Climate Adaptation and Vulnerability Assessment

May, 2025

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1 Executive Summary

As greenhouse gases build up in the atmosphere, extreme weather events are expected to intensify. Population growth, agricultural advances, industrial production, and technological progress have driven global development but intersect with climate systems in complex ways.

Across its service territory, San Diego Gas & Electric ("SDG&E" or "the Company") is already experiencing increasing extreme heat, wildfire risk, drought, and sea level rise (SLR). For example, the 2022 Labor Day heat wave produced over a week of sustained temperatures above 85 °F in the region, while the remnants of Hurricane Kay (2022) generated record-breaking wind gusts at numerous SDG&E weather network sites.[1] Given the changes in climate hazards, it is important for SDG&E to update its understanding of current and projected vulnerability across the service area.

SDG&E operates across the San Diego and southern Orange counties of California, supplying electricity and gas to 3.7 million customers.[2] With more than 140 years of experience in the region, the company remains deeply committed to the safe and reliable delivery of clean energy, making significant investments in grid resilience, operations, and planning to thoughtfully adapt to the changing climate.

In compliance with the directions issued by the California Public Utilities Commission (CPUC), this Climate Adaptation and Vulnerability Assessment (CAVA) represents a key milestone in SDG&E's adaptation and resilience journey. It evaluates the potential impacts of major climate hazards on the company's assets, operations, and services.

Through this CAVA, SDG&E evaluated the climate vulnerability of its electrical and gas assets and operations to specific climate hazards. In doing so, the Company measured exposure (the degree to which assets or regions may experience climate hazards based on their physical locations) as well as sensitivity (the degree to which an asset's integrity or operation could be adversely impacted in the event of hazard exposure). SDG&E also looked at adaptive capacity, defined as the degree to which an asset's vulnerability is reduced due to the ability to mitigate climate hazards' negative outcomes based on the operational maturity of the organization. The SDG&E CAVA analysis uses wherever possible global climate model (GCM) simulation results performed under the latest Coupled Model Intercomparison Project Phase 6 (CMIP6) protocol, which informed both the United Nations (UN) Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) and the Fifth National Climate Assessment (NCA5).

The latest CMIP6-based climate projections indicate that temperature is expected to gradually increase across the SDG&E service territory over time, but the rate of temperature increase could accelerate toward the latter half of the 21st century. Relative to the observed baseline period, there are some areas in the inland and mountain regions of the service territory that could experience substantial warming in the upcoming decades. The coastal region is expected to undergo more modest temperature increase.

Unlike temperature, there is a considerable level of uncertainty over future precipitation projection, with CMIP6 GCMs exhibiting quite a large variability over the service territory. Overall, there are indications that in comparison to the observed baseline period, some parts of the inland and mountain regions (e.g., inland valleys and western slopes of the mountains) could see an increase in precipitation, especially during the second half of the century, leading to greater inland flooding potential.[3] Change in precipitation elsewhere is projected to stay mostly small relative to the baseline.

Conditions that are conducive to large wildfires (sometimes referred to as elevated fire danger days) – which are closely related to temperature and precipitation, as well as humidity – are expected to worsen over the years, with a greater rate of change more likely during the latter half of the 21st century. A larger increase in elevated fire conditions is projected in the inland and mountain regions of the service territory.

Sea level is expected to rise gradually over the upcoming decades, with faster rates projected in the latter half of the 21st century, which could lead to potential flooding in isolated coastal locations around Mission Bay, San Diego Bay, and San Luis Rey River estuary. Changes to landslide risk are not projected to be significant, with modest impact to isolated areas expected.

Figure 1 shows a sample of the major asset classes that were analyzed. On the electrical side, SDG&E's five major asset classes were analyzed, including electrical distribution, transmission, substation, communication, and facilities assets. Four key climate hazards were used to evaluate each electrical asset's vulnerability: extreme heat, wildfire, inland flooding and coastal flooding. For gas assets, namely high-pressure pipes, medium-pressure pipes, regulators, compressors, and valves, five climate hazards were evaluated: wildfire, coastal flooding, inland flooding, landslides, and coastal erosion. SDG&E also assessed the vulnerability of the following operations and services to the same climate hazards: asset management, vegetation management, emergency response, communications, safety operations, reliability planning, and supply management.

Figure 1. *Sample of assets analyzed in the vulnerability assessments*

The assets analyzed in the vulnerability assessments include:

- 11,182 mi of Primary Underground Conductors (Distribution)
- 6,414 mi of Primary Overhead Conductors (Distribution)
- 176,378 Transformer Devices (overhead, pad-mount, subsurface)
- 2,014 mi of Overhead Line (Transmission)
- 200 mi of Underground Line (Transmission)
- 567 mi of Communication Overhead Fiber & Copper and 192 mi Underground
- 2,593 Communication Antennas
- 77 Facilities
- 581 mi of High-Pressure Gas Pipes
- 15,018 mi of Medium-Pressure Gas Pipes
- 23,175 Controllable Gas Valves

Figure 2 outlines some of the projected changes in specific hazards and their respective impact on the vulnerability of SDG&E assets. For a detailed description of climate hazards impact on SDG&E's assets over the CAVA time horizon (baseline-2070) refer to section 3.2. Through this analysis, the Company identified transmission overhead lines, pad-mounted transformers and switches, substation voltage regulators, overhead transformers, and communication centers as the assets most vulnerable to extreme heat across all time horizons. In terms of operations and services, SDG&E found that asset management, communications, and supply management were most vulnerable to extreme heat. The Company further found that progress could be made towards reducing the vulnerability of these operations through the consistent inclusion of projected changes in high-impact weather conditions, focused investment in technology and personnel training, and stakeholder engagement dedicated to this specific hazard. In addition, the analysis determined that transmission overhead lines, voltage regulators, overhead fiber communication assets, and communication centers are the most vulnerable assets to wildfire. At the same time, asset management was found to have the highest projected operational vulnerability to wildfire. SDG&E further determined a limited and localized increase in asset exposure to inland and coastal flooding in the future. In regard to gas assets, the Company identified regulators, high pressure pipes, and controllable gas valves as the assets with the highest vulnerabilities across all time horizons, experiencing a gradual, but steady increase in vulnerability to inland flooding, wildfire, and landslides from 2030 to 2070.

Figure 2. *Projected examples of impacts of different climate hazards on SDG&E's assets*

Extreme heat, wildfire, and inland flooding are projected to cause increased vulnerability to electrical and gas assets:

By 2030:

- 12% of overhead transformers scored high vulnerability to extreme heat.
- 41% of regulators, compressors, and valves scored medium vulnerability to inland flooding.

By 2050

- 24% of overhead transformers scored high vulnerability to extreme heat.
- 31% of high-pressure pipes scored medium vulnerability to landslides.

By 2070

- 41% of overhead transformers scored high vulnerability to extreme heat.
- 77% of high-pressure pipes scored medium vulnerability to inland flooding.

Based on the results of the vulnerability analysis, SDG&E identified potential adaptation measures designed to mitigate the impact of climate hazards on its assets and operations. The identified measures attain four key objectives:

(1) Strengthen assets and operations to withstand the adverse impacts of a climate hazard event,
(2) Increase the system's ability to anticipate when a climate hazard event may occur and absorb its effects,

(3) Bolster the system's ability to quickly respond and recover in the aftermath of a climate hazard event, and
(4) Advance and adapt the system to address a continuously changing threat landscape and perpetually improve resilience.

A list of adaptation measures was developed and categorized by resilience objective, asset type, and climate hazard. For example, the installation of additional cooling systems could help to control the temperature of sensitive components, the targeted undergrounding of communication cables to protect from wildfires, and the elevation of critical assets above projected flood level could mitigate the risk of inland flooding and sea level rise. Across operations and services and for most hazards, the analysis determined that their resilience could be enhanced by integrating both historical and projected high-impact weather conditions and improving on climate-hazard communication and feedback within the Company, regulatory agencies, communities, and customers served.

The SDG&E CAVA analysis includes substantial contributions from subject matter experts (SMEs) across SDG&E. In addition, Southern California Gas (SCG) SMEs were consulted for the vulnerability analysis of gas assets. External collaborators included expert teams from ICF, Accenture, San Diego Regional Climate Collaborative (SDRCC), University of California San Diego Scripps Institution of Oceanography, San Jose State University (SJSU), and Argonne National Laboratory.

2 Introduction

2.1 Overview of the SDG&E System

An innovative San Diego-based energy company, SDG&E serves the people and businesses of San Diego and southern Orange counties with natural gas and electricity. SDG&E has operated in the region for more than 140 years, delivering reliable energy to homes and businesses, supporting the shift to electrification, and championing the local economy by working with diverse suppliers. At present, the Company serves a population of 1.4 million business and residential accounts spread across a 4,100 square-mile service area, as shown in **Figure 3**. The service area spans 17 sovereign Tribal Nations (18 reservations), as well as two counties. It serves approximately 3.7 million customers through 1.49 million electric meters and 905,000 natural gas meters in San Diego and southern Orange counties.

Figure 3. *SDG&E's service territory map*

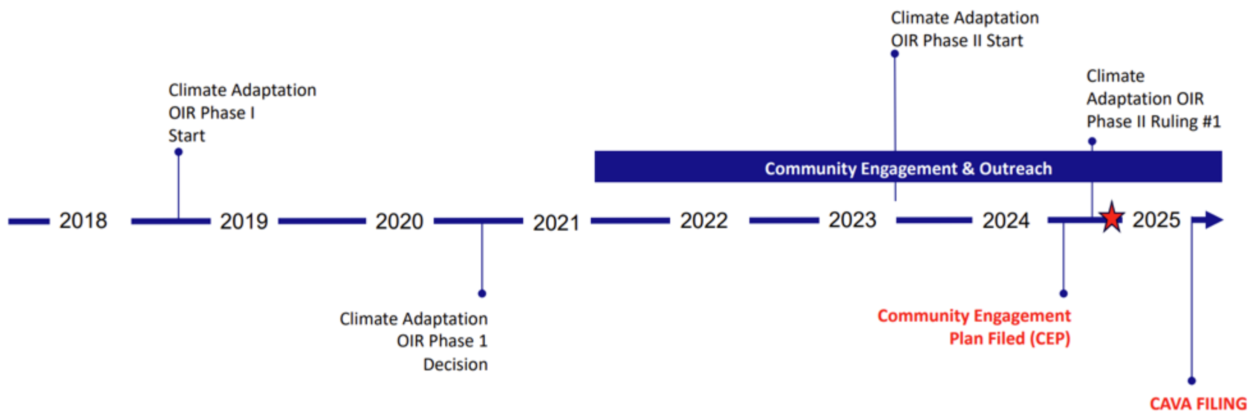
Today, California is leading efforts to address the challenges of a changing climate. The climate conditions in the SDG&E service area are projected to continue shifting in the coming decades. Resulting extreme weather events will have the potential to cause substantial economic and societal damage, with far-reaching acute and chronic consequences for the state and its residents.[4] This has prompted the CPUC to prioritize climate adaptation planning at the state level, as detailed in Section 2.2. Similarly, it has motivated investor-owned utilities (IOUs) such as SDG&E to update their understanding of the potential vulnerability of their assets and operations to climate-related events. This CAVA assesses the vulnerability of SDG&E's assets and operations to projected climate hazards and supports efforts to build resilience toward ensuring the safe and effective provision of electricity and gas to the Company's customers and communities.

2.2 Industry and Regulatory Context

In many jurisdictions across the United States (U.S.), efforts are underway to understand climate change vulnerabilities and to build resilience in the energy utility sector. For example, following Hurricane Sandy (2012), Con Edison completed a detailed vulnerability study in 2019 and a Climate Change Implementation Plan (CCIP) in 2020. Similarly, Duke Energy published a Climate Resilience and Adaptation Report in September 2023.[5] The report summarized climate change vulnerability and risk analysis for its transmission and distribution (T&D) assets and presented projections on how these changes may impact the utility's assets and planning practices. Some of these resilience efforts have been state-mandated, most notably outside of California are those in Connecticut, Maine, New York, and Oregon.[6] In 2022, the Public Utilities Regulatory Authority of Connecticut introduced a reliability and resilience framework to inform the planning and implementation of electric distribution companies' (EDCs) capital-based programs. In Maine, legislation was passed requiring utilities to submit a 10-year plan that outlines actions to address climate impacts on their T&D system. The New York State Public Service Commission mandated electric IOUs to submit a Climate Change Vulnerability Study (CCVS) along with a Climate Change Resilience Plan (CCRP). In Oregon, the Public Utility Commission established requirements for utilities to assess climate risks, including an assessment of climate risks posed to generation and distribution capacity in their Integrated Resource Plans (IRPs). As the effects of climate change worsen throughout the U.S., utility regulators expect utilities to mitigate substantial associated costs and safeguard the safe and reliable service to customers.

California is among those states taking direct action to respond to the threat of climate change and support energy utilities in their effort to become more resilient to those events. On April 26, 2018, the CPUC initiated an Order Instituting Rulemaking (OIR) R.18-04-019 on climate adaptation, which defined climate change adaptation for energy utilities and promoted efforts to ensure the provision of reliable and resilient service to customers. As a result of this proceeding, the Commission issued two subsequent decisions[7] in September 2020 (see Figure 4 for an overview of the regulatory timeline). The decisions promote the use of the "best available climate science" to make informed decisions toward building resilient infrastructure and services to tackle climate change. Specifically, decision 19-10-054 defines climate change adaptation for energy utilities in California, identifies data sources, and specifies planning standards. Decision 20-08-046 defines Disadvantaged Vulnerable Communities (DVCs), outlines specific requirements for the CAVA and Community Engagement Plan (CEP), and requires energy utilities to designate "climate change teams".

Figure 4. *CA OIR timeline overview*



The CPUC not only defines DVCs but also mandates robust utility engagement to empower and support these communities in building resilience. Under this framework, DVCs are identified using a combination of socioeconomic and environmental factors. A census tract or area meeting any of the following four criteria qualifies it as a DVC:

- **Top 25% of Census Tracts in CalEnviroScreen 4.0**: This tool measures cumulative pollution burden and socioeconomic vulnerability across Californian communities.
- **Tribal Lands**: Recognizing the unique vulnerabilities and historical marginalization of Native American communities.
- **Low-Income Households**: Defined as census tracts or areas where median household incomes fall below 60% of the statewide median.
- **Pollution Burdened Areas**: Census tracts or areas scoring in the highest 5% of pollution burden according to CalEnviroScreen 4.0 but excluded from an overall score due to unreliable health or socioeconomic data.

The decision also requires IOUs to submit a CAVA, a Community Engagement Plan (CEP), and a Disadvantaged Survey Report. Each of these filings is to be submitted on a four-year cycle. The CEP is filed one year before the CAVA, and the Survey Report is filed one year after. The CAVA and SDG&E's Risk Assessment Mitigation Phase (RAMP) applications are to be filed one year apart in future cycles, CAVA prior to RAMP, due to an updated Decision.[8] Additionally, the updated Decision introduces the adoption of a Global Warming Level (GWL) approach for future CAVA submissions starting in 2026 and mandates the use of Shared Socioeconomic Pathway (SSP) 3-7.0 as the reference scenario for the current cycle.

SDG&E's CAVA addresses the requirements set forth in the CPUC Climate Adaptation OIR (R.18-04-019) and follows industry best practices for assessing physical climate vulnerability. Table 1 below describes the specific regulatory requirements as set out by the CPUC, the category of vulnerability it relates to (Community Vulnerability, or Infrastructure, Operations

& Services Vulnerability), and the corresponding sections of the CAVA that address those requirements.

Table 1. *CPUC regulatory requirements and related sections in SDG&E's CAVA*

Category	Regulatory Requirement	Dedicated CAVA Section
Infrastructure, Operations & Services Vulnerability	* In addition to reviewing infrastructure, conduct an exposure analysis on services and operations, to identify which will be included for further analysis.	Section 3.2 describes the findings of vulnerability for infrastructure and operations and services.
Community Vulnerability	* Include the plan for engaging DVCs and community engagement.	Included in Section 2.4 and 4
Community Vulnerability	* Include an analysis of how IOUs promote equity in DVCs based on the communities' adaptive capacity	Included in Section 4
Community Vulnerability	* Include a summary of community engagement before, during, and after the CAVA process	Include in Section 4.2
Infrastructure, Operations & Services Vulnerability	* Combine exposure, sensitivity and adaptive capacity to determine vulnerability.	The vulnerability assessment methodology is described in Section 3.
Infrastructure, Operations & Services Vulnerability	* Include an array of options for dealing with vulnerabilities, ranging from easy fixes to complicated, long-term mitigation as well as green and sustainable remedies for vulnerable infrastructure.	Included in Section 5.

Category	Regulatory Requirement	Dedicated CAVA Section
Infrastructure, Operations & Services Vulnerability	* Include off-ramps for assets with low climate risk and a mechanism for reassessment as climate changes	Explained in Section 3.1 and results shown in Section 3.
Infrastructure, Operations & Services Vulnerability	* The CAVA covers the core period of 20-30 years, while also looking at the near-term timeframe of 10–20 years and a long-term timeframe of 30-50 years.	The climate data used, and results presented cover each of these timeframes as described in Section 3.
Infrastructure, Operations & Services Vulnerability	* Consider an analysis of temperature, sea-level rise, variations in precipitation, wildfire, and cascading events for utility-owned infrastructure & contracts.	The analyzed hazards are defined in Section 3.1.1.
Infrastructure, Operations & Services Vulnerability, and Community Vulnerability	** Use the Shared Socioeconomic Pathway (SSP) 3-7.0 as the reference scenario.	The results presented in Section 3.2 focus on SSP3-7.0.
Infrastructure, Operations & Services Vulnerability, and Community Vulnerability	** Third party analyses or datasets used by the IOUs should continue to be derived from or based on the same climate scenarios and projections as the most recent Statewide Climate Change Assessment.	Section 3.1.1 lists the data sources used for the analysis.
Infrastructure, Operations & Services	** Shall include comprehensive and clear	The analysis was conducted at an individual-asset resolution, and the

Category	Regulatory Requirement	Dedicated CAVA Section
Vulnerability, and Community Vulnerability	source data summary tables, clearly name the infrastructure data set used and last time it was updated, and consistent with that used for Wildfire Mitigation Plans. Strive to conduct the analysis at the smallest spatial resolution feasible.	infrastructure analyzed is listed in Sections 3.1 and 3.2.
* From Decision 20-08-046, September 3, 2020 (R. 18-04-019) ** From Decision 24-08-005, August 12, 2024 (R. 18-04-019)		

2.3 SDG&E's Climate Actions

SDG&E is committed to the safe delivery of electricity and gas to its customers. To that effect, the Company has geared its efforts toward addressing climate risks and vulnerabilities in the past, with the goal of strategically improving grid resilience across its service territory.

In 2014, SDG&E joined the Department of Energy Partnership for Energy Sector Climate Resilience, which led the organization to produce its first Climate Vulnerability Report and form the SDG&E Climate Advisory Group a year later.[9] In line with the guidelines issued by the CPUC, SDG&E published its RAMP filing in 2016, which includes actions to address climate-related risks, and participated in the California Energy Commission (CEC)-funded climate vulnerability study from 2016 to 2018. In 2018, given the heightened threat posed by wildfires across the Company's service territory, SDG&E formed the Fire Science and Climate Adaptation team.

Moving forward, SDG&E intends to grow and refine its efforts to address and enhance resilience. Some of the more recent works include the installation of a tide gauge and real-time coastal flood modeling, the analysis of outage data in connection with weather events, expanding fire science and integrating artificial intelligence to model fire behavior, and the system-wide vulnerability assessment and community engagement efforts presented in this report.

2.4 Community Engagement Plan and Considerations of Vulnerable Customers

SDG&E understands the importance of building resilience with and for the communities and Tribal Nations throughout San Diego and southern Orange counties. This CAVA will help SDG&E identify and characterize the potential impacts that climate change will bring to its service area and will help the Company to start identifying and implementing solutions and adaptation measures. SDG&E's Climate Adaptation CEP (published in 2024) comprehensively details its engagement with local communities and tribes (also see Appendix V – Community Engagement Plan (CEP)**.**

SDG&E's community engagement approach, as detailed in the CEP, centers around key foundational principles. This includes partnering with trusted Community-Based Organizations (CBOs) to facilitate mutually beneficial networks. SDG&E's approach also includes working with Tribal Nations, centering the two-way exchange of information between SDG&E and tribes for which the foundation is reciprocity and respect. Additionally, it includes considering a set of elements in the organization of outreach events, such as the provision of both in-person and virtual meeting options, the availability of food while upholding support to local vendors, the potential inclusion of incentives in the form of giveaways or raffles, and the creation of partnerships and the use of trusted community spaces.

In 2023, SDG&E founded the Equity-First Community Climate Coalition (EC3), a collective of local organizations collaborating to advance climate resilience and equity goals with SDG&E and the communities that it serves. The EC3 has developed a range of outreach opportunities designed to incorporate community feedback into the present CAVA. At the same time, SDG&E has engaged regularly with local governments and other stakeholders, like the San Diego Association of Governments (SANDAG) and the Port of San Diego. The Company also became a member of the San Diego Regional Climate Collaborative (SDRCC)'s Sea Level Rise (SLR) Working Group and the Adaptation Policy Working Group, two forums designed to promote innovation and information sharing as the region collectively works to adapt. Among a larger suite of outreach efforts, SDG&E hosted four Climate Readiness Information Sessions—designed to educate residents about the potential climate change impacts for the region, to inform them of SDG&E's work on the CAVA and the CEP, and to garner feedback on topics of concern—and rolled out a survey to assess the awareness of and concerns related to climate change and SDG&E's adaptation work.

Beyond initiatives that specifically touch on climate adaptation and resilience, SDG&E continues to play an active role in support of the communities it serves across San Diego and southern Orange counties. The Company has set up the SDG&E Community Assistance Fund, a $10-million shareholder funded grant program that provides local nonprofit organizations with support of up to $1 million. This is the largest one-year charitable initiative ever launched by SDG&E. The grant recipients selected offer services in the areas of food security and housing stability.

2.5 Organization of the CAVA

This CAVA is composed of three main parts:

1. **Infrastructure and Operations & Services Vulnerability (Section 3).** This section provides the results of SDG&E's climate vulnerability analysis of electrical assets and infrastructure, gas assets, and operations & services. It begins with an introduction of the vulnerability methodology, definitions for each of the components in the vulnerability equation, and the assets included in the analysis. It also presents forward-looking climate projection-based exposure scores by climate hazard in Subsection 3.2 with details for each of the asset types and combines them with sensitivity and adaptive capacity scores to determine vulnerability to extreme heat, wildfire, inland flooding, coastal flooding, and winter weather. The vulnerability to cascading events is also discussed qualitatively.

2. **Community Vulnerability (Section 4).** This section summarizes how SDG&E developed a Community Vulnerability Index alongside information on the lived experiences of communities and tribes to better understand community vulnerability. The findings presented in this section prepare SDG&E to conduct robust long-term resilience planning and identify localized interventions through a lens of equity.

3. **Adaptation and Resilience Measures (Section 5).** This section identifies examples of resilience measures to address the projected vulnerabilities for asset-hazard combinations that were identified as priorities, for both physical assets and operations. These measures, in coordination with findings from the community vulnerability analysis, support SDG&E's adaptation to the projected climate hazards.

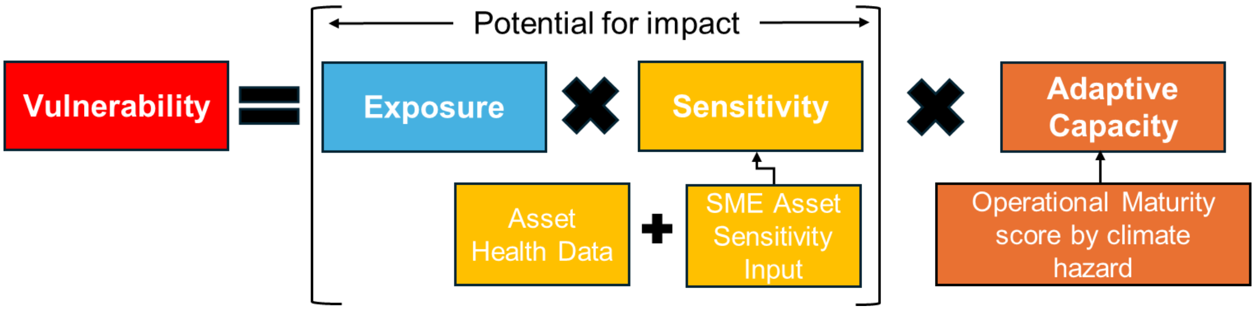
3 Infrastructure, Operations, & Services Vulnerability

3.1 Vulnerability Assessment Methodology

The methodology used in the SDG&E CAVA analysis is aligned with CPUC's guidance to consider (1) asset exposure to climate hazards, (2) system sensitivity to each climate hazard, and (3) utility adaptive capacity to determine vulnerability. The components of the methodology assessment and how they are combined to arrive at vulnerability scores are shown in Figure 5. Each component is defined below, with additional detail provided in the next section of this report.

- **Vulnerability:** The susceptibility of SDG&E's infrastructure and operations to the change in frequency and/or magnitude of climate hazards.
- **Exposure:** the degree to which assets or regions may experience climate hazards based on their physical locations.
- **Sensitivity:** the degree to which an asset's integrity or operation could be adversely impacted in the event of hazard exposure.
- **Adaptive Capacity:** the degree to which the vulnerability of an asset is reduced due to the ability to mitigate climate hazards' negative outcomes based on the organization's operational maturity.

Figure 5. *Framework for assessing asset vulnerability*



Climate vulnerability refers to the susceptibility of SDG&E's infrastructure and operations to the change in frequency and/or magnitude of climate hazards. This encompasses factors such as the exposure of gas pipelines to flooding and landslides, the sensitivity of power lines to extreme heat and severe weather, and the capacity of the utility to adapt to these evolving challenges—factors that are extensively explored in this CAVA analysis.

In contrast, climate risk refers to the consequences for human and ecological systems (as defined in IPCC AR6), stemming from the vulnerability of infrastructure and operations. Risk is evaluated by combining the likelihood of climate hazards with the potential consequences for the utility and the community it serves. While vulnerability focuses on the inherent characteristics that render the utility susceptible to harm, risk incorporates both the probability of climate events and the broader implications of energy delivery disruptions.

It is important to note that CAVA is exclusively focused on climate vulnerability. While climate risk is an essential consideration, it is evaluated within separate frameworks designed to address broader risk implications. These efforts that build upon the CAVA are evolving as SDG&E addresses emerging climate-related challenges.

3.1.1 Overview and Definitions

SDG&E's vulnerability assessment process identifies asset and operational vulnerabilities based on the exposure to climate hazards, asset sensitivity and the system's adaptive capacity. Climate hazard exposure, sensitivity, and adaptive capacity scores are calculated at an individual-asset level of granularity. These scores are then multiplied as in Figure 5 to generate final asset-specific vulnerability scores. The following subsections detail the scoring methodology employed to calculate each variable of the vulnerability assessment equation.

3.1.1.1 Exposure

Exposure is the degree to which assets and operations may experience climate hazards based on their physical locations. Exposure calculations are performed wherever possible with the most recent CMIP6-based datasets that have been generated with the support from the State of California or the U.S. federal government. The CMIP6 GCM simulations have been examined to develop the most up-to-date projections for the latest UN's IPCC 6th Assessment Report and the 5th National Climate Assessment, as well as the upcoming 5th California Climate Assessment. The CMIP6 protocol uses the Shared Socioeconomic Pathway (SSP) framework, and exposure scores are calculated at asset locations for future time periods using three SSPs: SSP3-7.0, which is the designated reference SSP scenario by the CAVA OIR, and SSP2-4.5 and SSP5-8.5 when appropriate.

Table 2 below describes the datasets that are used to quantify exposure to various climate hazards, many of which were calculated using the Localized Constructed Analogs (LOCA) version 2 for California (hereafter, LOCA2-CA) data. The LOCA method is a statistical procedure that transforms coarse-resolution GCM simulation output into high-resolution downscaled estimates via a multiscale spatial matching scheme to find analog days from the historical observational dataset. The LOCA2-CA dataset has been generated with fifteen of the best-performing CMIP6 models over California,[10] which have differing numbers of realizations/ensembles that can be as high as 10 members. The SDG&E CAVA analysis uses all of the available ensemble members to generate more robust projection statistics by better resolving changing hazard trends in the SDG&E service territory and tail-end exposure levels.

Projections for each metric variable are developed using the 20-year band approach. For example, to make a projection for the likely condition for 2030, the 20 years between 2020-2039 are examined, inclusive. Similarly for 2050 and 2070, 2040-2059 and 2060-2079 are used, respectively. The very first step of calculating a metric variable is to calculate it separately for each year in a 20-year period using all of the available ensemble realizations for all GCM simulations. The average of all ensemble realizations is used to be the representative condition of a GCM model. To help quantify uncertainty in the projections, two types of percentiles are often calculated in the analysis – across time/year dimension within the 20-year bands and across different GCM model dimension. To help differentiate these different percentile types, the percentiles along the time/year dimension within the 20-year bands will be referred to as time-P (for example, time-P50 and time-P95 for the 50th and 95th percentiles). The percentiles along the GCM model dimension will be referred to as model-P (for example, model-P50 and model-P90 for the 50th and 90th percentiles).

