Chapter 6.

Plug and play: enabling DER adoption

Chapter 6. Plug and play: enabling DER adoption

"Replacing traditional sources of energy completely with renewable energy is going to be a challenging task. However, by adding renewable energy to the grid and gradually increasing its contribution, we can realistically expect a future that is powered completely by green energy"

— Tulsi Tanti, world-renowned clean energy expert

6.1 Reader's guide

PGE's Distribution System Plan (DSP) takes the first step toward outlining and developing a 21st century community-centered distribution system. This system primarily uses distributed energy resources (DERs) to accelerate decarbonization and electrification and provide direct benefits to communities, especially environmental justice communities.[96] It's designed to improve safety and reliability, ensure resilience and security, and apply an equity lens when considering fair and reasonable costs.

This chapter provides a description of the activities, planned or in flight, and how our human-centered vision of the distribution system can provide safe, secure, reliable and resilient power, at fair and reasonable costs. It supports PGE's plug and play strategic initiative, describing our efforts to enhance our net metering map to include distributed generation readiness and demographics information, as well as how we'll perform hosting capacity analysis (HCA) twice annually beginning in 2022.[97] It also provides details on PGE's recommendation for HCA updates at the line segment level on an as-needed basis, rather than monthly or hourly. **Table 26** illustrates how PGE has met the Public Utility Commission of Oregon's (Commission or OPUC) DSP guidelines under Docket UM 2005, Order 20-485.[98]

WHAT WE WILL COVER IN THIS CHAPTER

An overview of hosting capacity analysis (HCA) and its role in the modernized grid

How HCA matures over time

How PGE identifies areas where distributed generation can be added

An overview of the options for analyzing hosting capacity

PGE's HCA plans moving forward

For more details on how PGE has complied with the requirements under UM 2005, Order 20-485, see **Appendix A. DSP plan guidelines compliance checklist**.

96. PGE uses the definition of environmental justice communities under Oregon House Bill 2021, available at oregonlegislature.gov
97. PGE's net metering map, available at portlandgeneral.com
98. OPUC UM 2005, Oregon 20-485 was issued on December 23, 2020, available at apps.puc.state.or.us

Table 26. Plug and play: guideline mapping

DSP guidelines	Chapter section
4.2.a	Section 6.4
4.2.b	Section 6.5

6.2 Introduction

Through Order 20-485, the OPUC required investor-owned utilities to conduct a system evaluation to identify areas where it is difficult to interconnect DERs without system upgrades and present the results through an unredacted map that is continuously available on the utility's website. PGE also is required to analyze three options to meet future HCA needs. This section provides an overview of HCA, what it is and how it can be used to support decisions. Also included is a description of PGE's partner and community feedback process, which helped shape PGE's approach.

PGE will use Electric Power Research Institute's (EPRI's) definition of hosting capacity.[99] According to EPRI:

> Hosting capacity in a distribution system is the amount of DERs that can be accommodated without significant upgrades or adversely impacting power quality or reliability under existing feeder design and control configurations.

Our plan is focused on HCA as it relates to distributed generation (DG) and does not include consideration of DERs such as electric vehicles (EVs), as described in EPRI's definition. Flexible loads such as EVs, hot-water heaters and behind-the-meter storage will be considered in future DSP submittals.

PGE is supportive of OPUC staff's goal of transparency and visibility into PGE's system. HCA will allow prospective interconnection customers to make more informed business decisions prior to committing resources to an interconnection application.

As PGE heard in OPUC staff's webinar series, and as witnessed from other states' experiences, use cases for HCA include:

- Preliminary screening for DG proposals
- Guidance in the early phases of the interconnection process
- Enhancing distribution system visibility when determining locations for future DG

PGE's approach to HCA has been shaped by conversations with partners, communities and other utilities that have implemented HCA tools and methodologies. We conducted a series of feedback sessions with partners and communities and interviews with peer utilities to gain insight into lessons learned and the most effective approach to delivering value.

We also hosted a total of six community workshops from March 2021 to September 2021. One of the primary objectives was to gather feedback for the HCA options analysis and clarify the use cases for the DG evaluation map.

PGE gathered feedback from the OPUC's Technical Working Group (TWG) via three sprint sessions over 10 weeks.[100] Each sprint session was composed of a feedback period, analysis of the feedback and updates to the map. The periods for each sprint session are outlined in **Figure 30**.

99. "Defining a Roadmap for Successful Implementation of a Hosting Capacity Method for New York State," EPRI, June 2016, available at epri.com
100. A description of the OPUC's TWG, available at edocs.puc.state.or.us

Figure 30. 2021 feedback sprints

Sprint 1, 5/3-5/21
5/3 – 5/7: Stakeholders provide feedback
5/10 – 5/21: PGE team incorporates feedback
Sprint 2, 5/24-6/11
5/24 – 5/28: Stakeholders provide feedback
5/31 – 6/11: PGE team incorporates feedback
Sprint 3, 6/14-7/2
6/14 – 6/18: Stakeholders provide feedback
6/14 – 7/2: PGE team incorporates feedback

During this process, PGE received 124 comments from partners and communities. The complete set of feedback with PGE's responses can be accessed on PGE's DSP website.[101]

The feedback process proved valuable for PGE as an opportunity to calibrate on terms, definitions and value levers. As noted earlier, the results of a complete HCA will not be available until late 2022. In the interim, it is important to identify the means by which PGE can support customers' DG decision-making processes.

A few examples of important takeaways from the feedback process are:

- **Naming the map:** Initially, the map's name was "DER Readiness Viewer." It became clear that the name needed to change to reflect the fact that only DG is addressed in the DSP Part 1 HCA requirements and represented on the map, not other DERs such as electric vehicles.
- **Recognizing complexity:** For the purpose of making the map and data usable, PGE provided some definitions and descriptions that were oversimplified. They do not apply in all situations. As a result, PGE is revisiting its definitions and how the data is presented.
- **Missing data:** Although the data PGE provided has been publicly available for more than a year, this feedback process revealed missing and inaccurate data that PGE will have an opportunity to correct in future publications.
- **Overall:** This activity generated productive conversations. Viewing data through the perspectives of different customers, partners and communities generated valuable insights, and PGE looks forward to continuing this dialogue as DG readiness and HCA analyses evolve.

101. PGE's DSP website, available at assets.ctfassets.net

6.3 Hosting capacity maturity model

PGE appreciates the OPUC's recognition of PGE's constrained feeder map as a starting point for communicating to partners and communities. We will continue to produce this level of hosting capacity and, with input from partners and communities, improve its usefulness. This level of data transparency is identified as Phase 1 in EPRI's hosting capacity maturity model, illustrated in **Table 27**.[102]

Table 27. Hosting capacity maturity model

Phase	Consideration	Data requirements	Outcome	Possible outputs
1. Indicator assessment (PGE current state)	Possible indicators such as: – Estimated minimum load levels – Voltage class – Substations over a MW threshold typically indicative of backfeed	– Currently available data – Understanding the interconnection queue	– Provides an indication where certain substations/ feeders may have high costs associated with interconnecting DER	– Maps indicating where interconnection costs may be higher
2. Hosting capacity evaluations – Radial systems	– All feeders modeled in service territory with periodic updates for existing DER and queued DER mapped into planning models	– All feeders modeled in service territory with periodic updates for existing DER and queued DER mapped into planning models	– Feeder-level hosting capacity determinations	– Maps indicating feeder-level hosting capacity
3. Advanced hosting capacity evaluations	– Substation and transmission assessments and mapping of distribution-level impacts to substation and transmission – Normal and reconfigured system models	– Substation and transmission assessments and mapping of distribution-level impacts to substation and transmission – Normal and reconfigured system models	– Refined hosting capacity evaluations that take into account additional criteria	– Maps indicating node/section-level hosting capacity
4. Fully integrated DER value assessments	– Increased level of detail regarding distribution constraints, asset performance and DER performance metrics – Models of emerging technologies, such as energy storage	– Increased level of detail regarding distribution constraints, asset performance and DER performance metrics – Models of emerging technologies, such as energy storage	– Comprehensive hosting capacity and DER value assessments considering both distribution and transmission – Ability to increase hosting capacity	– Maps indicating hosting capacity along with areas where DER can bring additional value to the grid

102. "Defining a Roadmap for Successful Implementation of a Hosting Capacity Method for New York State," accessed October 26, 2020, available at nyssmartgrid.com

While PGE's system modeling and remote sensing capabilities are maturing, PGE will use distribution system indicators to provide information to identify areas where DG can be accommodated. Possible indicators include daily minimum load (DML), installed/planned distributed generation and current system configuration. These indicators will allow developers to consider the type of constraints that may exist in different areas they are considering for installations.

