Chapter 13. Resilience

This chapter provides Portland General Electric's (PGE's) approach to resilience-related analysis as outlined in the Public Utility Commission of Oregon's (OPUC's) UM 2225 resiliency-specific guidelines, which requires the first Clean Energy Plan (CEP) to include a chapter or other narrative describing its resiliency-related analysis.[326] This includes detailing how PGE coordinated with communities and stakeholders, identifying resilience risks and opportunities, and describing the key resilience-related programs and opportunities PGE will prioritize to support community-based renewable energy (CBRE).

Chapter highlights

- PGE used existing risk assessment analysis regarding system and customer resilience, including energy equity work conducted through PGE's Distribution System Plan (DSP).
- PGE's current and potential resilience programs and opportunities are needed to anticipate, adapt to, withstand and quickly recover from disruptive events.

13.1 Resilience overview

PGE defines resilience as our ability to anticipate, adapt to, withstand and quickly recover from disruptive events. PGE plans for the resilience of our system by identifying critical risks related to generation, transmission, distribution, physical security and information technology operations. We align our resilience efforts and plans across multiple functions and business lines where feasible. PGE's goal is to develop strategies that contribute to community resilience across all of our planning environments. As contemplated by the OPUC's UM 2225 guidelines for the CEP, we considered and differentiated actions related to other plans, such as Distribution System Plan (DSP) and Wildfire Mitigation Plan (WMP) analysis.

[326] In the Matter of Public Utility Commission of Oregon, House Bill 2021 Investigation into Clean Energy Plans, Docket No. UM 2225, Order No. 22-390 (Oct 25, 2022), Appendix A at 40, available at: https://apps.puc.state.or.us/orders/2022ords/22-390.pdf

In this chapter, PGE describes how our planning efforts seek to advance resilience across three focus areas. Additional information related to these three areas can be found within our DSP Part 1.[327]

- **PGE infrastructure resilience:** investment in infrastructure, such as grid hardening, integrated grid and energy supply hardening that mitigates the occurrence of outages during a disruptive event such as a heatwave, wildfire, wind or ice.
- **Operational resilience:** improvements in PGE's ability to meet customers' needs during disruptive events and accelerate service restoration through emergency preparedness, outage response, cybersecurity and customer support.
- **Customer infrastructure resilience:** investigation into customer-sited solutions, such as microgrids, batteries and other distributed energy resources (DERs), that provide customers the ability to maintain electric service during disruptive events, during normal conditions and provide services to the grid.

13.2 Evaluating resilience risks

Recent seasonal trends in peak load and associated uncertainties around future climate change impacts make it more important than ever to consider multiple factors, such as our system constraints, community needs and climate change, in a holistic approach to providing customers with safe, reliable and resilient power. In the summer heat wave of 2021, PGE's net system load broke prior records on four days, making PGE a summer peaking utility. Winter loads continue to increase, with a new winter net system peak load set on December 22, 2022. PGE continues to see an increased frequency and impact of weather events on the system; we had 16 Major Event Days (MEDs) in 2021 and nine major event days in 2022.[328] In analyzing the data over the last 10 years, the largest contributors of weather-related outage events occurred from 2020 through 2022. In addition, these trends raise important issues pertaining to how utilities are expected to understand and incorporate the different community zone of tolerance levels (see **Section 13.3, Zone of tolerance**) when evaluating risk reduction and resilience investments.

As described below, PGE has taken multiple steps toward evaluating risks related to climate change and natural disasters. PGE also works to improve regional safety by reducing wildfire risk while limiting the impacts of Public Safety Power Shutoff (PSPS) events on customers and increasing the resiliency of PGE operations in the face of wildfires. We continue to build on

[327] PGE's DSP Part 1, Resiliency Chapter, available at: https://assets.ctfassets.net/416ywc1laqmd/4nOQVHQGlgbCRAAZWNpuEd/946827f45bb6859133a151a052578778/DSP_2021_Report_Chapter5.pdf.
[328] PGE utilizes the definition of Major Events, Major Event Days and reliability metrics from IEEE 1366-2022.

the work in our DSP and Wildfire Mitigation Plan (WMP) to evaluate resilience risks and strengthen our capacities and system resources to minimize risks, stresses and shocks to the system.[329]

13.2.1 Natural disaster risk assessment methodology

13.2.1.1 Transmission & distribution (T&D) seismic risk assessment

Substations are designed in accordance with the seismic requirements and recommendations of a number of standards, codes and guidelines. New foundations and structures are designed to meet the requirements of ANSI/ASCE 7 and the Oregon Structural Specialty Code. Substation equipment is specified to meet the high seismic requirements of IEEE 693. Substation physical designs follow industry best practices for seismic performance, such as flexible jumpers, equipment anchorage and seismic bracing.

In 2019, PGE developed a proof of concept to systematically assess seismic risk across our system to craft rational, economically prudent risk reduction investment plans. The study analyzed ground shaking caused by a magnitude 6.8 earthquake in Portland Hills, which would impact the Portland urban area of PGE's service area. We presented our proof-of-concept to the OPUC at a special public meeting on January 15, 2019.[330]

The goal was to assess the likelihood of asset failure, its impact on the grid and evaluate the feasibility of scaling the proof-of-concept model. The study determined that the likelihood of an electrical asset failing during a seismic event is largely determined by ground shaking and the asset's structural integrity. The results suggested that rather than model all critical assets, PGE should pursue an incremental approach focusing first on evaluating the seismic risk and resilience associated with oil circuit breakers (OCBs) and the relevant mitigations. OCBs were chosen because they are susceptible to failure with ground shaking and present a significant age-based reliability risk. To mitigate these risks, PGE is in the process of approving funding for a proactive OCB replacement program, which will remove these breakers from the system.

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[329] PGE's DSP and WMP, available at: Distribution System Planning | PGE (portlandgeneral.com) and Wildfire Safety | Wildfire Prevention Measures | PGE (portlandgeneral.com).

[330] PGE's presentation to the OPUC, available at: https://statics.teams.cdn.office.net/evergreen-assets/safelinks/1/atp-safelinks.html.

13.2.1.2 Generation seismic risk assessment

In 2014, PGE conducted a focused seismic risk and assessment of our hydroelectric facilities. Through established practices and regulatory requirements, the existing dam structures were known to be capable of withstanding a Maximum Credible Earthquake (MCE) produced ground shaking.[331] Powerhouse structures are not included in the evaluation of the dam. However, the powerhouse infrastructure is critical to the safe passage of river flows and is likely a critical generation asset following an earthquake event.