The future projections are compared to the baseline (also referred to as the observed) period, which is defined to be 1995-2014, as the historical simulation period of the CMIP6 experiments ends in 2014. Most of the metric variables for the baseline period are calculated from the high-resolution dynamic downscaling of the fifth generation ECMWF Reanalysis (ERA5) that has been performed using the Weather Research and Forecasting (WRF) model (hereafter referred to as ERA5WRF[11]). The ERA5WRF dataset has the same horizontal resolution of 3 km as in the LOCA2-CA dataset. To increase spatial resolution, the gridded LOCA2-CA-based results were interpolated from the native 3-km resolution to a hexagonal grid with approximately 800-meter resolution, using a nearest-neighbor interpolation. The spatial granularity achieved through this approach allows for granular (i.e., individual-asset resolution) exposure results.[12]

Table 2. *Description of the data sources used for exposure, and related descriptions*

Hazard	Dataset	Data Source	Description
Extreme Heat	LOCA2-CA 3 km gridded temperature projections[13]	Cal-Adapt Analytics Engine AWS S3 Data Catalog[14]	Gridded temperature projections were derived from the LOCA2-CA dataset using its daily maximum and minimum temperature variables.
Wildfire	Canadian Forest Fire Weather Index (FWI)[15] and historical burn probability data	Cal-Adapt Analytics Engine AWS S3 Data Catalog USDA/USFS Wildfire Risk	At the time of the SDG&E CAVA report, the CMIP6-based California wildfire projections by University of California Merced are not publicly available. Instead, SDG&E leveraged historical burn probability data and the Canadian FWI[17]. The Canadian FWI accounts for daily temperature, relative humidity, wind

Hazard	Dataset	Data Source	Description
		to Communities Dataset[16]	speed, and precipitation to provide an understanding of how conducive the projected conditions are to wildfire development. To understand the current and future exposure to wildfire, SDG&E CAVA evaluated the following variables for the vulnerability assessment: historical burn probabilities and annual change in the number of days above the 95th percentile FWI. The historical relative wildfire likelihood was obtained from the USDA and USFS Wildfire Risk to Communities dataset. The Canadian FWI was calculated using the LOCA2-CA dataset.
Inland Flooding	LOCA2-CA Variable Infiltration Capacity (VIC) 3 km gridded runoff and LOCA2-CA 3 km gridded precipitation projections	CEC AWS S3 Data Catalog[18]	LOCA2-CA VIC runoff projections are calculated based on meteorological data from 13 LOCA2-CA models that are used to drive the VIC land surface model. Runoff represents excess water that flows over the surface into adjacent bodies of water from precipitation, snowmelt, and irrigation that is not absorbed into the land. LOCA2-CA gridded precipitation projections follow the same approach as temperature projections described above.
Landslide	California DEC/Geological Survey Deep Landslide Susceptibility Rating and LOCA2-CA 3 km gridded	CEC AWS S3 Data Catalog[19] California Department of Environmental Conservation and California	LOCA2-CA gridded precipitation projections follow a similar approach as temperature projections described above for the SSP3-7.0 50th percentile scenario only. To understand present day and future exposure to landslides for gas assets, SDG&E evaluated the following variables

Hazard	Dataset	Data Source	Description
	precipitation projections	Geological Survey	for the vulnerability assessment: change in annual maximum 60-day total precipitation and historical landslide susceptibility. The historical relative landslide susceptibility was obtained from the California DEC and California Geological Survey Landslide Susceptibility Rating dataset.
Coastal Flooding	Coastal Storm Modeling System (CoSMoS) storm surge[20] and CMIP6 tide gauge SLR projections for the southern California coast at La Jolla tide gauge	CoSMoS California SLR Guidance: 2024 Science and Policy Update[21]	CoSMoS models inundation depths as a result of SLR and the 100-year and 20-year storms (note that as such, the baseline/0 SLR just shows the 100-year or 20-year storm) for 2030, 2050, and 2070 under intermediate-high SLR scenarios. CoSMoS inundation depth layers are available in 25 cm (~10 inches) SLR increments. The closest SLR depth layer is used for each SLR scenario. Coastal flood data used in this workbook are generated as a part of the USGS CoSMoS,[22] and SLR increments chosen for the study correspond with the updated 2024 SLR guidance from California's Ocean Protection Council (OPC).
Coastal Erosion	CoSMoS projected cliff retreat and shoreline conditions, as well as CMIP6 tide gauge SLR projections	CoSMoS California SLR Guidance: 2024 Science and Policy Update[23]	CoSMoS models geospatial cliff retreat and shoreline conditions for 2030, 2050, and 2070 SLR scenarios under intermediate-high and high sea level scenarios. SLR increments chosen for the study correspond with the updated 2024 SLR guidance from California's Ocean Protection Council (OPC).

Hazard	Dataset	Data Source	Description
Land Subsidence	USGS land subsidence in California	USGS Areas of Land Subsidence in California[24]	The USGS-developed map provides an overview of areas of recorded subsidence (historical and current) across California. Additionally, the map provides classifications for the causes of subsidence. The majority of land subsidence across the state is caused by groundwater pumping.

SDG&E selected threshold values for each metric that represents each climate hazard. The thresholds are used to score exposure levels on a 0-to-5 scale. A value of 0 represents no exposure and 5 represents maximum exposure. The hazard-specific exposure thresholds were selected using 20th, 40th, 60th, 80th percentiles as shown in Table 3. Exposure threshold percentiles are derived from all grid cells in the SDG&E service territory using the historical and CAVA OIR reference SSP3-7.0 projections between the center years of 2015-2090. Climate variable projections use sliding 20-year windows starting with a center year 2015 (2005-2024) and ending with a center year 2090 (2080-2099) to reduce the effects of naturally occurring internal climate variabilities, such as the El-Niño Southern Oscillations (ENSO). When determining exposure threshold percentiles, the projections that examine 50th percentile in a 20-year period (time-P50) and 50th percentile across the GCM model dimension (model-P50) are typically used at each grid cell. The climate-variable specific thresholds and scores are presented in section 3.2. Vulnerability Analysis.

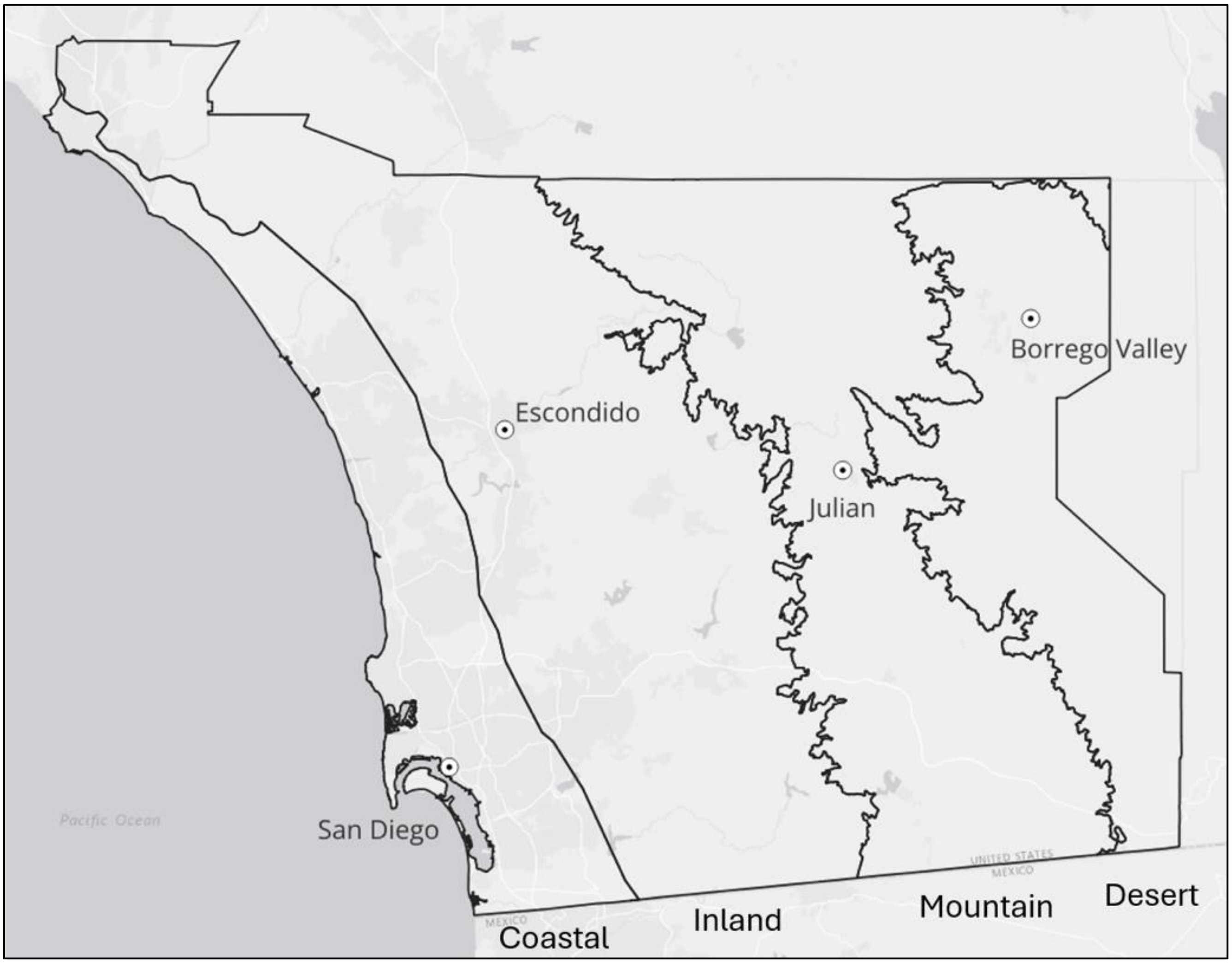
Table 3. *Exposure scoring using distribution of climate projections*[25]

Percentiles	*Exposure Score*
0	0
>0-20%	1
>20-40%	2
>40-60%	3
>60-80%	4
>80%	5

In some cases, quantiles were not sufficient to separate exposure scoring buckets and an expert evaluation of climate change was used to adjust the relative range of exposure across the service territory, using precedent from past vulnerability and risk assessments performed across North America and reviewing SDG&E SME input on design standards and risk tolerance. Exposure score thresholds remain constant and do not change over time. Scores are designed to capture the relative change in climate hazard distributions over time and assume that present-day exposure represents an acceptable level of risk. As the climate changes, however, SDG&E may be willing to accept a level of risk that exceeds the present day. This study helps to identify an acceptable level of risk based on the vulnerability scoring and monitor exceedance of those levels over time.

Climate hazard projections and exposure were mapped and summarized in Section 3.2. Vulnerability Analysis across the SDG&E service territory and by using four distinct regions, which are defined using the National Weather Service (NWS) Public Forecast Zones: Coastal, Inland, Mountain, and Desert, as shown in Figure 6. To visualize different emissions scenarios and model uncertainty in the climate projections, a representative location is used for each region: San Diego Downtown for Coastal, Escondido for Inland, Julian for Mountain, and Borrego Valley Airport (in Borrego Springs) for Desert.

Figure 6. *National Weather Service (NWS) zones in SDG&E service territory*[26]



SDG&E recognizes that the GWL framework will be required for any future CAVA filings with the CPUC, starting in 2026.[27] GWLs provide signposts for the level of increase in average global surface temperature over time, measured as anomalies relative to the pre-industrial reference temperature level. While the current SDG&E CAVA submission uses the most up-to-date, advanced climate science projections for California that are available to the utilities at the time of this filing (e.g., CMIP6, LOCA2-CA), SDG&E is still in the process of evaluating the use of a standardized GWL approach as the basis for CAVA planning, with the ultimate goal to align with how this framework is interpreted and established by California's Fifth Climate Change Assessment (or other state-issued policies) that examines the authorized datasets made available via the Cal-Adapt Analytics Engine. SDG&E also want to ensure that the adoption of the GWL framework would not preclude alignment with peer utilities as well as national, state, and local agencies, who predominantly use the year-based SSP projection framework as the basis for climate adaptation and resilience planning.

Although the SDG&E CAVA analysis has been performed with the state-of-the-art GCM simulations performed under the latest CMIP6 protocol, it is important to emphasize that there still exists a considerable level of inherent uncertainty associated with climate modeling, which requires making a number of approximations and assumptions to estimate the most likely climate conditions for the Earth system for future years. This has led to several areas of discrepancy between the observations and model simulations,[28] as well as the "hot model" problem, where GCMs predict future conditions that are significantly warmer than the likely range inferred from multiple lines of evidence.[29] As part of the efforts to circumvent this inherent uncertainty associated with climate modeling, the SDG&E CAVA analysis uses all the available CMIP6-based datasets and their realization/ensemble members wherever possible to ensure that projection metrics are targeting the most robust signals that are simulated across the CMIP6 GCMs.

3.1.1.2 Sensitivity

Sensitivity scores reflect the degree to which an asset's integrity or normal operation could be adversely impacted in the event of climate hazard exposure. The justification of asset sensitivity scores to the exposure of each hazard was coordinated with SMEs for each asset type included in the analysis. The assets included are listed in Sections 3.1.2 and 3.1.3 for electrical and gas assets, respectively.

Sensitivity was scored on a scale from 0 to 5, with 0 representing no impact in the event of hazard exposure and 5 representing significant impact. A general description that guided the scoring for each asset-hazard combination is presented in Table 4. The sensitivity score justifications for each asset-hazard combination are provided in Appendix I – Sensitivity Scoring Results.

Table 4. *Sensitivity scoring matrix*

Score	Explanation
N/A (0)	Asset, operation, or system faces **no adverse impacts** from this hazard. In the event of hazard exposure, asset components remain fully operational.
Minimal (1)	Asset is rarely impacted from this hazard and when impacted, **effects are minimal.** Minor wear and tear to assets may occur but can be addressed by routine maintenance.
Low (2)	Asset typically faces minimal adverse impacts from this hazard. In the event of hazard exposure some **long-term impacts may occur** (e.g., accelerated

Score	Explanation
	aging, temporary stress). While there are no immediate threats to functionality, repairs may be required to prevent further deterioration.
Moderate (3)	Asset or system may incur moderate, repairable physical damage from high-threshold hazard exposure, leading to **short-term operational disruptions**, with chronic impacts mitigated by certain factors.
High (4)	Asset or system may suffer immediate failure and **significant physical damage** from moderate hazard exposure, leading to prolonged operational disruptions and requiring extensive repairs.
Severe (5)	Asset or system with limited tolerance to hazards may **experience sudden failure**, damage, and long-term outages, requiring replacement or major reconstruction.

SDG&E derived a sensitivity score at the asset-type level with the definitions described above. SDG&E made the analysis more granular by including specific information at the individual-asset level, such as material, and asset health. For example, the sensitivity score of wooden poles to wildfire is higher than that of steel poles. Similarly, SDG&E SMEs are aware that their 4 kV distribution underground and overhead conductors are more sensitive to extreme heat. As a result, SDG&E increased the sensitivity score to extreme heat for 4 kV conductors relative to other conductors.

After modifying the asset score based on these individual characteristics, the integration of asset health postulates that assets that are adequately maintained and present no deficiencies might be more resistant to exposure to climate hazards. To determine asset health, SDG&E acquired probability of failure data from SDG&E's Asset Management team for primary underground conductors, primary overhead conductors, overhead structures, and substations.[30] Probability of failure was used as a proxy for asset health, and asset health was added to the general asset sensitivity score as follows:

- **Good health = 0**. If the probability of failure is between 0 and 40%. The original sensitivity value remains unchanged.
- **Fair health = 0.5**. If the probability of failure is between 40 and 70%. The original sensitivity value increases by half a point.
- **Poor health = 1**. If the probability of failure is between 70 and 100%, or if its probability of failure is unknown. Conservatively, the absence of health information was considered as detrimental as verified poor asset health. The original sensitivity value increases by one point.

It is important to note that the maximum possible sensitivity score is 5. When the SME asset sensitivity score is a 5, poor or unknown asset health does not increase the score to a 6. The reasoning is that if an asset can experience sudden failure upon exposure to a climate hazard, then the condition of the asset is moot. For example, a pad-mount transformer that is not rated to be submersible, will experience adverse effects when exposed to inland or coastal flooding regardless of asset health.

This sensitivity scoring approach considers any previously implemented resilience strategies that reduce sensitivity (e.g., changing wooden poles to steel) or asset conditions that may exacerbate potential impacts (e.g., poor asset health).

3.1.1.3 Adaptive Capacity

Generally, adaptive capacity is defined as the broad range of responses and adjustments to daily and extreme climate change-related events to mitigate the impact of those events. This study considers the adaptive capacity of SDG&E's business as well as the adaptive capacity of the communities it serves. Two distinct methods are utilized to evaluate these two types of adaptive capacity. The adaptive capacity of SDG&E's business was scored based on SME input within the operational maturity components and is factored into the vulnerability methodology equation in Figure 5. Community adaptive capacity was evaluated by developing the Community Vulnerability Index (CVI). Methodology and application of the CVI are detailed in Section 4.1 - Community Vulnerability Index (CVI).

Operational maturity is defined in this report as the level to which the Company engages in best practices that advance resilience to extreme weather. SDG&E evaluated the maturity level of five resilience practices,[31] which it arrived at after conducting research on operational resilience topics, selecting the most relevant for this purpose, and modifying it to fit the scope of this assessment and SDG&E's operations and services:

1. Inclusion of weather projections, to expand or adapt risk management activities and long-term planning.
2. Investment in new technology, to minimize negative impacts of extreme weather and deliver better or more efficient performance.
3. Accountability, by tracking performance metrics.
4. Communication and feedback, both within the organization and to the public to enhance accountability and sharing of best practices.
5. Workforce training, to maintain high quality, empower professional development, and foster dynamic and flexible workforces.

Operational maturity was scored from 0 to 5 by assessing each of the five resilience practices listed above. A question for each practice was posed to SMEs to which they answered on a point scale from 0 to 1, through the lens of each climate hazard: 0 (strongly disagree), 0.5 (somewhat agree or disagree), or 1 (strongly agree). The points were then added for each operation for a minimum score of 0 or a maximum score of 5. The questions are presented in Table 5.

Table 5. *Resilience practices questionnaire*

Resilience Practice	Question posed to SMEs
Inclusion of weather projections to build situational awareness	Are historical and projected weather due to climate change used to inform required updates?
Investment in new technology	Are there investments in new technologies and innovation to deliver better or more efficient performance?
Accountability	Is the success of the teams' performance related to the hazard tracked through performance metrics?
Communication and Feedback	Is diverse internal and external stakeholder communication and feedback related to the hazard occurring?
Workforce and Training	Are the personnel involved regularly trained to be flexible, collaborative, and prioritize safety in preparation for extreme weather events?

The operational maturity score for each operation and service was averaged by climate hazard. The resulting score was integrated into the vulnerability formula by turning it into an adaptive capacity multiplier that ranges from 0.95 to 1 through the following formula:

$$Adaptive\ capacity\ multiplier = \frac{100 - Operational\ Maturity\ Score}{100}$$

The interpretation of the formula above is that adaptive capacity can reduce the potential for impact (i.e., exposure x sensitivity) score by up to 5 %, when the operational maturity score by climate hazard is 5. It should be noted that existing system hardening and asset condition are already considered as part of the sensitivity scores. Therefore, a maximum reduction of 5 % was defined for adaptive capacity to preserve a higher weighting on the exposure and sensitivity components of the equation. The adaptive capacity multiplier is consistent for all electrical asset types, only changing by climate hazard. The results shown in Table 6. Operational maturity scores by climate hazard for electrical assets were used to arrive at the vulnerability results for each climate hazard presented in Section 3.2.

Table 6. *Operational maturity scores by climate hazard for electrical assets*

Operation and Service	Coastal Flooding (out of 5)	Inland Flooding (out of 5)	Wildfire (out of 5)	Extreme Heat (out of 5)
Emergency Response	4.0	4.0	4.5	3.5
Communication	2.5	2.5	4.5	2.5
Vegetation Management	2.5	2.5	4.5	3.0
Safety Operations	4.0	4.0	4.5	3.5
Reliability Planning	4.5	4.5	4.5	4.0
Asset Management	2.5	2.5	4.5	2.5
Supply Management	2.5	2.5	3.5	2.5
Average	3.2	3.2	4.4	3.1
Adaptive Capacity Multiplier	=(100-3.2)/100) **= 0.968**	=(100-3.2)/100 **= 0.968**	=(100-4.4)/100 **= 0.956**	=(100-3.1)/100 **= 0.969**

For gas assets, SDG&E adopted the adaptive capacity definition by SCG.[32] SCG determined if adaptive capacity was low, medium, or high depending on the capability to manage the climate hazard now and in the future. SDG&E converted the qualitative scores into a 0 (low), 3 (medium), 5 (high) scale for consistency. The adaptive capacity scores for gas assets are presented in Table 7.

Table 7. *Adaptive capacity scores for gas assets*

Asset Type	Coastal Flooding (out of 5)	Inland Flooding (out of 5)	Coastal Erosion (out of 5)	Landslide (out of 5)	Wildfire
High-Pressure Pipes	3	3	3	3	3
Medium-Pressure Pipes	3	3	3	3	3
Regulators, Compressors, Valves	5	5	5	3	3
Storage Fields*	3	3	1	3	3
* There are no storage fields in the SDG&E service territory					

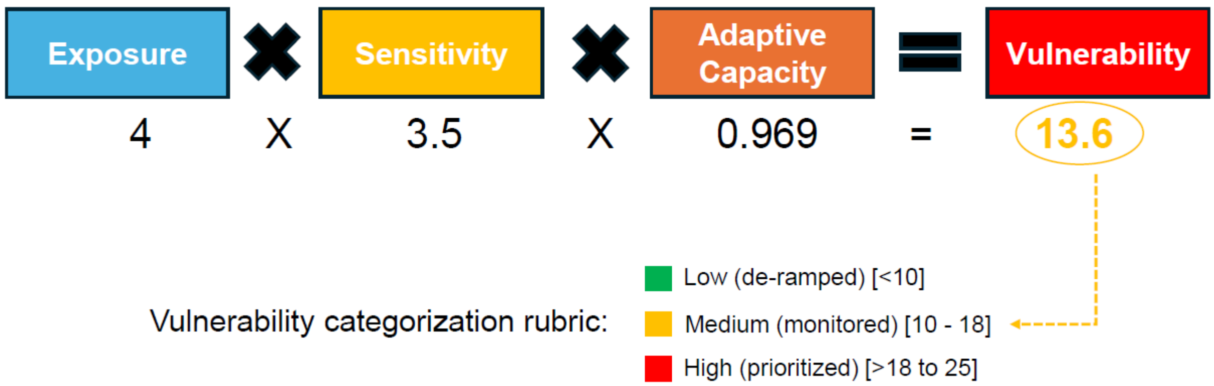
3.1.1.4 Vulnerability

Vulnerability is the potential impact for assets and operations due to climate hazards, reduced by the ability to cope or mitigate negative outcomes (i.e., adaptive capacity). The vulnerability scores were calculated at the individual-asset level. This analysis equips SDG&E with a comprehensive list of assets with their individual exposure, sensitivity, adaptive capacity and resulting vulnerability scores. The vulnerability scores were calculated for four time horizons (baseline, 2030, 2050, and 2070); three Shared Socioeconomic Pathways (SSP) scenarios (SSP2-4.5, SSP3-7.0, and SSP5-8.5); two percentiles across time dimension in 20-year bands (50th and 95th, referred to as time-P50 and time-P95); and two percentiles 50th and 90th percentiles across GCM model dimension (50th and 90th, referred to as model-P50 and model-P90).

This granular information allows SDG&E to identify assets, groups of assets, and geographical areas of concern to inform future planning. Assets can be ranked using the vulnerability scores to identify short-, medium-, and long-term interventions (i.e., resilience measures) that may be required for each asset type and climate hazard. The inherent uncertainty of climate projections is captured by the range of results through time horizons and socioeconomic pathways. This detailed vulnerability assessment equips SDG&E with inputs that can be integrated into existing processes for robust climate-resilience planning.

Vulnerability scores were summarized as “low”, “medium” or “high”, based on the thresholds shown in Figure 7. The intervention timeline for assets within the “low” vulnerability category could be included in long-term planning, assets in the “medium” category could be included in medium-term planning and assets in the "high" category could be included in short-term planning. The vulnerability results by asset type are presented in Section 4. An example of how exposure, sensitivity, and adaptive capacity are integrated to arrive at a vulnerability score is shown in Figure 7 below.

Figure 7. *Example of vulnerability scoring*



3.1.2 Electrical Assets in Scope

SDG&E's electrical assets were grouped into five asset families: distribution, transmission, substations, communication, and facilities. These can be defined as follows:

- Distribution assets deliver electricity to homes and businesses at voltages that typically range from 4.8 to 12.5 kilovolts (kV).
- Transmission assets carry electricity over long distances, typically from generation facilities to substations, or between substations, at nominal operating voltages ranging from 69 to 500 kV.
- Substations are facilities where one or more generation, transmission or distribution, or transmission systems interconnect to supply electricity to other parts of the grid. Substations provide isolation, switching, and transformation functions to protect the grid, facilitate operations, and maintain acceptable voltage levels.
- Communication assets are property or equipment used primarily for voice and data communications. These assets are essential for enabling and maintaining communication networks.
- Facilities refer to various types of building and center spaces that support SDG&E's operations including asset critical facilities (not to be confused with community critical facilities outlined in section 4).

Table 8 provides a list of electrical components included (i.e., individual assets) for each of the asset families included in the assessment.

Table 8. *List of electrical assets used in the vulnerability assessment*[33]

Asset Family	Components
Distribution	• Primary Underground Conductors (11,182 miles) • Primary Overhead Conductors (6,414 miles) • Poles (232,551 count) • Dynamic Protective Devices (6,733 count) • Switches (pad mount, underground, overhead) (13,466 count) • Transformer Devices (overhead, pad mount, subsurface) (176,378 count) • Voltage Regulators (419 count) • Capacitors (PF correcting equipment) (1,359 count)
Transmission	• Overhead Line Sub Segments (2,014 miles) • Underground Lines (200 miles) • Poles and Towers (14,538 count)
Substation	• Substation Transformers (684 count) • Substation Reactors (1,291 count) • Voltage Regulators (37 count) • Protection and Control Devices (13 count) • Switchgear, Circuit Breakers, and Capacitor Banks (1,131 count)
Communication	• Overhead Fiber, Copper (567 miles) • Underground Fiber, Copper (192 miles) • Communication Poles (10,087 count) • SCADA (RTU) (3,293 count) • Antennas (2,593 count)
Facilities	• Office Buildings (Headquarters, Call Centers, Training Centers, Warehouses, Generation admin offices) (8 count) • Construction & Operation Centers (includes battery storage facilities and microgrids) (11 count) • Communication Centers (56 count) • Asset Critical Facilities[34] (data centers, mission control grid operation center) (2 count)

3.1.3 Gas Assets in Scope

The analysis of gas assets in this CAVA focused on the following asset families: High Pressure (HP) pipes, Medium Pressure (MP) pipes, and Regulators, Compressors, and Valves. Table 9 provides a list of gas components of the system included in the assessment, divided by asset family.

Table 9. *List of gas assets used in the vulnerability assessment*

Asset Family	Components
High-Pressure (HP) Pipes	• High-Pressure Pipes (579 miles) • High-Pressure Service Pipes (2.4 miles)
Medium-Pressure (MP) Pipes	• Medium-Pressure Pipes (7,948 miles) • Medium-Pressure Service Pipes (7,070 miles)
Regulators, Compressors, and Valves	• Controllable Gas Valves (23,175 count) • Non-Controllable Gas Valves (2,203 count) • Regulators (666 count) • Moreno compressor station (1 count)

3.1.4 Operations and Services

Beyond physical assets, SDG&E's operations and services are a crucial part of the Company's ability to work as a coordinated and resilient system. Vulnerabilities across Operations and Services have the potential to result in delayed response, inability to quickly recover, or act toward improving resilience against climate events. SDG&E reviewed the following 7 operations and services that are key to the organization:

1. Asset Management
2. Vegetation Management
3. Emergency Response
4. Communications
5. Safety Operations
6. Reliability Planning
7. Supply Management

SDG&E identified how each of these operations and services could be impacted by climate hazards to identify ones that would require further analysis. For instance, the frequency with which some activities take place, the design standards and asset replacement rates, or safety protocol might need to be adjusted to account for projected weather conditions. The results of this analysis are provided in Section 3.2. Each of the operations and services are defined below.