Moving beyond Phase 1 in this maturity model requires advancements in forecasting, system monitoring and system modeling. PGE will begin to see these advancements with the implementation of its advanced distribution management system (ADMS) in 2022.

6.4 Distributed generation (DG) constrained areas

Recognizing that a true HCA requires complete and current distribution feeder models for the entire system, PGE is using distribution system indicators to identify areas where DG can be accommodated. Distribution system indicators include DML (the estimated level at which substation backfeed may occur), installed DG and planned DG.

PGE's current net metering map uses these indicators to help provide visibility into locations where there may be a significant cost to interconnect. These indicators can help developers identify the type of constraints that may exist in different areas where they are considering installations.

PGE's approach for conducting a system-wide HCA at the feeder level is presented in **Section 6.6**. The remainder of this section provides a discussion of distribution system indicators and how they can support DG siting and sizing decisions.

6.4.1 PGE GENERATION LIMITED FEEDER MAP

Most PGE feeders can support new net metering projects; however, a few areas have limited capacity to connect new generation projects without significant changes to the feeder or the substation. Small residential and business projects can usually still be accommodated but may require design changes to maintain grid safety and reliability.

For the purposes of our Generation Limited Feeder Map, PGE is using the following definition:

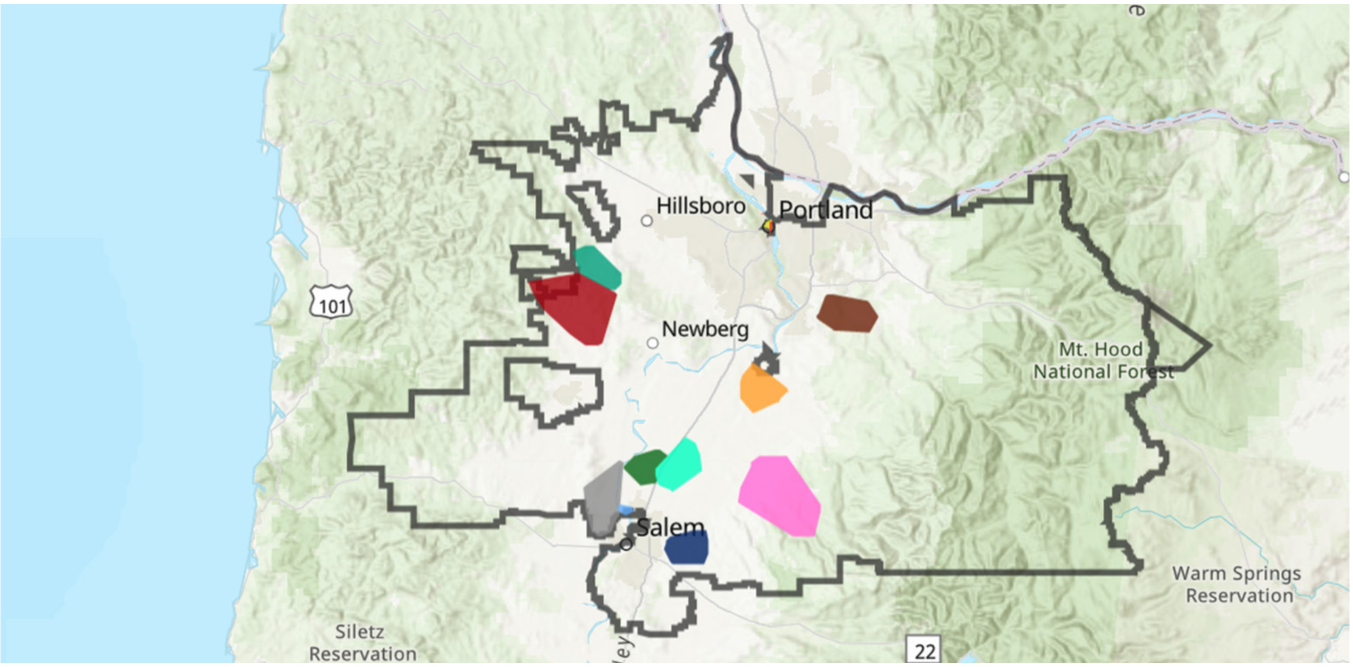
> A generation-limited feeder is a feeder that has installed and queued generation that exceeds 90% of the DML.

This use of DML data is an example of using distribution system indicators to support or inform the siting of DG.

PGE's generation limited feeder map, shown in **Figure 31**, allows a customer to enter their street address to find out if their location is served by a generation-limited feeder.[103]

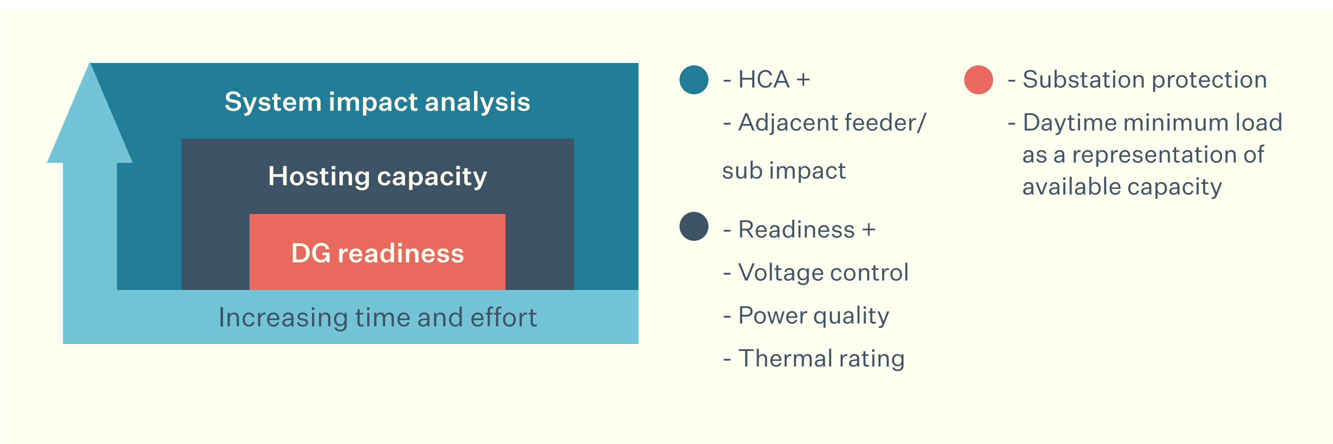
103. The data that supports production of PGE's Generation Limited Feeder map is publicly available and located on the portal for interconnection information, available at oasis.oati.com

Figure 31. PGE generation limited feeder map



The purpose of providing the net metering map is to enable customers to perform some preliminary screening activities before submitting an application for interconnection. The expectation is that empowering customers to take these steps will reduce the time and work necessary to process interconnection applications, enhance the customer experience and reduce the number of withdrawn applications. **Figure 32** depicts some of the interconnection screening activities.