Powerhouse structures were screened based on construction type and features vulnerable to ground motions. Outdoor powerhouses such as Round Butte, Pelton and North Fork were expected to perform well and within their elastic range, with reinforced concrete operating floors and protective structures over the generating units. Oak Grove, Faraday, River Mill and Sullivan powerhouses have a building enclosure and overhead bridge cranes. These structures were found to have sufficient mass, which could lead to a progressive failure and limit the ability to operate and pass flows.

For River Mill, Oak Grove and Sullivan, PGE evaluated the building performance for these structures based on the American Society of Civil Engineers (ASCE) 41 Seismic Evaluation and Retrofit of Existing Buildings. Initial screening procedures highlighted deficiencies in the lateral load-resisting system. A deficiency-based upgrade could be designed to achieve an Immediate Occupancy (IO) level of performance. Faraday could not be upgraded based on construction type. Faraday powerhouse was unreinforced masonry (URM) which is not allowed based on the site-specific design parameters. Reconstruction was the only alternative.

13.2.1.3 Community assessment

In 2022, PGE studied how seismic risk can be addressed from a customer-centric point of view. As a portion of PGE's DSP, we developed a framework for applying resiliency indicators (including seismic risk) to our Equity Index. We overlayed the Equity Index to the forecasted DER adoption at the census tract level within PGE's service area to highlight how this data might be used to develop targeted customer resiliency programs and initiatives.[332]

The seismic risk component of the Equity Index was included along with other factors such as wildfire and flood risk. To develop an Equity Index metric for seismic risk to customers, we

[331] Information about Maximum Credible Earthquake available at: https://www.ussdams.org/glossary_definition/earthquake-maximum-credible-mce/

[332] PGE's DSP Part 2, Equity Index and Community Targeting Assessment, available at: https://assets.ctfassets.net/416ywc1laqmd/79djvul6i8euOIXwjj1ba5/ffb773d38fa86b08ad1c11f9c7058fff/DSP_Part_2_-_AppendixN.pdf.

required data available for the entire service area. Therefore, we based our initial scoring on publicly available spatial seismic data from the US Geological Survey. The data reflects the peak acceleration value, which estimates the worst amount of shaking in about a 500-year time frame. As we move forward, we will reassess the seismic risk indicators in our Equity Index for customer risk assessment by evaluating the inclusion of new variables, like the OCBs described in **Section 13.2.1.1, Transmission & distribution (T&D) seismic risk assessment**.

13.2.2 Climate change vulnerability assessment

Climate change is considered as a cross-cutting factor (not as a standalone risk), possibly increasing the frequency and intensity of extreme weather, and increasing weather-related natural disaster risks. For example, when evaluating current generation, transmission and distribution risks during the energy supply-demand imbalance risk assessment, climate change was considered as a potential risk driver, making it a cross-cutting factor that impacts multiple enterprise-level risks. The specific risk events identified in that assessment were an ambient temperature-related generation derate or outage during a heat event, transmission outage during a heat event and widespread distribution interruptions due to an ice storm. In two cases, climate change was seen as potentially increasing the frequency and intensity of the event itself. In the other, it was acknowledged that climate change might increase the event consequences.

As noted in the 2023 WMP, PGE continues to further build upon its understanding of climate change impacts on wildfire risk and has leveraged fuel ecology and wildfire studies for the Willamette Valley and Oregon to develop variables to reflect these future projections. Our 2023 WMP was filed with the OPUC in December of 2022 and is pending review by the OPUC.

13.2.2.1 Oregon State University projections of extreme weather study

Historically, we have designed our transmission and distribution (T&D) system according to weather cases identified in the National Electrical Safety Code or based on actual events that struck the service area. However, climate change is likely to contribute to changes in the frequency and intensity of high-impact extreme weather events and past extremes may not accurately indicate future extremes. To increase PGE's understanding of the impacts of climate change on the distribution and transmission system, we worked with the Oregon Climate Change Research Institute and Oregon State University (OSU) to conduct a study. The study was designed to project extreme heat, extreme wind, freezing rain and ice accumulation within our service area through 2070 or beyond. The climate study was based on two different Representation Concentration Pathway (RCP) emissions scenarios (RCP 4.5 & RCP 8.5). The two RCP scenarios provided insight into two different potential climate futures to better prepare for a variety of potential outcomes. The study results are being evaluated to determine if changes to the design and construction standards of PGE's T&D are warranted.

13.2.3 Reliability metrics

Traditionally, System Average Interruption Frequency Index (SAIFI), System Average Interruption Duration Index (SAIDI), Customer Average Interruption Duration Index (CAIDI) and Momentary Average Interruption Frequency Index (MAIFI) are utility-centric reliability metrics that focus on the average grid performance. Customer-focused metrics such as Customers Experiencing Multiple Interruptions (CEMI) and Customers Experiencing Long Interruption Duration (CELID) are used to identify customers experiencing more frequent or prolonged duration interruptions.

PGE has started to augment the more traditional system-wide metrics with customer-centered metrics in analyses to identify the need for system improvements. Metrics like CEMI and CELID provide a more accurate picture of the reliability experienced by our most impacted customers. Traditional reliability metrics exclude MEDs, allowing a utility to compare grid performance year over year, regardless of variation in weather patterns. As PGE identifies opportunities to improve resilience, CEMI and CELID are calculated, including MEDs, to provide a clear picture of customer experience during disruptive events.

13.2.3.1 Value of service

As part of PGE's customer-centered risk-informed methodology, we leverage Pacific Gas & Electric's (PG&E's) 2012 reliability-based Value of Service (VOS) study approved by the California Public Utilities Commission (CPUC).[333] PGE has since escalated the 2012 values to 2022 dollars using the US Bureau of Labor Statistics' (BLS') CPI Inflation Calculator.[334] These VOS values are intended to reflect the baseline economic impact the different customer classes (residential, commercial and industrial) experience from an outage.

