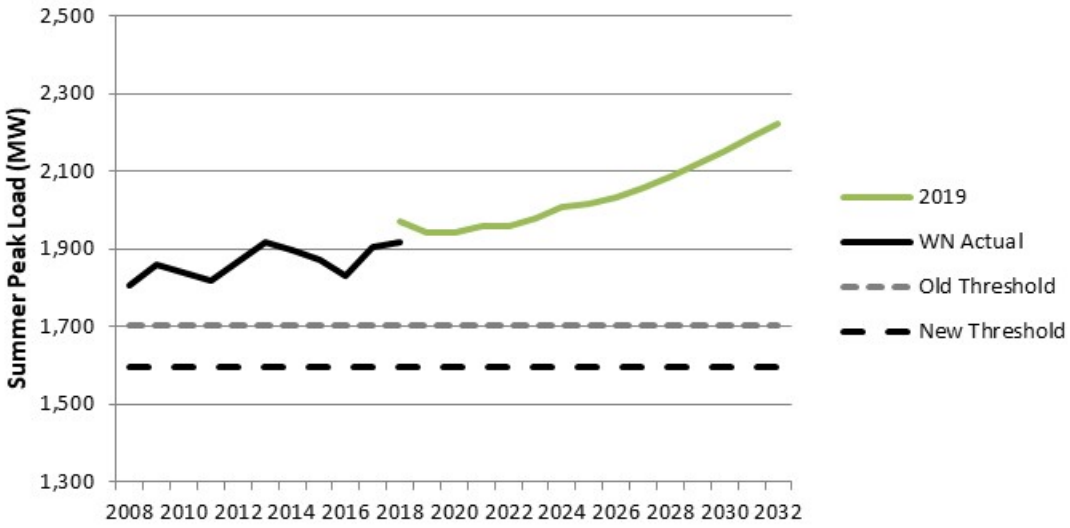
[42] We assume 81 MW of peak loads from transmission-service customers based on PSE's data response on September 9, 2019 to our data request on August 8, 2019.

[43] As mentioned previously, our analysis focuses on King County because PSE has not produced any updated historical or forecasted load estimates for the Eastside area despite the focus of its Needs Assessment reports being on the Eastside area.

[44] Quanta Technology. 2013, page 8, 9, 13 and 70; Quanta Technology. 2015, page 18 to 19.

A comparison of the load thresholds in Figure 10 reveals a more severe situation than found in the 2013 and 2015 Needs Assessment for the summer peak period: King County's summer peak loads have been exceeding the level of load concerns under N-1-1 contingencies both at the old and new threshold levels. More specifically, the peak load levels in King County have been 13 to 20 percent (or 200 MW to 300 MW) above the new threshold (assuming PSE's latest threshold is accurate). Given this current severe condition, we do not need to rely on load forecasts to determine the capacity needs because it would be infeasible to acquire sufficient demand-side resources to reduce this substantial gap within just a few years. At the current load levels, we have to conclude that there is an operational need to expand the transmission capacity in the region.

Figure 10. PSE King County: summer peak load estimates vs. peak load thresholds



Source: Compiled from PSE load forecast documents and discovery responses. WN Actual is weather-normalized actual peak load.

5. ASSESSMENT OF THE PROPOSED EASTSIDE PROJECT

5.1. The Proposal

PSE's proposed Energize Eastside project consists of upgrading the 115kV transmission lines to 230kV lines in the existing Willow 1 transmission line corridor and the construction of the Richards Creek substation in Bellevue. Our assessment finds that the upgraded transmission facilities proposed to traverse approximately 1.5 miles through Newcastle serve an operational need to safeguard the security of the bulk electric system.

5.2. Operational Need

We conducted a power flow analysis of PSE's transmission system with a focus on the Eastside project using the PowerWorld power flow model. Our analysis found that the facilities supplying the Eastside are currently experiencing a transmission capacity constraint that is especially pronounced during the summer in the Northwest area serving the South King County zone. A part of PSE's transmission planning responsibilities is to ensure the reliability of the transmission system it operates. This includes no long-term reliance on operating procedure corrective action plans.