Figure 32. Interconnection screening activities

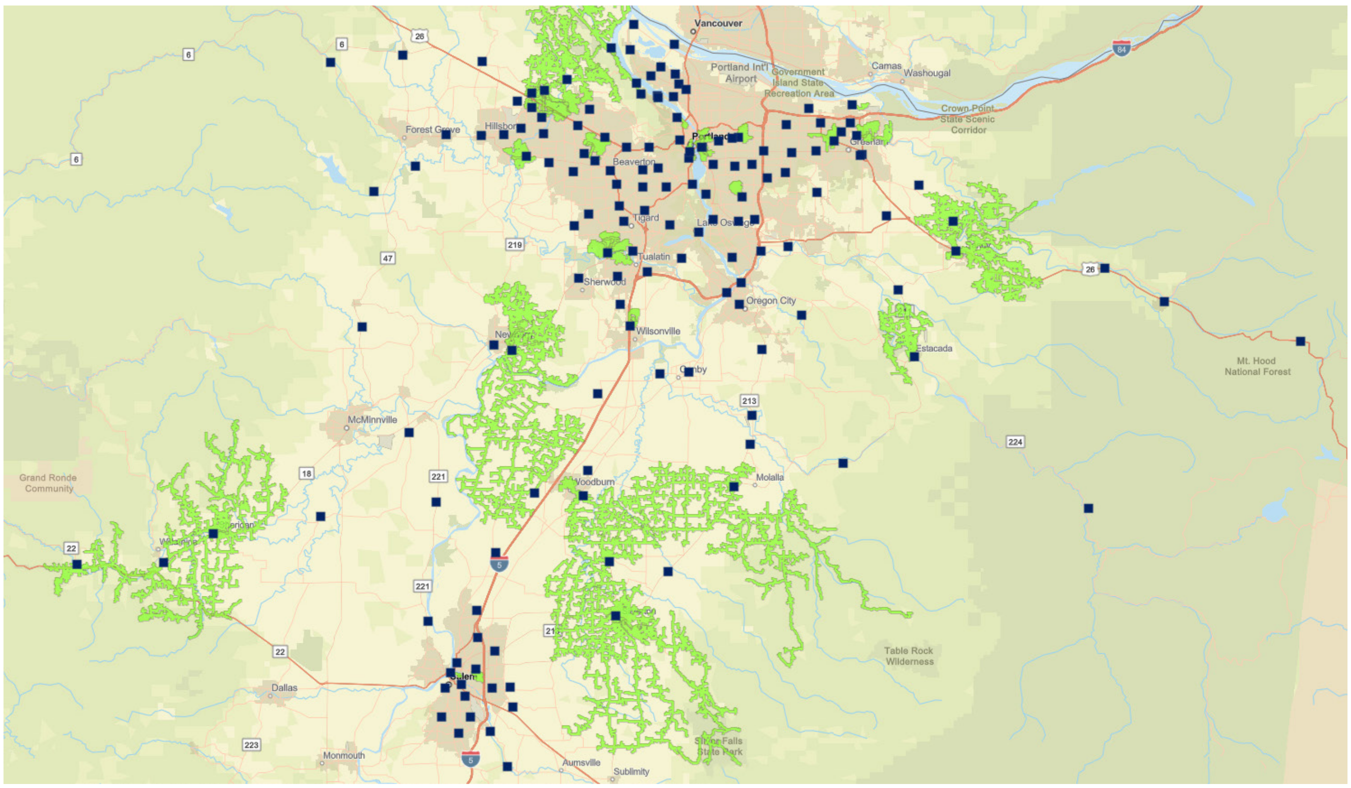


6.4.2 DISTRIBUTED GENERATION EVALUATION MAP

In an effort to expand the availability and usability of the data posted on OASIS, PGE worked with the OPUC's TWG to identify information that would be valuable to add to the generation limited feeders map (a sample of this data is available in **Appendix K. OASIS** dataset. The initial version of the distributed generation evaluation map is shown in **Figure 32**. The map provides access to several categories of PGE system data and demographic data from the U.S. Census Bureau.

The distributed generation evaluation map is a high-level display of the PGE distribution system's ability to accommodate DG. This map is one tool designated to help assess the grid's ability to support DG, such as rooftop solar or a larger solar installation.[104]

Figure 33. Distributed generation evaluation map



104. A complete description of the map's features can be found in the user guide posted on PGE's DSP website, available at assets.ctfassets.net

The information in the map can be used to support DG siting and sizing decisions in many ways:

- **DG-ready feeders and substation transformers:** This information is provided in contrast to the limited-generation feeders represented in the net metering map. The "DG-ready" designation indicates that these feeders and substation transformers have the protection equipment required to prevent damage during a backfeed event. The availability of protection equipment and implementation of protection schemes are cost drivers for DG installations. Knowledge of where protection is in place can help customers, installers and developers identify more cost-effective locations for DG installations.
- **Substation location:** This is an informational-only item. Distance from a substation to the point of interconnection, such as a solar installation, can be an interconnection cost driver. For example, if communication infrastructure (e.g., fiber) needs to be provided to a location, longer distances typically result in additional costs to prepare the utility poles for communication attachments.
- **Daytime minimum load (DML):** If a feeder is not identified as DG-ready, then the DML provides an indication of how much generation might be accommodated by a feeder. This information can be used in several ways:
  - DML helps identify how much DG could potentially be accommodated on a feeder.
  - DML indicates how to size a DG so that the DG does not exceed the DML.
  - If DG capacity in queue is greater than DML, then it is possible that the DG in queue may have to pay for upgrades to the feeder, substation or both, thus indicating that future installations may not have the same upgrade expenses.
  - DML is a proxy for hosting capacity, but it is not hosting capacity. Hosting capacity includes other considerations, such as the thermal rating of a feeder and voltage regulation. Therefore, DML can help with screening, but additional analyses are required to evaluate the impact of DG at a location.
- **DG capacity in queue:** This represents the amount of generation that was in the interconnection queue as of the date reflected in the "Date DG status updated" field. The number of projects in the queue, as well as the amount of proposed generation, provides a level of uncertainty to the future state of the associated feeder and transformer. With the possibility of projects removing themselves from the queue (the dropout rate has been as high as 60%), the study process becomes more complex with the added risk of re-studies.

PGE anticipates that the value of the Demand Generation Evaluation Map will evolve as partners, communities and customers use the map to support DG decisions.

6.5 Hosting capacity options analysis

The three options outlined in the OPUC's UM 2005 DSP requirements represent increasing degrees of granularity in both time and data resolution. The evaluation of each option is based on the best available information today. PGE recognizes that HCA is a rapidly evolving capability with new tools and techniques being introduced every year. We have used our current understanding of DG-specific HCA as a starting point and scaled that model to represent the three options, with additional assumptions incorporated to capture option-specific costs/benefits. For example, Option 1 outlines annual HCA at the feeder level; Option 2 outlines monthly HCA. The cost of Option 2, therefore, is approximately 12 times the cost of Option 1. As with any process, efficiencies will be gained, and annual costs are expected to decrease in iterations past the initial implementation timelines.

The outcome of this analysis may not be precise with respect to the actual cost of executing the different options, but we expect that it is representative of the relative complexity, effort and costs between the three options.

6.5.1 METHODOLOGIES

There are four main methods to analyze hosting capacity in the industry today: Stochastic, streamlined, iterative and hybrid. Electric Power Resource Institute (EPRI) has conducted several evaluations on the different hosting capacity methods, which all reached parallel conclusions. This means regardless of the hosting capacity method used, they all can provide similar, accurate results. The minor variations in input assumptions and factors have greater impact on results than one method versus another. EPRI recognized that hosting capacity methods are continuously evolving and improving as new technologies become available. A hybrid method, such as DRIVE, is the most likely and successful path going forward.

