# Non-Wires Solutions (DRAFT)

Technical Process & Procedures Manual

**NOTE: There are several instances where we have indicated "(process TBD)". The Community Workshops taking place March through May are focused on developing a draft version of these processes.**

## Contents



| Version Tracker | | | |
|---|---|---|---|
| **Version** | Date | **Change Implemented** | **Requested By** |
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# Introduction to non-wires solutions (NWS)

The landscape of utility planning is changing. This shift is created through state policy and regulation addressing climate change, the acceleration of customer adoption of distributed energy resources (DERs), customer preferences, and the declining costs of DERs; especially rooftop photovoltaic solar, electric vehicles, and energy storage.[1] As availability of and interest in DERs increase, this in turn influences how PGE approaches planning. Traditional distribution planning has historically assumed one-way power flows from generation to customers. Increasing DER penetration challenges, or at least modifies, that planning approach. Distribution Planners now need to consider energy produced by customers' solar panels, electric vehicle charging behavior, and growing amounts of digital technologies including controls such as devices that enable the utility to communicate with a customer's thermostat or water heater. In addition to modifying the distribution planning approach, DERs also present themselves as an opportunity to further decarbonization while serving as possible solutions to grid constraints. Utilizing DERs to address distribution system constraints is commonly referred to as non-wires solutions (NWS) or non-wire alternatives (NWA). For the purposes of this document, DERs that address distribution system constraints are referred to as NWS.

Partners, including regulators, are interested in exploring how NWS can expand the utility's solution tool kit to address distribution system constraints within PGE's Distribution System Plan (DSP) process. Additionally, partners and regulators are interested in understanding how NWS can complement environmental and social justice policies and foster procedural equity for historically underrepresented communities to create more equitable outcomes for all customers when making system investments.

Though our partnerships, Portland General Electric (PGE) has begun to shift its perspective and planning processes to be more human-centered. We are focused on developing a distribution system planning approach that considers all solutions, from multiple perspectives (such as environmental and societal) when making investment decisions. We also are working to balance current policies, customer needs and desires, and a growing number of other investment priorities as we consider alternative solutions, including customer sited DERs.

## Definition

An NWS is an investment, strategy, and/or action intended to defer, reduce, or remove the need for a traditional utility solution such as upgrading a substation or new power line. NWS projects are typically in a specific geographical region and solve an identified distribution system need such as managing load, generation, reliability, voltage regulation, and/or other wide-ranging distribution system needs. NWS can be stand-alone technologies/DERs or a

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

combination of several different technologies/DERs that can range from policy mechanisms such as time-of-use tariffs to technological solutions such as utility or customer owned DERs or controls. These solutions can be located either on the customer-side of the meter or the utility-side of the meter.

## Applicable solution types within NWS

NWS investments, strategies, and/or actions range from conserving energy through energy efficiency, to programs that shift or curtail load (such as demand response programs), to policy (such as pricing), to technology solutions (such as solar plus battery storage). NWS projects can include these and other investments individually or in combination to meet the specified needs in a cost-effective manner, considering the need to meet state policy goals, ensure compliance, or enhance the customer experience.

Examples include:

- Distributed Generation such as Solar PV
- Distributed Energy Storage
- Demand Resource such as Flexible Loads
- Energy Efficiency
- Conservation Voltage Reduction technologies
- Specific Rate Designs
- Enabling Technologies such as Advanced Devices, Controls, and Automation

# Distribution planning process with NWS

The flow chart below describes a technical distribution planning process that illustrates the processes we take from forecasting through solution identification, including NWS. The flow chart includes a description of each process step. Steps that are part of the traditional process are described briefly while NWS-specific processes are detailed in the hyperlinked sections. We recognize that to be truly human-centered in our planning, this process will need to evolve over time to include feedback identified by environmental justice and community-based organizations, which will be part of our continued efforts through 2022 and 2023.

**Figure 1. Draft distribution planning process with NWS**

| Distribution Planning Steps | Steps include NWS-specific activities |
|---|---|

| Step | Description |
|---|---|
| Step 0: Forecasting | • Annual load and DER forecasts are delivered to Distribution Planning<br>• Distribution Planning allocates the forecast to the substation level |
| Step 1: What is the problem? | • Determine why the current system is inadequate or constrained<br>• Common drivers are equipment loading, assessments to identify stress points, asset health/risk, reliability, safety |
| Step 2: Where is the problem located? | • Identify the area affected by the problem<br>• Review geographic boundaries, affected customers, approach to contingency analyses |
| Step 3a: Current state analysis | • Analyze study area with future loading conditions to understand violations and details such as time, location, magnitude, and contingency<br>• Review the alignment of grid needs and community needs **(process TBD)**<br>• Conduct screening to determine if NWS are feasible to address identified grid needs using the ***NWS Screening process***<br>• Public review of NWS candidates **(process TBD)** |
| Step 3b: Finding solutions: Solution analysis | • Develop and simulate different solutions that address all violations<br>• Develop an NWS as documented here: ***NWS development process*** |
| Step 4: What are the limitations of the solution? | • Determine if the solution resolves all violations<br>• Ensure solution meets policy objectives, if feasible |

| Distribution Planning Steps | Steps include NWS-specific activities |
| --- | --- |