The VOS values have two components:

- **Interruption cost** ($/kilowatt (kW) economic impact of an outage regardless of the duration), and
- **Duration cost** ($/kilowatt-hour (kWh) economic impact of an outage duration; up to 24 hours)

[333] PG&E's 2012 Value of Service Study, available at: http://www.caiso.mobi/Documents/AttachmentB_ISOResponsesCommentsDraft2012-2013TransmissionPlan.pdf.
[334] The US BLS' CPI Inflation Calculator, available at: https://www.bls.gov/data/inflation_calculator.htm.

As discussed in DSP Part 2, PGE has developed economic risk models as a tool to identify risk on the system. Risk is defined as the product of failure probability and consequence cost of failure. A consequence of failure includes:

- Type of customer (residential, commercial and industrial)
- Kilowatt load impacted
- Duration of impact
- VOS to customers
- Direct costs to PGE to respond to the outage.

These VOS measures will enable our teams to better understand how customers value both reliability and resiliency and what we should take into account when making decisions.

13.2.4 Community resilience index

As part of PGE's DSP Part 2, we conducted an assessment for considering diversity, equity and inclusion (DEI), environmental and resilience parameters as part of our distribution system planning process.[335] Resilience was based on environmental risk factors, such as wildfire or flood vulnerability areas, and grid/system needs, such as long-term outage locations. Through an assessment, we developed a set of indices needed to understand the geospatial distribution of these parameters within our service area and identify our most affected and vulnerable populations. We researched numerous factors that could explain the relative resilience of different portions of our distribution system. Through statistical and geospatial analyses, we summarized distributions of priority variables for resilience factors within our service area. These results were then statistically evaluated to develop quintile distribution frameworks. Within the study, we also presented a few application examples to show how we can integrate this toolkit into PGE's DER forecast model, AdopDER, and consider approaches for efficient targeting to influence program design, targeted deployment and benefit optimization based on locational factors.

The study aimed to achieve the following steps:

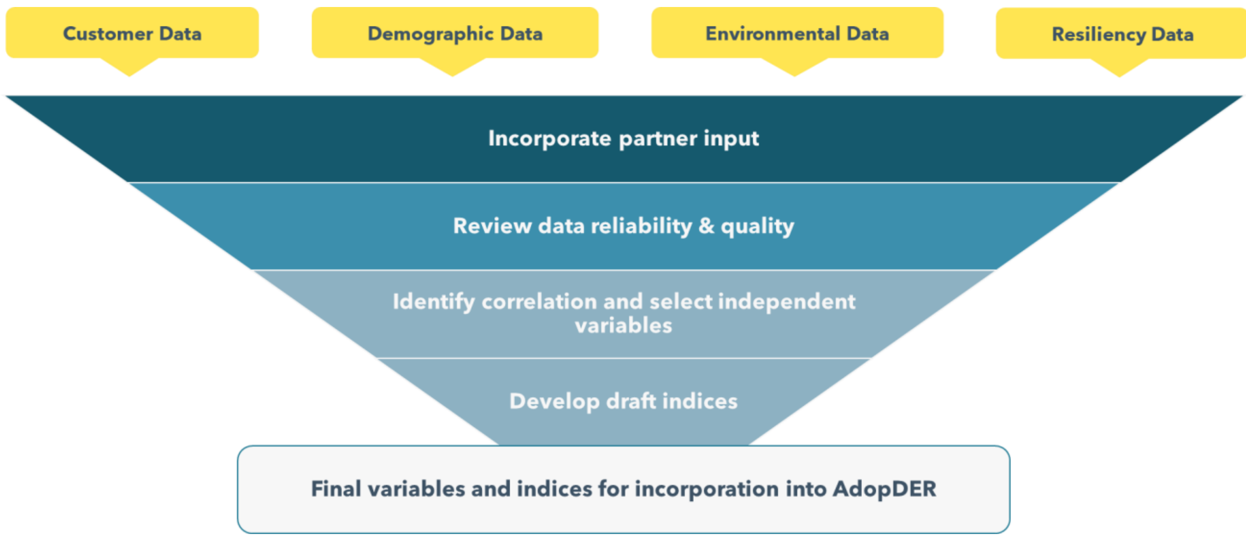
- Review available data sources and solicit stakeholder feedback to identify specific criteria and key variables used to characterize DEI, environmental and resilience parameters.

[335] PGE's DSP Part 2, Equity Index and Community Targeting Assessment, available at: https://assets.ctfassets.net/416ywc1laqmd/79djvul6i8euOIXwjj1ba5/ffb773d38fa86b08ad1c11f9c7058fff/DSP_Part_2_-_AppendixN.pdf.

- Develop a set of indices to account for the various underlying variables and locational elements across DEI, environmental and resilience prioritization areas.
- Summarize results of these indices to identify trends and consider future applications for resource planning, including siting locations for future non-wires solutions.
- Integrate with PGE's AdopDER model as a separate module for considering locational factors of DEI, environmental factors and resilience relative to feeder-level DER adoption forecasts.

Figure 109 provides an overview of these steps used in our approach.

Figure 109. Community targeting assessment approach



We are now proposing to leverage this analysis to target community resilience efforts in resource and program planning. **Table 75** shows the factors that were evaluated and those that were prioritized to develop the Index as part of our DSP Part 2.

Table 75. Data sources from DSP Part 2

Type	Source	Description
Geographic	PGE Shapefile Census Geographies	Define service area boundary and unit of geographic analysis
Income/demographics	ACS, PUMS PGE (CIS/Axiom); Greenlink; US DOE LEAD Tool	Characterize populations using DEI criteria

Type	Source	Description
Environmental	EPA EJScreen	Identify environmental indicators by location
Resilience	PGE (long duration outage locations, PSPS, major events); US Forest Service (wildfire risk); FEMA (flood risk); DOGAMI (seismic risk)	Identify areas at risk for long-term outages due to natural disasters/extreme weather
Customer arrearage	PGE (list of accounts with current and/or historical arrearages, assistance payments, disconnects/reconnects)	Characterize customers using DEI criteria

13.3 Zone of tolerance

The US GMLC's Considerations for Resilience Guidelines for CEPs report describes the "zone of tolerance" as a concept that "has been developed to account for different capabilities of households and communities to endure the adverse impacts of service disruptions."[336]

Through our work on our DSP Part 2, we aimed to develop better data that may enable us to widen the "resilient zone" so we are better able to assess and identify factors affecting risk disparity due to infrastructure service disruptions in wildfire, seismic and extreme weather events. PGE is considering new factors to assess the ability of a particular household or community to cope with service outages that can inform focused actions to increase customer and community resilience.