Table 28 summarizes the advantages and disadvantages of the four main hosting capacity methods.[105]

Table 28. Four main methods to analyze hosting capacity

Method	Approach	Advantages	Disadvantages	Computation time	Recommended use case
Stochastic	– Increase DER randomly – Run power flow for each solution	– Similar in concept to traditional interconnection studies – Becoming available in planning tools	– Computationally intensive – Limited scenarios	Hours/feeder	– DER planning
Iterative (Integration capacity analysis)	– Increase DER at specific location – Run power flow for each solution	– Similar in concept to traditional interconnection studies – Becoming available in planning tools	– Computationally intensive – Limited scenarios – Vendor-specific implementations can vary – Does not determine small, distributed rooftop Photovoltaic (PV)	Hours/feeder	– Inform screening process – Inform developers

105. Source: Methods and application considerations for hosting capacity (hawaiianelectric.com), available at hawaiianelectric.com

Table 28. Four main methods to analyze hosting capacity (continued)

Method	Approach	Advantages	Disadvantages	Computation time	Recommended use case
Streamlined	– Limited number of power flows – Utilizes combination of power flow and algorithms	– Computationally efficient – Not vendor tool-specific	– Novel approach to hosting capacity – Method not well understood – Limited scenarios – Not available in current planning tools	Minutes/feeder	– Inform screening process – Inform developers
Hybrid (DRIVE)	– Limited number of power flows – Utilizes combination of power flow and algorithms	– Computationally efficient – Many DER scenarios considered – Not vendor tool-specific – Broad utility industry adoption and input – Becoming available in planning tools	– Novel approach to hosting capacity – Method not well understood – Lag between modifications/upgrades and associated documentation	Minutes/feeder	– DER planning – Inform screening process – Inform developers

Table 29 shows the recommended use cases for each method. Exelon Corporation companies, such as Potomac Electric Power Company (Pepco) and Commonwealth Edison (ComEd), have used the stochastic method, while California utilities have used both the iterative and streamlined methods. More than 27 utilities have used the hybrid method via the DRIVE tool.

Table 29. Recommended use cases to analyze hosting capacity[106]

Method	Industry adoption	Recommended use case
Stochastic	Pepco, ComEd	– Enabling planning – Informing the public
Iterative	Southern California Edison (SCE), San Diego Gas & Electric (SDG&E)	– Assisting with interconnection – Informing the public
Streamlined	Pacific Gas & Electric (PG&E)	– Enabling planning – Informing the public
Hybrid-DRIVE	27+ utilities worldwide (including XCEL)	– Enabling planning – Assisting with interconnection – Informing the public

106. "Impact Factors, Methods, and Considerations for Calculating and Applying Hosting Capacity." January 31, 2018, pages xixii, 5-2, available at epri.com

Based on the positive experiences in other jurisdictions and PGE's own experience with the tool, we believe DRIVE is the correct tool at this time to perform our HCA and help inform where the system has availability to interconnect DG. As a hybrid method, DRIVE has several benefits, including computational efficiency, accuracy of results and multiple use case scenarios. Another advantage is PGE's use of CYME as the distribution planning tool, which integrates well with DRIVE. Additionally, DRIVE's continued growth in popularity has enhanced consistency across the industry in analyzing hosting capacity.

6.5.2 OPTIONS ANALYSIS

Table 30 shows the three options outlined in the OPUC UM 2005 DSP requirements. The second and third characteristics are particularly important, as they represent the granularity of analysis. The DRIVE tool supports analysis at the granularity requested in all three options. The challenge is in providing the inputs to the DRIVE tool to enable analysis at increasing levels of granularity.

A summary of the options analysis results is presented in **Table 31**. A more detailed description of each option appears in the following sections.

Table 30. Three HCA options included in the options analysis

HCA characteristic	Option 1	Option 2	Option 3
Methodology	Stochastic modeling/ EPRI DRIVE modeling	Same as option 1	Iterative modeling
Geographic granularity	Circuit	Feeder	Line segment
Temporal granularity	Annual minimum daily load	Monthly minimum daily load	Hourly assessment
Data presentation	Web-based map for the public and available tabular	Same as option 1	Same as option 1
Data update frequency	Annual refresh	Monthly refresh	Monthly refresh
Other info	Queued generation	Same as option 1	Same as option 1

Table 31. HCA options analysis summary[107]

Evaluation parameter	Option 1	Option 2	Option 3
Timeline	12 months	24 months	24-36 months
Cost	$141k	$2.61M	$58.38M
Data security risk	Low	Low	Medium
Result validation	Low	High	High
Implementation concerns	Low	Medium	High
Interconnection use case implications	Medium	High	High
Planning use case implications	Low	Medium	Medium
Locational value and benefits	Medium	Medium-high	Medium-high
Interaction with grid needs identification	Medium	Medium-high	Medium-high

107. Costs and hourly estimates are provided for the purpose of comparing the options. They are subject to change.

In the analysis of each option, PGE considered these questions from the DSP guidelines:

- What are the costs and timeline?
- What are the implementation barriers?
- How frequently should the data and map be updated?
- How helpful will this be for grid needs identification?
- How helpful will this be for interconnection studies?

The DSP questions were translated into the evaluation parameters shown in **Table 31**.

The definition of each evaluation parameter and its rating scale follow:

- **Timeline:** the duration required to develop the capability to execute HCA at the specified level of granularity
- **Cost:** the monetary value of the people, processes and tools required to execute HCA at the specified level of granularity

Table 32. Criteria that utilize a low/medium/high rating scale

Evaluation criterion	Low	Medium	High
Data security risk: the degree of risk related to system or customer data	Individual customer data or system vulnerability is not exposed	PGE must take additional steps to obscure the data so that individual customer data or a system vulnerability is not exposed.	Information about an individual customer can be derived from the information provided or a system vulnerability can be identified.
Result validation: the effort needed for input and output data quality assurance (QA) to validate the results	All the data is the most recent for the effort; some data clean-up and validation work is necessary.	Detailed QA will be done by engineers to validate assumptions, models and results.	Automated QA will be done by engineers to validate results and models.
Implementation concerns: challenges and roadblocks for data availability, staff and computational resources	No immediate or severe concerns	Anticipate data availability, system process and computationally intensive issues with moderate possibilities for delays	Anticipate data availability, system process and computationally intensive issues with severe possibilities for delays
Interconnection use case implications: the ability of HCA results to support the interconnection process (e.g., DG siting and sizing decisions)	The HCA results do not support DG siting/sizing decisions; only generation-constrained areas will be identified.	The HCA results support DG siting/sizing decisions, but may not be reliable. Feeder, substation and system-level data will be shared for all connected DG as well as DG in queue. Overview of constraints evaluated will be provided. Maps will be refreshed annually.	The HCA results provide a high degree of confidence in DG siting/sizing decisions. Feeder, substation and system-level data will be shared for all connected DG as well as DG in queue. Overview of constraints evaluated will be provided. Maps will be refreshed more frequently.

Table 32. Criteria that utilize a low/medium/high rating scale

Evaluation criterion	Low	Medium	High
Planning use case implications: the ability of HCA results to serve as a tool for distribution system planning	Distribution Planning is made aware of the location and size of the DERs being interconnected, but cannot control or direct the location of DERs; DER-related distribution upgrades are made in a reactive manner.	Hosting capacity is evaluated to understand the impacts of DERs on the feeders at different loading levels, locations and type of DER, among other factors. Time-varying impacts of DERs on the distribution system are studied. High DER penetration effects are studied, along with their mitigation options. Provides a basis for cost benefit and deferral framework.	Hosting capacity captures both transmission and distribution impacts. The analysis informs and captures much more detailed and granular results. The analysis informs non-wires solutions' (NWS) cost/benefit and deferral framework. Improved system and scenario planning with enhanced load and DER forecasts. Improvements to update cost allocation for the services provided by DERs. Benefits and impacts of smart inverters and energy storage are evaluated. Grid impacts are studied when feeders are reconfigured.
Locational value and benefits: the ability of HCA results to support the evaluation of locational value and benefits	Cannot help the evaluation of locational value and benefits	Evaluation of some, but not all, locational value and benefits are supported by the HCA results.	Evaluation of locational value and benefits is supported by the HCA results.
Interaction with grid needs identification: HCA results can be used to assess grid needs	HCA results do not support grid needs analysis.	HCA results partially support grid needs analysis.	HCA results support grid needs analysis.

The following sections provide an analysis of each option. The criteria described previously are applied to each option.