3.1.4.1 Asset Management

Asset management in an electrical utility involves the strategic and systematic process of developing, operating, maintaining, and upgrading electrical infrastructure assets to ensure their reliability, efficiency, and safety. This practice encompasses the comprehensive management of assets throughout their lifecycle, integrating people, processes, data, analytics, and technology to mitigate risks and optimize performance. It includes the coordination of design standards, maintenance protocols, and interactions with external entities, such as equipment manufacturers and regulatory bodies, to stay abreast of the latest industry standards and innovations.

The SDG&E Asset Integrity Management (AIM) program, driven by the asset management organization, advances the development and implementation of a comprehensive, sustainable and risk-informed Asset Management System (AMS), encompassing people, process, data, analytics, and technology.[35] SDG&E uses tools like the DOBLE ARMS software, which compiles asset data and ranks assets based on their vulnerability while identifying those that may be at risk during wildfire and extreme heat events. Given that the risk of extreme heat events and wildfire conditions are projected to increase in the coming decades, there may need to be a shift in the asset management approach to account for these changes in climate change. SDG&E also uses standard ratings for lines; these specifications are required to be kept up to date by Western Electricity Coordinating Council (WECC) for rating overhead and underground lines. As the climate changes, line ratings may need to change to account for shifts in climate conditions.

The asset management group coordinates design standards with operations, maintenance and engineering teams. The group interacts with external entities, like equipment manufacturers and industry standards (e.g., Institute of Electrical and Electronics Engineers), to stay informed on the latest requirements and recommendations.

3.1.4.2 Vegetation Management

SDG&E's vegetation management program involves tracking and maintaining an inventory of trees and poles, patrolling lines, and pruning or removing hazardous trees. This program aims to reduce wildfire risk and maintain service reliability by ensuring trees do not contact power lines. It includes database management of tree characteristics, such as species, growth rates, and failure likelihood, to guide clearance activities. The program specifies trimming extents, such as a minimum post-trim clearance of 12 feet for high fire threat districts (HFTD)[36] and 18 inches for non-HFTD areas, always ensuring tree clearance. SDG&E's robust vegetation management program trims or removes approximately 175,000 trees annually, focusing on avoiding risks within its service area.

SDG&E currently uses several standards and procedures to guide its vegetation management practices, including data collection, workforce development, and clearance requirements. The attributes of the approximately 500,000 trees in its service area are uploaded to an ESRI powered database whenever an inspection is performed. Currently, SDG&E uses this ESRI powered database to keep track of trees and poles.

While the database is comprehensive, including every tree and pole on a district/community level, SDG&E has not formally adopted any predictive analytics currently. This program could benefit by incorporating remote sensing, LIDAR, and satellite imagery to help augment activities and data analytic modeling with its wildfire team to help prioritize and better predict areas where trimming is needed. For all trees within an HFTD (66% of the service territory), inspections are performed three times per year. Trees within HFTDs have a strict minimum clearance of 12 feet at all times; however, trimming always exceeds this minimum to ensure asset safety. Although the trimming protocols are cycled and not condition-based, the vegetation management team performs multiple, redundant activities within the annual cycles that ensure vigilance and routine inspection and corrective action where necessary.

While SDG&E does not use any specific climate considerations for vegetation management, it does require that a portion of its workforce has a certain level of background with relevant topics such as tree health and biology, and should include topics such as weather conditions, topography, etc. As the risk of wildfire grows, however, there may need to be a shift in the frequency of vegetation management practices to better mitigate projected increases in wildfire risk. Additionally, changes in the frequency and severity of winter storms can pose a risk as severe storms can lead to tree contact with lines. Accounting for projected climate change in vegetation management practices will be important for maintaining safety and reliability.

3.1.4.3 Emergency Response

SDG&E's emergency response practice involves coordinated efforts to manage and mitigate the impacts of unforeseen events, such as wildfires, storms, and other natural disasters. The practice includes comprehensive planning and preparation, such as the development of emergency response plans that comply with regulatory requirements and may consider dynamic climate hazard emergencies. SDG&E employs technologies for communication and situational awareness, leveraging Emergency Operation Centers (EOCs), advanced virtual EOCs, and redundant communications technologies, such as radio and satellite phones. Routine training exercises, in collaboration with regional partners, ensure readiness for various hazards, including both historical and emerging threats. The practice also includes maintaining robust customer communication strategies, particularly with vulnerable communities, to provide timely updates during events like Public Safety Power Shutoffs (PSPSs).

The SDG&E General Order 166, 2021 Emergency Response Plan Compliance Report includes the Wildfire Mitigation Plan (WMP). The WMP explicitly includes consideration of climate change risk in compliance with the California CPUC statutory wildfire mitigation plan requirement of "including consideration of dynamic climate change risk." The WMP team is coordinating with the Fire Science and Climate Adaptation (FS&CA) CAVA team for alignment in the datasets and methodology that will be used to examine the future projections of wildfire-related risk/vulnerability across the SDG&E service territory. Climate change is expected to alter the frequency and intensity of various hazards, including extreme heat, wildfires, and flooding in SDG&E's region. These shifts may lead to increased demands on emergency response services, potentially straining this program and necessitating adaptations to address evolving climate conditions effectively.

3.1.4.4 Communications

SDG&E's communications group encompasses a wide range of activities aimed at ensuring clear, timely, and effective communication with customers, partners, and other stakeholders. The communications group uses various technologies, including text, email, phone, and web portals to disseminate information before, during, and after events such as power outages, maintenance work, and emergency situations. The goal is to provide real-time insights and updates, maintain situational awareness, and ensure that all affected parties, including vulnerable communities and first responders, are adequately informed and prepared. Effective communication is crucial for maintaining service reliability, safety, and customer trust, particularly in the face of increasing climate-related risks and the potential need for more frequent PSPS events.

SDG&E communicates with customers and partners (including first responders, tribal leaders, and hospitals) in 22 languages through text, email, and phone, as well as using the Public Safety Partner Portal. The procedures in place dictate that contact with customers should take place before, during, and after events.

As climate change impacts the frequency and severity of different climate events, there may be a need for more frequent and targeted communications. For example, daily maximum temperatures above 104 °F are projected to increase across the service territory in the coming decades. This may require more targeted communications with communities, particularly those most vulnerable to extreme heat, to both warn of looming events and communicate during events.

3.1.4.5 Safety Operations

SDG&E's safety operations encompass a comprehensive framework designed to safeguard employees, contractors, and the community from various occupational hazards. The Company adheres to stringent standards set by the California Division of Occupational Safety and Health (CALOSHA), implementing measures like engineering controls, scheduling adjustments, and personal protective equipment (PPE) to mitigate risks associated with extreme heat, wildfire smoke, and other hazardous conditions. Emphasis is placed on continued training with the goal of empowering staff to recognize and respond to unsafe situations effectively. Furthermore, contractors must meet rigorous safety criteria, ensuring a unified commitment to maintaining a safe working environment across all operations.

CALOSHA sets temperature thresholds for indoor and outdoor work at 87 °F and 95 °F, respectively. If the indoor temperature thresholds are met or exceeded, then engineering controls are implemented (air conditioning, fans, etc.). Additionally, SDG&E's heat illness prevention safety standard outlines roles and responsibilities for different groups to prioritize employee safety for outdoor temperatures. Given that extreme heat is projected to increase in the coming decades, the Company may need to invest more resources in cooling and safety protocols to continue to prioritize employee safety.

In 2019, the Wildfire Smoke Protection Policy became a permanent regulation in the State of California, setting guidelines for safe worker conditions in wildfire conditions. While climate change was not explicitly incorporated into the regulation, SDG&E is working with its wildfire team to consider the impacts of climate change to advance in particulate monitoring both independently and in coordination with San Diego County. Given that the risk of wildfire is projected to increase across the service territory, it is important to continue evaluating the Wildfire Smoke Protection Policy to ensure that it accounts for projected changes in wildfire risk.

Additionally, tree contractors working with SDG&E must be registered with a safety clearing house and have an acceptable safety rating. SDG&E also mandates a ratio of supervisors to field workers and encourages several mitigation measures, including scheduling (e.g., time limits of exposure), and PPE (e.g., cooling vests), and training to understand unsafe conditions and take necessary safety-preserving actions.

3.1.4.6 Reliability Planning

Reliability planning at SDG&E is a critical process aimed at ensuring consistent and dependable electricity delivery to customers amidst various challenges, particularly those posed by weather conditions. It includes load forecasting and capacity planning practices. SDG&E's 2021 Annual Electric Reliability Report highlights weather as a major factor in unplanned outages over the past decade, with high winds, rainstorms, and wildfires being key contributors. By analyzing the vulnerability of assets to such events and conducting annual summer preparedness programs, SDG&E identifies circuits at risk of overloading and ensures readiness for peak demand periods. For example, the planning process incorporates a threshold of 100 °F ambient temperature and 2 feet per second wind speed to model and predict the impact of extreme heat on system performance. This approach helps to mitigate potential reliability issues and maintain service standards even as climate change alters the frequency and intensity of extreme weather events.

Capacity planning compares the existing delivery capacity of grid assets to forecast power flows on those assets to identify areas of the grid where demand growth could result in power flows exceeding asset ratings. For the identified assets, the planning process determines the infrastructure investments that will align system capacity with expected customer demand. T&D capacity planning uses load forecasts and asset ratings as inputs. Asset ratings are themselves dependent on ambient temperature. Ambient temperatures significantly above those assumed in planning, coupled with higher than projected peak demand, such as might occur during a heat wave, could result in equipment overloads which could impact reliability.

Load forecasting projects peak demand and energy usage for future periods. For the CPUC-jurisdictional IOUs, including SDG&E, system-level electric load forecasts used in transmission and distribution planning are primarily provided by the California Energy Commission (CEC) via their annual Integrated Energy Policy Report (IEPR). The CEC's IEPR load forecasting process considers factors including demographic and macroeconomic concepts, weather, energy prices, building and appliances standards and saturations, energy efficiency programs and other factors affecting consumption, such as changing technologies. Historically, SDG&E's role in electric load forecasting has been to provide inputs and suggestions for the development of the IEPR's system-level electric load forecast and to disaggregate the CEC's formally adopted IEPR system-level forecast to individual substations and circuits. SDG&E uses a variety of inputs for this disaggregation processing, such as observed heating degree days, cooling degree days, and relative humidity corresponding to recorded loads, as well as 30-year historical averages for normalizing recorded loads to average weather conditions.

SDG&E conducts annual summer preparedness programs, creating a watch list of distribution circuits that could overload. This involves analyzing assumptions and data feeds to identify vulnerable areas and ensure readiness for high-demand periods. If the reliability planning process does not adequately model the potential impact of increasing storms, wildfires, and heat waves on reliability, system performance could fall below acceptable levels in the future.

3.1.4.7 Supply Management

The Supply Management, Logistics, & Supplier Diversity department (Supply Management) is responsible for identifying, purchasing, and managing the procurement contracts of products and services needed to run the Company's business. Supply Management delivers value to its business clients, and therefore ratepayers, by leveraging technology and tools to assess market and spend intelligence. This information assists in meeting purchasing needs, developing and executing strategies to reduce costs, and managing contract performance. Supply Management engages internal departments and external suppliers to optimize the value that SDG&E receives from its sourcing dollars.[37]

Notable factors that influence costs in Supply Management are:

- Increased company-wide capital spending, requiring more contracts.
- Increased number of suppliers to provide products and services.
- Increased inventory of products to support major capital projects.
- Comprehensive plan to incorporate sustainability within the supply chain.
- Compliance with the CPUC Diverse Business Enterprises (DBEs) goals associated with General Order (GO) 156.

3.2 Vulnerability Analysis

This section provides the findings of the vulnerability assessment, organized by climate hazard. Each subsection characterizes the climate hazard across the service territory to arrive at location-specific exposure scores and describes the sensitivity of assets and operational maturity to arrive at vulnerability scores. Finally, the vulnerability of operations and services is discussed.

3.2.1 Extreme Heat

Hazard Characterization

Extreme temperatures and heat waves are already becoming more common and are expected to increase in frequency and intensity in the future years due to climate change. San Diego County has repeatedly broken maximum temperature records, most recently in September of 2024. This recent heat wave had daytime highs of 102°F to 112°F at inland locations and 90°F to 104°F in the mountain regions.[38] During a 2022 heat wave, temperatures soared to 95°F at the coast and above 100°F inland, leading to power outages for thousands of residents. The prolonged nature of above-average temperature, coupled with high humidity, made it particularly challenging as overnight temperatures remained uncomfortably high. Residents were urged to reduce energy consumption to alleviate the strain on the power grid.[39] The average annual temperature in San Diego is expected to increase by 7-9°F by the late 21st century. Coastal and inland areas may see temperatures as high as 100-110°F and near 110-125°F on the average hottest day of the year by the late century, respectively.[40]

Variables and Methods

In consultation with SDG&E engineers and SMEs, the following climate variables[41] were analyzed for extreme heat and used for asset exposure:

- Annual number of days with daily average temperature above 77°F
- Annual number of days with daily maximum temperature above 100.4°F
- Annual number of days with daily maximum temperature above 104°F

SDG&E standards assume an average ambient temperature of 77°F (25°C) for distribution conductors and a maximum ambient temperature of 100.4 °F (38°C) for rating transmission conductors and 104°F (40°C) for rating transformers, reactors, and voltage regulators. Standards are derived from the Institute of Electrical and Electronics Engineers (IEEE) standards.[42]

Projected Change across the SDG&E Service Territory

The following figures illustrate the baseline (1995-2014) conditions and projected change by 2050 for each of these variables. Figure 8 shows the observed baseline (1995-2014) and projected change by 2050 in the annual number of days with average daily temperature above 77°F under the reference SSP3-7.0 scenario. Historically, the Coastal region and high-altitude portions of the Mountain region have experienced the fewest days with average temperature above 77°F, while the Desert region has experienced the most. By 2050, nearly all regions within the SDG&E service territory are projected to experience an increase in the annual number of days with daily average temperature above 77°F. Large portions of the Inland, Mountain, and Desert regions are projected to experience the largest increase in days, while much of the immediate coastal region is projected to experience no or small increases in days.

Figure 8. *Baseline and projected annual days with average temperature above 77°F*

Observed baseline (1995-2014; left panels) and projected changes (right panels) in the annual number of days with daily average temperature above 77 °F. Projected values represent median-year (time-P50) 2050 with median-model (model-P50; upper right panel) and extreme-model (model-P90; lower right panel) views under the SSP3-7.0 scenario.

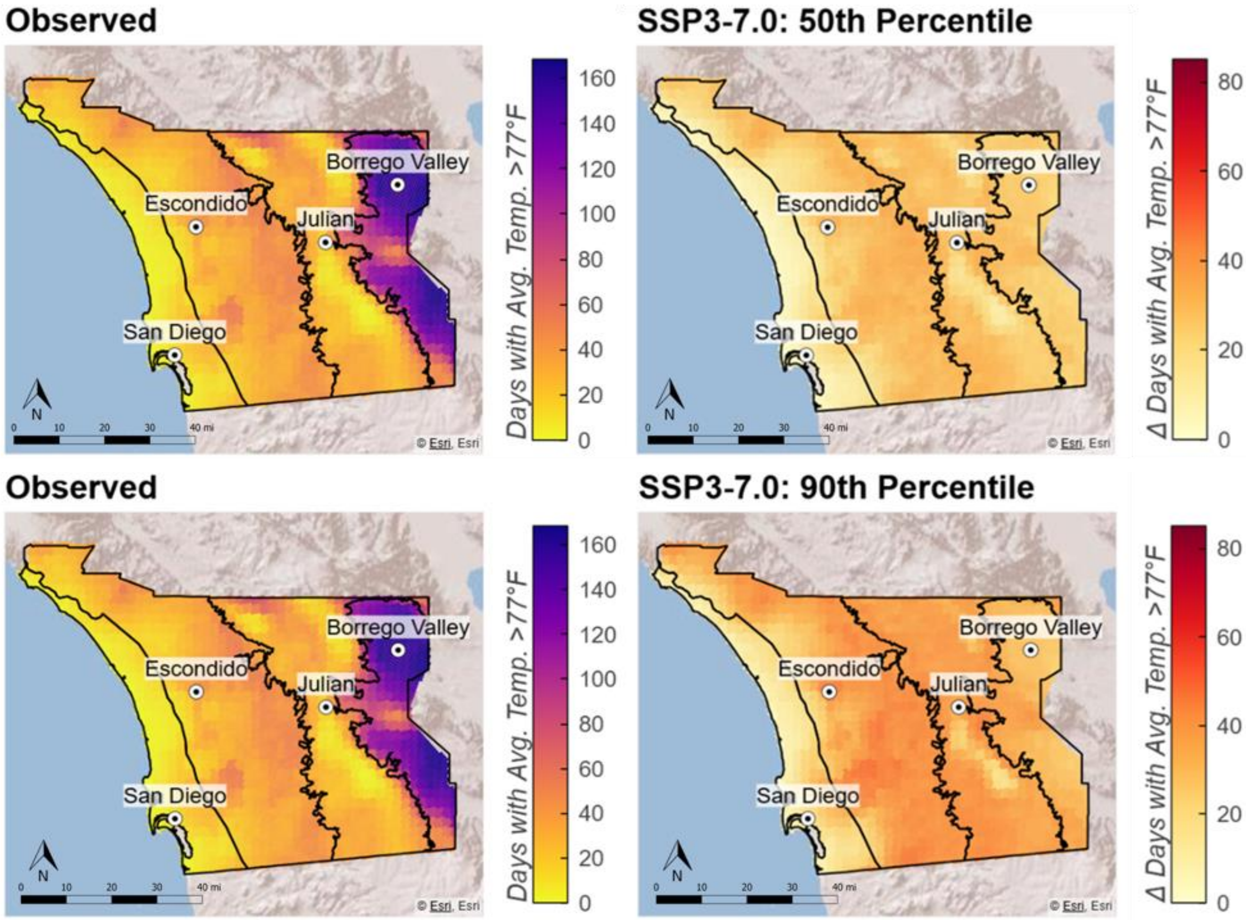


Figure 9 shows the observed and projected change by 2050 in the annual number of days with daily maximum temperature above 100.4°F under the reference SSP3-7.0 scenario. Historically, much of SDG&E's Coastal and Mountain regions have experienced near zero days with daily maximum temperature above 100.4°F, while pockets of the Inland region and much of the Desert region have experienced the most days. By 2050, increases in the number of days with daily maximum temperature above 100.4°F are projected to be highest in the Desert region and low-lying areas in the Inland and Mountain regions across all scenarios. Nearly the entire Coastal region is projected to experience no increase in the number of days with maximum temperature above 100.4°F.

Figure 9. *Baseline and projected annual days with maximum temperature above 100.4°F*
Observed baseline (1995-2014; left panels) and projected change (right panels) in the annual number of days with daily maximum temperature above 100.4°F. Projected values represent median-year (time-P50) 2050 with median-model (model-P50; upper right panel) and extreme-model (model-P90; lower right panel) views under the SSP3-7.0. scenario.

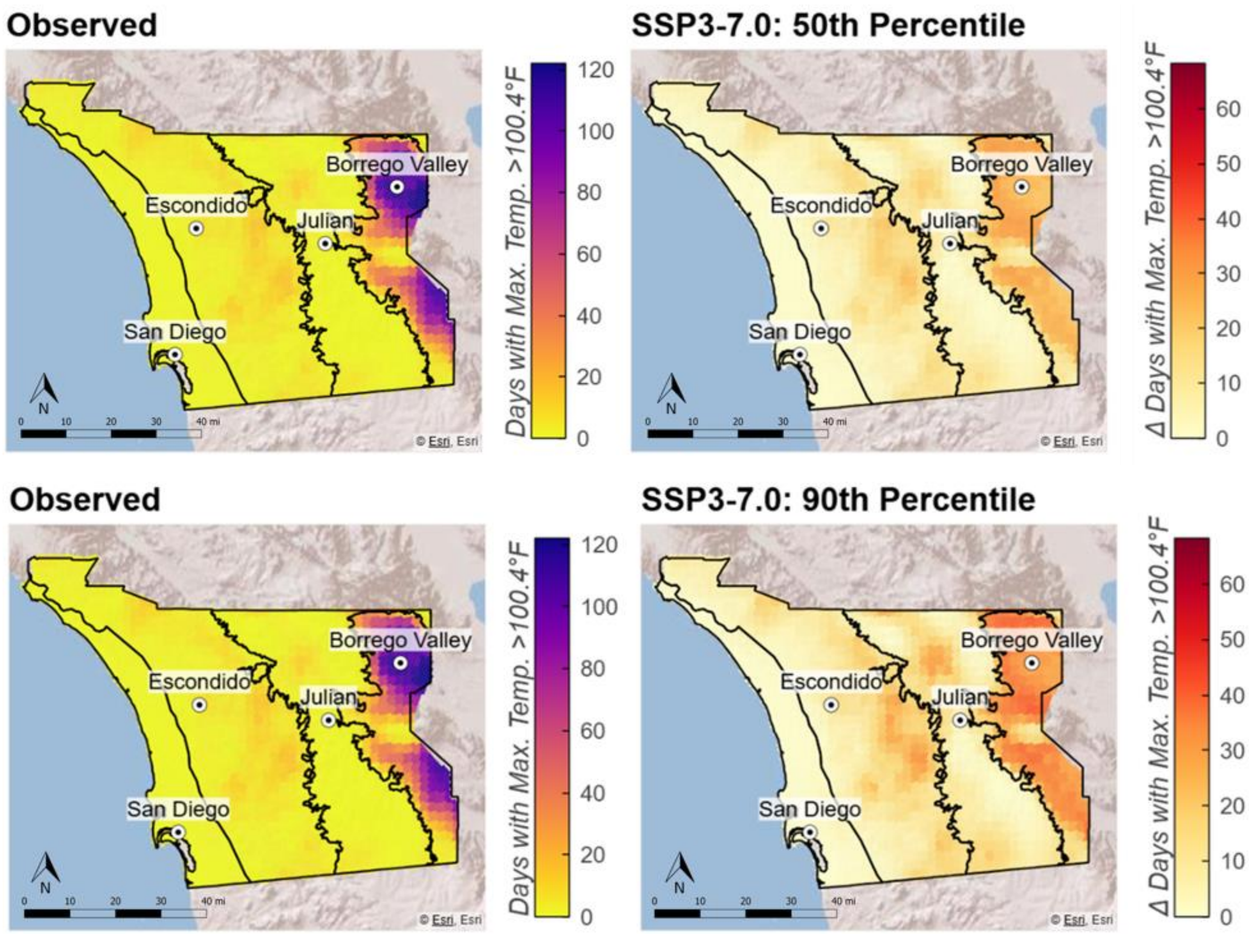
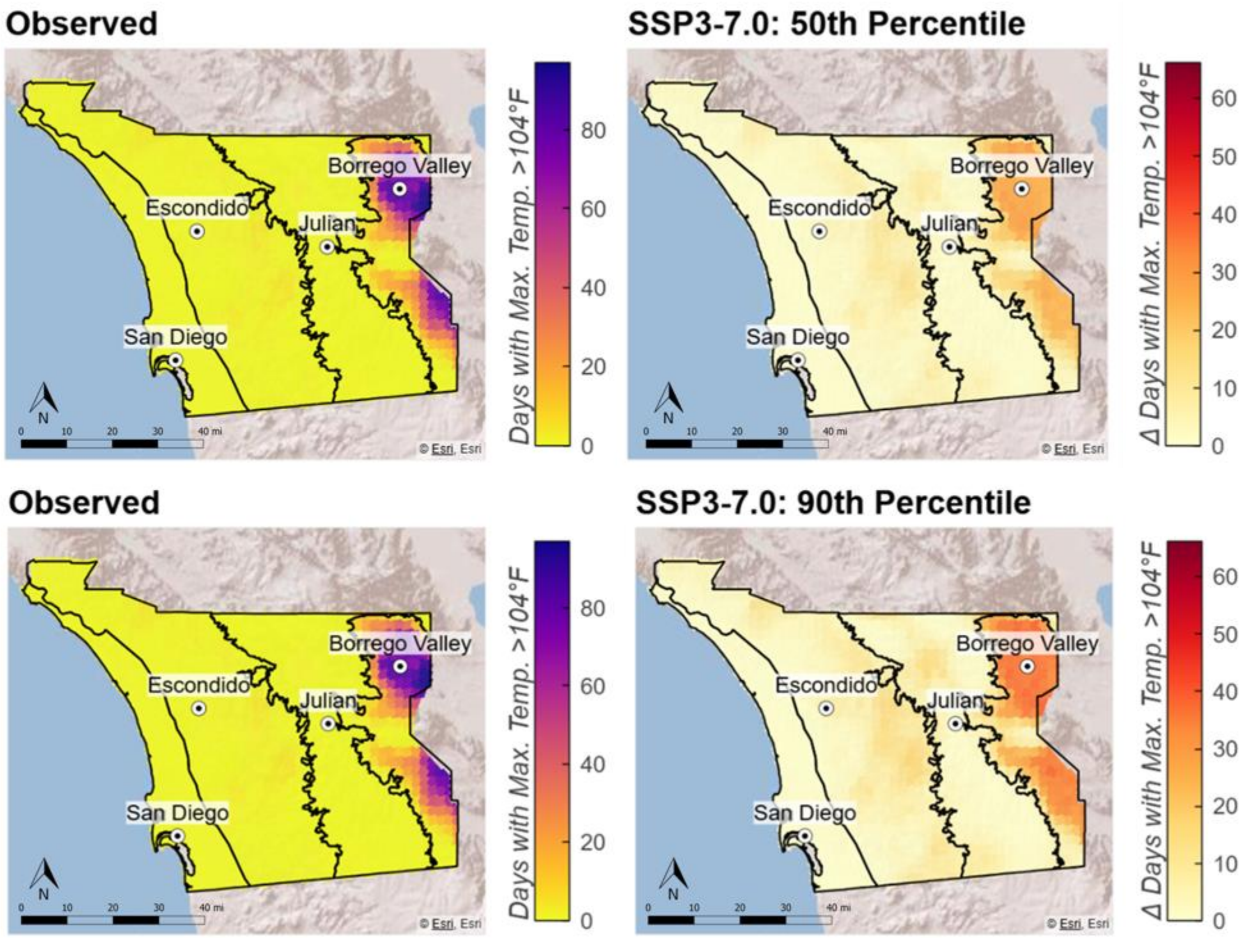


Figure 10 shows the observed and projected change by 2050 in the annual number of days with daily maximum temperature above 104°F under the reference SSP3-7.0 scenario. Historically, the majority of SDG&E's service territory has experienced around zero days per year with maximum temperature above 104°F, with the exception being pockets of the Desert region around Borrego Valley and locations in the southeast. By 2050 the largest projected increases in the number of days with maximum temperature above 104°F are within the Desert region, while low-lying portions of the Inland and Mountain region are projected to see smaller increases across all scenarios.

Figure 10. *Baseline and projected annual days with maximum temperature above 104°F*

Observed baseline (1995-2014; left panels) and projected change (right panels) in the annual number of days with daily maximum temperature above 104°F. Projected values represent median-year (time-P50) 2050 with median-model (model-P50; upper right panel) and extreme-model (model-P90; lower right panel) views under the SSP3-7.0 scenario.



Model and Scenario Uncertainty Projected Change

The ribbon plots below (Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16) highlight changes in the annual number of days above a certain temperature under different SSP scenarios for the following three temperatures: 77°F, 100.4°F, and 104°F. The ribbon plots are calculated using the model ensemble 10th through 90th percentiles (model-P10 and model-P90) to account for the full range of potential climate futures in each emissions scenario. For all three temperatures and percentiles, the number of days above the given temperature threshold is projected to increase throughout the 21st century, especially by 2070. Notably, the increase in temperature could be more pronounced, especially by late century under a high-end, SSP5-8.5 scenario. Under SSP2-4.5, increases will be less pronounced and start to level off after 2050 as mitigation measures are enforced. The uncertainty in the values for all models is represented by the shaded regions surrounding the 50th percentile line. For each variable, results are also presented for 20-year P50 projections, representing the "median" year for each 20-year projection, and P95 projections, representing a more "extreme", tail-end 95th percentile year for each 20-year projection.

Projections for all extreme heat variables tend to demonstrate a relatively low degree of uncertainty relative to other climate hazards, as models show greater agreement on warming trends in response to increases in greenhouse gases. Despite general agreement in warming trends across the service territory during the 21st century, the magnitude of the increase comes with some uncertainty based on a large spread in the model ensembles and increasing temperature projections across emissions scenarios. Lower emissions (SSP2-4.5) projections tend to project less warming relative to higher emissions scenarios (SSP3-7.0 and SSP5-8.5).

Under the SSP3-7.0 50th percentile scenario for the number of days with daily average temperature above 77°F, the projected increase from baseline is significantly higher than the baseline in all four locations, as shown in Table 10. The table below provides an overview of median-year climate projections (time-P50) (Figure 11).