13.3.1 Energy equity index development

Within PGE's DSP Part 2, we reviewed a large number of factors that could represent the ability of our communities to withstand the effects of long-term outages. This data was then distilled to develop an Energy Equity index to approximate our customer's zone of tolerance. Currently, six energy equity indicators are used for distribution system planning on projects weighting and scoring Energy Burden, Dwelling Type, Owners/Renters, People of Color, households without internet and households with disability.

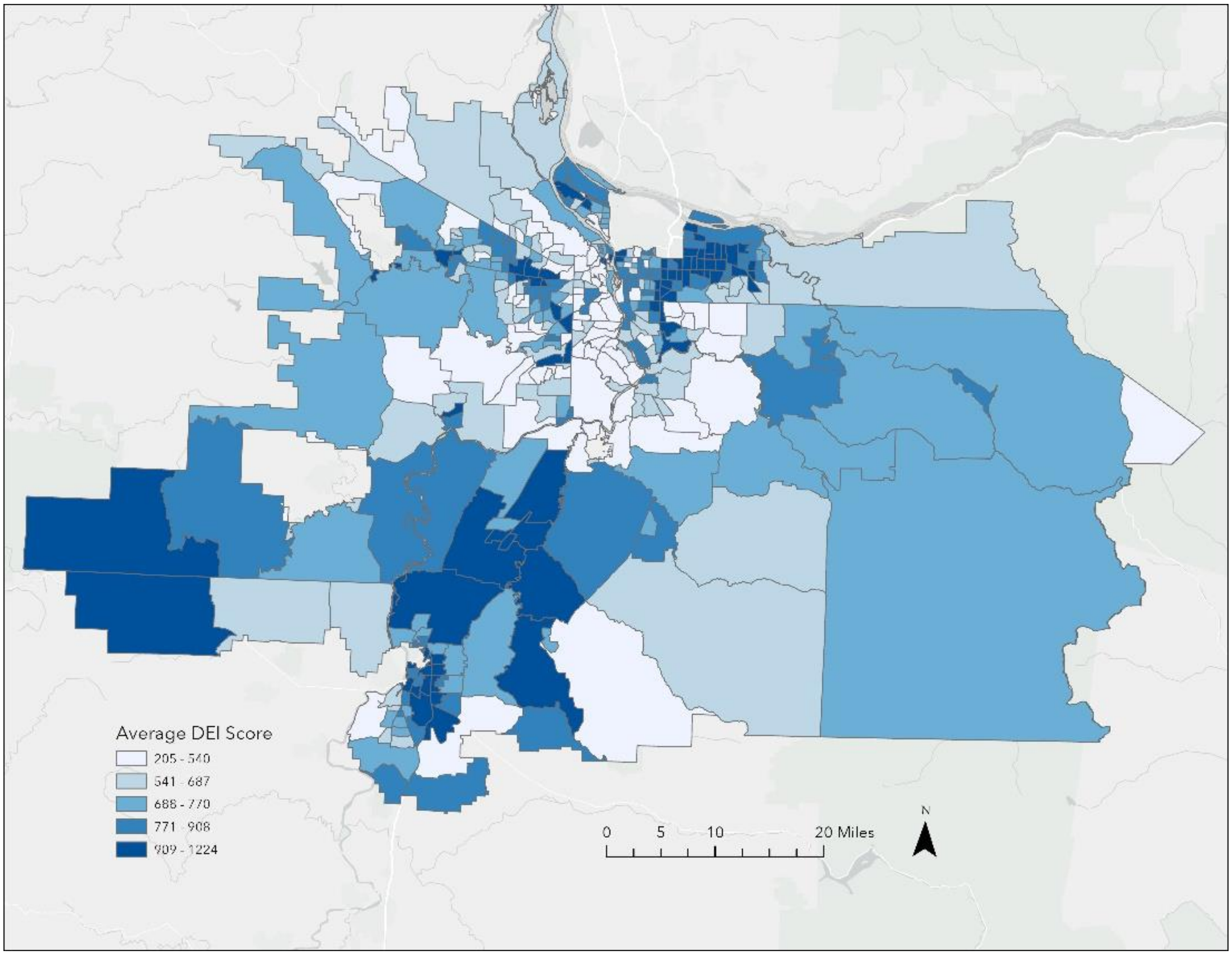
[336] The OPUC's Considerations for Resilience Guidelines for Clean Energy Plans report, available at: https://edocs.puc.state.or.us/efdocs/HAH/um2225hah113046.pdf.

To illustrate an example of this weighting, energy burden received the highest weighting (and associated scoring) within the DEI category. The decision to prioritize this variable over others within the DEI category was a function of the following:

- Latent factor analysis results—energy burden received one of the highest explanatory capacities under the DEI category.
- The community-based organization DSP Community Workshops conducted by PGE in 2022, positioned this variable as highly relevant to determine disadvantaged communities.

Within the energy burden variable, points were allocated based on the geographic distribution of the variable (using quartiles). Thus, to reflect a higher prioritization of energy burden within the DEI index, we assigned the highest score (Q4 value = 300) to premise IDs in census tract areas within the highest quartile of average energy burden. The middle quartiles then received reduced scores (Q3/Q2 values = 150), with the lowest score assigned to the lowest quartiles (Q1 value = -50). Through this approach, customers with a higher energy burden would receive more points than those falling in the middle of the distribution, while customers showing the least amount of energy burden were given negative points. PGE followed a similar approach for other variables; however, those variables with lower prioritization within a category, such as households with internet access for the DEI category, would have a lower point distribution that would effectively result in a lower weight for the index development (i.e., Q4 = 60, Q3/Q2 = 20 and Q1 = -20). Finally, to build the index, we summed or subtracted points for each customer depending on where they sit on the distribution of each variable composing the index (**Figure 110**).

Figure 110. DEI index



13.3.2 Justice 40 initiative

In 2021, President Biden signed Executive Order (EO) 14008 into effect.[337] Section 223 of this EO creates a goal that 40 percent of the overall benefits of certain Federal investments flow to disadvantaged communities (DACs) that are marginalized, underserved and overburdened by pollution.