6.5.3 OPTION 1: ANNUAL REFRESH AT CIRCUIT LEVEL

Option 1 as defined in the DSP requirements represents the base case for performing HCA and reflects the starting point for most utilities that have begun performing HCA. The description of Option 1 as provided in the DSP requirements is included in **Table 33**.

Table 34 includes a summary of the results of PGE's analysis of Option 1. A brief description of the evaluation of each parameter follows.

Table 33. HCA Option 1 requirements

HCA characteristic	Option 1 requirement
Methodology	Stochastic modeling/EPRI DRIVE modeling
Geographic granularity	Circuit
Temporal granularity	Annual minimum daily load
Data presentation	Web-based map for the public and tabular format
Data update frequency	Annual refresh
Other info	Queued generation details

Table 34. Analysis summary for option 1

Evaluation parameter	Option 1	Evaluation rating description
Timeline	12 months	No lead time is required to prepare for this level of HCA execution. PGE owns the tools and has the capability to perform Option 1. The resources to perform this analysis need to be made available and that resource commitment is outlined in **Table 35**.
Cost	$141k	Cost details are included in **Table 35**.
Data security	Low	Due to the granularity of data being presented, there is little to no risk to data security.
Result validation	Low	Provision of data on an annual basis makes the QA process easy to execute; no automation or expedited processing are required.
Implementation concerns	Low	Annual processing of HCA leverages data that PGE already produces and tools that PGE currently uses.
Interconnection use case implications	Medium	The basic information to support siting and sizing is available, but the frequency may render it inaccurate.
Planning use case and implications	Low	DER upgrades are made in a reactive manner.
Locational value and benefits	Medium	The evaluation of benefits is limited based on the spatial and temporal granularity of data. Not all benefits can be identified or maximized.
Interaction with grid needs identification	Medium	The evaluation of grid needs is limited based on the spatial and temporal granularity of data.

The detailed breakdown of costs is included in **Table 35**.

Table 35. Option 1 estimated cost detail

Activity	Hours	Cost
Setup	1,120	$67,200
GIS	120	$7,200
Reporting	120	$7,200
Modeling	700	$42,000
Analysis	163	$9,750
License renewals		$7,200
Total	**2,223**	**$140,550**

Note that the activities and costs summarized in **Table 35** are explained further in **Section 6.6**.

6.5.4 OPTION 2: MONTHLY REFRESH AT FEEDER LEVEL

Moving beyond annual to monthly HCA updates would stretch the manual processes beyond their limits, therefore performing the analysis will require automation of various components of the process, as well as completing the field verification and underlying data updates. This automation will not only allow for more frequent updates, but it will also improve the accuracy of the information. The description of Option 2 as provided in the DSP requirements is included in **Table 36**.

Table 36. HCA Option 2 requirements

HCA characteristic	Option 2
Methodology	Same as Option 1
Geographic granularity	Feeder
Temporal granularity	Monthly minimum daily load
Data presentation	Same as Option 1
Data update frequency	Monthly refresh
Other info	Same as Option 1

Table 37 includes a summary of the results of PGE's analysis of Option 2. A brief description of the evaluation of each parameter follows.

The detailed breakdown of costs is included in **Table 38**.

Table 37. Analysis summary for Option 2

Evaluation parameter	Option 2	Evaluation rating description
Timeline	24 months	In order to execute HCA on a monthly basis, additional field data collection will need to occur, as well as automation of data management and analyses. The estimated time to put those tools and processes in place is approximately two years.
Cost	$2.61 million	Cost details are included in **Table 38**.
Data security	Low	Due to the granularity of data being presented, there is little to no risk to data security.
Result validation	High	Execution of HCA on a monthly basis requires automation or another means of expedited processing.
Implementation concerns	Medium	Monthly execution will put pressure on the resources involved, both computational and personnel.
Interconnection use case and implications	High	The interconnection queue is updated on a monthly basis. Monthly execution of HCA will provide the most up-to-date DG information relative to the information in the queue.
Planning use case and implications	Medium	Execution on a monthly basis provides more of an opportunity to factor DG requests into DG investment planning processes.
Locational value and benefits	Medium-high	The evaluation of benefits is limited based on the spatial and temporal granularity of data — not all benefits can be identified or maximized. Note that the ability to maximize locational net benefits is more of an operational capability. The ability to control DG installations is necessary to achieve more value/benefits.
Interaction with grid needs identification	Medium-high	The evaluation of grid needs is limited based on the spatial and temporal granularity of data. Note that the ability to maximize DG's contribution to grid need is more of an operational capability. The ability to control DG installations is necessary to achieve more value/benefits.

Table 38. Option 2 estimated cost detail

Activity	Hours	Cost
Setup	13,440	$806,400
GIS	1,440	$86,400
Reporting	1,440	$86,400
Modeling	8,400	$504,000
Analysis	1,950	$117,000
DRIVE software, data management and computing		$1,007,200
Total	**26,670**	**$2,607,400**

Note that the activities and costs summarized here are explained further in **Section 6.6**.

6.5.5 OPTION 3: HOURLY REFRESH AT THE LINE SEGMENT

Performing HCA on an hourly basis at the line segment level creates an exponential increase in the data collection needed. It requires an increase in our monitoring/sensing and data polling processes to an hour or sub-hour frequency. In some cases, current equipment does not support that frequency or granularity. New equipment will need to be deployed and existing equipment will need to be reconfigured.

Much of this monitoring/sensing currently takes place at the substation transformer. Extending a similar level of sensing/monitoring and data polling to the line segment level will require deployment of additional equipment.

The exponential increase in data collection requires expanded storage and processing capabilities and, potentially, communication bandwidth to transport data from remote monitoring equipment.

Based on these factors, a significant increase in cost and timeline to develop the capability is to be expected for Option 3. The costs and timeline outlined below are in line with the costs estimated by peer utilities as shown in their HCA plans (e.g., SCE and MN Xcel). We have noted in the following outlined costs where we believe the investment is already being made. For example, PGE's distribution automation program will deploy remote sensing capabilities on line segments, thereby reducing the cost to implement this level of HCA.

The requirements for Option 3 are depicted in **Table 39**.

Table 40 includes a summary of the results of PGE's analysis of Option 3. A brief description of the evaluation of each parameter follows.

Table 39. HCA Option 3 requirements

HCA characteristic	Option 3
Methodology	Iterative modeling
Geographic granularity	Line segment
Temporal granularity	Hourly assessment
Data presentation	Same as Option 1
Data update frequency	Monthly refresh
Other info	Same as Option 1

Table 40. Analysis summary for Option 3

Evaluation parameter	Option 3	Evaluation rating description
Timeline	24-36 months	In order to execute HCA on an hourly basis, additional field data collection will need to occur, as well as automation of data management and analyses. The estimated time to put those tools and processes in place is 2-3 years.
Cost	$58.38M	Cost details are included in **Table 41**.
Data security	Medium	Data will be published at the line segment level, and that will expose some customer information. PGE will need to perform some aggregation, such as applying the 15/15 rule, to protect customer data.[108]
Result validation	High	Execution of HCA on an hourly basis requires automation or another means of expedited processing.
Implementation concerns	High	Hourly execution will require a new execution paradigm.

108. The 15/15 rule is an approach to maintaining customer privacy. More information is available at elevatenp.org

Table 40. Analysis summary for Option 3 (continued)

Evaluation parameter	Option 3	Evaluation rating description
Interconnection use case and implications	High	The interconnection queue is updated monthly. Hourly execution of HCA will provide the most up-to-date DG information relative to the information in the queue.
Planning use case and implications	Medium	Execution on an hourly basis does not provide more information for planning purposes than monthly execution.
Locational value and benefits	Medium-high	The evaluation of benefits is limited based on the spatial and temporal granularity of data — not all benefits can be identified or maximized. Note that the ability to maximize locational net benefits is more of an operational capability. The ability to control DG installations is necessary to achieve additional value/benefits.
Interaction with grid needs identification	Medium-high	The evaluation of grid needs is limited based on the spatial and temporal granularity of data. Note that the ability to maximize DG's contribution to grid need is more of an operational capability. The ability to control DG installations is necessary to achieve more value/benefits.

