Capacity as a Growing Issue for Northwestern Utilities
Board Learning Paper

Prepared by Steve Lacey
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In the Northwest, energy efficiency was originally seen as a resource to help the region meet its energy supply needs. In the past five years or so, overall supply has become less of an issue while capacity—or the maximum amount of energy that can be delivered at any specific time—has grown in importance. Leadership in the region is realizing that as renewable, intermittent generation resources become a greater portion of the mix, if something significant were to happen to the hydropower resource (a low water year, climate change impacts, removal of dams, etc.), it may not have sufficient capacity to meet power needs during peak times.

This paper explores the historical context and factors contributing to this situation, and how utilities typically address it. It also considers how the unique characteristics of the Northwest have shaped our capacity constraints and what role, if any, energy efficiency has in managing them.

EnergyTrust of Oregon

Historical Perspective

The Northwest Power Act enacted in 1980 intended to ensure low-cost electricity to Northwest ratepayers from federal dams in the Columbia River Basin. It also created the Northwest Power and Conservation Council, which is tasked with developing a 20-year regional power plan that guides the Bonneville Power Administration's (BPA)[1] resource decision-making. BPA manages the region's hydroelectric system and provides low-cost electricity primarily to public and cooperative utilities and, to a lesser extent, investor-owned utilities. As demand in the region grew, cheap hydropower has become a less dominant contributor to the region's resource—it now makes up less than 40% of the overall energy mix, while energy efficiency is the second largest resource.[2]

Hydropower has the greatest resource availability in the spring when demand is typically the lowest, which gives energy efficiency a prominent rank in meeting capacity constraints. The 2021 Northwest Power Plan projects to lose as much as 3,500 MW of electricity supply due to coal plant retirements by 2029. While the expected addition of 3,500 MW of renewable resources by 2027 will help mitigate this loss, renewable resources with variable generation cannot begin to replace the firm capacity of retired regional coal plants on a one-to-one basis. Flexible end-use load resources can help integrate renewable resources into the system and fill an expanding capacity gap by helping meet demand during peak times and allowing for more flexibility in load control.

Terms & Definitions

Capacity: Capacity is the maximum level of electric power (electricity) that a power plant can supply at a specific point in time under certain conditions. It should be noted that capacity constraints extend to the electric distribution system and its ability to deliver safe and reliable power to electric consumers. One can also extend this definition to natural gas distribution systems where there is concern for new and system upgrades that will last for many years. The distribution system is the primary area that Energy Trust can play a supporting role in alleviating localized constraints.

Distribution System Planning (DSP): As part of utility Integrated Resource Planning filings with the Oregon Public Utility Commission (OPUC), OPUC broadened the planning process to include more thoughtful consideration of electric utility grid modernization and to increase focus on the distribution system. This includes forecasting load growth, grid needs, capacity analysis, energy efficiency and renewable energy contributions.

Distributed Energy Resources (DERs): Distributed energy resources are small-scale electricity supply or demand resources that are interconnected with the electric grid. DERs can provide electricity generation, storage or other energy services and are typically connected to the lower voltage distribution system.[3] DERs include a variety of technologies such as rooftop solar with storage equipment, smart thermostats, electric vehicles and other appliances that can be integrated with the grid. Energy efficiency and renewable programs typically fall under DER efforts.

Demand Response (DR): Demand response is a strategy employed by utilities to manage system loads to reduce grid stress and mitigate high energy costs. These typically involve the curtailment of customers' loads to shift consumption patterns away from peak times.

[1] https://www.bpa.gov/

[2] 2023 NW Power and Conservation Council Overview, nwcouncil.org

[3] How Distributed Energy Resources Can Lower Power Bills, Raise Revenue in US Communities, World Resource Institute

Non-wires Solutions (NWS): Non-wires solutions include any electrical grid investment intended to defer or remove the need to construct or upgrade components of a distribution and/or transmission system. These solutions employ methods to address overcapacity conditions on power system feeders. Non-wires solutions fall under the DER umbrella of services and include private generation and advanced grid technologies like smart meters, grid sensors and pricing mechanisms.

Current State

Pacific Power: Pacific Power's Distribution System Planning filing[4] to the OPUC found that 22% of systems circuits had distribution system needs, or infrastructure updates needed to continue to meet demand in a given area. Among these needs, 61% were related to, meaning too much consumer demand on the system. A significant percentage of these needs may be well suited to non-wires solutions.

Portland General Electric: PGE's Distribution System Planning filing[5] to the OPUC identifies the top 12 grid locations where load growth or other factors are creating capacity constraints. Non-wires solutions will include leveraging significant energy efficiency and private generation from rooftop solar in many of these locations. PGE is currently piloting a number of efforts to address these constraints, including its Smart Grid Test Bed Collaboration, which Energy Trust is supporting.

Northwest Energy Efficiency Alliance (NEEA)[6]: NEEA's work envisions flexible, end-use loads providing grid resources to help lower costs for the energy system. These resources can augment the system's ability to absorb intermittent renewable energy outputs, which has minimal impact on greenhouse gas emissions compared with other ways of balancing the grid, such as with carbon-based generating resources or market purchases.