The US DOE currently has a working definition of disadvantage based on cumulative burden. Thirty-six (36) burden indicators reflect fossil dependence, energy burden, environmental and climate hazards and socio-economic vulnerabilities.[338] PGE is leveraging this data source

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[337] *See* Tackling the Climate Crisis at Home and Abroad, 86 FR 7619 (February 1, 2021), available at: https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad, and https://www.regulations.gov/document/EPA-HQ-OPPT-2021-0202-0012.

[338] The US DOE's Justice40 Energy Justice Mapping Tool, available at: Energy Justice Dashboard (anl.gov).

as part of its energy equity mapping through its DSP to assist in our equity mapping to identify DAC within PGE's service area. This tool allows access and the opportunity to explore DAC using census tract data. US DOE's Justice40 data illustrates areas that may have greater need, outcomes and impacts. Applying equity indicators to our maps and data may inform decisions for future projects, plans and processes and how they could affect communities.

13.3.3 Medical Certificate Program

The PGE Medical Certificate Program provides awareness of where some customers, who are most vulnerable to a loss of electricity, are located throughout our service area.[339] This program allows a customer that provides us with an accepted medical certificate to set up more lenient payment arrangements or renegotiate payment arrangements when financial hardship can be demonstrated. This program continues the disconnection of service when payment arrangements are not kept and allows PGE to provide better outreach and support to our most vulnerable customers during a resilience event.

In evaluating resilience opportunities in our WMP, we proposed to pilot programs to specifically address the needs of these customers (within this plan, see **Section 13.5.9, Portable storage**). Beyond that direct activity, the location of these customers can provide valuable insight when prioritizing community resilience investments.

13.3.4 Heat vulnerability data

Climate change will continue to impact the frequency and intensity of extreme temperature events. During the summer of 2021, PGE experienced record-setting peak loads as the Portland metro region experienced a "heat dome" lasting several days which shattered historical temperature records. In addition to spikes in cooling-related peak loads, human health and safety risks also increase during extreme temperature events. In response to these extreme heat events, state and local governments responded by pursuing emergency cooling ordinances and response efforts; for example, the City of Portland developed and launched a Heat Response Program, and Oregon passed Emergency Heat Relief legislation to support vulnerable Oregonians.[340,341]

In the midst of this context, PGE initiated a research and development (R&D) project with researchers at Portland State University to study customer heat vulnerability across our

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[339] More information on PGE's Medical Certification Program, available at: https://www.oregon.gov/puc/Documents/OregonMedicalCertificateProgram.docx.pdf.
[340]See Portland Clean Energy Fund's Heat Response Program, available at: https://www.portland.gov/bps/cleanenergy/heat-response-program
[341] See SB 1536 (2022), available at: https://olis.oregonlegislature.gov/liz/2022R1/Downloads/MeasureDocument/SB1536/Enrolled

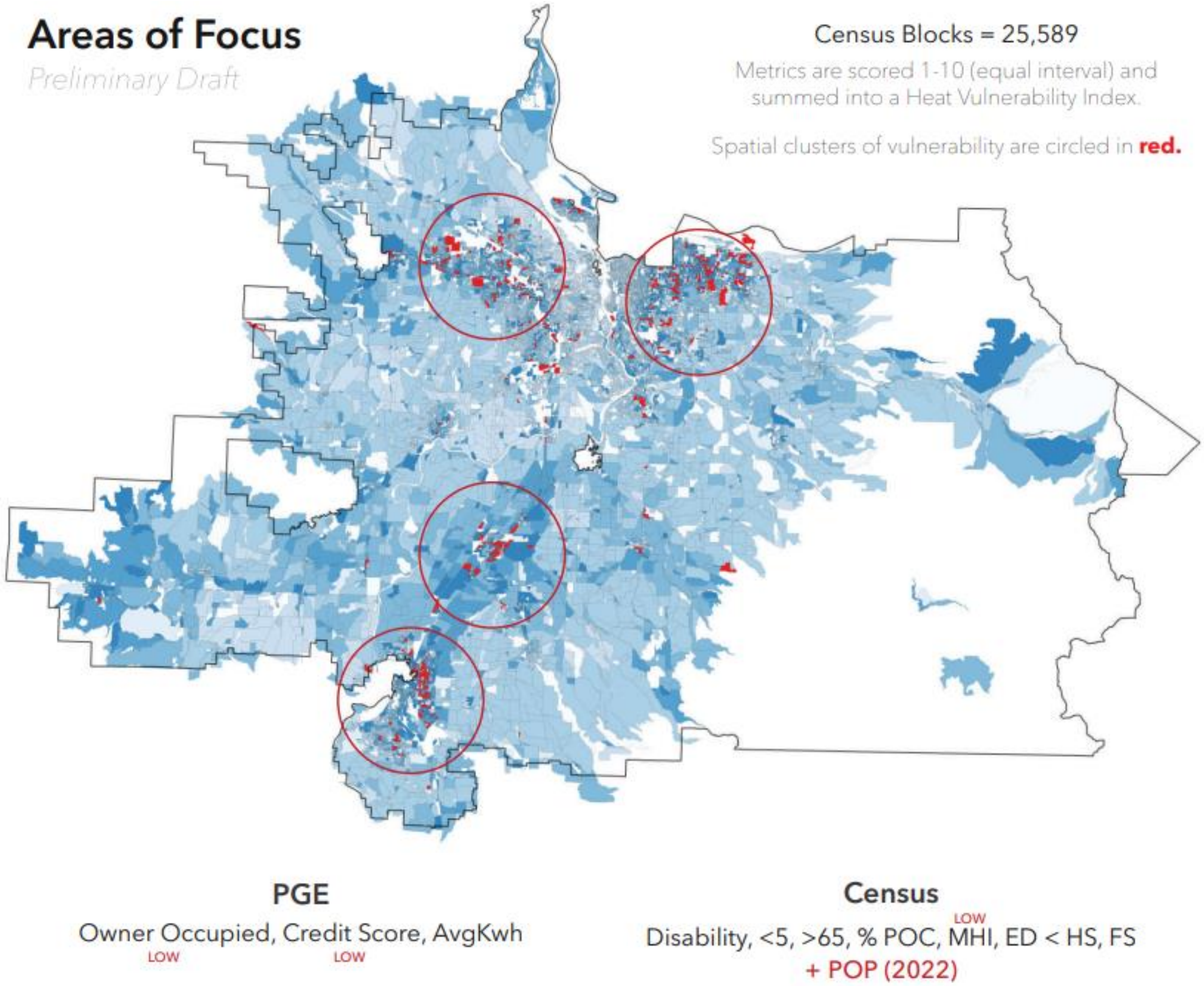
service area. The research builds on Portland State's extensive past efforts to model urban heat island dynamics to inform PGE's distribution grid planning efforts and related customer program development efforts.