PGE expects that one-half to two-thirds of the costs cited above could be attributed to modernized grid efforts already underway.

The detailed breakdown of costs is included in **Table 41**.

Table 41. Option 3 estimated cost detail

Activity	Hours	Cost
Setup	645,120	$38,707,200
GIS	6,240	$374,400
Reporting	1,440	$86,400
Modeling	36,400	$2,184,000
Analysis	117,000	$7,020,000
DRIVE software, data management and computing		$10,007,200
Total	**806,200**	**$58,379,200**

Note that the activities and costs summarized here are explained further in **Section 6.6**.

6.6 Plan to conduct initial hosting capacity analysis (HCA)

PGE plans to conduct HCA twice annually and at the feeder level. This places PGE's initial HCA between Option 1 and Option 2, described above. There are a few factors that contribute to taking this approach:

1. PGE currently is required to update its DML analysis and limited generation feeder list twice annually.[109] DML is the primary input into conducting HCA and represents a significant amount of the time and effort required to perform HCA.

2. PGE is required to update its peak load data twice annually. In addition to performing HCA during minimum load scenarios, the EPRI DRIVE tool will also run its iterative process for heavy loading scenarios.

3. PGE does not use "circuit" in its infrastructure analysis and planning. Feeders are the unit of infrastructure that PGE is most familiar with. Furthermore, EPRI's DRIVE tool, by default, provides results at the line segment level. It is possible that PGE's initial HCA will provide results at this level. We will investigate the possibility of providing results at this level while committing to providing results at the feeder level.

Table 42 reflects how PGE's approach maps to the three options presented in the OPUC's DSP requirements.

Table 42. PGE's HCA approach mapped to the options

HCA characteristic	Option 1	Option 2
Methodology	Stochastic modeling/ EPRI DRIVE modeling	Same as Option 1
Geographic granularity	Circuit	Feeder
Temporal granularity	Annual minimum daily load	Monthly minimum daily load
Data presentation	Web-based map for the public and available tabular	Same as Option 1
Data update frequency	Annual refresh (**PGE's analysis is semi-annual**)	Monthly refresh
Other info	Queued generation	Same as Option 1

It is important to note that the costs of conducting HCA twice annually is approximately two times the cost as described in the Option 1 analysis. However, because PGE already is incurring much of this cost to meet other obligations, the proposed approach adds minimal incremental cost. **Section 6.6.1** describes the methodology employed to execute HCA, operating assumptions, DRIVE settings, the execution plan and examples of the HCA results.

109 Order 20-402 requires that PGE's list of generation-limited feeders is updated twice per year, which requires updates to DML and peak load information. More information is available at apps.puc.state.or.us

6.6.1 METHODOLOGY OVERVIEW

PGE currently has its distribution system modeled in the CYME software. In total, PGE serves 653 feeders in its service territory. Broadly, the inputs to CYME include PGE's Geospatial Information System (GIS), supervisory control and data acquisition (SCADA) and aggregate consumption data from advanced metering infrastructure (AMI) records. This information is used to build the feeder models through the CYME gateway and Python scripting. Data quality checks are performed both via the CYME gateway process and after the feeder models are created. Some data checks include accurate representation of feeder voltage, specifying accurate voltages, and definitions for overhead and underground conductors, transformers, capacitors, reclosers, fuses and regulators, among other power system equipment. Other errors are corrected by engineers as and when they are noted.

Once the CYME models are created, loads on individual feeders are usually allocated based on historical loading data. Load forecast data is used where necessary. Base case power flow analysis is performed typically for peak and daytime minimum loading conditions. Feeder performance is studied and validated using available measurements. Errors may sometimes be identified in this data, in which case appropriate corrections are made. Once these models are created, the appropriate input files are created for the HCA in DRIVE, where the DRIVE hybrid method is used to conduct the analysis.

6.6.2 ASSUMPTIONS

The following assumptions are used when assembling the inputs for and conducting the HCA:

- Power flow models: As mentioned earlier, CYME power flow models are checked for data accuracy at multiple levels. PGE considers data quality to be a continuous process and will continue to improve its QA process.
- Low-voltage secondary systems: PGE's GIS system currently models the primary side of the distribution system in detail. The load is aggregated to the service transformer on the secondary side. Secondary conductors are not modelled.
- Load: Peak and daytime minimum load was calculated for each feeder. This is true of both SCADA and MV90 substations.
- Conductor spacing: Conductor spacing is used to model the electrical impedance characteristics of the distribution lines. PGE uses this information where available to calculate conductor impedance. For a substantial portion of the distribution grid, PGE uses conductor nameplate information to calculate impedances.
- Capacitors: Capacitors are modelled in accordance with their nameplate and operational details as available in the GIS system. For the most part, PGE employs fixed capacitor banks on its feeders. Where PGE employs capacitor controls, the appropriate state of the capacitor in the peak and daytime minimum load condition is reflected in the DRIVE analysis.
- Feeder topology: PGE regularly reconfigures feeders as a normal course of business. For the purposes of this analysis, however, we assumed the configuration of the system is correct and static. Therefore, this analysis is a point-in-time snapshot of hosting capacity as of the date of our analysis, which is a reality of any analysis of the distribution system.
- Substation voltage set point: PGE maintains records of the substation load-tap-charging (LTC)/voltage regulator voltage set points. These set points are allocated in CYME per substation. These set points affect the feeder hosting capacity.
- DG output: PGE assumes 100% of the allowed DG output was flowing on the associated distribution feeders during the boundary conditions of peak load and daytime minimum loading.

6.6.3 HOSTING CAPACITY EXECUTION PLAN

PGE has already embarked on a proof of concept to visualize available generation capacity at an entire feeder or circuit-level granularity on a feeder-by-feeder basis. This method uses available data and does not incorporate use of the EPRI DRIVE tool that is specified in the options analysis requirements described earlier.

PGE currently possesses the tools to perform HCA using EPRI DRIVE system wide. The process to do so adds a slightly more labor than the current method of calculating and publishing the daytime minimum load twice annually. **Table 43** draws a comparison between a single iteration of the current method and a single iteration of a method that produces a more granular output via usage of the EPRI DRIVE tool.

Table 43. Comparison of current practice vs. proposed approach

Current practice (per iteration)			DRIVE model incorporation (per iteration)		
Activity	**Hours**	**Cost**	**Activity**	**Hours**	**Cost**
Setup	1,200	$67,200	Setup	2,240	$134,400
GIS	80	$4,800	GIS	240	$14,400
Reporting	120	$7,200	Reporting	240	$14,400
			Modeling	1,400	$84,000
			Analysis	325	$19,500
			DRIVE license renewals		$7,200
Total	**1,400**	**$79,200**	**Total**	**4,445**	**$273,900**

The transition from publishing DML twice annually to producing an HCA twice annually will cost an additional $195k (from **Table 40**, the DRIVE model incorporation cost minus the current practice cost). PGE's Distribution Planning Team will be expected to execute the bulk of the analytical work. Initially, this will add a workload equivalent to one full-time distribution planner. When staffing levels are appropriate to execute the additional workload, the fist iteration/output is expected to be published within 12 months.

The GIS team will use the data outputs from the EPRI DRIVE tool to publish comprehensive system maps. The Interconnection team will assist in report verification and posting information on OASIS (**Table 44**).