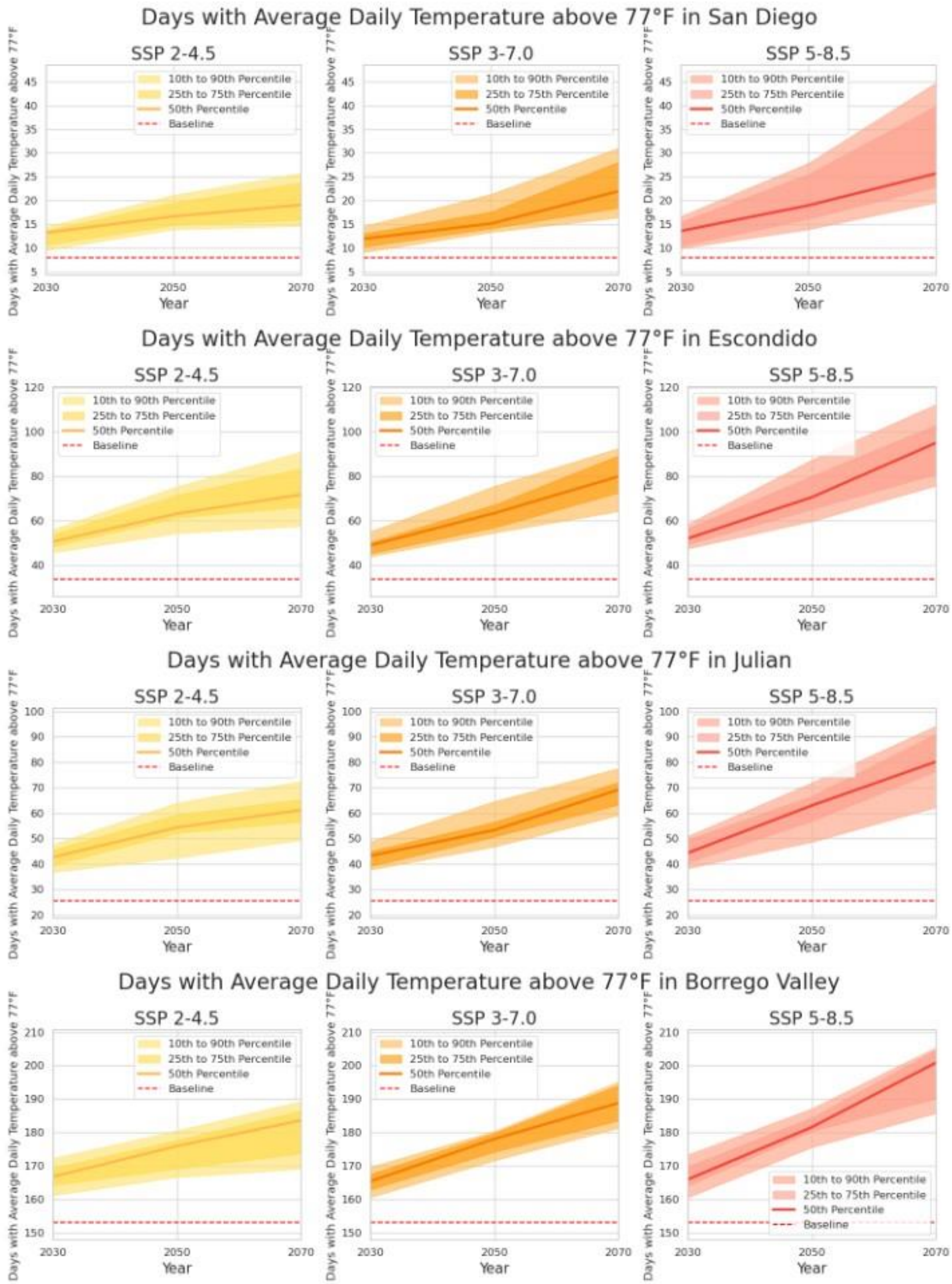
Table 10. *Projected days >77°F in San Diego County locations*

Median-year (time-P50) projections for the annual number of days with average daily temperature exceeding 77°F in San Diego, Escondido, Julian, and Borrego Valley. Projected change is relative to the 1995-2014 baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Average daily temperature above 77 °F	8 days per year	2030	4 days (2-8 days)
			2050	7 days (5-20 days)
			2070	14 days (7-37 days)
Escondido (Inland)	Average daily temperature above 77 °F	34 days per year	2030	15 days (12-24 days)
			2050	30 days (21–54 days)
			2070	47 days

				(24-79 days)
Julian (Mountain)	Average daily temperature above 77 °F	26 days per year	2030	17 days (11-25 days)
			2050	28 days (17-47 days)
			2070	44 days (24-69 days)
Borrego Valley (Desert)	Average daily temperature above 77 °F	153 days per year	2030	12 days (8-20 days)
			2050	25 days (13-34 days)
			2070	35 days (17-52 days)
* The values represent SSP3-7.0 model 50th percentile (model-P50) results with the range from SSP2-4.5 model 10th percentile (model-P10) to SSP5-8.5 model 90th percentile (model-P90) given in parentheses. All show the median-year (time-P50) projections.				

Figure 11. *Projected days >77°F in San Diego County (2030, 2050, 2070, time-P50)*
Annual number of days with average daily temperature exceeding 77 °F in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for the median-year projections (time-P50).



Climate models project the changes outlined below for extreme-year projections (time-P95) (Figure 12 and Table 11)

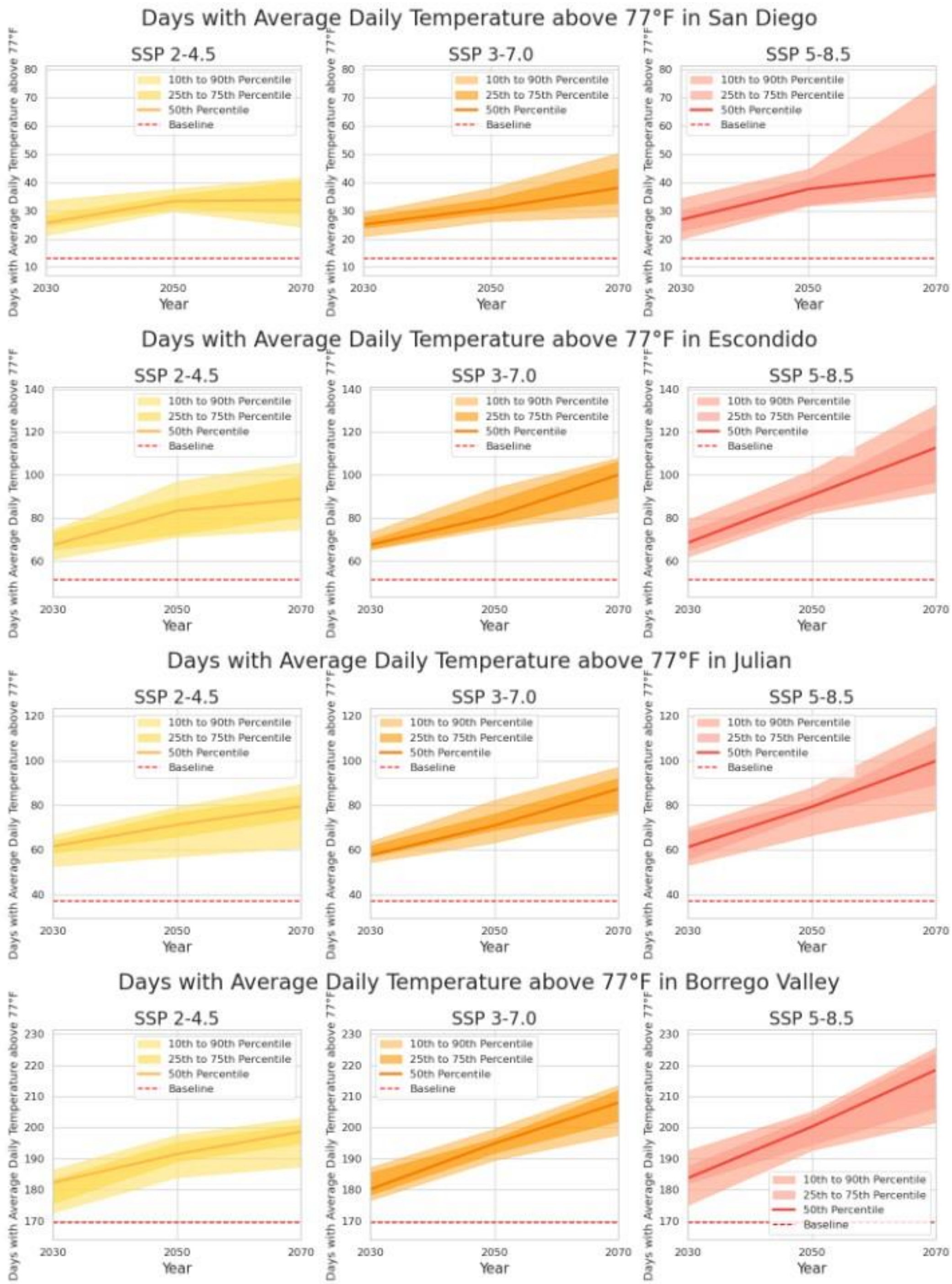
Table 11. *Extreme-Year (P95) Projected Days >77°F in San Diego County*

Projected change is relative to the 1995-2014 baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Daily average temperature above 77 °F	13 days per year	2030	12 days (8-21 days)
			2050	18 days (17-32 days)
			2070	25 days (12-62 days)
Escondido (Inland)	Daily average temperature above 77 °F	51 days per year	2030	16 days (10-28 days)
			2050	30 days (20-51 days)
			2070	49 days (23-81 days)
Julian (Mountain)	Daily average temperature above 77 °F	37 days per year	2030	21 days (5-33 days)
			2050	33.9 days (20-51 days)
			2070	50 days (24-78 days)
Borrego Valley (Desert)	Daily average temperature above 77 °F	170 days per year	2030	10 days (2-22 days)
			2050	25 days (15-36 days)
			2070	39 days (18-56 days)
* The values represent SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) given in parentheses. All show the extreme-year (time-P95) projections.				

Figure 12. *Extreme-year (P95) projected days >77°F in San Diego County locations (2030, 2050, 2070)*

Annual number of days with average daily temperature exceeding 77 °F in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for the extreme-year projections (time-P95).



As shown in Figure 13 and Table 12, under the SSP3-7.0 50th percentile scenario, Escondido, Julian and Borrego Valley are projected to see a significant increase in the number of days with maximum daily temperatures exceeding 100.4°F compared to the baseline. In contrast, San Diego is not expected to experience a significant increase, as the temperature threshold is expected to remain exceedingly rare. Figure 14 (model-P95) highlights an even greater increase in the number of days than Figure 13 (model-P50). Overall, climate models project the changes outlined below for median-year projections (time-P50) (Figure 13, Table 12).

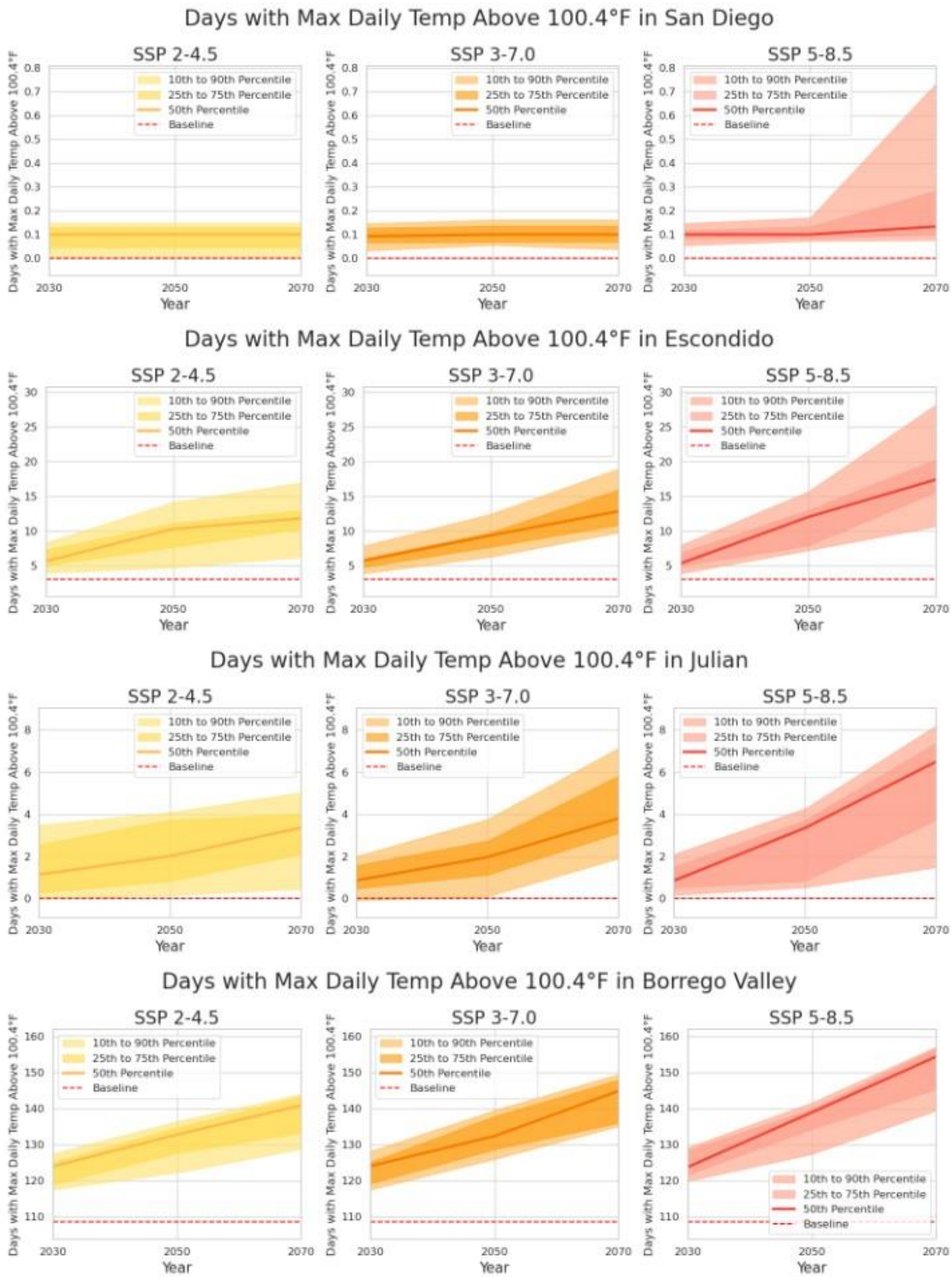
Table 12. *Overview of model projections for median-year (time-P50)*

Projected change is relative to the 1995-2014 baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Daily maximum temperature above 100.4 °F	0 days per year	2030	0 days (0–0 days)
			2050	0 days (0-0 days)
			2070	0 days (0-1 days)
Escondido (Inland)	Daily maximum temperature above 100.4 °F	3 days per year	2030	3 days (1-5 days)
			2050	6 days (2-13 days)
			2070	10 days (3-25 days)
Julian (Mountain)	Daily maximum temperature above 100.4 °F	0 day per year	2030	1 days (0 – 2 days)
			2050	2 days (0-4 days)
			2070	4 days (0-8 days)
Borrego Valley (Desert)	Daily maximum temperature above 100.4 °F	109 days per year	2030	14 days (8-20 days)
			2050	24 days (14-33 days)
			2070	37 days (20-49 days)
* The values represent SSP3-7.0 model 50th percentile (model-P50) result with the range from SSP2-4.5 model 10th percentile (model-P10) to SSP5-8.5 model 90th percentile (model-P90) given in parentheses. All show the median-year (time-P50) projections.				

Figure 13. *Median-year (P50) projected days >100.4°F in San Diego County locations (2030, 2050, 2070)*

Annual number of days with the daily maximum temperature exceeding 100.4 °F in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for median-year projections (time-P50).



Climate models project the changes outlined below for extreme-year projections (P95) (Figure 14, Table 13).

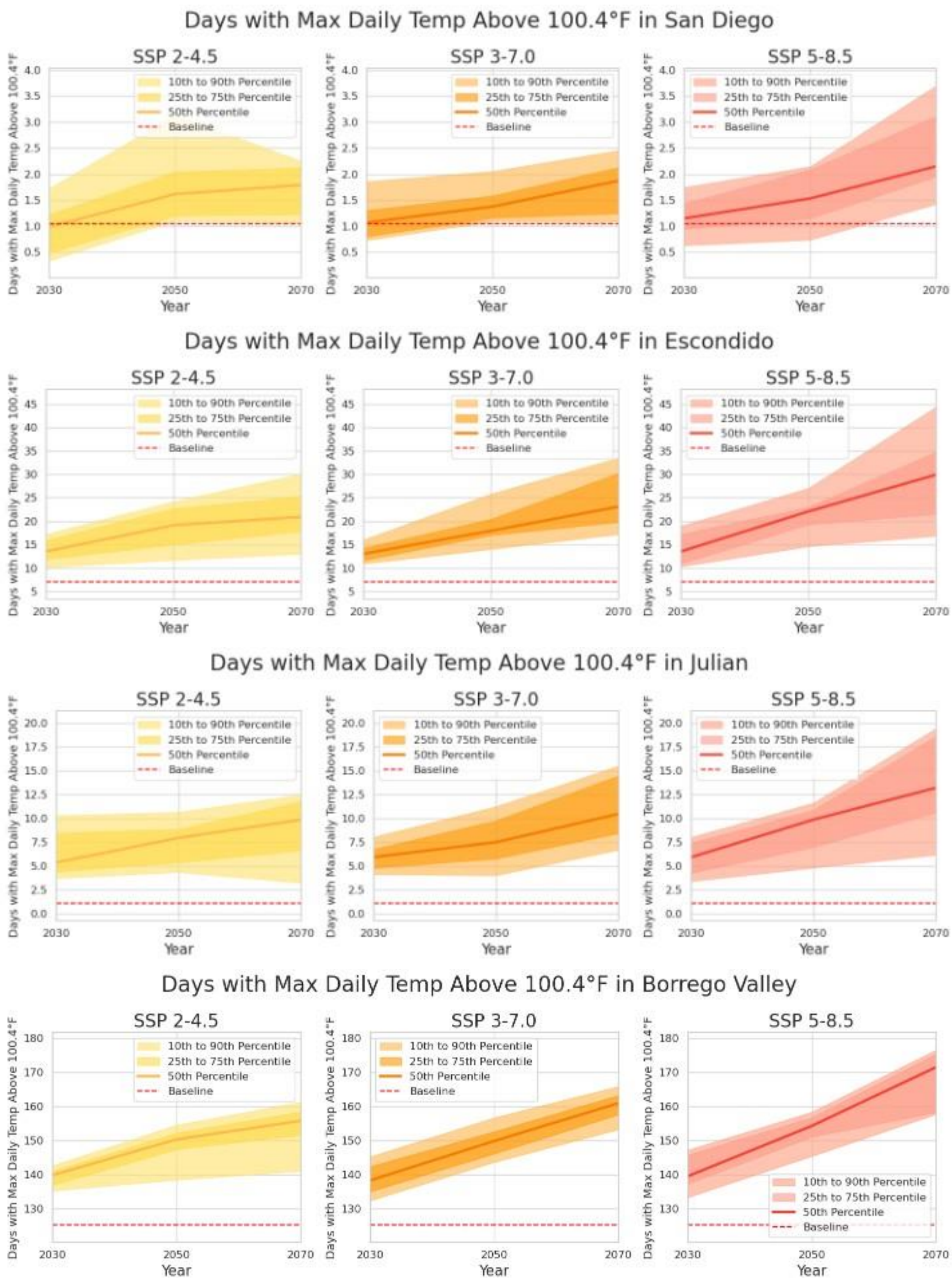
Table 13. *Overview of model projections for extreme-year (time-P95)*

Projected change is relative to the baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline
San Diego (Coastal)	Daily maximum temperature above 100.4 °F	1 day per year	2030	0 days (0-1 day)
			2050	0 days (0-1 days)
			2070	1 days (0-3 days)
Escondido (Inland)	Daily maximum temperature above 100.4 °F	7 days per year	2030	6 days (3-11 days)
			2050	11 days (5-16 days)
			2070	16 days (6-37 days)
Julian (Mountain)	Daily maximum temperature above 100.4 °F	1 day per year	2030	5 days (3-7 days)
			2050	7 days (4-11 days)
			2070	10 days (2-20 days)
Borrego Valley (Desert)	Daily maximum temperature above 100.4 °F	125 days per year	2030	13 days (10-22 days)
			2050	25 days (13-33 days)
			2070	36 days (16-51 days)
* The values represent SSP3-7.0 50th Percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) given in parentheses. All show the extreme-year (time-P95) projections.				

Figure 14. *Extreme-year (P95) projected days >100.4°F (38°C) in San Diego County locations (2030, 2050, 2070)*

Annual number of days with the daily maximum temperature exceeding 100.4 °F (38 °C) in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for extreme-year projections (time-P95).



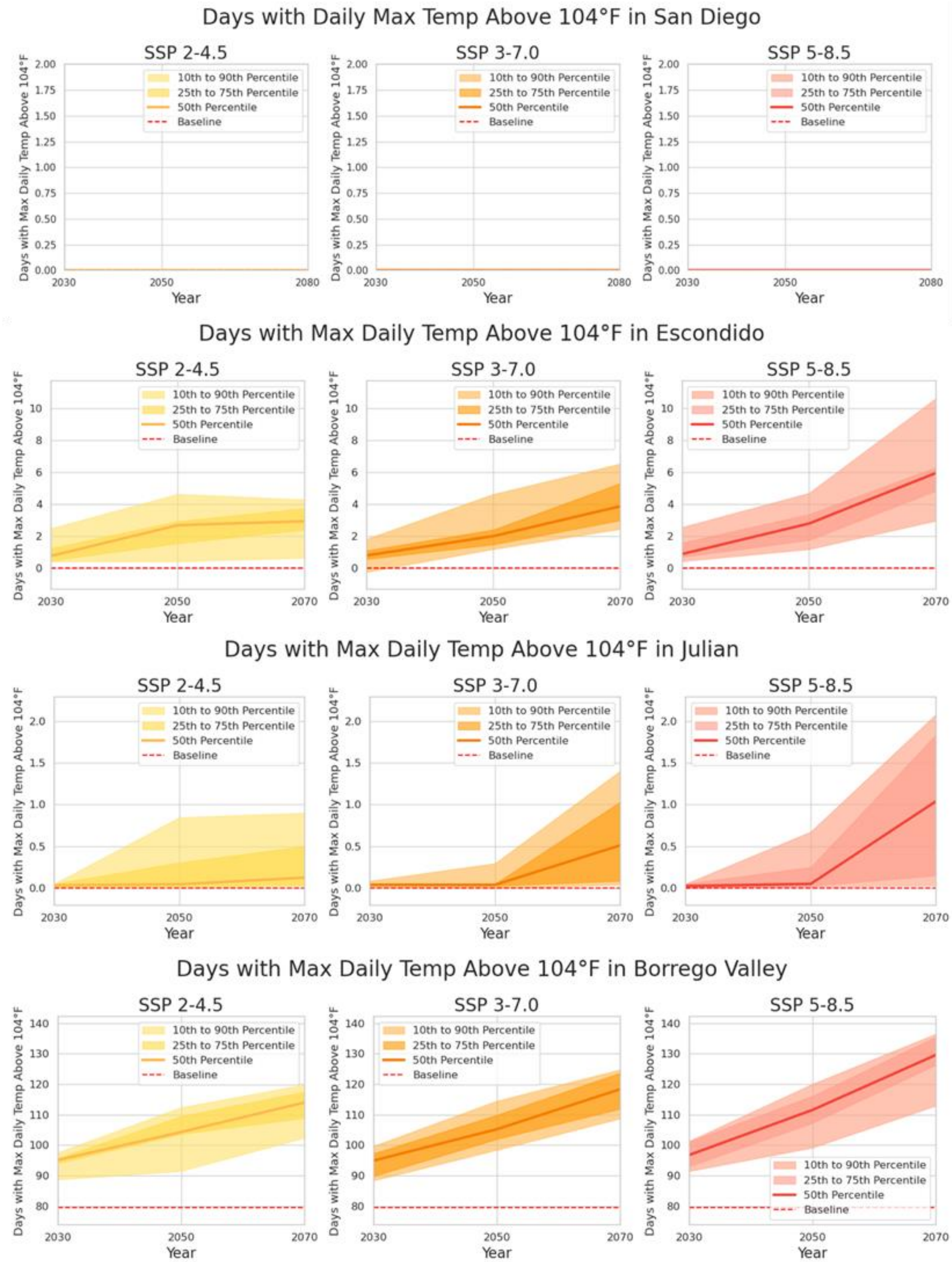
The projected number of days with maximum daily temperatures exceeding 104 °F, shows a significant increase compared to the baseline in Borrego Valley and Escondido, and minimal increases in the other locations under the SSP3-7.0 50th percentile scenario (model-P50) highlighted in Table 14. San Diego is not expected to experience any days above 104 °F under all emissions scenarios and time horizons. Figure 16 (time-P95) displays an even greater increase in the number of days than Figure 15 (time-P50). Overall, climate models project the changes outlined below for median-year projections (time-P50) (Figure 15, Table 14).

Table 14. *Overview of model projections for median-year (time-P50) Projected change is relative to the baseline*.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Daily maximum temperature above 104 °F	0 days per year	2030	0 days (0-0 days)
			2050	0 days (0-0 days)
			2070	0 days (0-0 days)
Escondido (Inland)	Daily maximum temperature above 104 °F	0 days per year	2030	1 day (0-2 days)
			2050	2 days (0-5 days)
			2070	4 days (1-11 days)
Julian (Mountain)	Daily maximum temperature above 104 °F	0 days per year	2030	0 days (0-0 days)
			2050	0 days (0-1 days)
			2070	1 days (0-2 days)
Borrego Valley (Desert)	Daily maximum temperature above 104 °F	80 days per year	2030	14 days (9-21 days)
			2050	6 days (12-41 days)
			2070	39 days (23-57 days)
* The values represent SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) given in parentheses. These use time 50th percentile (time-P50).				

Figure 15. *Median-year (P50) projected days >104°F (40°C) in San Diego County locations (2030, 2050, 2070)*

Annual number of days with the daily maximum temperature exceeding 104 °F (40 °C) in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for median-year projections (time-P50).



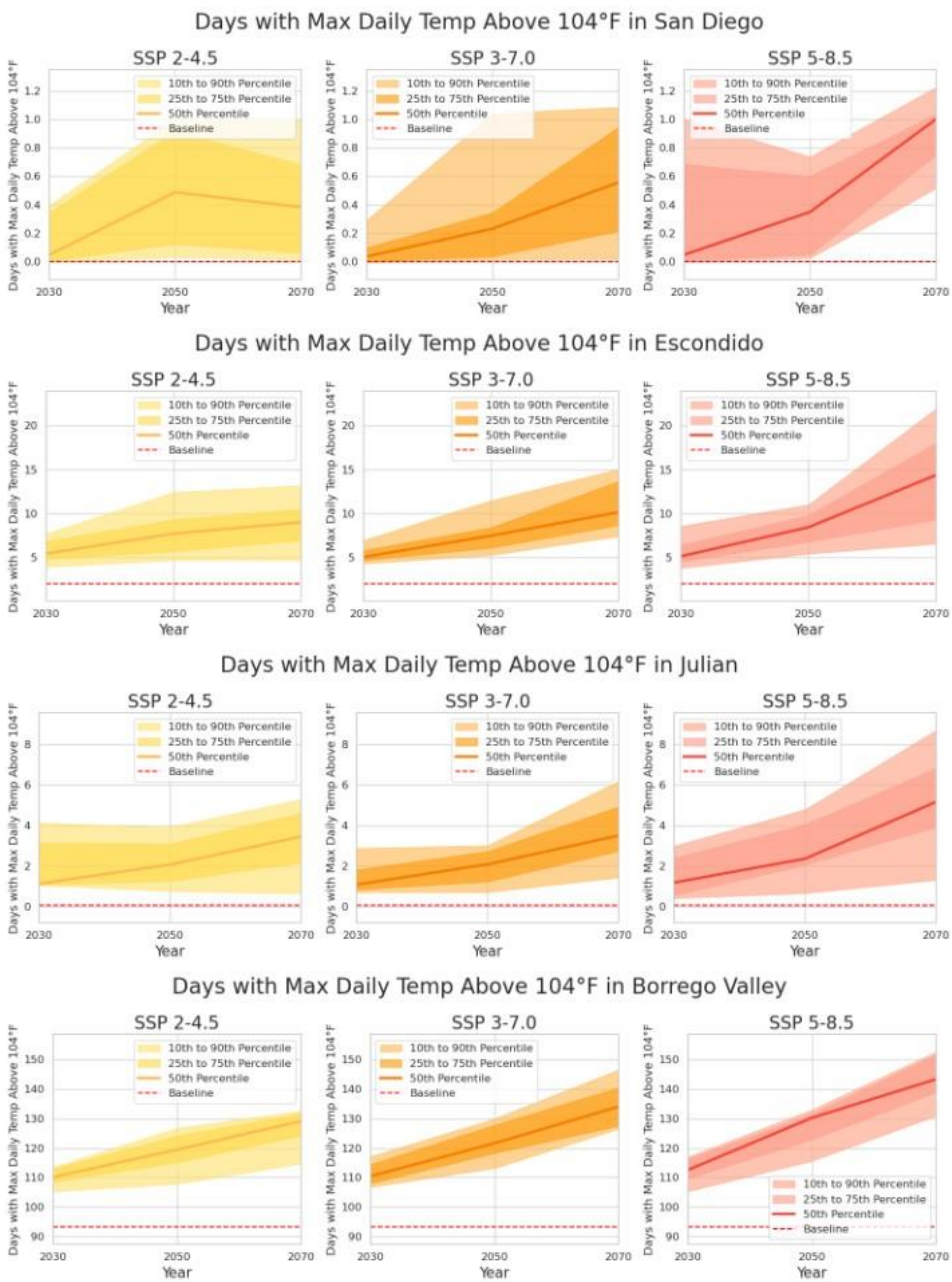
Climate models project the changes outlined below for extreme-year projections (time-P95) (Figure 16, Table 15).