The study uses data across environmental, social and built environment indices combined into a Heat Vulnerability Index. Examples of datasets used across these three areas that are known to influence heat vulnerability are:

- **Environmental data:** tree canopy cover, localized heat (temperature), percent of impervious pavement.
- **Social data:** socioeconomic factors (e.g., income, food security), demographics (e.g., race, age) and other factors such as disability data and overall population in a given area.
- **Built environment data:** building type, building age.

We applied the results of the Heat Vulnerability Index to our service area to identify areas of focus for near-term planning efforts. **Figure 111** shows a map of the PGE service area with four main zones of high heat vulnerability, indicating that cooling relief and resiliency initiatives geared at these population zones may significantly bolster customer resiliency during future extreme heat events.

Figure 111. Map of Heat Vulnerability Index scores in the PGE service area



PGE plans to continue socializing the results of our heat vulnerability assessment with municipal entities and communities through our Community Learning Labs and DSP community engagement meetings. In particular, we are interested in exploring the potential synergies between this level of data analysis and different customer DER programs that could alleviate these risks and also present opportunities for managing grid needs. For example, the cluster identified in East Portland in **Figure 111** is overlapping with the grid needs from our concept proposal presented in DSP Part 2 for the Eastport Plaza NWS, as well as the newer grid need identified for Arleta and Holgate substations, which are adjacent to Eastport and still score in high heat vulnerability areas.[342]

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[342] PGE's DSP Part 2, Grid Needs Chapter, available at: DSP_Part_2_-_Chapter04.pdf (ctfassets.net).

13.4 Historical reliability data

PGE uses historical reliability performance data to evaluate the system's reliability and resiliency risk. The data informs the failure probability assumptions in the economic risk models for asset-caused and geographic-caused failures and is used to develop potential mitigation solutions. When evaluating risk, PGE considers the factors shown in **Table 76.**

Table 76. Factors considered when evaluating risk

Performance measures	Considered in risk evaluations	OPUC report
All outages (planned, major event or underlying)	Yes	Annual Report on Electric Reliability
Primary initiating event for each major event the utility analyzed	Yes	MED Exception Filing
Top causes for each day during which a major event occurred	Yes	MED Exception Filing
Number of customers out and the restoration performance for their supply	Yes	Annual Report on Electric Reliability & MED Exception Filing
Estimated costs to the utility to recover from the major event	Yes	NA
Estimated unserved energy during the period of a major event	PGE does not yet calculate this value	NA
Demographics of the community, including classification of energy equity or other social or EJ measures	Yes	NA
Estimated impacts to the customers	Yes	NA

Table 76 indicates which factors are also identified within our Annual Reliability Report, shared publicly in OPUC Docket RE 113 in May.[343] Our Annual Reliability Report provides distribution system performance information based on customer service interruptions. The

[343] PGE's Annual Report can be found: *In the Matter of Portland General Electric Company, Annual Reliability Report,* Docket No. RE 113, available at: https://apps.puc.state.or.us/edockets/docket.asp?DocketID=18326.

report is used to understand the overall reliability of the distribution system and to identify areas of improvement.

Within PGE's Annual Reliability Report, we include a definition for outage and outage data, including total outage hours, minutes, top outage causes and major initiating events such as equipment failure, lighting, vegetation, wildlife and weather. Additional detail on historical reliability performance can be found in our Annual Reliability Report. The results for 2022 will be included in our May 2023 filing.

Through Order 22-390, the OPUC provided resiliency-specific guidance that when evaluating resiliency risk, utilities should "rely on measurable historical reliability performance measures such as outage data and major events." PGE relies on historical reliability data already captured within our Annual Report. Moving forward, PGE suggests reliability reporting related to major outage events be included in the Annual Reliability Report rather than in the CEP. While pertinent to analyzing all resilience investments, it does not uniquely impact the resource procurement decisions being evaluated in the Integrated Resource Plan (IRP) and the CEP. Having a separate report to refine existing reported reliability data and the analysis can create confusion and possibly inconsistency between datasets. Additionally, PGE uses the VOS to estimate impacts on the customer. See **Section 13.2.3.1, Value of service**. We also identify and use socioeconomics and demographic data within our DSP Part 2. Specifically, we evaluated demographics as it relates to resiliency within our DSP Part 2, Appendix N, Equity index and community targeting assessment (see **Section 13.3.1, Energy equity index development**).[344]

13.5 Programs and opportunities

During PGE's community engagement process, we discussed potential resiliency analysis, approaches, programs and opportunities. For example, we received positive feedback in our Community Learning Labs that expanding metrics used in project scoring to have a CEMI reduction metric, in addition to the metrics identified in the DSP, may be useful in evaluating potential resilience projects. We will continue to explore these ideas with the community when evaluating resilience projects (such as T&D system projects) for the various benefit streams.

The following descriptions provide examples of the activities we are planning and/or undertaking to enable customers to mitigate the effects of disruptive events and access to the services they need.

[344] PGE's DSP Part 2, Appendix N, available at: https://assets.ctfassets.net/416ywc1laqmd/79djvul6i8euOIXwjj1ba5/ffb773d38fa86b08ad1c11f9c7058fff/DSP_Part_2_-_AppendixN.pdf.

13.5.1 Resilience in other plans

PGE has identified resilience as an important component of our DSP and WMP.[345] These plans have specific resilience programs and opportunities needed to address the modernization of the grid, acceleration of DER, energy equity and wildfire mitigation. PGE's DSP is filed in OPUC Docket UM 2197 and our WMP is filed in OPUC Docket UM 2208.[346]

13.5.2 CBRE potential study

The OPUC issued initial CEP guidance through Order 22-390. This guidance included conducting a CBRE potential study for the initial CEP. As described in **Chapter 7, Community benefits indicators and community-based renewable energy**, PGE conducted a CBRE potential study for this CEP and aims to build on this work to inform future CEPs. PGE intends to conduct a future CBRE potential study that will identify opportunities for CBRE actions, including distributed resources and their resilience benefits, and the study will be developed in coordination with communities, including EJ communities, stakeholders and Staff. PGE intends to coordinate this work, including coordination across other planning efforts, such as our DSP.