Power systems are operated so that overloads do not occur either in real-time or under any statistically likely contingency. Contingencies can consist of several actions or elements, such as an outage of a single transmission line or an outage of several lines, a number of generators, and the closure of a normally open transmission line. The North American Electric Reliability Corporation (NERC) develops and enforces standards to ensure the reliability of power systems in North America. The Transmission Planning Standard (TPL) defines system performance requirements under both normal and various contingency conditions. The NERC transmission planning standards currently subject to enforcement are NERC TPL-001-4 and TPL-007-3.[45] We used these requirements to analyze PSE's transmission system, which is part of the Western Interconnection bulk electric system. The analyzed contingencies included (1) no contingencies, (2) events resulting in loss of a single system element, and (3) events resulting in loss of two or more system elements.

Under several contingencies, our power flow analysis verified that transformers at the Sammamish and Talbot Hill substations experience overloads when modeled using reasonable simulation parameters and MVA limits for normal and emergency operations. If these overloads are left unaddressed, Newcastle may experience reliability issues with its electric supply.

Electricity is primarily served to customers through distribution substations that are close to the loads. The city of Newcastle is primarily served by the Hazelwood Substation in the South King zone of the

[45] North American Electric Reliability Corporation. n.d. "Mandatory Standards Subject to Enforcement." Available at https://www.nerc.net/standardsreports/standardssummary.aspx.

Northwest area. Based on the power flow analysis we conducted to verify the claims of transmission constraints used to justify the proposed facility upgrades, we found that increasing the load served by the Hazelwood substation had little effect in the flows through the Sammamish transmission substation. We conclude that the operational need claimed by the utility is not triggered by peak demand solely arising from Newcastle, but instead the operational need results from the requirement to secure the system at a regional level and comply with NERC reliability standards for the bulk electric system. We note that if the bulk electric system fails, Newcastle will be without electric supply unless island-able distributed generation (*i.e.*, generation near load centers) is available. Our review did not identify significant distributed generation capacity in the Newcastle area.

There is a possibility that the power flow through the Northern Intertie to PSE's territory is affecting the summer peak situation in King County. Our power flow models verify that even with the Northern Intertie adjusted to zero flow, the Talbot Hill 230kV/115kV transformer on circuit #2 would still be overloaded when accounting for secondary contingencies. Note that the Northwest system that serves King County has interchange schedules with several other systems including BC Hydro, and during the summertime most of the interchanges are power imports into the Northwest area. The Northwest–BC Hydro interchange transfers take place through the High Voltage Northwest transmission system. Our assessment found that these transfers have minimal impact on the transmission power flows that supply the distribution facilities that feed the load centers of the Eastside.

5.3. Reliability Improvement

Electric utilities commonly experience facilities outages, either planned or unplanned. A well-planned system will feature redundancy and absorb these outages to maintain continuity of supply to customers and ensure service reliability in the Eastside.

In order for Newcastle to benefit from this level of reliability, PSE proposed to upgrade the existing 115kV line in the Willow 1 transmission line corridor (Figure 11 and Figure 12, next page) to 230kV lines. Under this proposal, residents in Newcastle would see the higher transmission towers needed to comply with the 2017 National Electrical Safety Code.

Figure 11. Existing two 115kV electric transmission facilities on H-frame poles travel in existing transmission corridor through Newcastle around SE 80th Way, Newcastle, WA 98056

Source: Google Earth, retrieved September 2019. Note: City of Newcastle Public Notice of Proposed Land Use Action is visible.

Figure 12. Current 115kV electric transmission facilities around 12828 SE 80th Way, Newcastle, WA 98056

Source: Google Earth, retrieved September 2019.

We highlight that a dual 230kV transmission line operated by Seattle City Light (SCL) already travels through Newcastle (Figure 13 below).

Figure 13. Seattle City Light 230kV Transmission Line at Donegal Park [SE 74th ST, Newcastle, WA 98056]

Source: Google Earth, retrieved September 2019.

6. KEY FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

6.1. Key Findings

Power flow cases analysis shows that the current summer electric peak demand in King County has already triggered an operational need for the proposed transmission expansion under system contingency scenarios.

Our power flow model assessment finds that the regional capacity thresholds in King County estimated by PSE are reasonable.

Our assessment of PSE's load forecasting methodology finds that the PSE load forecast approach follows a standard industry practice, although it has some limitations regarding the way it incorporates demand-side resources.

Our assessment of PSE's historical peak loads found that PSE's winter peak load actually has been declining over the past several years. While our assessment did not find a need at today's load level using the Old Threshold used in PSE's studies (the 2013 and 2015 Quanta studies), the 2018 load was above the New Threshold that PSE developed using revised methodology in 2016.