Table 15. *Overview of model projections for extreme-year (time-P95)*
Projected change is relative to the baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Daily maximum temperature above 104 °F	0 days per year	2030	0 days (0-1 days)
			2050	0 days (0-1 days)
			2070	1 days (0-1 days)
Escondido (Inland)	Daily maximum temperature above 104 °F	2 days per year	2030	3 days (2-7 days)
			2050	6 days (3-9 days)
			2070	8 days (3-20 days)
Julian (Mountain)	Daily maximum temperature above 104 °F	0 days per year	2030	1 days (1-3 days)
			2050	2 days (1-5 days)
			2070	3 days (1-9 days)
Borrego Valley (Desert)	Daily maximum temperature above 104 °F	93 days per year	2030	17 days (4-21 days)
			2050	29 days (15-40 days)
			2070	41 days (22-60 days)
* The values represent SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) given in parentheses. These use time 95th percentile (time-P95).				

Figure 16. *Annual number of days with the daily maximum temperature exceeding 104 °F (40 °C) in San Diego County locations (2030, 2050, 2070)*

Projected values represent 2030, 2050, and 2070 in three SSP scenarios of SSP2-4.5, SSP3-7.0, and SSP5-8.5 for extreme-year projections (time-P95).



3.2.1.1 Exposure Scores

Exposure Approach

Exposure was scored on a 0-to-5 scale, with 0 representing no exposure and 5 representing very high exposure. The 0-to-5 scale aligns with approaches undertaken by other utility companies across the U.S. that are engaging in similar vulnerability scoring exercises. SDG&E developed temperature thresholds for exposure scoring buckets using SME-provided information using assumed ambient temperatures used to rate assets, derived from Institute of Electrical and Electronics Engineers (IEEE) standards. Table 16 outlines this information across all assets analyzed in this scoring exercise.

Table 16. *SME-provided design-rated maximum and average temperature across six SDG&E asset types*

Asset Type	Temperature Threshold*
Transmission conductors	100.4 °F (38 °C)
Substation transformers	86 °F (30 °C) average, 104 °F (40 °C) max
Substation reactors	86 °F (30 °C) average, 104 °F (40 °C) max
Distribution conductors	77 °F (25 °C) average
Distribution OH transformers	86 °F (30 °C) average, 104 °F (40 °C) max
Distribution voltage regulators	86 °F (30 °C) average, 104 °F (40 °C) max
Facilities and Communication	86 °F (30 °C) average, 104 °F (40 °C) max
*These temperature thresholds are associated with assumed ambient temperatures for equipment design ratings. Once these thresholds are exceeded, current-carrying capacity may be reduced, internal heating might reduce lifespan, or increased sag in overhead conductors may occur.	

Table 17, Table 18, and Table 19 show asset-specific exposure thresholds used to bucket temperature scores, which were developed based on climate hazard distributions and SME feedback. Each variable represents standalone counts of temperature exceedances per year. Exposure scoring for the temperature hazard uses variables based on which asset type is scored.

Table 17. *Asset-specific exposure thresholds for the annual number of days with daily maximum temperature over 104 °F (40 °C)*

Hazard	**Temperature**	
Asset Type	Substation Transformers and Reactors, Distribution OH Transformers, and Distribution Voltage Regulators	
Variable	**Annual number of days with daily maximum temperature over 104 °F (40 °C)**	
Thresholds	*Days*	*Exposure Score*
	0 days	0
	>0 – 0.5 days	1
	>0.5 – 1 days	2
	>1 – 3 days	3
	>3 – 10 days	4
	>10 days	5

Table 18. *Asset-specific exposure thresholds for the annual number of days with daily maximum temperature over 100.4 °F (38 °C)*

Hazard	**Temperature**	
Asset Type	Transmission Conductors	
Variable	**Annual number of days with daily maximum temperature over 100.4 °F (38 °C)**	
Thresholds	*Days*	*Exposure Score*
	0 days	0
	>0 – 1 days	1
	>1 – 5 days	2
	>5 – 12 days	3
	>12 – 28 days	4
	>28 days	5

Table 19. *Asset-specific exposure thresholds for the annual number of days with daily average temperature over 77 °F (25 °C)*

Hazard	**Temperature**	
Asset Type	Distribution Conductors	
Variable	**Annual number of days with daily average temperature over 77 °F (25 °C)**	
Thresholds	*Days*	*Exposure Score*
	0 days	0
	>0 – 35 days	1
	>35 – 55 days	2
	>55 – 74 days	3
	>74 – 103 days	4
	>103 days	5

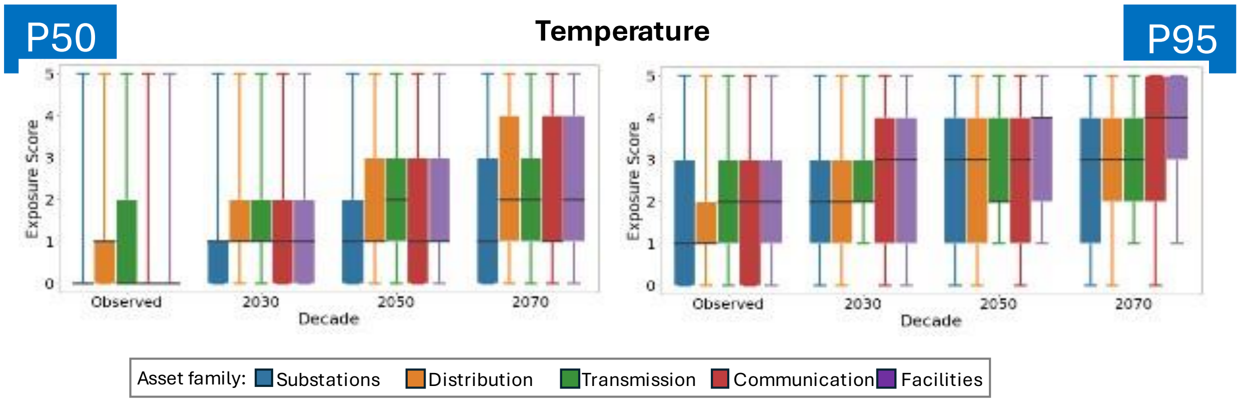
3.2.1.1.1 Exposure Summary

As temperatures warm, exposure to extreme heat is projected to increase steadily through the 21st century across the SDG&E service territory, with the greatest increase in the Inland and Mountain regions. The cooler Coastal region is projected to have the lowest exposure scores with the smallest increase, while the hotter Desert region is also projected to experience a small increase in exposure due to historically high exposure scores. Figure 17 shows boxplots for the distribution (minimum, 25th percentile, 50th percentile, 75th percentile, and maximum values) of temperature exposure scores for each asset family under the SSP3-7.0 50th percentile (model-P50) scenario and across time.

Across all asset families, temperature exposure scores are projected to increase over time. The median-year (time-P50) and median-model (model-P50) temperature exposure scores across most asset families are projected to increase from 0-1 in the observed baseline period to 1–2 by 2070. The extreme-year (time-P95) and median-model (model-P50) temperature exposure scores are projected to increase from 1-2 in the observed period to 3–4 by 2070. Under median-year (time-P50) temperature exposure scores, the communication and facilities asset families are projected to experience the greatest change in exposure magnitudes, while distribution and facilities are projected to experience the greatest change in extreme-year (time-P95) exposure magnitudes. Exposure score distributions by region are provided in Appendix II – Regional median-year (time-P50) exposure boxplots.

Figure 17. *Temperature exposure score distributions by asset family*

Temperature exposure score distributions for each asset family for the observed baseline, 2030, 2050, and 2070 for SSP3-7.0 50th percentile (model-P50) scenario. Exposure score distributions are shown for median-year and extreme-year (time-P50 and time-P95) and median-model (model-P50) for each time horizon.

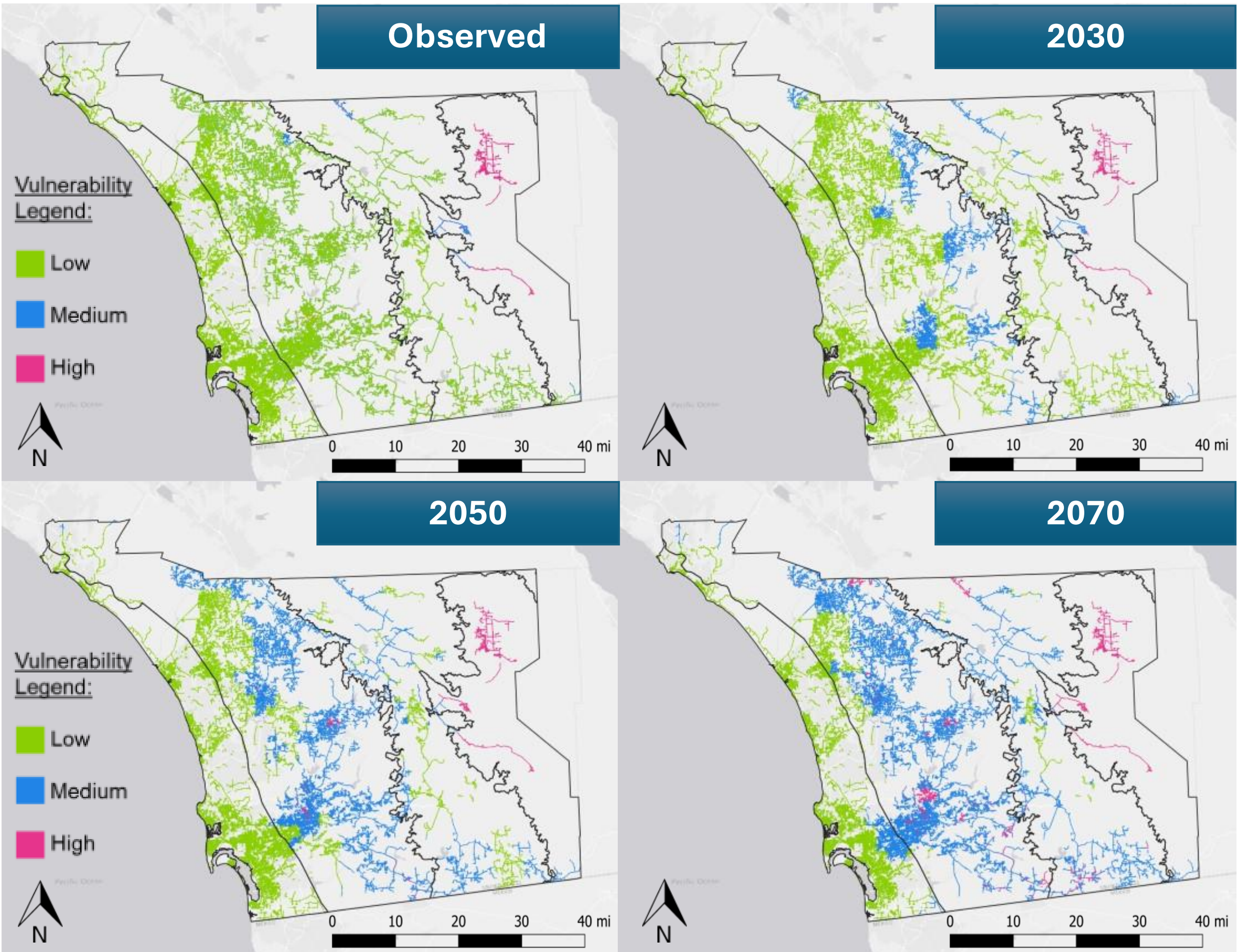


3.2.1.2 Sensitivity and Vulnerability Scores

In the observed baseline period, extreme heat already poses a significant threat to many SDG&E assets, with facilities (high), distribution, and substation asset families (medium) already experiencing higher vulnerability. By 2070, SDG&E is projected to experience changes in exposure to extreme heat throughout the service territory, resulting in notable shifts for all electrical asset classes toward high vulnerability (with the exception of communication assets, which increases to medium). One example is shown in Figure 18, which illustrate the shift in vulnerability for overhead conductors to extreme heat in the observed baseline of 1995-2014, 2030, 2050, and 2070, with the greatest regions of vulnerability being the desert, mountain, and inland regions. Detailed results are presented by asset family in the following subsections.

Figure 18. *Overhead conductor vulnerability to extreme heat*

Map of overhead conductors & vulnerability to extreme heat in the 1995-2014 baseline, 2030, 2050, and 2070 for the median-year (time-P50) and median-model (model-P50) view under the SSP3-7.0 scenario.



3.2.1.2.1 Transmission

Sensitivity Scores

Out of all transmission components in scope (i.e., transmission equipment outside of substation fences), overhead line segments are the most sensitive to extreme heat. High ambient temperature conditions reduce the ability of conductors to dissipate heat and are frequently associated with higher demand because of customers' use of air conditioning and increase in generation demand. Transmission conductors could require derating to prevent sag beyond design standards and loss of material strength. Underground line sub segments (cables) are less sensitive to extreme heat, given that ground temperatures are relatively stable. Overhead transmission structures, including poles and towers, are not considered sensitive to extreme temperatures and heat waves. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for extreme heat in Section 3.1.1, the resulting vulnerability scores are presented in Table 20. Most transmission overhead line assets (88%) and 100% of the transmission underground line assets and overhead structures have low vulnerability to extreme heat in the observed baseline period. While this remains true for transmission underground lines and overhead structures across all time horizons, the vulnerability of transmission overhead line assets changes significantly over time.

For instance, under the SSP3-7.0 50th percentile (model-P50) and median-year (time-P50) view, which is more conservative, 88% of transmission overhead line assets have a low vulnerability in the baseline period. This percentage is projected to fall to 76% in 2030, 66% in 2050, and 58% in 2070. At the same time, the percentage of transmission overhead line assets with high vulnerability is expected to jump from 6% in the baseline to 10% in 2030, 18% in 2050, and 26% in 2070. Under the SSP3-7.0 95th percentile view, this trend is further exacerbated. While the percentage of assets with low vulnerability is projected to drop from 67% in the baseline down to 54% in 2030, 48% in 2050, and 41% by 2070, the percentage of those with high vulnerability is projected to increase from 9% in the baseline to 25% in 2030 and 33% in 2050, ultimately reaching 40% in 2070.

Table 20. *Transmission assets and projected vulnerability to extreme heat*

Transmission assets and projected vulnerability to extreme heat (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, Model-P50)		
	Low	Medium	High	Low	Medium	High
Transmission Asset Vulnerability						
	Transmission Overhead Line					
Baseline	88%	6%	6%	67%	24%	9%
2030	76%	15%	10%	54%	21%	25%
2050	66%	16%	18%	48%	18%	33%

2070	58%	17%	26%	41%	19%	40%
	Transmission Underground Line					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Structures (Transmission)					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.1.2.2 Distribution

Sensitivity Scores

Distribution scope includes equipment outside of a substation fence, such as primary overhead conductors, overhead transformers, pad-mounted transformers, and subsurface transformers, which are all highly sensitive to extreme heat. High ambient temperature conditions and extreme temperatures reduce transformer capacity and the ability of conductors to dissipate heat, and they are frequently associated with higher demand due to customers' use of air conditioning. Additionally, the increasing frequency, severity, and duration of heat waves have the potential to accelerate distribution asset aging. Pole-mounted capacitors are also found to be moderately sensitive to extreme heat due to high temperatures potentially resulting in accelerated aging and risk of failure despite design ambient temperatures being typically around 131°F (55°C). Both primary conductors and dynamic protective devices (fault interrupters, reclosers, auto-throwovers, switches, fuses) have low sensitivity to extreme heat. In the case of the former, while ground temperatures are relatively stable, prolonged conditions of high load and high temperatures like those that occur during heat waves can result in the ground surrounding underground cables accumulating heat, preventing overnight cooling, and exacerbating thermal runaway conditions. As for the latter, the design ambient temperature of protective devices can range from 104°F (40°C) to 131°F (55°C), but high temperatures may still result in accelerated aging and risk of failure. Finally, poles are not found to be sensitive to extreme temperatures and heat waves. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for extreme heat in Section 3.1.1, the resulting vulnerability scores are presented in Table 21 Most distribution assets have low vulnerability to extreme heat, but only overhead structure assets remain largely unaffected over time. For example, 100% of overhead structure assets are projected to have a low vulnerability to extreme heat across all time horizons and both median-year and extreme-year (time-P50 and time-P95) views of the SSP3-7.0 median-model (model-P50) scenario.

For all other asset types, the percentage of assets with low vulnerability decreases over time and that of assets with medium to high vulnerability increases. For instance, while 100% of primary underground conductor assets have low vulnerability in the baseline period to extreme heat under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) view, that percentage remains at 100% in 2030 but drops down to 98% in 2050 and 95% in 2070. Dynamic protection devices follow a similar path, with 100% having low vulnerability to extreme heat in the baseline but dropping to 97% in 2030, 91% in 2050, and 83% in 2070. Under the SSP3-7.0 extreme-year (time-P95) view, the projected percentage of assets with low vulnerability in 2030, 2050, and 2070 is expected to be 98%, 95%, and 90% respectively for primary underground conductors and 81%, 71%, and 67% for dynamic protection devices. Interestingly, for these asset types, no asset is expected to show high vulnerability to extreme heat, regardless of the time horizon or the scenario adopted.

On the contrary, overhead transformers have the largest proportion of expected high vulnerability assets to extreme heat by 2070 across both percentile views, with the percentage of assets rising from 2% in the baseline, to 12% in 2030, 24% in 2050, and 41% in 2070 under the SSP3-7.0 median-year (time-P50) view and from 24% in the baseline to 45% in 2030, 58% in 2050, and 65% in 2070 under the SSP3-7.0 extreme-year (time-P95) view.

Table 21. *Distribution assets and projected vulnerability to extreme heat*

Distribution assets and projected vulnerability to extreme heat (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Distribution						
	Overhead Structures (Distribution)					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Primary Overhead Conductor					
Baseline	98%	1%	1%	85%	14%	1%
2030	84%	15%	1%	51%	46%	3%
2050	61%	37%	3%	37%	56%	7%
2070	42%	53%	6%	28%	47%	25%
	Primary Underground Conductor					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	98%	3%	0%
2050	98%	2%	0%	95%	5%	0%
2070	95%	5%	0%	90%	10%	0%
	Overhead Transformer					
Baseline	89%	9%	2%	43%	34%	24%
2030	69%	20%	12%	31%	25%	45%
2050	54%	22%	24%	24%	18%	58%
2070	43%	16%	41%	20%	15%	65%
	Pad-mounted Transformer					
Baseline	96%	3%	0%	61%	23%	16%
2030	84%	12%	4%	52%	23%	25%
2050	74%	14%	13%	42%	22%	36%

2070	65%	13%	22%	34%	25%	42%
	Subsurface Transformer					
Baseline	98%	2%	1%	82%	8%	10%
2030	91%	6%	2%	80%	8%	12%
2050	86%	7%	7%	75%	9%	16%
2070	84%	6%	10%	69%	13%	18%
	Voltage Regulator					
Baseline	84%	12%	4%	24%	70%	6%
2030	53%	43%	4%	11%	73%	17%
2050	32%	59%	9%	6%	58%	36%
2070	17%	65%	19%	5%	41%	54%
	Dynamic Protection Devices					
Baseline	100%	1%	0%	88%	12%	0%
2030	97%	4%	0%	81%	19%	0%
2050	91%	9%	0%	71%	29%	0%
2070	83%	17%	0%	67%	33%	0%
	Pad-mounted Switches					
Baseline	99%	1%	0%	74%	18%	9%
2030	91%	7%	2%	61%	25%	14%
2050	85%	8%	7%	49%	26%	25%
2070	76%	12%	12%	38%	32%	30%
	Underground Switches					
Baseline	99%	1%	0%	80%	13%	8%
2030	94%	5%	1%	73%	18%	9%
2050	90%	7%	3%	64%	19%	17%
2070	83%	8%	8%	55%	25%	21%
	Overhead Switches					
Baseline	93%	7%	1%	52%	47%	1%
2030	75%	24%	1%	42%	51%	7%
2050	63%	34%	4%	35%	49%	16%
2070	54%	39%	7%	28%	44%	29%
	Distribution Capacitors					
Baseline	95%	4%	0%	60%	39%	1%
2030	82%	17%	0%	51%	45%	4%

2050	74%	24%	2%	42%	47%	11%
2070	65%	30%	4%	35%	47%	18%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.1.2.3 Substations

Sensitivity Scores

Voltage regulators are highly sensitive to extreme heat. High temperatures reduce regulator capacity, and the projected increase in the frequency, severity, and duration of heat waves has the potential to accelerate aging, although it is not expected to result in asset failure. To a lesser extent, substation transformer and reactor assets are found to have moderate sensitivity to extreme heat. For the former, extreme temperatures reduce transformer capacity and may require load relief actions when coupled with high loads, although SDG&E typically does not load transformers to the maximum name plate. For the latter, shunt reactors, that are typically rated for a specific ambient temperature, cannot be offloaded, so temperatures above design thresholds may accelerate material aging but it is not expected to result in failure.

For protection control devices, circuit breaker, switchgear, and capacitors bank assets, sensitivity to extreme heat is low. For substation protection and control assets, while high temperatures may result in accelerated aging and cause a risk of failure, most assets of this type are in a control shelter with climate control which reduces asset sensitivity.

For circuit breakers and switchgears, extreme heat can impede the dissipation of heat, causing circuit breakers to overheat and leading to degraded insulation and a higher risk of failure. With respect to capacitor banks, extreme heat can cause overheating, leading to reduced efficiency, shorter lifespans, and the potential failure of internal components. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for extreme heat in Section 3.1.1, the resulting vulnerability scores are presented in Table 22. The majority of substation transformer, substation voltage regulator, substation reactor, circuit breaker, switchgear, and capacitor bank assets have low vulnerability in the baseline to extreme heat under both SSP3-7.0 median-model (model-P50) and median-year and extreme-year (time-P50 and time-P95) views.

In the case of circuit breakers, switchgears, and capacitor banks, while the percentage of assets with medium vulnerability will increase over time, no asset is expected to reach high vulnerability to extreme heat. On the contrary, while 84% of substation voltage regulator assets have low vulnerability in the baseline to extreme heat under SSP3-7.0 median-year (time-P50) view, that percentage drops to 73% in 2030, 65% in 2050, and 62% by 2070. The corresponding percentage of substation voltage regulator assets with high vulnerability to extreme heat under this scenario is projected to reach 5%, 14%, and 19% in 2030, 2050, and 2070 respectively.

Table 22. *Substation assets and projected vulnerability to extreme heat*

Substation assets and projected vulnerability to extreme heat (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Substation						
	Substation Transformer					
Baseline	91%	6%	3%	80%	17%	3%
2030	89%	8%	3%	73%	24%	3%
2050	85%	12%	3%	60%	37%	3%
2070	75%	23%	3%	53%	44%	4%
	Substation Voltage Regulator					
Baseline	84%	11%	5%	65%	30%	5%
2030	73%	22%	5%	57%	24%	19%
2050	65%	22%	14%	38%	38%	24%
2070	62%	19%	19%	27%	41%	32%
	Substation Reactor					
Baseline	99%	2%	0%	91%	9%	0%
2030	97%	3%	0%	82%	18%	0%
2050	91%	9%	0%	65%	35%	0%
2070	84%	17%	0%	55%	45%	1%
	Substation DPD					

Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Circuit Breakers					
Baseline	95%	5%	0%	91%	9%	0%
2030	94%	6%	0%	89%	11%	0%
2050	93%	7%	0%	83%	17%	0%
2070	89%	11%	0%	80%	20%	0%
	Switchgear					
Baseline	95%	5%	0%	91%	9%	0%
2030	94%	6%	0%	89%	11%	0%
2050	93%	7%	0%	83%	17%	0%
2070	89%	11%	0%	80%	20%	0%
	Capacitor Banks					
Baseline	95%	5%	0%	91%	9%	0%
2030	94%	6%	0%	89%	11%	0%
2050	93%	7%	0%	83%	17%	0%
2070	89%	11%	0%	80%	20%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.1.2.4 Communication

Sensitivity Scores

Both antenna and Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU) assets are moderately sensitive to extreme heat. In both cases, it is a function of overheating, which may damage internal electronic components, reduce the operational lifespan of antennas, and impair their performance. It can lead to unreliable data transmission and increased maintenance risk. At the same time, overhead fiber and copper assets, underground fiber and copper assets, and communication poles are not considered sensitive to extreme heat.

For overhead fiber and copper assets, the outer sheaths of aerial fiber and copper cables are typically designed for exposure to temperatures of around 158°F (70°C), meaning those cables are not sensitive to extreme heat. And, unlike power cables, communication cables do not produce substantial heat in operation. For underground fiber and underground copper, it is important to note that ground temperatures in the U.S. are typically no greater than 95°F (35°C). The outer sheaths of direct buried copper communications cables are typically designed for exposure to temperatures of around 158°F (70°C), thus such cables are not sensitive to extreme heat. Moreover, unlike power cables, communication cables do not produce substantial heat in operation. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for extreme heat in Section 3.1.1, the resulting vulnerability scores are presented in Table 23. Most communication assets have low vulnerability to extreme heat, with 100% of (both overhead and underground) fiber and copper assets, as well as overhead structures (communication), having low vulnerability to extreme heat across all time periods.

However, while 92% of SCADA RTU assets are considered in the observed baseline period to have a low vulnerability to extreme heat under SSP3-7.0 median-model (model-P50) and median-year (time-P50) view, that percentage drops to 76% in 2030, 64% in 2050, and 55% by 2070, meaning a larger proportion of assets will become vulnerable in the future. At the same time, the percentage of those assets considered to have high vulnerability to extreme heat rises from 1% in the baseline and 2030, to 4% in 2050 and 8% in 2070. This is even starker for the SSP3-7.0 extreme-year (time-P95) view, with the proportion of SCADA RTU assets with low vulnerability dropping from 55% in the baseline, to 43% in 2030, 35% in 2050, and 28% by 2070, while that of assets with high vulnerability to extreme heat rises from 2%, to 8%, 17%, and 27% over the same time periods.

Table 23. *Communication assets and projected vulnerability to extreme heat*

Communication assets and projected vulnerability to extreme heat (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Communication						
	Overhead Fiber					
Baseline	100%	0%	0%	100%	0%	0%

2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Copper					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Underground Fiber					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Underground Copper					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Structures (Communication)					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	SCADA RTU					
Baseline	92%	6%	1%	55%	43%	2%
2030	76%	23%	1%	43%	50%	8%
2050	64%	32%	4%	35%	48%	17%
2070	55%	37%	8%	28%	45%	27%
	Antennas					
Baseline	93%	6%	1%	56%	43%	1%
2030	78%	21%	1%	44%	49%	7%

2050	67%	30%	3%	35%	49%	16%
2070	58%	34%	7%	28%	48%	24%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.1.2.5 Facilities

Sensitivity Scores

Communication centers are found to be moderately sensitive to extreme heat. The equipment within those centers requires extensive temperature control to prevent overheating, and it is typically found in unmanned climate-controlled enclosures. As a result, should the Heating Ventilation and Air Conditioning (HVAC) system be compromised, the equipment would be impacted by high temperatures.

All other asset types, namely office buildings, construction and operations centers, and asset critical facilities, have a low sensitivity to extreme heat. For office buildings (headquarters, call centers, training centers, warehouses), both maintenance and upgrading cooling options—such as HVAC systems, insulation, and window blinds—can be easily addressed through regular building maintenance. Construction and operation centers (including battery storage facilities and microgrids) are typically housed indoors, so their sensitivity to extreme heat is the same as office buildings.