13.5.3 EPRI Climate READi: Power resilience and adaptation initiative

PGE understands the need to develop a common framework to understand the impacts of climate risks on the reliability and resilience of energy infrastructure. As such, PGE is participating in the EPRI Climate READi: Power Resilience and Adaptation Initiative. EPRI's initiative will convene global thought leaders and scientific researchers necessary to build an informed and consistent national approach. There are three primary targets for this initiative over the next three years.

- Develop a common approach for using climate data for specific power system assets and system vulnerability assessments, including how to treat the inherent uncertainty in climate variables.
- Identify and assess potential adaptation and mitigation strategies and their impact on risk.

[345] PGE's DSP and WMP, available at: Distribution System Planning | PGE (portlandgeneral.com) and Wildfire Safety | Wildfire Prevention Measures | PGE (portlandgeneral.com).
[346] *In the Matter of Portland General Electric Company, Distribution System Plan*, Docket No. UM 2197 (filed Oct 15, 2021), available at: https://apps.puc.state.or.us/edockets/DocketNoLayout.asp?DocketID=23043 and *In the Matter of Portland General Electric Company, Wildfire Protection Plan*, Docket No. UM 2208 (filed Dec 7, 2021), available at: https://apps.puc.state.or.us/edockets/DocketNoLayout.asp?DocketID=23111.

- Offer guidelines for risk-based methods for prioritizing risk mitigation investments across generation, transmission, distribution and customer resources.

13.5.4 Smart battery pilot

PGE launched its five-year Smart Battery pilot in 2020.[347] Through this program, PGE works with residential customers with home battery energy storage devices. The program seeks to install and connect residential energy storage batteries that will contribute up to 9.5 megawatt hours of energy to our grid. Once installed, these distributed assets will contribute toward a virtual power plant (VPP) made up of DERs that can be operated individually or combined to serve the grid, adding flexibility that supports PGE's transition to a cleaner energy future. In addition, the energy storage batteries provide customers with a backup energy resource they can rely on in the event of a power outage.

In February of 2023, PGE received approval for a tariff update to the pilot based on learnings from the first two years of operation and to move the pilot closer toward a cost-effective and scalable structure. The update transitioned the ongoing customer payment structure from a flat monthly participation reward toward a pay-for-performance model, giving customers more customization on how we use their battery. The update also adjusts the up-front rebates to reflect the changed boundaries of the Smart Grid Testbed.

Historical information on this pilot can be found within the OPUC's Energy Storage Docket UM 1856.[348] If PGE files any revisions to our Schedule 14, it will also be within Docket UM 1856.[349]

13.5.5 Energy partner on-demand

Energy Partner On-Demand is a demand response (DR) program providing incentives to large nonresidential customers during seasonal peak time events for reducing their load.[350] The program develops highly customized load curtailment plans that can work with a variety of unique types of businesses. In June 2022, the program received regulatory approval to expand upon the grid services that Energy Partner may provide PGE and support customers' resilience and clean energy goals by incorporating battery energy storage as a dispatchable resource.

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[347] PGE Tariff Schedule 14, available at: Microsoft Word 014-21-10 Eff June 2.2021 (ctfassets.net).
[348] *In the Matter of Portland General Electric Company, Draft Storage Proposal,* Docket No. UM 1856, available at: https://apps.puc.state.or.us/edockets/docket.asp?DocketID=20913.
[349] PGE's Schedule 14, available at: https://assets.ctfassets.net/416ywc1laqmd/7rEQyshErHsASDCZZtIjL5/3e00bcdd66fc74c75e9f1a7af8c9efe4/PGE_Advice_No._22-43_Sch_7_and_14_Res_Energy_Storage_Update_OL_12.12.22.pdf.
[350] PGE tariff Schedule 26, available at: Microsoft Word 026 22-35 Eff Jan 1.2023 (ctfassets.net).

13.5.6 Energy partner resilience (dispatchable standby generation)

In 1999, the MacLaren Youth Correctional Facility became the first PGE customer to enroll their standby generator in our Dispatchable Standby Generation (DSG) program. This program is a collaboration with customers that interconnect generation resources, providing electricity to PGE's grid when there is a critical need for power in the local region. Since then, the DSG program has grown to 59 sites with a cumulative nameplate generation capacity of 130 megawatts (MW). While not fuel-restrictive, the bulk of this capacity has historically consisted of internal combustion diesel generators, and we have undertaken a concerted effort to modernize and decarbonize the program by adjusting the program tariff to target the integration of non-emitting energy storage.

PGE has successfully integrated customer-sited batteries for grid services, as demonstrated by the Beaverton Public Safety Center and Anderson Readiness Center. With the increased commercialization of battery energy storage, PGE proposed to build upon those capabilities to expand the DSG program to include battery energy storage systems greater than 250 kilowatts (kW). We received approval to do so in June of 2022.[351] In addition to contingency reserve and frequency response, customers with battery energy storage may opt to also participate in other demand response activities.[352] With the addition of batteries, we branded the program as "Energy Partner Resilience" for customer communications.

This program can now provide the same advanced resilience support to enrolled customers as our legacy DSG program while also supporting our customer's, PGE's and Oregon's decarbonization targets.

13.5.7 Multi-unit microgrid demonstration- Salem smart power center

In 2013, PGE commissioned the Salem Smart Power Center (SSPC), a 5 MW, 1.25 megawatt-hour (MWh) battery energy storage system that, at the time, was part of the largest regional smart grid demonstration project in the nation. As this battery energy storage system

[351] See Docket ADV 1385, PGE Advice 22-05, *Schedule 200 Dispatchable Standby Generation Update* (June 1,2022), regarding the OPUC's approval of PGE's request to include battery storage in our DSG program, available at: https://edocs.puc.state.or.us/efdocs/UBF/adv1385ubf161150.pdf

[352] A flexible load service not currently possible with fossil-fueled resources. Additionally, Contingency Reserve is the portion of resource capacity that is capable of being synchronized and ramping to a specified load in 10 minutes (or that is capable of being interrupted in 10 minutes) and that is capable of running (or being interrupted) for at least 60 minutes from the time it reaches its award capacity. Frequency Response is similar; however, it has a response time at 22 seconds and duration typically less than 1 minute.