Capacity Constraining Factors

A utility's ability to deliver sufficient power at specific times can be constrained or exacerbated by a variety of factors. In the Pacific Northwest, some of the more prominent causes of capacity constraint include:

- *Population growth*: The population of Northwest has been steadily growing at a considerable rate due to the attractive quality of life in the region, particularly within certain urban areas. As demand begins to outpace the capacity of existing distribution system equipment, that equipment becomes stressed, which may lead to failure. PGE has identified a growing population as the leading factor to capacity constraint on its system.[5]
- *Climate change*: As the region experiences frequent extreme climate events, new types of equipment are increasing the demand on existing systems. The demand for air conditioning is growing in response to warmer summers and more frequent wildfires are creating a need for new indoor air quality solutions. The growth of these new end uses is putting stress on existing distribution systems.
- *Reduced hydropower availability*: As weather patterns change—particularly lower precipitation and warmer weather, which lead to diminished snowpack levels that melt during the shoulder months—availability of this low-cost and peaking source of power is

[4] Pacific Power- DSP filing to OPUC UM 2005 PacifiCorp's Compliance per Order No. 20-485, Oregon Distribution System Plan Report - Part 2. Filed 8/15/2022 Page 76

[5] Portland General Electric- DPS filing to OPUC UM 2005 PGE's Compliance per Order No. 20-485, Distribution System Plan - Part 2. Filed 8/15/2022 Page 89

[6] NEEA Draft 2025-2029 Strategic Plan, Goal 2

decreasing. Additionally, efforts to remove or decommission older dams due to environmental concerns are becoming more prevalent in the region.

- *Business development*: The Northwest has historically been and is presently an attractive region for businesses to site their operations because energy costs are favorable. Starting with aluminum production, which was eventually replaced with semiconductor and technology business, the region is now attracting data centers. These large energy consumers favor the green power mix of Northwest utilities, which is provided at a moderate cost and within a moderate climate that allows for efficient heating and cooling.
- *Electrification*: Increasingly, businesses and residential consumers are seeking alternatives to traditional fossil fuels for heating, process loads and transportation. Utility and federal promotion of electric vehicles (EVs) and heat pumps will create a need to upgrade existing power distribution systems to meet future demand.
- *Greening of the grid and effects on transmission and distribution (T&D) system infrastructure*: Significant increases in utility scale wind and solar generation, which are typically sited near existing transmission lines, put pressure on available T&D capacity. To unlock greater resource availability, siting new generation will require transmission expansion and interconnection at great economic and environmental cost.

Tools to Address Capacity Constraint

Distribution system planning is a holistic approach to addressing capacity constraints. Utilities employ various methods to address capacity constraints beyond traditional power generation solutions, which are increasingly challenging to build due to legislation requiring them to reduce carbon emissions. Complicating the issue is that the demand for new renewable generation requires utilities to site new and upgrade existing transmission infrastructure needed to deliver power to local distribution systems. Tools to mitigate capacity constraints at the distribution system level include:

- **Demand response** solutions, also known as flexible load control programs, can include the ability to shut off or turn down appliances such as water heaters, furnaces, heat pumps, irrigation motors and business customer loads. These programs tend to be managed by the utilities and customer participation may be voluntary or mandatory depending on the rules of the program. Utilities may also employ business contracts with customers that enable the utility to interrupt power or to dispatch onsite generation when curtailment is needed.
- **Flexible grid management** tools, a form of non-wires solutions, are a subset of demand response that seek to shift loads prior to or after known curtailment events. Examples include producing and storing hot water in grid-connected water heaters, utilizing smart thermostats to pre-cool or pre-heat facilities and deploying the power stored in consumer-owned batteries.
- **Time of use** rates provide lower rates to consumers that encourage them to shift their use of discretionary appliances to times when utilities typically have excess inexpensive power. These rates provide disincentives for consumers to use appliances such as dishwashers, clothes dryers and water heaters during peak load periods.
- **Targeted load management** is a strategy of concentrating energy efficiency and renewable solutions in specific geographic areas that will be or are experiencing distribution system capacity constraints.
- **Distributed generation and storage** is a way for consumers to generate power onsite to offset power purchased from their electric utility. With the addition of battery storage, these systems can provide temporary power during outages.

- **Virtual power plants** consist of hundreds or thousands of instances of the tools noted above that are aggregated and truly coordinated with grid operations. They can provide the same kind of reliability and economic value to the grid as traditional power plants.[7]
- **Energy efficiency**, a characteristic of many of the strategies noted above, can also mitigate capacity constraints because it reduces the overall base load of the system.

What This Means for Energy Trust

Increasingly, the decarbonization of the energy sector will put tremendous stress on the existing electric grid. Considering that there is currently more natural gas being consumed by society than electricity, it will be a monumental and costly effort to enable the grid to accommodate a transition to predominantly electric end uses.

Energy Trust is in a unique position to help with this transition through its delivery infrastructure and close relationships with partner utilities. For example, there is a two-fold benefit for the installation of smart thermostats and direct-controlled efficient water heaters. First, because these devices operate more efficiently than standard equipment, the energy they save over the baseline help lower system peaks and reduce capacity constraints on the system. Second, with utility control programs in effect, these appliances could be controlled to further reduce load on the system during peak events and mitigate potential failures. Working together with utilities to design and implement programs can accelerate the adoption of these products by homeowners and businesses.

Other examples of collaboration with utilities to address capacity constraints include Energy Trust's Targeted Load Management initiatives (TLM) and solar plus storage offer. In the case of TLM, utilities identify capacity constrained areas that would require significant load reduction to forestall needed system upgrades and refer them to Energy Trust. A resource potential analysis conducted by Energy Trust can determine if an efficiency or renewable energy solution is viable in that area. Energy Trust has successfully completed TLM projects for Pacific Power and NW Natural. As for solar plus storage, there is opportunity for utilities to leverage Energy Trust's established solar program infrastructure to enable these systems to be controlled by utilities during peak events through demand response programs that incent customer investment and participation.

[7] Clean Energy 101: Virtual Power Plants, Rocky Mountain Institute