Finally, for asset critical facilities (including data centers and mission control grid operation centers), the specific equipment requires extensive temperature control to prevent overheating, but SDG&E has invested in hardening asset critical facilities such that the sensitivity to extreme heat is low. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for extreme heat in Section 3.1.1, the resulting vulnerability scores are presented in Table 24, all asset critical facilities have low vulnerability to extreme heat across all time horizons and scenarios. In the case of office buildings and construction and operation centers, while 100% of assets have low vulnerability in the baseline to extreme heat under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) view, this changes with time.

For example, the percentage of office building assets with low vulnerability to extreme heat drops from 100% in the baseline and 2030 to 75% in 2050 and 2070. Similarly, the proportion of construction and operation center assets with low vulnerability to extreme heat falls from

100% in the baseline down to 91% in 2030 and 2050 and to 73% in 2070. At the same time, the proportion of those assets with medium vulnerability to extreme heat increases across time horizons. This is starker under the SSP3-7.0 extreme-year (time-P95) view, as the share of office building assets with medium vulnerability to extreme heat rises from 25% in the baseline and 2030 to 63% in 2050 and 2070. At the same time, the proportion of construction and operation center assets with medium vulnerability to extreme heat grows from 18% in the baseline to 27% in 2030, 36% in 2050, and 46% in 2070 under the same view. Still, it is notable that throughout time periods and scenarios, no asset under these asset types is expected to reach high vulnerability to extreme heat.

On the contrary, communication centers exhibit a significant proportion of assets with high vulnerability. Under the SSP3-7.0 median-year (time-P50) view, 11% of those assets have high vulnerability to extreme heat in the baseline, a number which remains stable across 2030, 2050, and 2070. Under the SSP3-7.0 extreme-year (time-P95) view, the initial 11% of assets are with high vulnerability both in the observed baseline and 2030, growing to 18% by 2050 and 30% by 2070. 100% of asset critical facilities are projected to remain with low vulnerability across all time horizons.

Table 24. *Facility assets and projected vulnerability to extreme heat*

Facility assets and projected vulnerability to extreme heat (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Facilities						
	Office Buildings					
Baseline	100%	0%	0%	75%	25%	0%
2030	100%	0%	0%	75%	25%	0%
2050	75%	25%	0%	38%	63%	0%
2070	75%	25%	0%	38%	63%	0%
	Construction and Operation Centers					
Baseline	100%	0%	0%	82%	18%	0%
2030	91%	9%	0%	73%	27%	0%
2050	91%	9%	0%	64%	36%	0%

2070	73%	27%	0%	55%	46%	0%
	Communication Centers					
Baseline	88%	2%	11%	61%	29%	11%
2030	75%	14%	11%	32%	57%	11%
2050	64%	25%	11%	27%	55%	18%
2070	43%	46%	11%	14%	55%	30%
	Asset Critical Facilities					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.1.2.6 **Gas**

Vulnerability analysis to extreme heat was not performed for gas assets because they are not sensitive to the hazard.

3.2.1.3 Vulnerability of Operations & Services

SDG&E characterized the vulnerability of its operations and services to extreme heat by considering the exposure of SDG&E's service territory to the hazard and the sensitivity of each operation and service.

Extreme heat is projected to increase across the SDG&E service territory in the future. For example, the number of days with daily maximum temperature over 104 °F (40 °C), could increase by as much as 60 days by 2070 in certain parts of the service territory. The heightened exposure of the service territory to extreme heat is likely to impact SDG&E's operations and services in direct and indirect ways. It could, for instance, directly impact vegetation management as it becomes unsafe for workers to perform the necessary targeted ground-to-sky trimming activities during extreme heat events. At the same time, the reduced operational efficiency of assets and their accelerated failure rate would indirectly impact SDG&E's operations and services in calling for strengthened reliability planning. In addition, where SCADA equipment is not available, asset management could be affected as workers need to take manual load ratings on transformers to ensure acceptable ratings during heat days.

To understand the sensitivity of operations and services to extreme heat, SDG&E characterized their current operational maturity to this hazard.[43] The output of the operational maturity scoring is presented in
Table 25.

Table 25. *Operational maturity scores of SDG&E's operations and services for extreme heat*

	Historical & projected extreme weather	Investment in new technology	Performance metrics	Stakeholder engagement	Personnel Training	TOTAL (out of 5)
Asset Management	0.5	0.5	0.5	0.5	0.5	**2.5**
Vegetation Management	0.5	0.5	0.5	0.5	1	**3**
Emergency Response	0.5	1	0.5	0.5	1	**3.5**
Comms.	0.5	0.5	0.5	0.5	0.5	**2.5**
Safety Operations	0.5	1	0.5	0.5	1	**3.5**
Reliability Planning	0.5	1	1	0.5	1	**4**
Supply Management	0.5	0.5	0.5	0.5	0.5	**2.5**

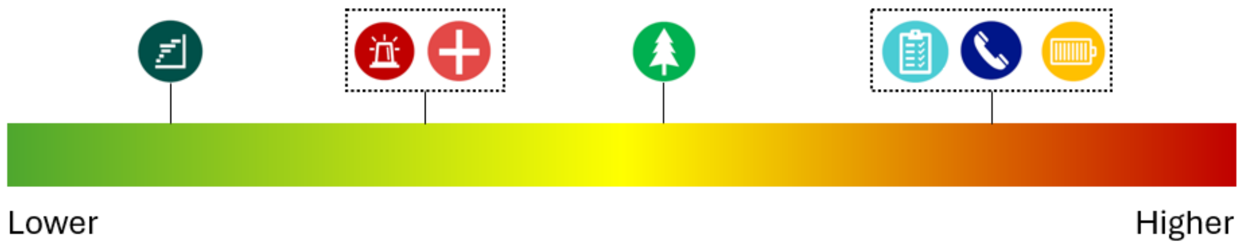
Based on the projected high exposure of the SDG&E's service territory to extreme heat and on the operational maturity scores obtained, asset management, communications, and supply management have the highest projected operational vulnerability to the hazard. In each case, resilience practices are not currently fully incorporated.

Vegetation management appears to be in better standing, through frequent personnel training in the preparation of extreme heat events. A stronger integration of this resilience practice makes vegetation management less sensitive to extreme heat.

Emergency response and safety operations currently incorporate personnel training and investments in new technologies and innovations to deliver better or more efficient performance, making them less sensitive and less vulnerable to extreme heat.

Finally, reliability planning is least vulnerable across all operations and services by tracking performance under extreme heat conditions, in addition to the other resilience practices mentioned above. These results are summarized in Figure 19, below.

Figure 19. *Graphical representation of the vulnerability of SDG&E's operations and services to extreme heat*



3.2.2 Wildfire

Hazard Characterization

In 2024, there were over 8,000 wildfires, resulting in more than 1 million acres of burned land in the state of California.[44] Many wildfires occurred on elevated fire danger days, or days with environmental conditions that are conducive to rapid wildfire spread, which are projected to increase in frequency through 2100. The projected increase in temperature is expected to have a direct contribution to increasing wildfire risk by potentially creating more frequent and longer dry conditions that will likely lead to lower fuel moisture levels[45] and impact the magnitude, timing, and frequency of wildfires.

Variables and Methods

The following climate variables were analyzed to determine present-day and future exposure to wildfires:

- Annual number of days above the 1995-2014 historical 95th percentile Canadian Forest Fire Weather Index (hereafter referred to as FWI)
- USDA/USFS Wildfire Risk to Communities Historical Wildfire Likelihood

The variables listed above were calculated using FWI and historical burn probability data. The data used to determine wildfire risk were obtained through the Cal-Adapt Analytics Engine AWS S3 Data Catalog and USDA/USFS Wildfire Risk to Communities Dataset. At the time of the current SDG&E CAVA filing, the CMIP6-based wildfire projections for California by University of California Merced[46] were not publicly available. Instead, SDG&E leveraged historical burn probability data and FWI. FWI accounts for daily temperature, relative humidity, wind speed, and precipitation to provide an understanding of how conducive the projected conditions are to wildfire development.

The FWI is a widely used, generalized measure of fire potential that incorporates both fuel aridity and fire weather (using daily maximum temperature, minimum or average relative humidity, wind speed, and precipitation), irrespective of fuel type and abundance. The FWI relies on meteorological variables and therefore captures the environmental conditions that are conducive to wildfire. It is important to note that FWI does not include three important factors of wildfire risk and spread: vegetation/fuel availability and type, ignition (natural vs. human-caused), and fire suppression and management. Therefore, an increase in the frequency of high fire danger days (> the historical 95th percentile FWI value) does not necessarily correlate with an increase in the frequency or intensity of wildfires, as additional factors are required for wildfire ignition and propagation. Finally, FWI does not explicitly simulate wildfire ignition and spread, and not all extreme fire weather days result in a wildfire. When a wildfire occurs in the observed world, feedback from wildfire dynamics (e.g., heat from wildfires resulting in convective activity) could affect subsequent wildfire risk.

The FWI system, developed by the Canadian Forest Fire Danger Rating System, consists of six components that account for the effects of fuel moisture and weather conditions on fire behavior. The first three components are fuel moisture codes, which are numeric ratings of the moisture content of the forest floor and other dead organic matter. There is one fuel moisture code for each of three layers of fuel: litter and other fine fuels, loosely compacted organic layers of moderate depth, and deep, compact organic layers. The remaining three components are fire behavior indices, which represent the rate of fire spread, the fuel available for combustion, and the frontal fire intensity. Calculation of the components is based on consecutive daily observations of temperature, relative humidity, wind speed, and daily precipitation. The six standard components provide numeric ratings of relative potential for wildland fire.

Projected Change across the SDG&E Service Territory

The following figures illustrate the observed baseline and projected change in the annual number of days with FWI above its 1995-2014 historical 95th percentile for 2050 and historical burn probabilities. Figure 20 shows the baseline and projected change in days above the annual historical 95th percentile FWI (hereafter referred to as high fire danger days[47]) by 2050. Historically, the greater number of high fire danger days occurs in the Desert, Mountain, and Inland regions with lower humidity and higher temperatures, while the Coastal region has fewer high fire danger days. By 2050, while there are slight decreases in some places near the coastline, nearly all of SDG&E's service territory is projected to experience greater high fire danger days, with the largest increases in lower-lying areas of the Mountain and Inland regions. This is likely due to projected increases in temperature and decreases in humidity and precipitation.

Figure 20. *Observed and projected days above the historical 95th percentile of FWI*
Observed baseline (1995-2014; left panels) and projected change (right panels) in the annual number of days with FWI above its 1995-2014 historical 95th percentile value. Projected values represent median-year (time-P50) 2050 with median-model (model-P50; upper right panel) and extreme-model (model-P90; lower right panel) views under the SSP3-7.0 scenario.

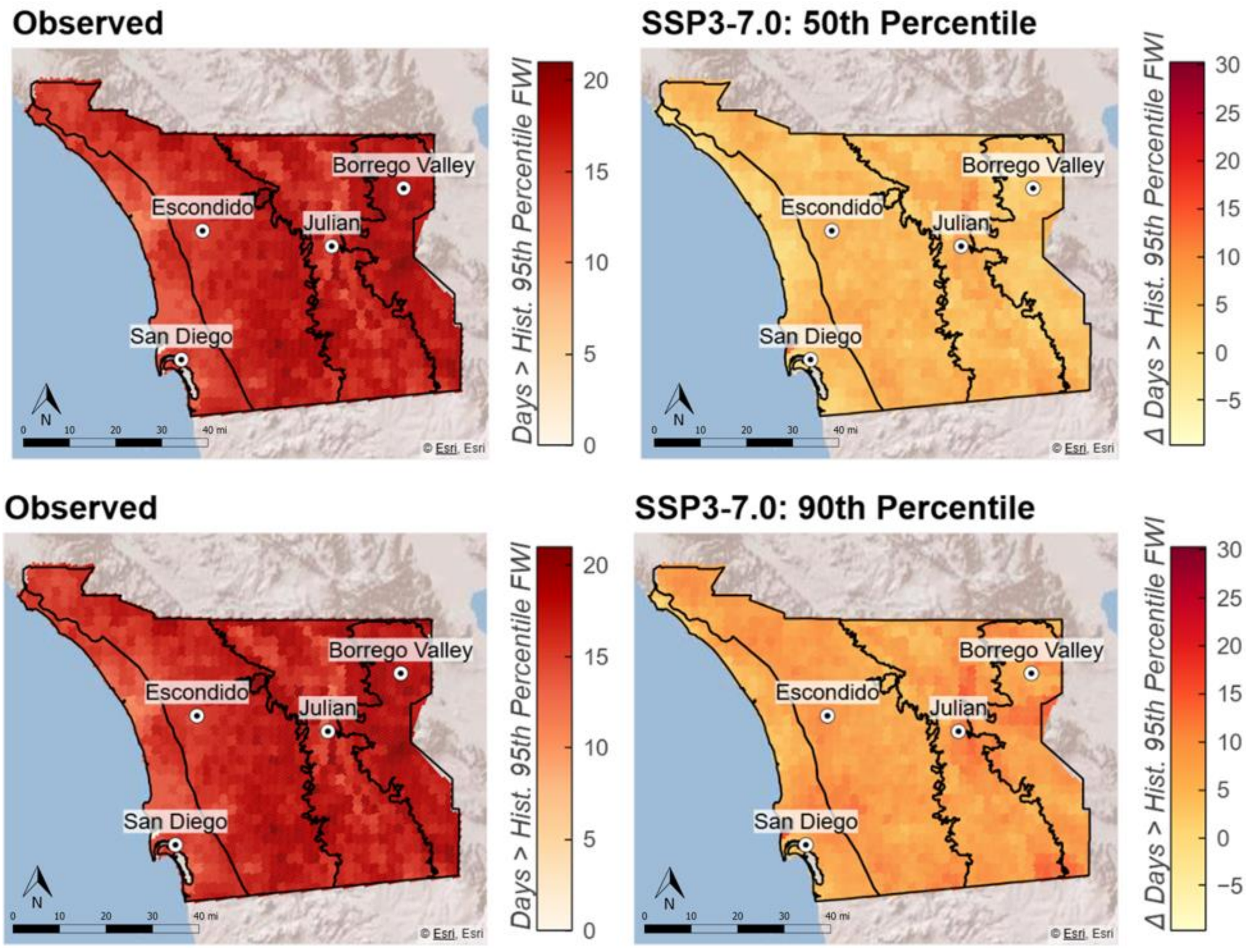
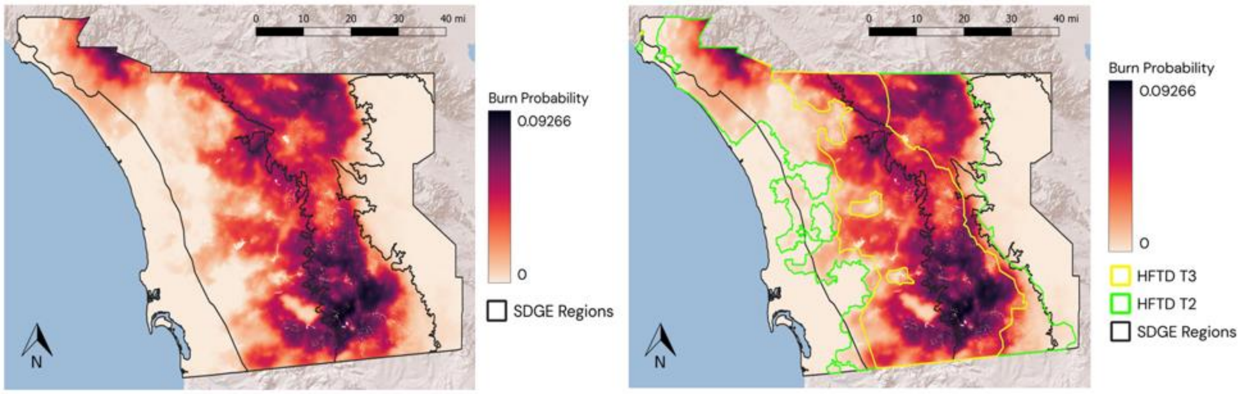


Figure 21 below shows the historical burn probabilities across the SDG&E service territory with color contours highlighting Tier 2 and 3 High Fire-Threat Districts (HFTDs). The HFTD tiers align well with higher burn probabilities, indicating that burn probability is a strong proxy for baseline exposure of wildfire. Burn probability is highest in the Mountain and Inland regions and near-zero in much of the Coastal and Desert regions.

Figure 21. *Historical burn probability across the SDG&E service territory*

Tier 2 and Tier 3 CPUC High Fire-Threat Districts (HFTDs) are shown in green and yellow, respectively.



Model and Scenario Uncertainty Projected Change

The ribbon plots highlighted in Figure 22 (time-P50) and Figure 23, Figure 24 (time-P95) showcase the annual number of days above the historical 95th percentile FWI in four cities in the SDG&E service territory. FWI projections demonstrate high model and scenario uncertainty across the service territory, which is likely reflecting the influence of more uncertain precipitation, humidity, and wind projections relative to temperature that drive variability in the FWI calculations. This leads to a large model ensemble spread and differences in projected trends across emissions scenarios. Overall, climate models project the changes outlined below for median-year projections (time-P50) (Figure 22, Table 26).

Table 26. *Overview of model projections for median-year (time-P50)*

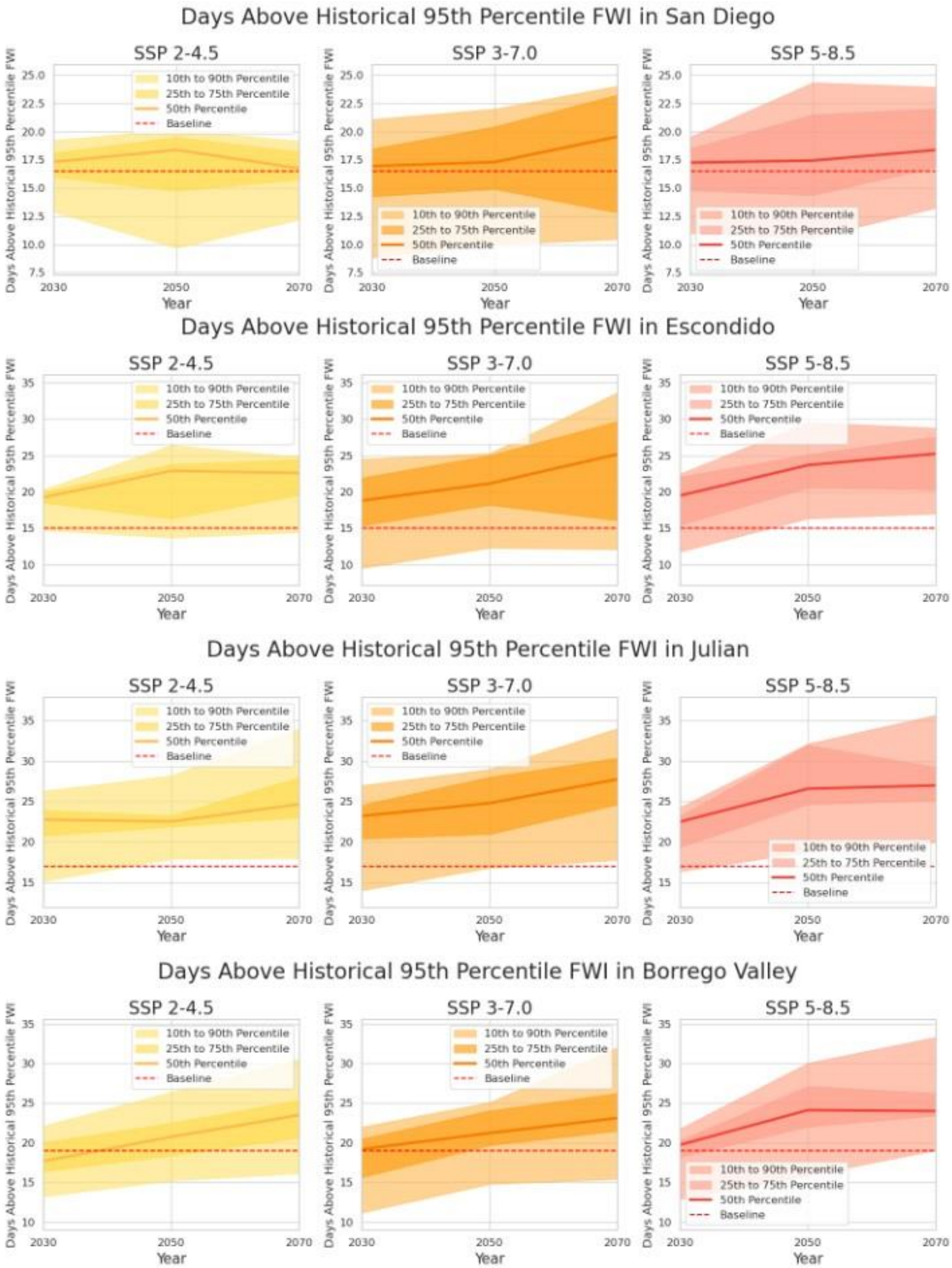
Projected change is relative to the 1995-2014 baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Days above historical 95th percentile FWI	17 days per year	2030	0 days (-4 to +3 days)
			2050	1 days (-7 to +8 days)
			2070	3 days (-4 to +7 days)
Escondido (Inland)	Days above historical 95th percentile FWI	15 days per year	2030	4 days (0 to + 7 days)
			2050	7 days (-1 to +15 days)
			2070	11 days (-1 to +14 days)
			2030	6 days (-2 to +7 days)

Julian (Mountain)	Days above historical 95th percentile FWI	17 days per year	2050	8 days (1 days to +15 days)
			2070	11 days (1 day to +18 days)
Borrego Valley (Desert)	Days above historical 95th percentile FWI	19 days per year	2030	0 days (-6 to +3 days)
			2050	2 days (-4 to +3 days)
			2070	4 days (-3 to +14 days)
* The value presented represents SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use time 50th percentile (time-P50)				

Figure 22. *Annual days above historical 95th percentile FWI in San Diego County locations*

Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for median-year projections (time-P50).



Climate models project the changes outlined below for extreme-year projections (time-P95) (Figure 23, Table 27).

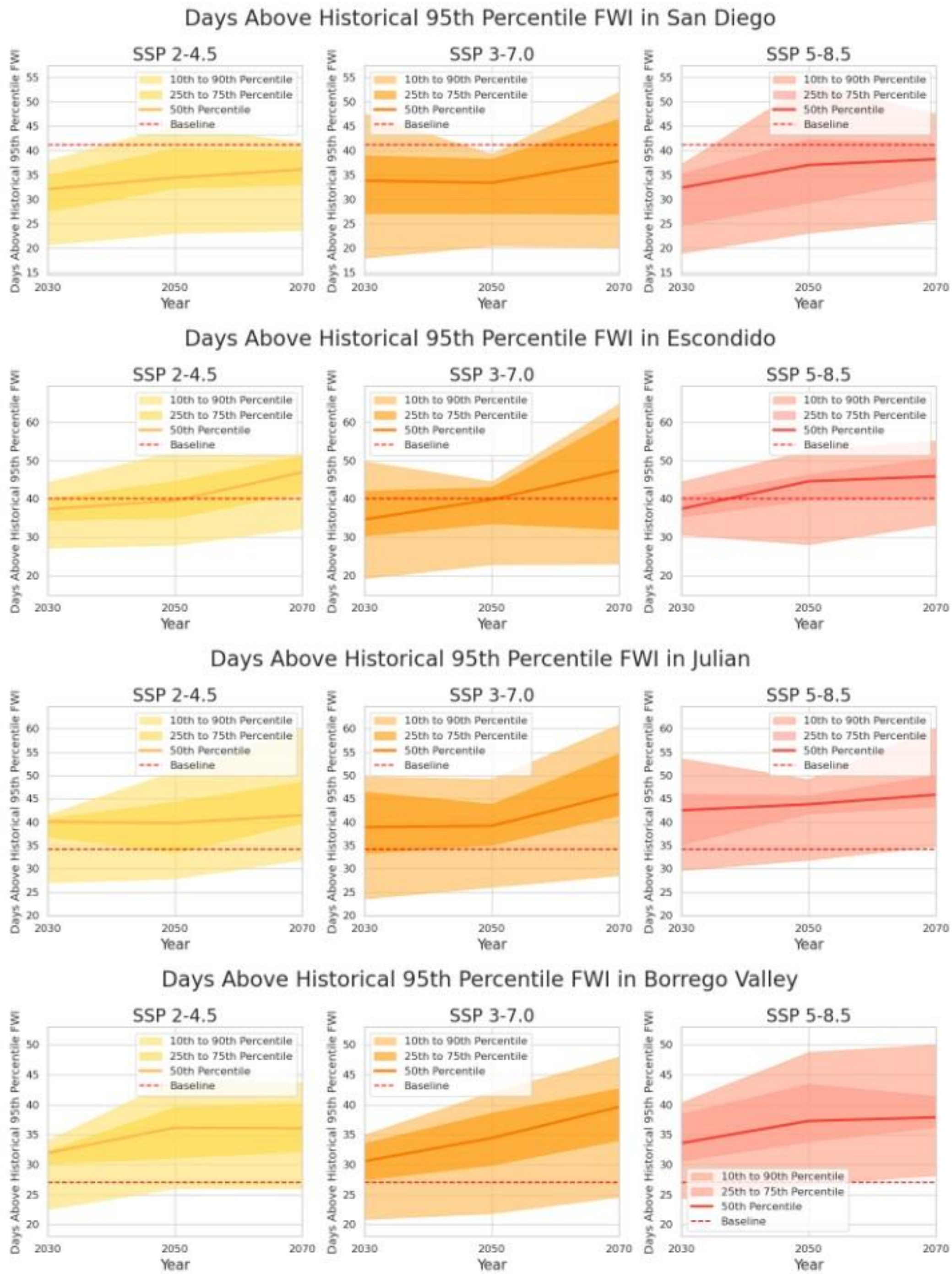
Table 27. *Overview of model projections for extreme-year (time-P95)*

Projected change is relative to the 1995-2014 baseline.

Location	Variable	Baseline (1995-2014)	Year	Projected change from baseline*
San Diego (Coastal)	Days above historical 95th percentile FWI	41 days per year	2030	-8 days (-20 to -3 days)
			2050	-8 days (-11 to +20 days)
			2070	-3 days (-17 to +6 days)
Escondido (Inland)	Days above historical 95th percentile FWI	41 days per year	2030	-6 days (-14 to +3 days)
			2050	-1 day (-13 to +12 days)
			2070	7 days (-9 to 14 days)
Julian (Mountain)	Days above historical 95th percentile FWI	34 days per year	2030	5 days (-7 to +20 days)
			2050	5 days (-7 to +15 days)
			2070	12 days (-2 to +26 days)
Borrego Valley (Desert)	Days above historical 95th percentile FWI	27 days per year	2030	3 days (-5 to +13 days)
			2050	7 days (-1 to +22 days)
			2070	13 days (-1 to 23 days)
* The value presented represents SSP3-7.0 50th Percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use time 95th percentile (time-P95)				

Figure 23, Figure 24. *Extreme-year (P95) projected days above historical 95th percentile FWI in San Diego County locations*

Annual number of days above the historical 95th percentile FWI in San Diego, Escondido, Julian, and Borrego Valley. Projected values represent 2030, 2050, and 2070 in SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for extreme-year projections (time-P95).



3.2.2.1 Exposure Scores

Exposure Approach

Exposure was scored on a 0-to-5 scale, with 0 representing no exposure and 5 representing very high exposure. The 0-to-5 scale aligns with approaches undertaken by other utility companies across the U.S. that are engaging in similar vulnerability scoring exercises. Wildfire thresholds were developed with exposure scoring using FWI projections. Exposure was evaluated using both FWI projections and the USFS/USDA Wildfire Risk to Communities historical burn probability dataset to identify areas most likely to be exposed to wildfire under increases in FWI. The following table (Table 28) shows asset-specific exposure thresholds used to bucket wildfire scores:

Table 28. *Exposure score thresholds for different wildfire variables*

Hazard	Wildfire			
Asset Type	All assets			
Weighting	50%		50%	
Variable	**Annual number of days above historical 95th percentile FWI**		**Historical wildfire probability**	
Thresholds	*Days*	*Exposure Score*	*Annual Likelihood (%)*	*Exposure Score*
	< 19 days	0	0%	0
	> 19 – 20 days	1	> 0 – 0.1%	1
	> 20 – 23 days	2	> 0.1 – 0.5%	2
	> 23 – 25 days	3	> 0.5 – 2.5%	3
	> 25 – 28 days	4	> 2.5 – 5%	4
	> 28 days	5	> 5%	5

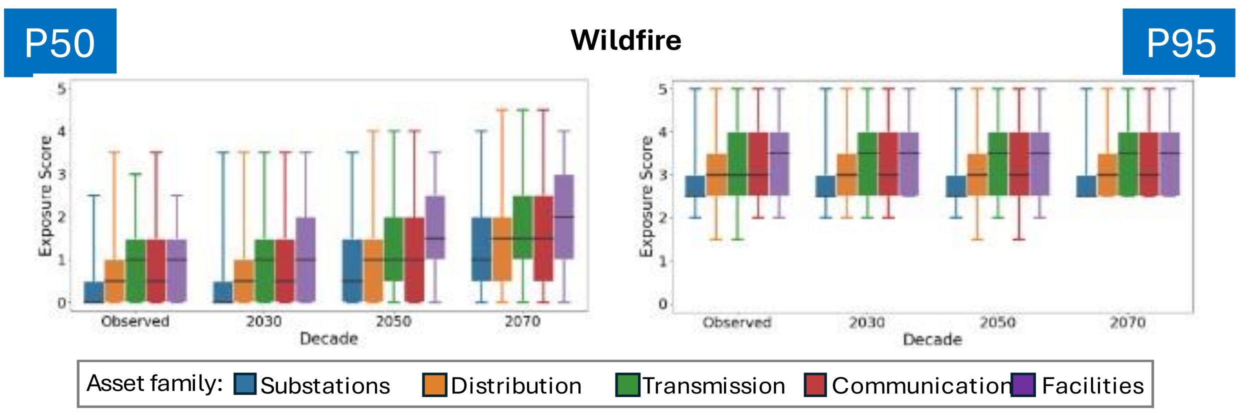
3.2.2.1.1 Exposure Summary

Exposure to wildfire is projected to increase across the service territory through the 21st century, particularly in the Mountain and Inland regions where exposure scores are projected to be highest Figure 25 shows boxplots for the distribution (minimum, 25th percentile, 50th percentile, 75th percentile, and maximum values) of wildfire exposure scores for each asset family across time under the SSP3-7.0 median-model (model-P50) scenario. Across all asset families, wildfire exposure scores are projected to increase over time.