**Step 5: Benefits and Risks: Decision making**

- Perform benefit-cost analysis (BCA) and develop metrics to help compare different projects
- The results are combined in a decision-making rubric that weights risk, economics, and equity metrics to determine the project of choice
- The details of this process are documented here: ***Decision making***

**Step 6: Are there additional impacts to consider?**

- Community, customer, and environmental considerations
- Personnel or public safety considerations
- Complexities such as construction sequencing, new technology, and long lead items

**Step 7: Whitepaper recommendation**

- Describe the analyzed solutions and the recommendation in a whitepaper
- Include details such as, benefit-cost analysis (BCA), equipment life, and sizing
- Public review of solutions **(process TBD)**

**Step 8: Accept Recommendation**

- PGE finalizes solution and prepares to move to implementation phase

# NWS specific processes

In this section, we detail the steps that are specific to the NWS elements within the planning process as noted within this document. **It is important to note there are processes that will be developed through our DSP partner engagement efforts.**

## NWS screening

The NWS screening is intended to describe the criteria we will utilize to identify if an NWS can solve the identified grid need(s). Below are the four components of the screening:

1. Type of grid need
2. Forecast certainty
3. Lead time
4. Minimum project cost

### 1. Type of grid need

The grid needs process aims to identify the technical requirements and capabilities needed on the distribution system to ensure a safe, reliable, resilient system that provides adequate power quality to the customers it serves. The different types of grid needs we have identified for PGE's NWS process are outlined in **Table 1**, along with examples of wired and non-wired solutions that can resolve the problem (Link: Distribution system asset class definitions).

**Table 1. Types of projects that are suitable for non-wired solutions**

| Type of grid need | Example of traditional solution | Example NWS product and/or service |
|---|---|---|
| **Thermal capacity upgrade projects or N-0[2] capacity projects usually driven by growth in load on existing infrastructure** | Substation transformer capacity upgrade<br>Reconductoring of circuit (larger wire size)<br>Building new feeder | DERs that can reliably shape or be dispatched to alleviate existing or forecasted peak load on the distribution circuit or at substation transformer |
| **Reliability solutions driven by N-1 contingency requirements** | Substation transformer capacity upgrades<br>Reconductoring of circuit<br>Build new feeders | DERs that can be reliably dispatched to provide contingency relief at a requested time, duration and/or frequency<br>Distribution automation |

[2] The N-0 condition represents the system performance under normal conditions, where all equipment is working as designed. The N-1 condition represents system performance where a substation transformer experiences failure or is undergoing a planned outage and cannot serve the intended load. In contingency cases, neighboring transformers from either the same or adjacent substations must pick up the load to avoid a customer outage.

| Type of grid need | Example of traditional solution | Example NWS product and/or service |
|---|---|---|
| **Hosting capacity and volt-var improvements** | Capacitor banks<br>Change load tap changer settings<br>Line voltage regulators<br>Protection upgrades (Hot Line Blocking, 3V0 Protection)[3] | Smart inverters and batteries could be used to provide volt-var and Conservation Voltage Reduction (CVR) services<br>This would include supporting voltage quality, reducing losses, and net energy consumption on the feeder |
| **Resiliency upgrades, new supply paths for increased resiliency** | New substation or feeders<br>New switching points or tie lines<br>Reconductors<br>Substation upgrades | Microgrids for partial/full back-up power during grid and/or wildfire related emergencies<br>Distribution automation |
| **Customer experience** | Case by case | Case by case |
| **Policy-driven NWS** | Case by case | Case by case |

### 2. Forecast certainty

Modeling NWS, especially customer-sited solutions, is complex given the stochasticity and interactive effects of different technologies under different grid operating conditions. The addition of forecast uncertainty exponentially increases the complexity and time required to analyze the different NWS options. To ensure prudent use of planning resources, **the forecast variation within a study area must be reasonably certain for the project to be considered for an NWS**. Presently, this is determined by the distribution planning team based on the available data and confidence. Over time, PGE will establish a metric and threshold to determine forecast certainty.