Table 44. HCA tasks, resources and effort

HCA activity	Resources	Level of effort (hours)	Notes
Create base case models, distribution (CYME) model validation; functionality testing	Planning engineers CYME software	1,400	Approximately 1 hour per feeder
Calculate peak and DML	Feeder voltage at any location not to go below specified voltage magnitude	2,240	Includes peak winter, peak summer, minimum and daytime minimum load
Load data into DRIVE and execute HCA		325	Approximately 15 minutes per feeder

Table 44. HCA tasks, resources and effort (continued)

HCA activity	Resources	Level of effort (hours)	Notes
Result validation		40	Estimated effort to identify, analyze and correct issues for 653 feeders
Reporting	Planning engineers Interconnections team Excel	200	Includes publishing system data content that resides in OASIS
Result publication	EPRI DRIVE ARC GIS	240	Transfer of data from DRIVE to ARC GIS and Excel; visualization and testing of data

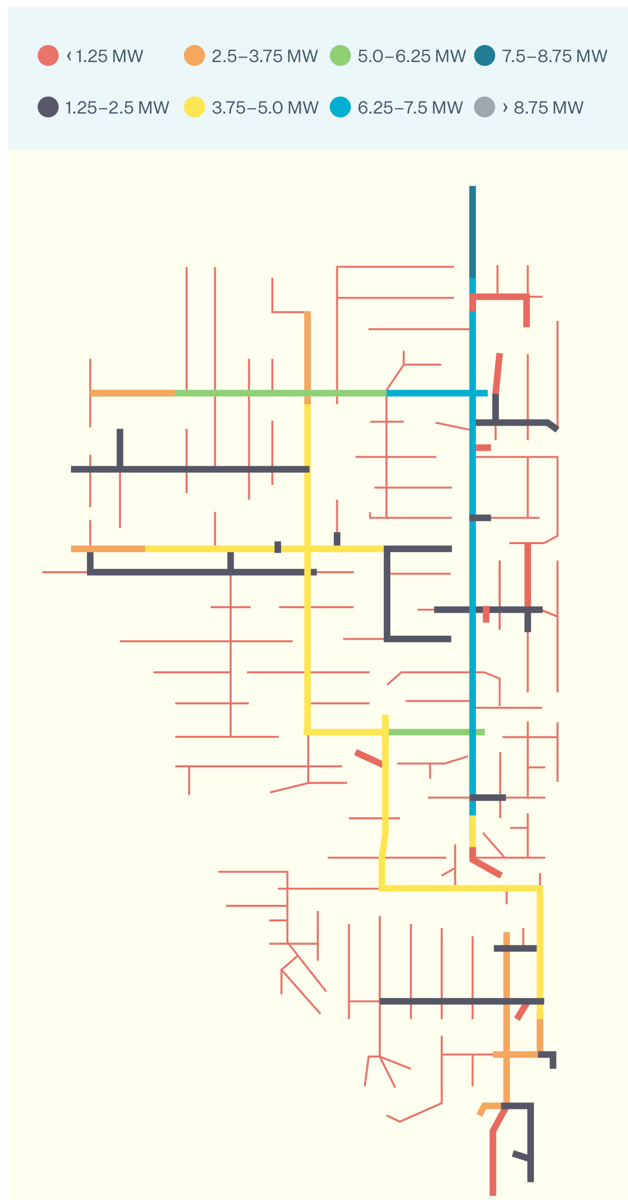
Engineers will first spend time creating and validating base case models through the CYME gateway. PGE uses automated scripts and works directly with CYME to rectify errors that can be corrected in the gateway. Additional detail about the QA process is provided in **Section 6.6.5**.

Once these models are created, work will be done to create peak and daytime minimum loading conditions from historical SCADA loading data. CYME models are then created with the peak loading and daytime minimum loading conditions. These CYME model outputs are validated once again.

Next, data is prepared for input to DRIVE. DRIVE runs automated scripts that select the necessary feeder and system data from CYME. Analysis is performed in DRIVE one feeder at a time. Batch runs often present unidentifiable problems, and one problematic feeder can ruin an entire batch process. Results are validated, then heat maps are consolidated and excel files are prepared for publication.

A sample screenshot of a hosting capacity output map is shown in **Figure 34**. All outputs will be consolidated and transitioned to a public-facing GIS platform.

Figure 34. Sample screenshot of the hosting capacity heat map[110]



110. The data shown is for illustration purposes only.

6.6.4 LIMITING CRITERIA AND VIOLATION THRESHOLDS

Broadly, DRIVE v2.1 evaluates hosting capacity violations under voltage, congestion, protection and power quality and reliability thresholds.

Table 45 describes the limiting criteria and violation thresholds that are established in DRIVE in more detail. Final analysis may result in changes to the criteria shown below.

Table 45. Limiting criteria and violation thresholds

Criteria	Description	Threshold	Basis
Primary over voltage	Feeder voltage at any location not to go above specified voltage magnitude	5%	ANSI C84.1 Range A — maintain quality of service to customers
Primary under voltage	Feeder voltage at any location not to go below specified voltage magnitude	5%	ANSI C84.1 Range A — maintain quality of service to customers
Primary voltage deviation	Feeder voltage at any location not to change by more than specified percent	3%	Maintain power quality for customers
Regulator voltage deviation	Feeder voltage observed at any regulating device not to change by more than a specified amount of the regulating device bandwidth	50%	Prevent reliability and power quality issues by avoiding excessive regulator operations
Primary voltage unbalance	Feeder voltage unbalance at any location not to exceed a specified percent	1-3%	Phase imbalance requirements
Thermal for load	Power flow through any element in the direction away from feeder head not to exceed a percentage of the element's normal rating	100%	Continue reliable customer service by staying within the normal ratings of existing elements
Thermal for gen	Power flow through any element in the direction toward the feeder head not to exceed a percentage of the element's normal rating	100%	Continue reliable customer service by staying within the normal ratings of existing elements
Additional element fault current	Feeder fault current not to increase by more than a percentage of fault current prior to generation	10%	Based on worst-case scenarios from internal studies — maintain customer reliability
Breaker relay reduction of reach	Breaker fault current not to decrease by more than a percentage of fault current prior to generation	10%	Based on worst-case scenarios from internal studies — maintain customer reliability
Reverse power flow	Power flow through specified elements not to flow in the direction toward feeder head	100%	Potential protection and thermal issues can occur with reverse power flow into the substation

Table 45. Limiting criteria and violation thresholds (continued)

Criteria	Description	Threshold	Basis
Unintentional islanding	Power flow through specified elements not to be reduced by more than a percentage of minimum power flow	100%	Power flow through the selected elements is allowed to zero, but reverse power flow is prohibited
Ground fault overvoltage (3v0)	Power flow through substation not to be reduced by more than a percentage of minimum load power flow	100%	Substations equipped with 3v0 sensing at the substation
Sympathetic breaker tripping	Breaker zero sequence fault current not to exceed specified amount in amps	300 amps	Related to breaker protection flags

6.6.5 QUALITY ASSURANCE AND ACCURACY ASSESSMENT

PGE performs a series of quality assurance protocols throughout its analysis process to ensure the inputs and results are as accurate as possible. This includes the following steps:

- Running model clean-up checks in CYME after extracting asset data from PGE's GIS. This ensures consistency in feeder modeling for both subsequent modeling and from one feeder to the next.
- Checking for exceptions within CYME to verify no issues exist. After a power flow analysis is run, some "out of bounds" exceptions may exist. This could include high or low voltages, overloads and model connection issues. These exceptions are flagged for engineer investigation and correction.
- Responding to any flags generated by DRIVE. After the CYME model is finalized, it its converted by DRIVE to enable processing in DRIVE. During this conversion, further flags can occur that alert us to any abnormal conditions. These conditions are then followed up on by an engineer.
- Comparison of DRIVE results with previous analysis to check for any large deviations in values or thresholds violated. If we find deviations larger than 500 kW or see a change in the number of times a certain threshold is violated, an engineer determines if the change in results was appropriate. For example, if additional DERs were added to a feeder, we would expect the hosting capacity to decrease and would see this in the analysis. If we see any unexpected changes in the results, we will investigate them further and make corrections if needed.