The 50th percentile boxplot mark of median-year (time-P50) wildfire exposure scores across most asset families is projected to increase from 0 to 1 in the observed baseline period and 2030, to 0.5-1.5 by 2050, and 1 to 2 by 2070. Generally, the 50th percentile boxplot mark of extreme-year (time-P95) wildfire exposure scores is projected to increase from 0 to 1 in the observed period to 2.5-3.5 by 2070. Under median-year (time-P50) wildfire exposure scores, the communication and facilities asset families experience the greatest change in exposure magnitudes, while transmission and facilities experience the greatest change in extreme-year (time-P95) exposure magnitudes. Exposure score distributions by region are provided in Appendix II – Regional median-year (time-P50) exposure boxplots.

Figure 25. *Wildfire exposure score distributions by asset family*

Wildfire exposure score distributions for each asset family for the observed baseline, 2030, 2050, and 2070 for SSP3-7.0 50th percentile (model-P50) scenario. Exposure score distributions are shown for median-year and extreme-year (time-P50 and time-P95) and median-model (model-P50) for each time horizon.

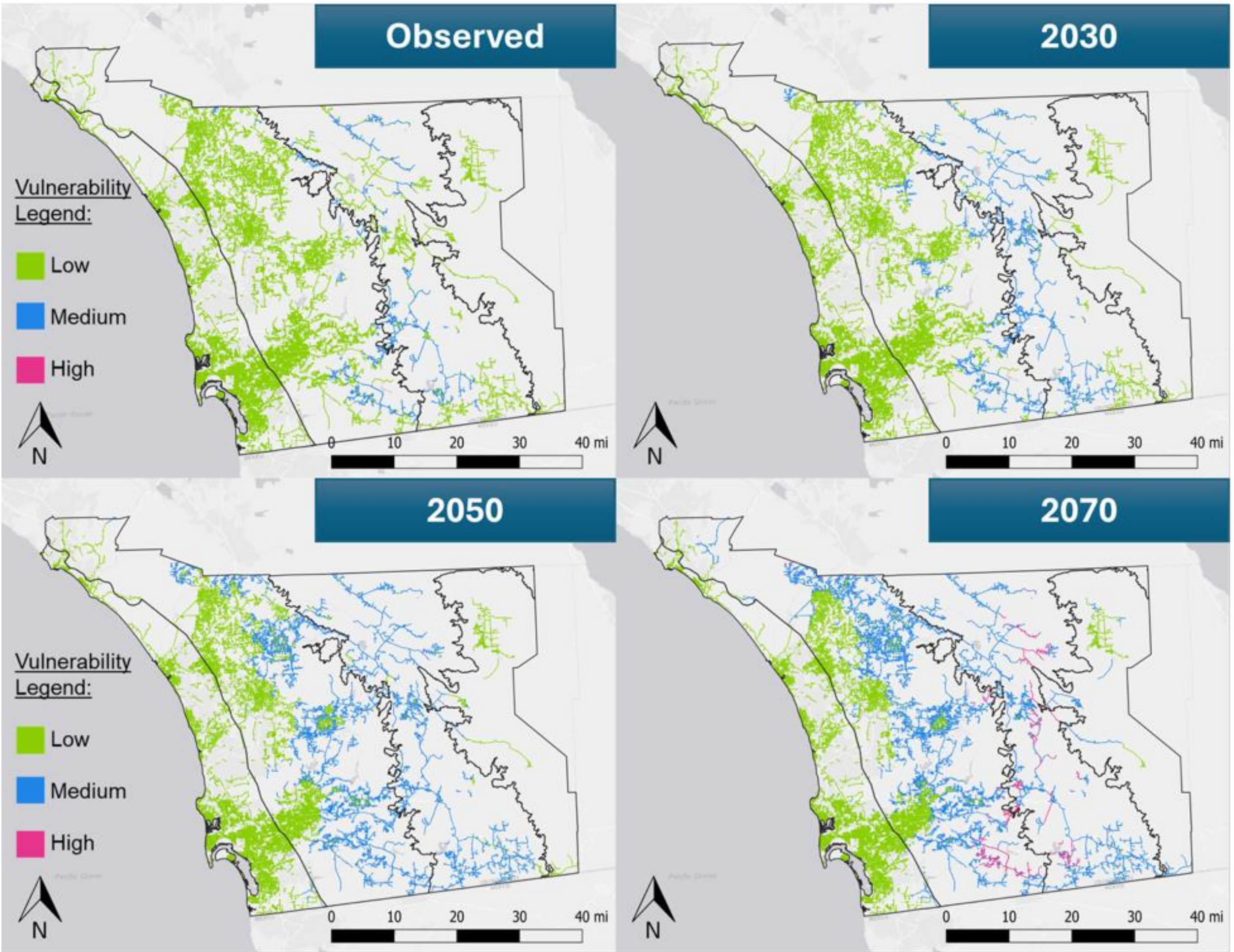


3.2.2.2 Sensitivity and Vulnerability Scores

In the baseline period, a majority of assets have low vulnerability to wildfires, with localized areas of medium vulnerability in the inland and mountain regions. By 2070, higher vulnerability becomes more widespread in the inland and mountain regions, with many electrical assets at low vulnerability in the baseline shifting toward medium vulnerability, and those at medium vulnerability shifting toward high vulnerability. The most notable change toward 2070 in terms of the percentage of assets to medium and high vulnerability scores are for primary overhead distribution conductors, overhead fiber lines, SCADA units, and communication centers. These shifts in vulnerability and regionality are illustrated in the map below (Figure 26), which shows vulnerability for overhead conductors and wildfires in the baseline, 2030, 2050, and 2070.

Figure 26. *Overhead conductor vulnerability to wildfire*

Map of overhead conductors & vulnerability to wildfire in the 1995-2014 observed baseline, 2030, 2050, and 2070 for the median-model (model-P50) and median-year (time-P50) view under SSP3-7.0 scenario.



3.2.2.2.1 Transmission

Sensitivity Scores

Out of all transmission asset types, overhead line segments and poles and towers are both moderately sensitive to wildfire. Even though SDG&E has taken steps to mitigate wildfire risk, such as implementing vegetation management programs to prevent encroachment of transmission lines, conductors may still be sensitive to wildfires. Additionally, heavy smoke from nearby wildfires can affect conductors and cause electrical arc, thus de-energizing conductors. In the case of poles and towers, fire in the direct vicinity of a transmission tower may threaten the tower's integrity, despite steel transmission potentially having a marginally lower sensitivity to wildfire and existing vegetation management practices that reduce the likelihood of wildfires reaching transmission structures. In contrast, underground line sub segments (cables) are essentially protected from wildfire risk given that they are underground. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 29. Most transmission assets have low vulnerability in the baseline to wildfire in the median-model (model-P50) view under the SSP3-7.0 scenario. For transmission underground line assets, vulnerability is projected to remain low across future time horizons.

For overhead structures, vulnerability is projected to increase over time under the SSP3-7.0 median-year (time-P50) and median-model (model-P50) view. The proportion of transmission overhead structures with medium vulnerability could grow from 0% in the baseline, to 2%, 5%, and 11% by 2030, 2050, and 2070, respectively. This is also true under SSP3-7.0 extreme-year (time-P95) view, where the proportion of assets with medium vulnerability is expected to grow from 56% to 57% between now and 2030 then remaining stable through 2050 and 2070. For transmission overhead line assets, the proportion of assets with medium vulnerability from wildfire is projected to grow from 0% in the baseline to 7% in 2030, 11% in 2050, and 20% by 2070 under the SSP3-7.0 median-year (time-P50) view, while it is expected to grow from 66% in the baseline to 69% in 2030 and remaining stable until 2070 under SSP 3-7.0 extreme-year (time-P95) view. Under that same time-P95 view, the percentage of transmission overhead line assets with high vulnerability to wildfire grows from 5% in the baseline to 6% in 2030 before remaining stable through 2070.

Table 29. *Transmission assets and projected vulnerability to wildfire*

Transmission assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 model-P50, time-P50)			Vulnerability Levels (SSP3-7.0 model-P50, time-P95)		
	Low	Medium	High	Low	Medium	High
Transmission						
	Transmission Overhead Line					
Baseline	100%	0%	0%	29%	66%	5%
2030	93%	7%	0%	26%	69%	6%
2050	89%	11%	0%	26%	69%	6%

2070	80%	20%	0%	26%	69%	6%
	Transmission Underground Line					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Transmission Overhead Structures					
Baseline	100%	0%	0%	44%	56%	0%
2030	98%	2%	0%	43%	57%	0%
2050	95%	5%	0%	43%	57%	0%
2070	89%	11%	0%	43%	57%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.2.2.2 Distribution

Sensitivity Scores

Out of all distribution asset types, poles, primary overhead conductor, overhead transformer, pad-mounted transformer, voltage regulator, dynamic protective device, and capacitor assets all have a high sensitivity to wildfire. In the case of poles, fire in the direct vicinity may threaten the asset integrity, and distribution poles tend to be both lower than transmission ones and made of wood. Higher wildfire exposure for primary overhead conductors stems from proximity to the ground and to tall vegetation compared to transmission conductors. Similarly, overhead transformer assets run at the same height as distribution conductors and therefore face similar risks. Pad-mounted transformers are susceptible to damage from wildfire by being at grade level. The specificity of location as a determinant of sensitivity is also found to be relevant for voltage regulators and pole-mounted capacitors, which can be exposed to wildfire conditions by being placed along distribution circuits, as well as dynamic protective devices (fault interrupters, reclosers, auto-throwovers, switches, fuses). The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 30. Most distribution assets have low vulnerability in the baseline to wildfire under the SSP3-7.0 median-model (model-P50) and median-year and extreme-year (time-P50 and time-P95) views. For primary underground conductors and subsurface transformers, all assets are projected to continue to have a low vulnerability to wildfire across future time horizons and different climate scenarios.

For overhead structures, primary overhead conductors, overhead transformers, pad-mounted transformers, voltage regulators, and dynamic protection devices, assets are projected to experience an increase in vulnerability to wildfire over time. This change is more evident under the SSP3-7.0 extreme-year (time-P95) view. For example, while 95% of primary overhead conductor assets have low vulnerability in the baseline to wildfire under the SSP3-7.0 median-year (time-P50) view, this proportion drops to 89% in 2030, 74% in 2050, and 66% in 2070, but the proportion with medium vulnerability increases from 5% in the baseline period to 11%, 26%, and 31% by 2030, 2050, and 2070, respectively. Under the SSP3-7.0 extreme-year (time-P95) view, the proportion of those assets with medium vulnerability to wildfire remains stable at 69% from the baseline to 2030 and remaining mostly unchanged through 2070. The primary overhead conductor assets with high vulnerability are projected to remain stable at 31% across all time horizons.

Table 30. *Distribution assets and projected vulnerability to wildfire*

Distribution assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 model-P50, time-P50)			Vulnerability Levels (SSP3-7.0 model-P50, time-P95)		
	Low	Medium	High	Low	Medium	High
Distribution						
	Distribution Overhead Structures					
Baseline	98%	2%	0%	13%	73%	14%
2030	96%	4%	0%	13%	73%	14%
2050	89%	11%	0%	16%	70%	14%
2070	83%	16%	1%	13%	74%	14%
	Primary Overhead Conductor					
Baseline	95%	5%	0%	0%	69%	31%
2030	89%	11%	0%	0%	69%	31%
2050	74%	26%	0%	3%	66%	31%
2070	66%	31%	3%	0%	69%	31%
	Primary Underground Conductor					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%

2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Transformer					
Baseline	96%	4%	0%	0%	72%	28%
2030	91%	9%	0%	0%	72%	28%
2050	77%	23%	0%	3%	69%	28%
2070	68%	30%	2%	0%	72%	28%
	Pad-mounted Transformer					
Baseline	100%	0%	0%	0%	93%	7%
2030	99%	1%	0%	1%	92%	7%
2050	95%	5%	0%	3%	90%	7%
2070	91%	9%	0%	0%	93%	7%
	Subsurface Transformer					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Voltage Regulator					
Baseline	94%	6%	0%	1%	41%	58%
2030	78%	22%	0%	0%	42%	58%
2050	52%	48%	0%	0%	42%	58%
2070	38%	60%	2%	0%	42%	58%
	Dynamic Protection Devices					
Baseline	99%	1%	0%	0%	93%	7%
2030	98%	2%	0%	1%	92%	7%
2050	94%	6%	0%	4%	90%	7%
2070	92%	8%	0%	0%	93%	7%
	Pad-mounted Switches					
Baseline	100%	0%	0%	0%	96%	4%
2030	100%	0%	0%	1%	95%	4%
2050	98%	2%	0%	2%	94%	4%
2070	95%	5%	0%	0%	96%	4%
	Underground Switches					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%

2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Switches					
Baseline	99%	2%	0%	0%	83%	17%
2030	95%	5%	0%	0%	83%	17%
2050	87%	13%	0%	3%	80%	17%
2070	81%	19%	1%	0%	83%	17%
	Distribution Capacitors					
Baseline	100%	0%	0%	0%	93%	7%
2030	99%	2%	0%	0%	92%	7%
2050	94%	6%	0%	3%	90%	7%
2070	91%	9%	0%	0%	93%	7%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.2.2.3 Substations

Sensitivity Scores

All substation assets have a low sensitivity to wildfire. This is related to vegetation cutbacks around substations helping to reduce sensitivity to wildfire, which implies that all components within the boundary of a substation have the same sensitivity to wildfire. However, substation components will be sensitive to wildfire in the event of exposure. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 31. Most substation assets have low vulnerability to wildfire across all time horizons and under the SSP3-7.0 median-model (model-P50) and median-year and extreme-year (time-P50 and time-P95) views.

For circuit breakers, switchgears, and capacitor banks, the percentage of assets that have low vulnerability under the SSP3-7.0 median-year (time-P50) view drops only marginally from 100% in the baseline, 2030, and 2050 to 99% in 2070, as the proportion of assets with a medium vulnerability to wildfire increases from 0% in the baseline, 2030, and 2050 to 1% in 2070. For these same asset families, vulnerability scores under SSP3-7.0 extreme-year (time-P95) view follow a similar trend, with the percentage of assets with low vulnerability dropping from 94% in the baseline to 93% in 2030, before remaining stable in 2050 and 2070, as the proportion of assets with medium vulnerability rises from 6% in the baseline to 7% in 2030, 2050, and 2070.

For substation transformers and substation voltage regulators asset vulnerability, the percentage of assets with a high vulnerability remains at 0% across all time periods under both scenarios. The percentage of assets with medium vulnerability increases over time.

Table 31. *Substation assets and projected vulnerability to wildfire*

Substation assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 model-P50, time-P50)			Vulnerability Levels (SSP3-7.0 model-P50, time-P95)		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Substation						
	Substation Transformer					
Baseline	100%	0%	0%	96%	4%	0%
2030	100%	0%	0%	96%	5%	0%
2050	100%	0%	0%	96%	5%	0%
2070	99%	1%	0%	96%	5%	0%
	Substation Voltage Regulator					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Substation Reactor					
Baseline	100%	0%	0%	99%	1%	0%
2030	100%	0%	0%	99%	1%	0%
2050	100%	1%	0%	99%	1%	0%
2070	100%	1%	0%	99%	1%	0%
	Substation DPD					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Circuit Breakers					

Baseline	100%	0%	0%	94%	6%	0%
2030	100%	0%	0%	93%	7%	0%
2050	100%	0%	0%	93%	7%	0%
2070	99%	1%	0%	93%	7%	0%
	Switchgear					
Baseline	100%	0%	0%	94%	6%	0%
2030	100%	0%	0%	93%	7%	0%
2050	100%	0%	0%	93%	7%	0%
2070	99%	1%	0%	93%	7%	0%
	Capacitor Banks					
Baseline	100%	0%	0%	94%	6%	0%
2030	100%	0%	0%	93%	7%	0%
2050	100%	0%	0%	93%	7%	0%
2070	99%	1%	0%	93%	7%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.2.2.4 Communication

Sensitivity Scores

Across all communication assets, overhead fiber, overhead copper, SCADA (RTU), and antennas are found to have severe sensitivity to wildfire. Wildfire impacts overhead fiber assets by affecting the protective sheathing around the fiber cables, leading to exposure and potential damage to the fibers themselves. Similarly, for overhead copper assets, intense heat from wildfires may damage conductor insulation and lead to short-circuits or conductor failure. RTUs are also sensitive to fire, and assets can be exposed to wildfire conditions by being placed near the location of distribution transformers, which also implies that the sensitivity is lower for SCADA units within substations. Finally, antennas can be exposed to wildfire conditions and, even in the absence of direct contact, their components are found to be sensitive to the heat conditions of a fire. Communication poles have a low sensitivity to wildfire given that they are made of steel and underground fiber and copper assets have no sensitivity to wildfire because they are underground. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 32. Underground fiber and copper assets consistently have low vulnerability to wildfire across time horizons and scenarios. Overhead fiber, overhead structure, and SCADA (RTU) assets see a rise in the percentage of assets with medium to high vulnerability under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) view.

Under this scenario, 91% of overhead fibers assets have low vulnerability to wildfire in the baseline, a proportion that drops to 85% in 2030, 68% in 2050, and 57% in 2070-while the share of those assets with medium vulnerability to wildfire grows from 9% in the baseline to 15% in 2030, 32% in 2050, and 39% in 2070, and that of assets with high vulnerability remains at 0% in the baseline, in 2030, and in 2050, before reaching 4% in 2070. Under SSP3-7.0 extreme-year (time-P95), the share of those assets with high vulnerability to wildfire remains stable across all time horizons at 42%, that of SCADA (RTU) assets remains stable at 22% across all time horizons, and that of antennas reaches 18% in the baseline. Beyond 2030, and in 2050 and 2070, those respective shares remain stable.

For overhead copper assets, the percentage of assets with low vulnerability remains close to 100% across all time horizons under the SSP3-7.0 median-year (time-P50) view. However, under the SSP3-7.0 extreme-year (time-P95) view, the share of assets with medium vulnerability to wildfire peaks at 99% in the baseline and 2030, before remaining relatively stable at 97% in 2050 and 99% in 2070.

Table 32. *Communication assets and projected vulnerability to wildfire*

Communication assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Communication						
	Overhead Fiber					
Baseline	91%	9%	0%	0%	58%	42%
2030	85%	15%	0%	0%	59%	42%
2050	68%	32%	0%	0%	58%	42%
2070	57%	39%	4%	0%	59%	42%
	Overhead Copper					
Baseline	100%	0%	0%	0%	99%	1%
2030	99%	1%	0%	0%	99%	1%
2050	99%	1%	0%	2%	97%	1%

2070	99%	1%	0%	0%	99%	1%
	Underground Fiber					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Underground Copper					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Structures (Communication)					
Baseline	100%	0%	0%	64%	36%	0%
2030	99%	1%	0%	64%	36%	0%
2050	96%	4%	0%	64%	36%	0%
2070	92%	8%	0%	64%	36%	0%
	SCADA RTU					
Baseline	98%	2%	0%	0%	77%	22%
2030	92%	8%	0%	1%	77%	22%
2050	82%	18%	0%	3%	75%	22%
2070	75%	24%	1%	0%	78%	22%
	Antennas					
Baseline	98%	2%	0%	0%	81%	18%
2030	94%	6%	0%	1%	81%	18%
2050	85%	15%	0%	3%	79%	18%
2070	79%	20%	1%	0%	82%	18%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.2.2.5 Facilities

Sensitivity Scores

Out of all facilities assets, communication centers have the highest sensitivity to wildfires. This is due to most assets being found in remote locations that are hard to access, making clearance maintenance of surrounding vegetation challenging. Additionally, fire protection is unmanned and thus less stringent. Operations and access may also be affected by larger wildfires moving through the area, and wildfires have the potential to critically damage facility equipment (like servers and IT or HVAC equipment) and restrict access to communication centers. Furthermore, office buildings (headquarters, call centers, training centers, warehouses) and construction and operation centers have moderate sensitivity to wildfires. In both cases, this is due to operations and access being potentially affected by larger wildfires moving through the area, despite SDG&E's office buildings being traditionally located within urban and suburban areas and the Company adhering to the San Diego County Fire Code. In the case of construction and operations centers, lower sensitivity can be assigned to newer facilities due to the existence of better fire-protection systems. Finally, and for similar reasons to those cited previously, asset critical facilities have low sensitivity to wildfires. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 33. Critical facilities assets have consistently low vulnerability across scenarios and time horizons. Office buildings and construction and operation centers, however, experience a rise in the proportion of their assets with medium vulnerability to wildfire. For instance, under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) view, while 0% of construction and operation centers assets have medium vulnerability in the baseline to wildfire, that proportion increases to 9% by 2030 before stabilizing in 2050 and 2070. Under the SSP3-7.0 extreme-year (model-P95), the proportion of those assets with medium vulnerability remain stable at 46% across all time horizons. The share of those assets with high vulnerability to wildfire under that scenario also remains constant at 9% in the baseline, 2030, 2050, and 2070. A similar trend is also observed with communication centers, as the percentage of assets with medium and high vulnerability grows slightly in the coming decades under the SSP3-7.0 extreme-year (model-P95) view. The former remains constant from 46% in the baseline and in 2030, 45% in 2050, and 46% in 2070, while the latter remains at 54% in the baseline, remaining stable through 2030, 2050, and 2070.

Table 33. *Facility assets and projected vulnerability to wildfire*

Facility assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Facilities						

	Office Buildings					
Baseline	100%	0%	0%	88%	13%	0%
2030	100%	0%	0%	88%	13%	0%
2050	100%	0%	0%	88%	13%	0%
2070	88%	13%	0%	88%	13%	0%
	Construction and Operation Centers					
Baseline	100%	0%	0%	46%	46%	9%
2030	91%	9%	0%	46%	46%	9%
2050	91%	9%	0%	46%	46%	9%
2070	91%	9%	0%	46%	46%	9%
	Communication Centers					
Baseline	93%	7%	0%	7%	39%	54%
2030	82%	18%	0%	0%	46%	54%
2050	59%	41%	0%	2%	45%	54%
2070	39%	54%	7%	0%	46%	54%
	Asset Critical Facilities					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.2.2.6 Gas Assets

Sensitivity Scores

Out of all gas asset types, regulators, compressors, and valves have the highest sensitivity to wildfire. This is due to these assets being generally above ground and therefore potentially directly impacted by exposure to wildfire. High- and medium-pressure pipes both have significantly lower sensitivity to wildfire than regulators, compressors, and valves since they are typically buried below ground and are less likely to be damaged by exposure to wildfires. For medium-pressure pipes, sensitivity is determined to be lower than high-pressure pipes due to various material and location differences. Sensitivity scores for gas assets were determined by SCG SMEs and used to determine the asset vulnerabilities shown in the tables below.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for wildfires in Section 3.1.1, the resulting vulnerability scores are presented in Table 34, Table 35, and Table 36. All gas assets have low vulnerability in the baseline to wildfire under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) views.

For regulators, vulnerability is projected to increase. The proportion of gas regulator structures with medium vulnerability could grow from 0% in the baseline and in 2030, to 2% in 2050 and to 6% in 2070 under SSP 3-7.0 median-year (time-P50). Under SSP3-7.0 extreme-year (time-P95), the proportion of gas regulator assets with medium vulnerability remains stable at 72% in the baseline and 2030, decreasing to 70% in 2050, and rising back to 72% in 2070

For high-pressure pipes, the share of assets with medium vulnerability from wildfire is projected to remain constant at 0% between now and 2070 under the SSP3-7.0 median-year (time-P50) view. Likewise, under the SSP3-7.0 extreme-year (time-P95) view, vulnerability to wildfire remains constant, and the share of assets with medium vulnerability remains at 12% in the baseline, 2030, 2050, and 2070. Throughout time periods, it is notable that the share of those assets with high vulnerability to wildfire remains at 0%.

Table 34. *High Pressure Pipe assets and projected vulnerability to wildfire*

High Pressure Pipe assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Med.	High	Low	Med.	High
High-Pressure Pipes (HPPs)						
	HPP					
Baseline	100%	0%	0%	88%	12%	0%
2030	100%	0%	0%	88%	12%	0%
2050	100%	0%	0%	88%	12%	0%
2070	100%	0%	0%	88%	12%	0%
	HP Service Pipes					
Baseline	100%	0%	0%	95%	5%	0%
2030	100%	0%	0%	95%	5%	0%
2050	100%	0%	0%	95%	5%	0%

2070	100%	0%	0%	95%	5%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 35. *Medium Pressure Pipe assets and projected vulnerability to wildfire*

Medium Pressure Pipe assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Med.	High	Low	Med.	High
Medium-Pressure Pipes (MPPs)						
	MPP					
Baseline	100%	0%	0%	99%	1%	0%
2030	100%	0%	0%	99%	1%	0%
2050	100%	0%	0%	99%	1%	0%
2070	100%	0%	0%	99%	1%	0%
	MP Service Pipes					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 36. *Regulator, Compressor, and valve gas assets and projected vulnerability to wildfire*

Regulator, Compressor, and valve gas assets and projected vulnerability to wildfire (by % of total number of assets of each type) for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Med.	High	Low	Med.	High
Regulators, Compressors, Valves						
	Controllable Gas Valve					
Baseline	100%	0%	0%	56%	44%	1%

2030	100%	0%	0%	56%	44%	1%
2050	100%	1%	0%	56%	43%	1%
2070	99%	1%	0%	56%	44%	1%
	Non-Controllable Gas Valve					
Baseline	100%	0%	0%	94%	6%	0%
2030	100%	0%	0%	94%	6%	0%
2050	100%	0%	0%	94%	6%	0%
2070	100%	0%	0%	94%	6%	0%
	Regulator					
Baseline	100%	0%	0%	28%	72%	1%
2030	100%	0%	0%	28%	72%	1%
2050	98%	2%	0%	29%	70%	1%
2070	94%	6%	0%	28%	72%	1%
	Compressor Station*					
Baseline	100%	0%	0%	-	-	-
2030	100%	0%	0%	-	-	-
2050	0%	100%	0%	-	-	-
2070	0%	100%	0%	-	-	-

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%
**Vulnerability scores for the Moreno compressor station are from the SCG CAVA analysis*

3.2.2.3 Vulnerability of Operations & Services

SDG&E characterized the vulnerability of its operations and services to wildfire by considering the exposure of SDG&E's service territory to the hazard and the sensitivity of each operation and service.

Exposure to wildfire is projected to increase across certain locations within the SDG&E service territory in the future. For example, the number of days above historical 95th percentile FWI could increase by 12 days in the Borrego Valley and Julian regions by 2070. The heightened exposure of the service territory to wildfire is likely to impact SDG&E's operations and services in direct and indirect ways. It could, for instance, provoke more frequent Public Safety Power Shutoffs, and thereby directly impact reliability planning. At the same time, such a scenario could also indirectly stimulate communication activities, as the reduced operational efficiency of assets and their accelerated failure rate makes communication with customers more urgent.