### 3. Lead time

Timeline suitability is recommended to make sure there is sufficient time to develop an NWS, engage with the community, and implement the chosen solution before the need

[3] Hot line blocking and 3VO protection enable the affected lines and substation transformers to safely accept backfeed from distributed energy resources, such as rooftop solar installations.

date. Aligning with national best practices,[4] the typical minimum amount of lead time required for NWS is estimated to be between 26 and 52 months. PGE will not apply this as a bright line test for the lead time and expects this requirement to evolve. This lead time is largely a function of the following processes:

- **NWS development process**. PGE has considered that NWS is a new process within Oregon and may require additional regulatory approvals. This consideration, along with the iterative nature of developing an NWS could increase the overall lead times for NWS. We estimate that this process may take between 6 to 12 months.
- **Implementation process**. The implementation time for the chosen solution is also a function of the scale and complexity of the project. We estimate that this process may take between 20 to 40 months.

4. **Minimum project cost**

Smaller projects are often addressed by wired solutions that are cheaper than the fixed cost of performing an NWS process. Further, the value of the avoided or deferred wired solution must be large enough to make a meaningful difference to DER adoption through different program mechanisms, such as marketing or incentives. For these reasons, and in alignment with national best practices, PGE maintains a **minimum project cost** threshold for NWS. This will allow us to focus on utility projects of sufficient scale that are more likely to be good candidates for NWS.

As a starting point, a nominal figure of $1 million will serve as guidance with respect to NWS suitability, but not applied as a bright line test. This cost suitability nominal figure will evolve over time, will be updated regularly and will be PGE-specific. We also will consider the size of the project when determining costs.

- **Multi-feeder/substation**. Typical lead time of 2 years or more to design and construct. Cost of project is typically higher (more than $1 million). Geographic footprint is likely to cover a larger area.
- **Feeder/circuit-specific**. Typical lead time of 9 months to 2 years to design and construct. Cost of project is typically lower (less than $1 million). Geographic footprint is also likely to cover a smaller area than a large project.

## NWS development process

If an NWS is deemed suitable to address a specific grid need PGE will perform the following steps:

- **NWS customer engagement (process TBD)**. An integral part of developing an NWS is the assessment of DER potential in the area affected by the NWS. Many factors contribute to this assessment and customer preferences is one of them. We

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[4] Screening of Non-Wires Alternatives in Distribution Planning: Guidance, Criteria, and Current Practices. EPRI, Palo Alto, CA: 2020. 3002018820.

expect to create a process for gathering this information and we will continue to work with partners to refine that process over time.

The process will likely include elements such as:

- Articulation of the problem, system need, and potential solutions.
- Sharing of relevant datasets such as environmental justice data that show energy burden and other equity indicators of each study area.
- An assessment of community needs in each study area through surveys and workshops such as preferences of DERs within a possible NWS, and preferred locations of assets such as substations.
- Detailed survey of building stock and end uses to determine range of feasible solutions
- Compile community feedback into a community needs assessment.

- **Resource applicability**. Determine which resources, or **Applicable solution types within NWS** can address the grid need. This is performed by comparing the operating characteristics of the DER with the identified grid needs. Applicable resources are available at the right location, at right time of day, for the right duration, for the required number of days in the year, at the right contingency, and preferred by the community among other relevant factors determined on a case-by-case basis.
- **Resource contribution**. For the applicable resources, the locational technical achievable potential is determined. For behind the meter solutions, PGE uses our AdopDER model to determine feeder level potential combined with historical participation at the requisite geographical granularity. PGE will evaluate front of the meter solutions through our internal engineering or product/program development teams.
- **Resource supply curve**. Once the applicable resources and their respective contributions are identified, the solutions are stacked based on their respective resource economics to develop a supply curve of resources in increasing cost to customers. When stacking these resources, the model will also consider the interactive effects of these resources and how that may impact the distribution system need and any community needs. The intersection of the total contribution from the DERs and the grid capacity need determines the size of the applicable solution. Over time, we will perform probabilistic modeling to determine the portfolio that meets the grid need given the uncertainty of the forecast and portfolio's performance. The portfolio can be refined with each iteration in consideration of cost-effectiveness, risk, and/or equity goals.

  The resource economics include the following benefit cost analysis:

  - **Determining costs and benefits**. Today, PGE's benefit cost ratio is calculated based on the present value of the costs and benefits over the lifetime of the project. Given the geographic granularity of an NWS, localized costs and benefits are accounted in the benefit cost ratio. These include deferral impacts of the traditional solution (also called locational value) and costs of developing and implementing an NWS. PGE is looking at multiple sources to identify the right costs and benefits for NWS. For this work, we have reviewed the National Standard Practice Manual,[5] US Department of Energy's next generation of distribution planning,[6] New York's Benefit Cost Analysis handbook,[7] and California's DER Avoided Cost Calculator,[8] which are vetted by experts across several jurisdictions and stakeholders to determine the range of costs and benefits applicable to NWS analysis.