approaches its 10-year anniversary and is demonstrating end-of-life characteristics typical of a 10-year-old battery energy storage system, we are evaluating how to evolve the resource best to continue to provide value.[353]

In the Fall of 2022, the City of Salem, in partnership with PGE, received a one million dollar grant from the Oregon Department of Energy's (DOE's) Community Renewable Energy Grant Program. The project is described as follows:

> *A community energy resilience project, in partnership with PGE, to create a solar powered community microgrid with battery storage and electric vehicle charging. The system will connect to a solar array on and serve Salem's new Public Works Operations building and its electric vehicle charging stations, allowing it to function during grid outages. The microgrid will serve 96 apartments in six buildings, 34 homes, one local business, three other government buildings and a cellular communications tower, providing uninterrupted power during grid outages.*[354]

Leveraging the existing building and infrastructure of the SSPC and with a new and modern battery energy storage system, PGE seeks to build the first community microgrid of its kind in the Northwest. We are currently working with the City of Salem to begin construction in 2023 and anticipate the microgrid will be energized in 2024. When complete, the microgrid will provide grid services to support our decarbonization targets and resilience for our communities and critical facilities within the microgrid boundary.

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353 PNNL conducted an assessment of battery performance and economic potential on PGE's Salem Smart Power Center, which can be found at. The Salem Smart Power Center (pnnl.gov).

354 Oregon Department of Energy, Press Release, October 18, 2022, *Oregon Department of Energy Grant Program Supports Renewable Energy Projects from Ashland to Ontario*, available at: https://energyinfo.oregon.gov/blog/2022/10/18/oregon-department-of-energy-grant-program-supports-renewable-energy-projects-from-ashland-to-ontario

13.5.8 Community resilience hubs

As part of PGE's considered approaches to CBREs, we will leverage existing microgrid projects such as the Beaverton Public Safety Center (BPSC). At BPSC, we are also exploring the use of a portable battery energy storage unit to provide backup power to their electric vehicle fleet in the event of an outage while also having the flexibility to be used for urgent needs elsewhere. This work, along with community collaboration, will help inform potential community resiliency, such as CBREs for critical facilities (e.g., police, fire, EMS, wastewater treatment and water pumping facilities) and local resilience hubs.[355] Any potential programs will aim to work with community and local governments such as municipalities. This collaboration will help us identify microgrid solutions. For example, we are developing analytical approaches to identify CBRE locations. With this data-driven information, we can work with targeted communities to assess their resiliency needs and desired solutions.

With any resiliency solution, such as a microgrid, it is important that the solution be able to act as a locational grid asset during normal conditions and a resilience resource in the event of an outage. We will investigate the potential federal and state funding needed to support the cost of such an investment. Additionally, we aim to co-optimize any flexible resiliency load for the VPP, non-wires solutions and community benefits.

One consideration of any CBRE project is the need to provide direct community benefits. As starting points, some community benefits we may consider are:

- Reduction in recovery time of a local community in the aftermath of a natural or human-made disaster.
- Safety net resource for highly vulnerable households to reduce the negative effects of power outages and extreme conditions
- Increased renewable generation within and for our communities.
- Operational cost savings for host sites that can be passed to community members.

[355] We are defining local resilience hubs as a facility where members of the public may convene in the event of a power outage.

13.5.9 Portable storage pilot

Within PGE's 2023 WMP, we requested a pilot to provide portable energy storage to our most vulnerable customers affected by a PSPS. This program seeks to provide financial support for portable batteries to customers enrolled in our Medical Certificate Program who reside in a designated PSPS area. The objective is to increase resilience for customers dependent on electrically powered medical devices. A portable battery solution also allows renters, multi-unit housing dwellers and those who cannot afford a larger backup system to increase their resilience or those who struggle with other traditional methods (such as propane or diesel generators). Should the OPUC acknowledge this item within our WMP, we intend to request approval to implement the program.

We are exploring utilizing a portable battery unit at the Beaverton Public Safety Center. This portable battery will provide backup power to a panel of electric vehicle chargers. With this work, we will explore operations around the portable aspects of the battery.

13.5.10 Public safety partner engagement program

PGE is a provider of a core service for our communities. We cooperated with the communities in our service area to plan for and respond to emergency situations. Recognizing the importance of this cooperation, our Business Continuity and Emergency Management Team (BCEM) is formalizing a program to encourage and increase our ongoing engagement with the emergency management community, focusing on emergency preparedness and community resilience collaboration.

To achieve this, BCEM engages with public safety partners where we have distribution services and/or assets. Primarily this means interacting with the county emergency management agencies, which can provide a central coordination point for all the sub-jurisdictions, such as cities and special districts. The goals of this program are to:

- Enrich public/private sector emergency management partnerships.
- Enhance mutual readiness through coordinated preparedness activities.
- Strengthen connections between PGE and our communities.

PGE hopes to achieve these goals by increasing our interaction with the local community. We plan to host all-hazards summits to discuss preparedness activities and any specific concerns regarding upcoming seasonal hazards with local emergency managers. Additionally, through individual meetings with County Emergency Managers and participation in regional advisory bodies, we seek to engage with a broad cross-section of the community that is focused on community resilience.

For example, PGE is a member of the Regional Disaster Preparedness Organization (RDPO). The RDPO is a partnership of government agencies, non-governmental organizations and private-sector stakeholders in the Portland Metropolitan Region collaborating to increase the region's resilience to disasters. As resilience programs are developed, we will look to these groups and processes to refine our programs and ensure our communities leverage new resilience initiatives.

13.6 Looking ahead

The GMLC's report provides valuable insight into practices that can inform PGE's future analyses and links to practitioners we can turn to for additional knowledge and lessons learned.

During the ideation stage of our planning, we heard from the community that equity mapping within our investment decision framework is an area of interest. PGE's resiliency planning will continue to be refined as our understanding of our communities and climate change evolve. For example, we are exploring the idea of using maps with multiple layers such as equity metrics, outage information, risk assessment and PGE infrastructure information.

We understand CEPs will evolve PGE's planning practices over time and hope that initial guidance established through the current process accounts for the time needed to engage and collaborate with communities effectively. This includes engaging on such topics as CBIs, resiliency and community-based renewables while balancing the need to quickly procure clean energy resources to meet our decarbonization targets by 2030.