While we found that PSE's own winter load forecast is above the load threshold for concern in King County, we cannot conclude based on the data we analyzed whether there is any clear need created by the winter peak load for transmission capacity expansion in the future. PSE's past winter peak load forecasts have been over-predicting winter peak loads. The current forecast does not appear to fully incorporate the declining trend in weather-normalized winter peaks. Further, the current forecast does not appear to have incorporated the WUTC's recommendation to assume that in the longer term "a reasonable level of emerging retrofit conservation measures will be available in the market at cost-effective rates even though they cannot be accurately identified or predicted now."[46]

On the other hand, based on PSE's latest estimate for load thresholds in King County, which our power flow analysis verified, we found there is a summer transmission capacity deficiency in King County under N-1-1 contingencies even at today's peak load level. We further found that the capacity deficiency for the summer season has been 13 to 20 percent (or 200 MW to 300 MW) above the area's capacity threshold.

[46] WUTC. 2018. Page 11.

6.2. Conclusions

PSE demonstrated that the proposed transmission upgrades are needed to safeguard the operational reliability of the electric system as a whole. To maintain system security, power systems operators need to ensure overloads do not occur either in real-time or under any statistically likely contingency. Not securing the bulk electric system to operate reliably over a broad spectrum of system conditions and following a wide range of probable contingencies can affect the electric supply reliability in Newcastle. This peer review verified that under specific contingencies (N-1-1 and N-2) the as-is bulk electric system serving Newcastle is already operationally stressed. This means that PSE's application has met the threshold for approval dictated by Newcastle City Code C-5 under NMC 18.44.052 Utility facilities – Regional: "[t]he applicant shall demonstrate that an operational need exists that requires the location or expansion at the proposed site."

The current transmission deficiency can be resolved by upgrading one of the 115kV transmission lines between the Talbot Hill and Sammamish substations to 230kV and installing an additional 230kV/115kV 325MVA transformer at the proposed Richards Creek substation in Bellevue. Upgrading the second 115kV transmission line that currently travels through the same corridor, Willow 1, to 230kV is consistent with good system planning, given that facilities to support these higher voltages will already be deployed.

6.3. Recommendations

Transmission solutions

We recommend that the Conditional Use Permit to PSE to upgrade the identified approximately 1.5 miles of existing 115kV lines with 230kV lines be conditioned on conducting an independent design assessment of the overhead transmission facilities traversing Newcastle. That assessment should verify compliance with the clearance safety rules for the installation and maintenance of overhead electric supply of the 2017 National Electrical Safety Code (NESC), ANSI C2 Part 2. [47] We also recommend that the City of Newcastle sends field inspectors during the transmission line upgrades to ensure compliance with the 2017 NESC.

[47] https://apps.leg.wa.gov/WAC/default.aspx?cite=296-45-045

APPENDIX A. REVIEWED MATERIAL

We reviewed the following materials in order to evaluate PSE's filings against the City of Newcastle's code requirements.

- Quanta Technology (2013) Eastside Needs Assessment
- Quanta Technology (2013) Eastside Solutions Study Report
- Quanta Technology (2015) Supplemental Eastside Needs Assessment
- Quanta Technology (2015) Supplemental Eastside Solutions Study Report
- Energy and Environmental Economics (2014) PSE Screening Study
- Strategen (2015) Eastside System Energy Storage Alternatives Screening Study
- Strategen (2018) Eastside System Energy Storage Alternatives Assessment – Report Update.
- PSE (2017) 2017 PSE Integrated Resource Plan
- PSE's Annual Report of Energy Conservation Accomplishments
- PSE (2019) Overview of Integrated Resource Plans and Cost-Effective Conservation in Washington
- Portland General Electric 2019 Draft Integrated Resource Plan
- Navigant (2017) 2017 IRP Demand-Side Resource Conservation Potential Assessment Report, Appendix J to PSE's 2017 Integrated Resource Plan
- Utility System Efficiencies, Inc. (2015) Independent Technical Analysis of Energize Eastside for the City of Bellevue, WA
- CADMUS Group (2013) Comprehensive Assessment of Demand-Side Resource Potentials (2014-2033)
- November 2017 Newcastle Site Plans, Variance and Non-Variance
- Tetra Tech (December 2013) Eastside 230kV Project Constraint and Opportunity Study for Linear Site Selection
- PSE (2017) Newcastle Alternative Siting Analysis