  - **Modeling the cost-effectiveness.** Once the costs and benefits are calculated for each resource in the portfolio, a portfolio level cost-effectiveness is conducted that accounts for the interactive effects of these resources in meeting the grid need such as solar photovoltaics and BESS.

- **Simulating NWS solutions in CYME.[9]** PGE uses CYME to conduct distribution system simulations. NWS solutions will likely be integrated within CYME through modified load profiles. The study area is simulated in CYME to determine if the NWS solution addresses all applicable violations under both N-0 (normal) and N-1 (contingency) grid conditions. Typical violations include exceeding the allowable thresholds for voltage, voltage variations, and thermal ratings of equipment. PGE will analyze peak and day-time minimum loading impacts.[10] PGE will explore the possibility of performing a time-series power flow analysis to show the temporal impact on the violations. If the NWS successfully addresses the applicable violations, the project is moved to the next step in the process.

As part of the solution development, PGE will also consider eliminating NWS that may result in unsafe conditions, negatively impact reliability, negatively impact equity, create equipment or human safety concerns, and/or other case-by-case considerations.

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[5] National standard practice manual, available at: https://www.nationalenergyscreeningproject.org/wp-content/uploads/2020/08/NSPM-DERs_08-24-2020.pdf

[6] Dept. of Energy's next generation distribution system platform, available at: https://gridarchitecture.pnnl.gov/media/Modern-Distribution-Grid-Volume-III.pdf

[7] NY's BCA handbook for all IOUs, available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=16-M-0412

[8] CA's approach to valuing DERs, available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M340/K054/340054558.PDF

[9] PGE uses CYME, a recognized industry software solution, to perform distribution system modeling. CYME has a broad range of capabilities including power flow analyses, fault analyses, hosting capacity analysis, and reliability analysis.

[10] PGE's Distribution engineering planning study process, available at: https://assets.ctfassets.net/416ywc1laqmd/2mXm5Y5DdL28KRZvoy3URG/5f1d35bb2121a3e4b1ec9e76bf8f1e8f/DSP_2021_Report_Appendix_B.pdf#page=1

## Decision making

All wired and non-wired solutions are analyzed through a comprehensive set of metrics and analysis including, but not limited to:

- **Lifecycle cost of ownership** which is the delta between the current system and the proposed solution, where lifecycle cost of ownership is the cost to own and maintain asset(s) over time and is the net present value of the cost stream. This includes maintenance, risk, and capital investment costs.
- **Risk based benefit cost (B/C) analysis** which compares the delta in lifecycle cost of ownership divided by capital investment required to determine whether risk and reliability benefits exceed investment.
- **Near-term risk** is annual probability of failure multiplied by consequence of failure. Consequence of failure is primarily focused on the customer's reliability experience, monetized by willingness-to-pay. The analysis also includes, where applicable, calculated safety and environmental risks.
- **Near-term customer interruptions (CI)** is the annual probability of failure multiplied by consequence of failure, where consequence of failure is represented in the number of customer interruptions.
- **Near-term customer minutes interrupted (CMI)** is the annual probability of failure multiplied by consequence of failure, where consequence of failure is represented in customer minutes interrupted.
- **Resource-economics based B/C analysis** is the portfolio level costs and benefits of the selected DERs within the NWS as determined in the **Resource Supply Curve** process. PGE will include the deferral value of the distribution system upgrade in this step. We expect to use the present worth method to determine the distribution deferral value, in line with national best practices.[11] We will combine the risk-based and resource-economics-based B/C analysis during decision making.
- **Equity metrics (process TBD)** is a new process for PGE. Moving forward, we will perform an equity analysis for each solution option that is proposed for a grid need.
- **Resilience metrics** are a new addition to PGE's decision-making process. Moving forward, we will evaluate resilience metrics for each solution option that is proposed to address a grid need. We will leverage leading industry resilience metrics such as Customers Experiencing Multiple Interruptions (CEMI) and Customer Experiencing Long Interruption Duration (CELID) to evaluate resilience.

Once each metric is calculated, PGE will leverage a rubric to score the different elements and determine the recommended solutions. Each metric has an associated weight that

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[11] Locational Value of Distributed Energy Resources developed by Lawrence Berkeley National Laboratory, Contract No. DE-AC02-05CH11231, available at: https://emp.lbl.gov/publications/locational-value-distributed-energy

determines the effective impact of the metric to the final decision. Following the development of the equity metrics with partners (i.e., community-based organizations and environmental justice communities) and the OPUC, these weights will be shared with stakeholders through our DSP public process.