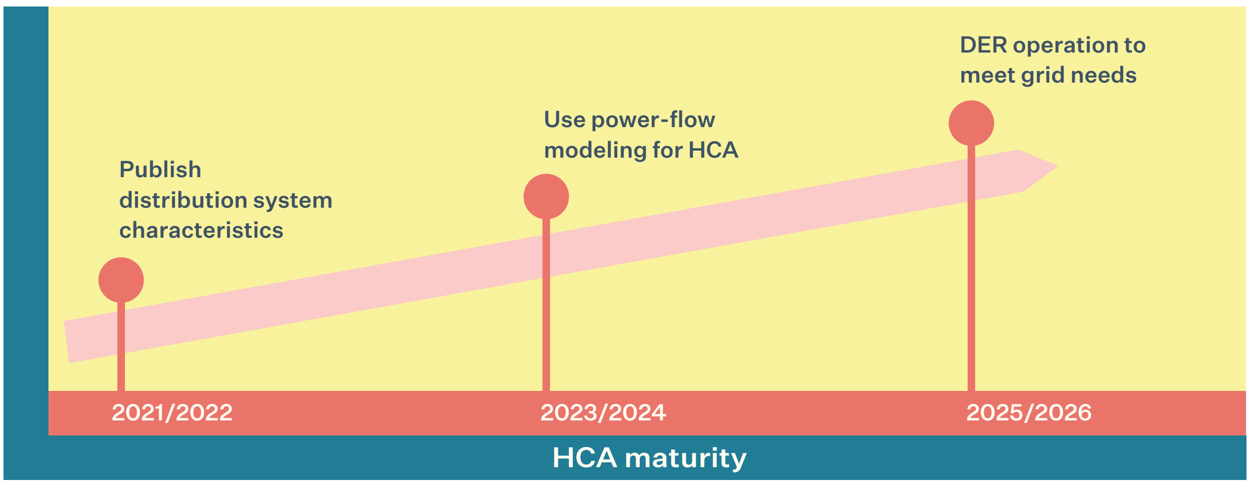
The initial HCA outlined here puts PGE on a path to move from Phase 1 to Phase 2 of maturity as described by EPRI in **Table 27**. This plan also enables us to take advantage of data, processes and tools that are already established, lowering the barriers to executing the initial HCA. We look forward to completing this analysis and initiating additional rounds of partner and community feedback to advance understanding of what is most valuable and refocus efforts in future iterations of HCA. The following section reflects PGE's thoughts on the evolution of HCA.

6.7 Evolution and near-term action

A mature HCA capability is essential to PGE's vision of a plug and play DER future. The ability to seamlessly interconnect a modernized grid with a multi-directional flow is a key enabler to improved access to DERs. HCA provides the necessary visibility into system conditions to support seamless, on-demand integration of DERs. By modernizing PGE's planning capabilities, such as system modeling, reliability analysis, DER analysis and contingency analysis, we can use the outputs to generate a comprehensive HCA. This will facilitate a streamlined interconnection process that provides customers an experience that enables DER adoption.

Figure 35 illustrates PGE's hosting capacity roadmap, which outlines the progression through increasing degrees of granularity in both time and system data. The roadmap focuses on meeting the Stage 3 objectives outlined in the OPUC's UM2005 DSP Guidelines.[111] The progression through the roadmap stages will be punctuated by periods of partners and community feedback. The measure of success at each stage will be the value delivered to partners and communities, as well as to PGE.

Figure 35. Hosting capacity analysis roadmap



	2021/2022	2023/2024	2025/2026
Hosting capacity analysis (HCA)	• Publish info about equipment, performance and queue to inform siting, reduce failed applications • Expand data displayed on net metering map • Identify how ADMS can support HCA	• Use ADMS to support powerflow modeling • Use HCA in distribution studies and investment planning, e.g., add capacity for DER penetration	• Increase granularity, data sharing, frequency • Leverage ADMS/ Distributed Energy Resource Management System (DERMS) to match DERs with load
Interconnection	• HCA as screening tool for developers/customers • Technical outreach and education regarding data	• More granular visualization of hosting capacity in GIS	• Recruit DERs to meet grid needs • Evolve distribution market functions
Target use cases	Identify favorable DER locations communicate DER readiness accelerate screening process	Support investment decision-making to increase DER readiness	Promote DER investment to address grid needs, facilitate distribution market operations

111. OPUC's UM 2005 DSP Initial Guidelines, available at apps.puc.state.or.us

PGE anticipates that an ideal future state for HCA is an analysis that is:

- Accurate at the time and place of use
- Cost-effective
- User-friendly for both external and internal audiences

This future state echoes the DSP requirement's Stage 3 benchmark of "Update and publish hosting capacity maps and datasets sufficiently accurate and frequent to streamline interconnection." This does not inherently call for "real-time" hosting capacity.

We view the term "real-time" as being reflective of system operating conditions — within a time frame of seconds or less. That level of temporal granularity is required for distribution grid operations, while distribution grid planning requires data at the granularity of a year or greater. We are assuming that the term "real-time" as discussed in the DSP workshops is intended to apply to the planning process generally and the HCA specifically. If so, the available hosting capacity on sections of distribution feeders would need to be updated and made available publicly on a virtually continuous basis (temporally in a matter of seconds, minutes or hours) because the values will change continuously based upon changing system conditions. There would be significant cost associated with the additional resources required (e.g., software, staffing, training and data sharing) to achieve and maintain this capability for planning, rather than operational, schemes.

In PGE's view, HCA is clearly a planning tool and should be subject to the temporal standard of a planning analysis. The interconnection process is based on forward-looking analysis using set values that allow months for review and approval of interconnection applications, construction, inspection and, ultimately, energization. As the term "real-time" is applied in the interconnection context, it must refer to how frequently the hosting capacity values used in the analysis of new interconnection applications are updated.

PGE's long-term plan for HCA includes establishing criteria aimed at targeting feeders in need of updated HCA and ensuring that analysis takes place on a regular basis, with the results uploaded to a publicly accessible location directly following the updated analysis.

To streamline the process of updating the hosting capacity of feeders and avoid having to run the HCA on all distribution feeders on a continuous basis, PGE will develop a method to identify which feeders have had, or are forecasted to have, changes that would appreciably affect the hosting capacity value. This will target planners' efforts toward the feeders where the hosting capacity value would have reason to change. This could be as few as 20% of PGE's 653 feeders.

PGE will develop a process in which a review would take place on a time- or event-basis to detect which feeders require an updated HCA. Sample criteria for triggering this determination could include:

- Voltage conversion: Has a voltage conversion of the feeder or on part of the feeder taken place?
- Load variation: Does the load forecast for the feeder show a significant increase or decrease?
- Reconfiguration: Has the feeder been reconfigured?
- Reconductoring/phasing: Has any section of the feeder been reconductored (or phases added)?
- Voltage controlling/regulating devices: Has a device that either directly controls or affects voltage, such as a line voltage regulator and/or capacitor, been installed or removed from the feeder?
- Customer class composition: Has the composition of any of the customer classes on the feeder changed?
- DER capacity additions: Does the total DER capacity of recent interconnection applications on a feeder exceed a load or generation capacity threshold?
- Protective devices/settings: Has a protective device been installed/removed (e.g., line recloser) or settings been changed?

This targeting of feeders would eliminate the need to continually update hosting capacity on feeders where no change in the value should be expected and represents an efficient, cost-effective method given the amount of new DER capacity applications PGE receives on any given distribution feeder. As adoption and penetration of DERs increase, it will become even more important to forecast how much, when and where different types of DERs will reside.

The objectives of HCA are to provide increased transparency as to where each utility has hosting capacity, provide developers/customers visibility into better or worse locations for DERs, and understand where and how DERs impact the entire distribution system. Over time, combining this analysis with existing DER penetration and long-term DER forecasts can help inform where infrastructure upgrades may be considered.

We anticipate that, as HCA matures and more datasets become available, combining these data will enable us and our customers to identify and unlock the value of DERs. As we move through our modernized grid roadmap and Community Engagement Plan toward a 21st century community-centered distribution system, integration of DERs should be seamless. The ability to seamlessly interconnect with a modernized grid is a key enabler to improved access to DERs, achieving a plug and play future.