To understand the sensitivity of operations and services to wildfire, SDG&E characterized their current resilience to this hazard.[48]

The output of the operational maturity scoring is presented in Table 37**.**

Table 37. *Operational maturity scores of SDG&E's operations and services for wildfire*

	Historical and projected extreme weather	Investment in new technology	Performance metrics	Stakeholder engagement	Personnel Training	TOTAL (out of 5)
Asset Management	0.5	1	1	1	1	**4.5**
Vegetation Management	0.5	1	1	1	1	**4.5**
Emergency Response	0.5	1	1	1	1	**4.5**
Comms.	0.5	1	1	1	1	**4.5**
Safety Operations	0.5	1	1	1	1	**4.5**
Reliability Planning	0.5	1	1	1	1	**4.5**
Supply Management	0.5	0.5	1	0.5	1	**3.5**

Based on the projected high exposure of the SDG&E's service territory to wildfire and on the operational maturity scores obtained, supply management has the highest projected operational vulnerability to the hazard. In particular, investments in new technologies, diverse and external stakeholder communication and feedback, and the use of historical and projected extreme weather to inform updates are three key resilience practices that are not fully incorporated.

Asset management, vegetation management, emergency response, communication, safety operations, and reliability planning all have lower operational vulnerability to wildfire. This is due to a strong incorporation of key resilience practices, including investments in new technologies and innovations, tracking of teams' performance through performance metrics, diverse and external stakeholder communication and feedback, and regular training of personnel. These results are summarized in Figure 27, below.

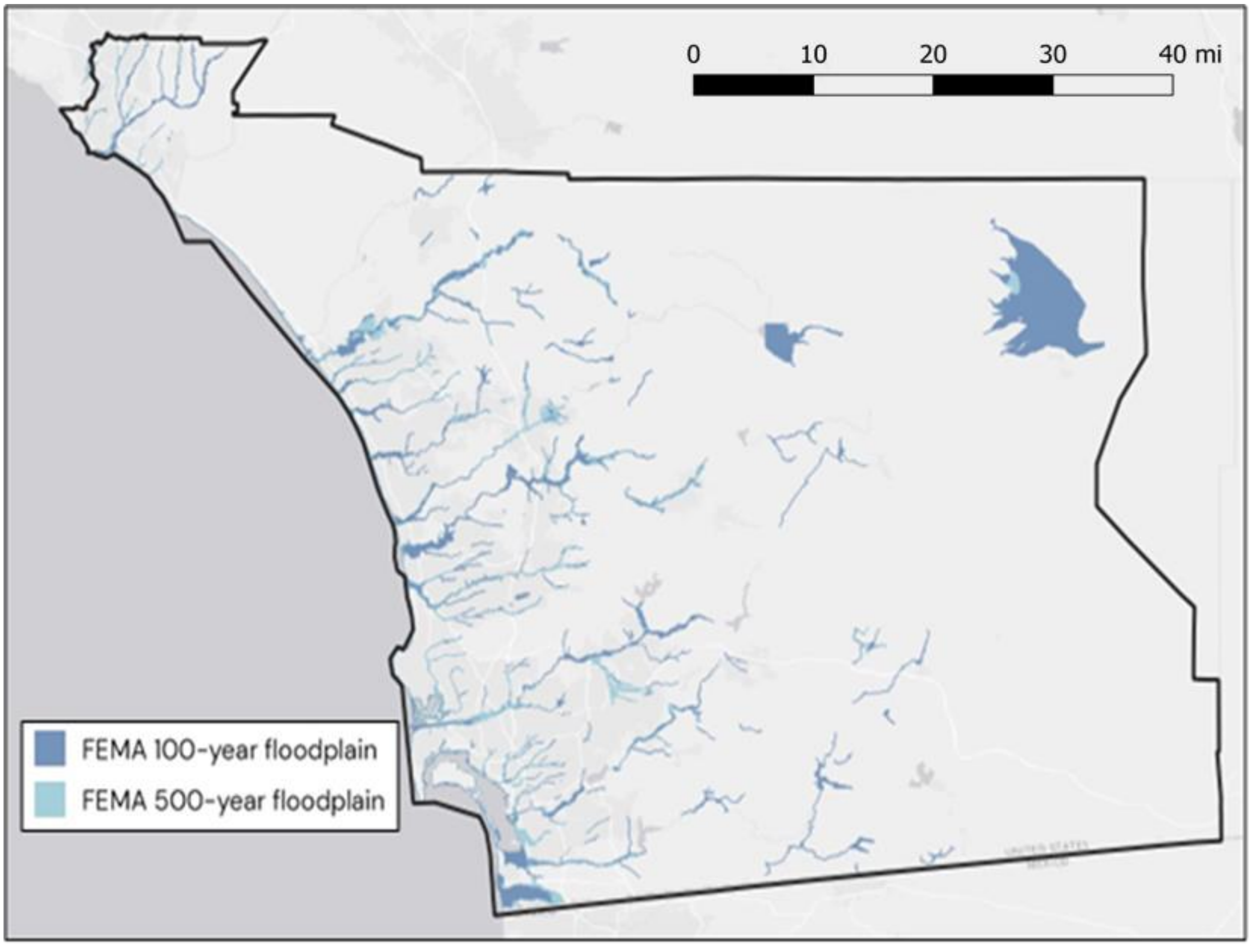
Figure 27. *Graphical representation of the vulnerability of SDG&E's operations and services to wildfire.*

3.2.3 Inland Flooding

Hazard Characterization

The SDG&E service territory usually experiences flooding either during the most extreme precipitation events of the wet season or when heavy rain follows extended periods of drought.[32] The geographic profile of the region includes desert plains, river valleys and creeks, mountains topping out at over 6,000 feet, and coastal areas with bays, inlets, and estuaries. Figure 28 demonstrates the extent of a severe 1-in-100- or 1-in-500-year floodplain under historical conditions across the region. The most significant inundation is clustered in the western portion of the service territory following riverbeds originating in the mountains, although Federal Emergency Management Agency (FEMA) floodplain data coverage is limited in San Diego County.

Figure 28. *FEMA historical 100-year and 500-year floodplains – SDG&E service territory*
100-year floodplains are shown in a dark blue and 500-year floodplains are shown in a light blue.



Atmospheric river events in recent years have placed a spotlight on the impact of heavy rainfall on flooding as well as landslides in the region. Inland flooding and heavy rainfall can contribute to landslides in California by saturating the soil and reducing stability. The infiltration of water raises pore water pressure, weakening soil cohesion and leading to landslides. Heavy rainfall can also lead to soil erosion, which can remove stabilizing vegetation and soil layers, and trigger rapid debris flows. Climate change can exacerbate these conditions by causing cascading impacts, such as heavy rainfall followed by droughts, which can further destabilize the soil and trigger landslides.

Variables and Methods

The following climate variables[49] were analyzed to determine present-day and future exposure to inland flooding:

- Annual Maximum 1-day Runoff
- Annual Maximum 3-day Precipitation

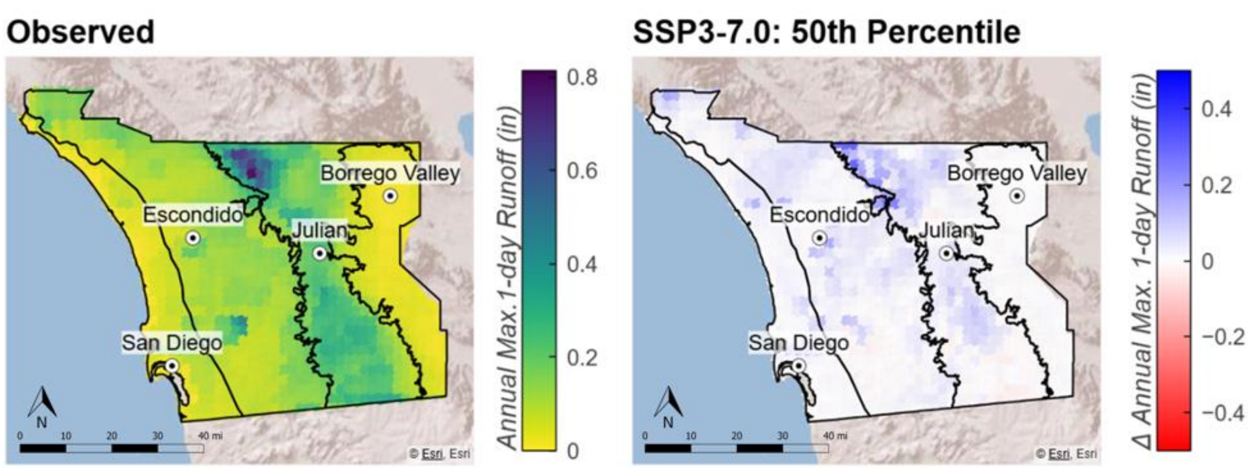
These variables were calculated using LOCA2-CA-based Variable Infiltration Capacity (VIC) 3 km gridded runoff and LOCA2-CA 3 km gridded precipitation projections. LOCA2-CA VIC runoff projections are calculated based on meteorological data from 13 CMIP6-based LOCA2-CA models that are used to drive the VIC land surface model. Runoff represents excess water that flows over the surface into adjacent bodies of water from precipitation, snowmelt, and irrigation that is not absorbed into the land.

Projected Change across the SDG&E Service Territory

The following figures show the observed and projected change in annual maximum 1-day runoff and maximum 3-day precipitation across the SDG&E service territory under the SSP3-7.0 median-model and extreme-model (model-P50 and model-P90) and median-year (time-P50) views. Figure 29 shows the observed and projected change by 2050 in annual maximum 1-day runoff. Historically, the immediate coastline and much of the Desert region experience close to 0 inches of runoff. There are isolated pockets of higher runoff values in the Inland Region and generally higher runoff values in the Mountain region, with maximum runoff values toward Palomar Mountain. Under the SSP3-7.0 median-model (model-P50) view, most of the Desert and Coastal Regions are projected to experience zero or near-zero change in annual maximum 1-day runoff. Increases in annual maximum 1-day runoff are projected to occur throughout most of the Mountain Region and Inland Region. Projections of change in annual maximum 1-day runoff are more extreme under the SSP3-7.0 extreme-model (model-P90) view, with larger increases in runoff intensity throughout most of the Mountain Region, more of the Inland Region, and increasingly the Coastal Region.

Figure 29. *Observed and projected change in annual maximum 1-day runoff*

Projected values represent 2050 SSP3-7.0 median-model and extreme-model (model-P50 and model-P90).



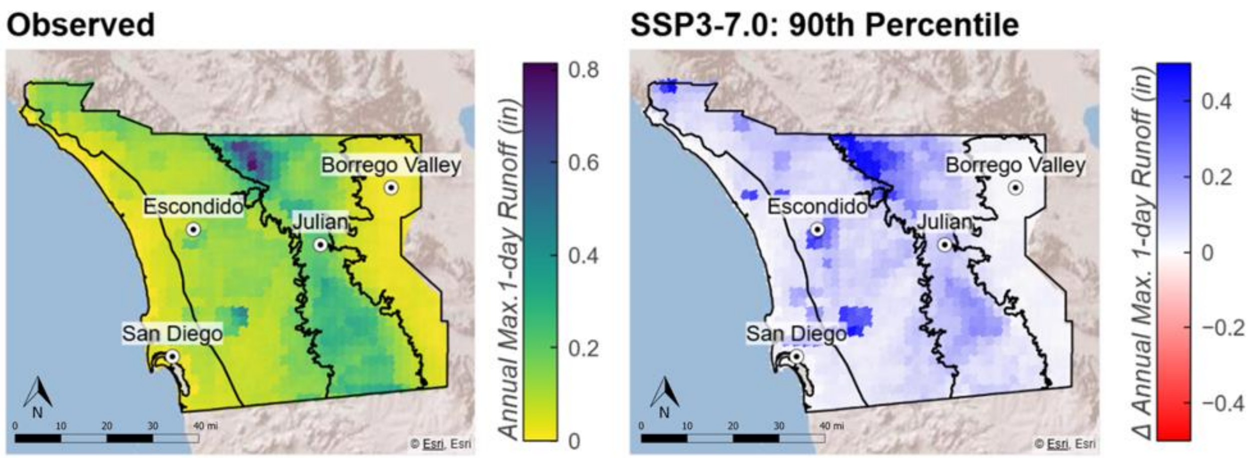
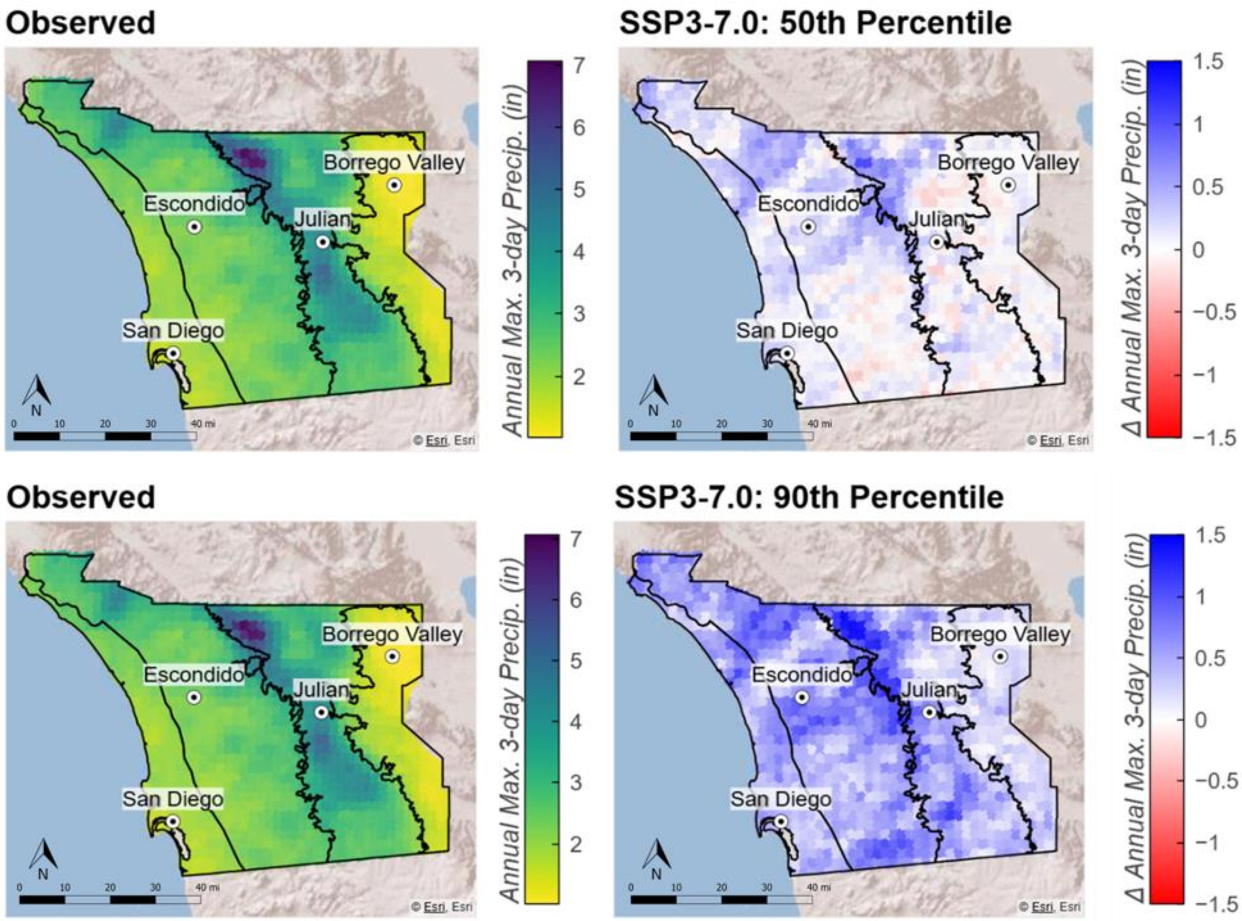


Figure 30 shows the observed and projected change by 2050 in annual maximum 3-day precipitation. Historically, portions of the Desert Region experience the lowest intensity of 3-day precipitation, followed by low-elevation areas of the Coastal Region. As altitude increases in the Inland and Mountain regions, the annual maximum 3-day precipitation increases as well, with maximum values occurring toward Palomar Mountain. Under the SSP3-7.0 median-model (model-P50) and median-year (time-P50), sporadic increases and decreases are projected across the SDG&E service territory, with many areas projected to experience near zero change in annual maximum 3-day precipitation. Pockets of the southern Inland region and central Mountain region are projected to experience decreases in annual maximum 3-day precipitation, while increases are projected to occur throughout most of the Coastal Region and the northern halves of the Inland and Mountain Regions. Projections of change in annual maximum 3-day precipitation are more extreme under the SSP3-7.0 extreme-model (model-P90), with larger increases in precipitation intensity projected throughout most of SDG&E service territory, especially in the Mountain, Inland, and Coastal Regions.

Figure 30. *Observed and projected change in annual maximum 3-day precipitation*

Projected values represent 2050 SSP3-7.0 median-model and extreme-model (model-P50 and model-P90).



Model and Scenario Uncertainty Projected Change

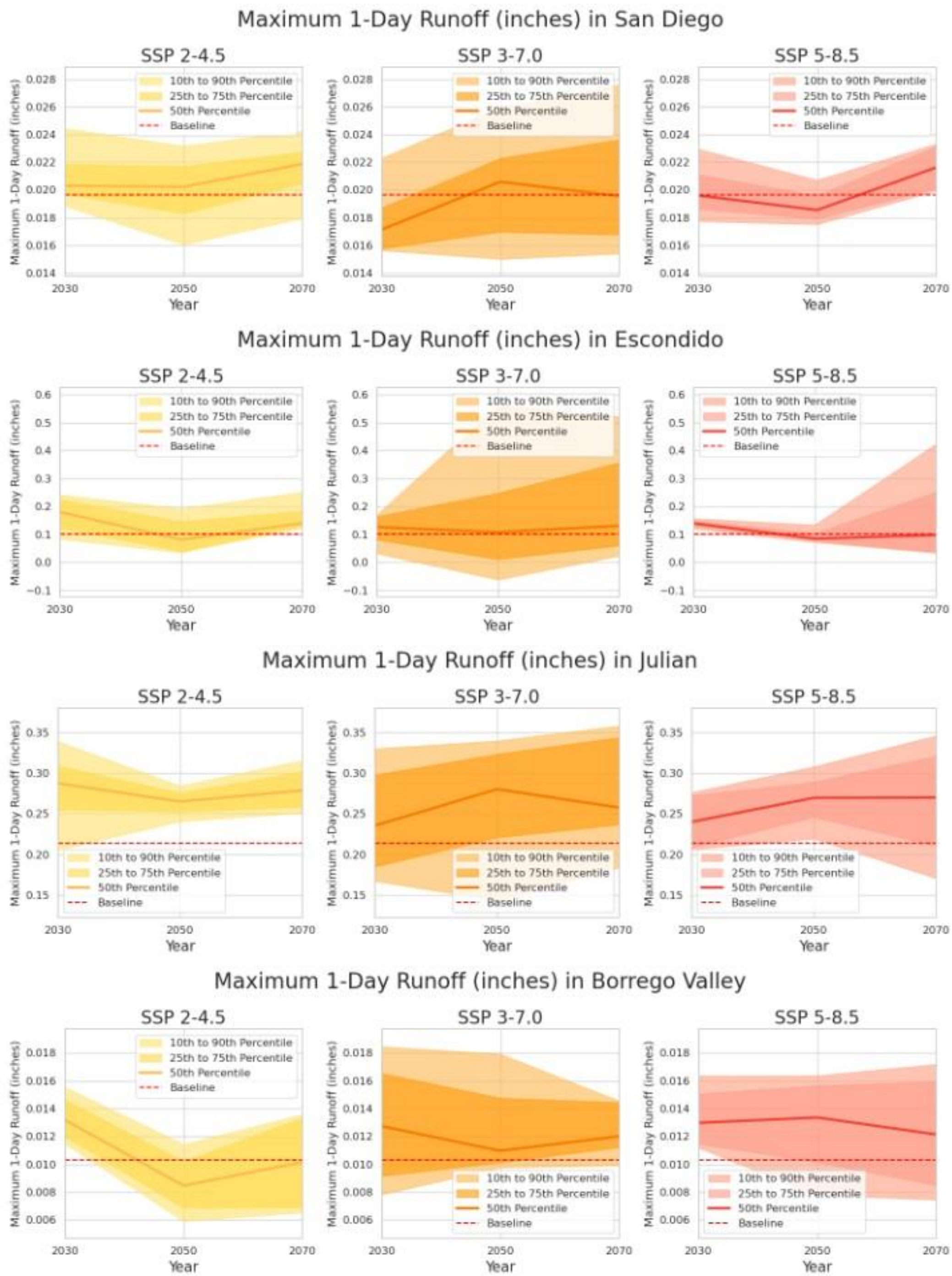
The ribbon plots highlighted in Figure 31 (time-P50) and Figure 32 (time-P95) showcase the number of maximum 1-day runoff in inches for four cities of Borrego Valley, Escondido, Julian, and San Diego in the SDG&E service territory. Overall, both model and scenario uncertainty are relatively high for runoff projections across the service territory due to a large model ensemble spread and differences in projected trends across emissions scenarios. As conveyed by the model-P10 and model-P90 values, the cities of San Diego and Escondido for all three SSP scenarios are not projected to experience a significant increase or decrease from the baseline value. For SSP3-7.0 and SSP5-8.5, Borrego Valley is projected to experience a slight increase in maximum runoff. For all three SSP scenarios, Julian is projected to experience the greatest increase in maximum 1-day runoff. Overall, climate models project the changes outlined below for median-year projections (time-P50) (Figure 31, Table 38).

Table 38. *Overview of model projections for median-year (time-P50)*

Projected change is relative to the baseline.

Location	Variable	Baseline	Year	Projected change from baseline*
San Diego (Coastal)	Maximum 1-day runoff (inches)	0.02 inches	2030	0 inches (0 to 0 inches)
			2050	0.01 inches (-0.01 to 0 inches)
			2070	0 inches (-0.003 to 0 inches)
Escondido (Inland)	Maximum 1-day runoff (inches)	0.1 inches	2030	0 inches (0 to 0 inches)
			2050	0 inches (-0.07 to +0.03 inches)
			2070	0.03 inches (0.02 to 0.32 inches)
Julian (Mountain)	Maximum 1-day runoff (inches)	0.2 inches	2030	0.02 inches (0 to 0.08 inches)
			2050	0.07 inches (0.04 to 0.1 inches)
			2070	0.05 inches (0.05 to 0.14 inches)
Borrego Valley (Desert)	Maximum 1-day runoff (inches)	0.01 inches	2030	0 inches (-0.003 to +0.005 inches
			2050	0.001 inches (-0.004 to +0.006 inches)
			2070	0.001 inches (-0.0035 to +0.007 inches)
* The value presented represents SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use median-year (time-P50) projections.				

Figure 31. *Maximum 1-Day Runoff in inches for four San Diego County locations*
Projected values represent 2030, 2050, and 2070 in the SSP2-4.5, SSP3-7.0, and SSP5-8.5 scenarios for median-year projections (time-P50).



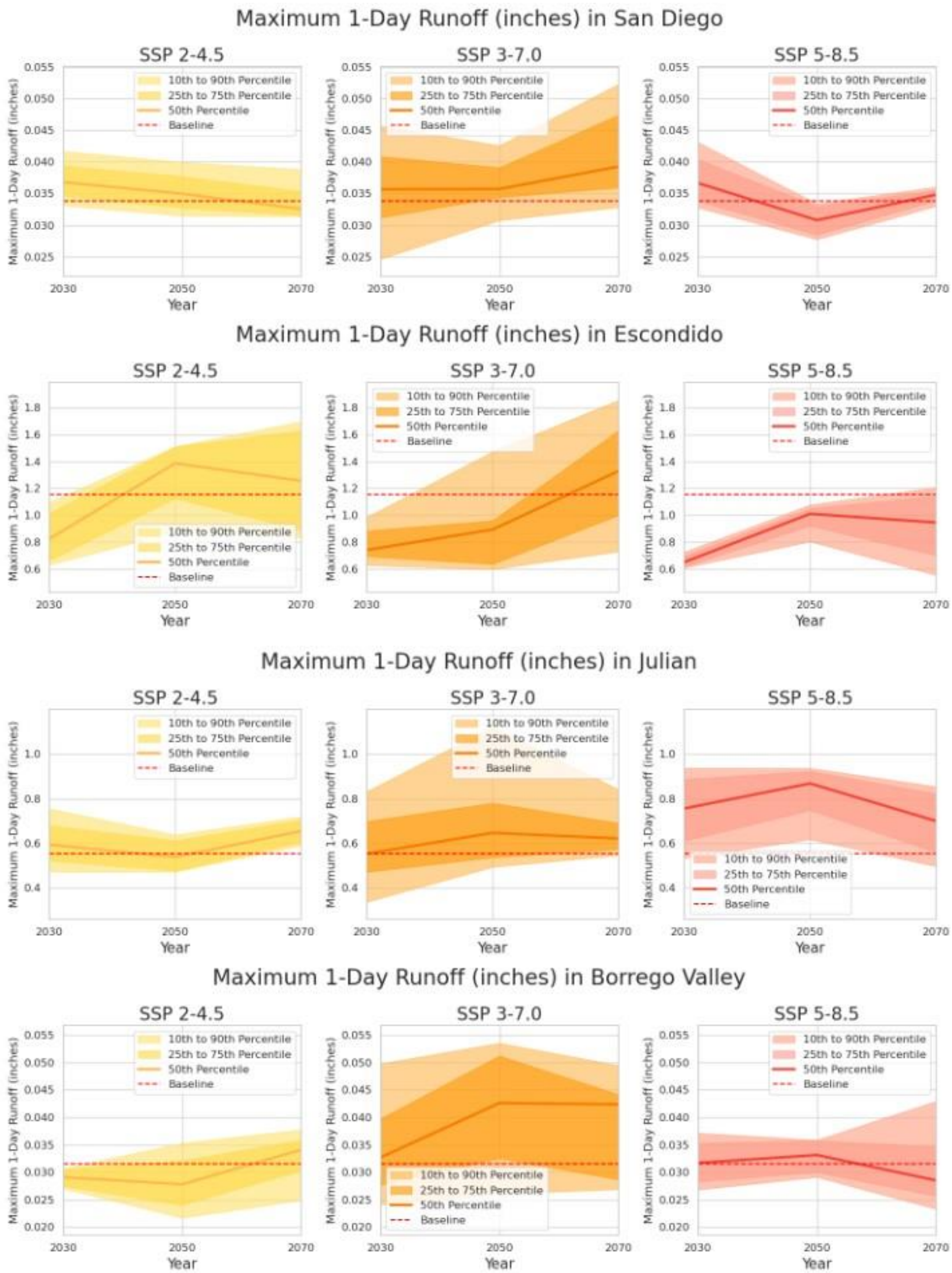
Overall, climate models project the changes outlined below for 20-year extreme projections (P95) (Figure 32, Table 39).

Table 39. *Overview of model projections for extreme-year (time-P95)*

Projected change is relative to the baseline.

Location	Variable	Baseline	Year	Projected change from baseline*
San Diego (Coastal)	Maximum 1-day runoff (inches)	0.03 inches	2030	0 inches (0 to 0 inches)
			2050	0.005 inches (0 to 0 inches)
			2070	0.009 inches (0 to 0.006 days)
Escondido (Inland)	Maximum 1-day runoff (inches)	1.15 inches	2030	-0.4 inches (-0.6 to -0.5 inches)
			2050	0.26 inches (0.28 to 0.074 inches)
			2070	0.1 inch (-0.4 to 0 inches)
Julian (Mountain)	Maximum 1-day runoff (inches)	0.55 inches	2030	0 inches (-0.1 to +0.4 inches)
			2050	0.1 inches (-0.08 to +0.39 inches)
			2070	0.07 inches (0.038 to 0.3 inches)
Borrego Valley (Desert)	Maximum 1-day runoff (inches)	0.03 inches	2030	0 inches (-0.005 to +0.007 inches)
			2050	0.01 inches (-0.01 to 0 inches)
			2070	0.01 inches (-0.01 to +0.03 inches)
* The value presented represents SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use extreme-year (time-P95) projections.				

Figure 32. *Maximum 1-Day Runoff in inches for four San Diego County locations*
Projected values represent 2030, 2050, and 2070 in three SSP scenarios of SSP2-4.5, SSP3-7.0, and SSP5-8.5 extreme-year projections (time-P95).



The ribbon plots highlighted in Figure 33 (time-P50) and Figure 34 (time-P95) showcase the maximum 3-day precipitation in inches for four cities of Borrego Valley, Escondido, Julian, and San Diego in the SDG&E service territory. Similar to the runoff projections, both model and emissions scenario uncertainty are relatively high for precipitation projections across the service territory. The maximum 3-day precipitation for all four cities is projected to increase by around 0.1 inches or more for the 2050 SSP3-7.0 model-P50 and time-P50 view. However, in the extreme-year (time-P95) view, San Diego is projected to experience a significant decrease in maximum 3-day precipitation for all three SSP scenarios.

Overall, climate models project the changes outlined below for median-year (time-P50) (Table 40, Figure 33).

Table 40. *Overview of model projections for median-year (time-P50)*

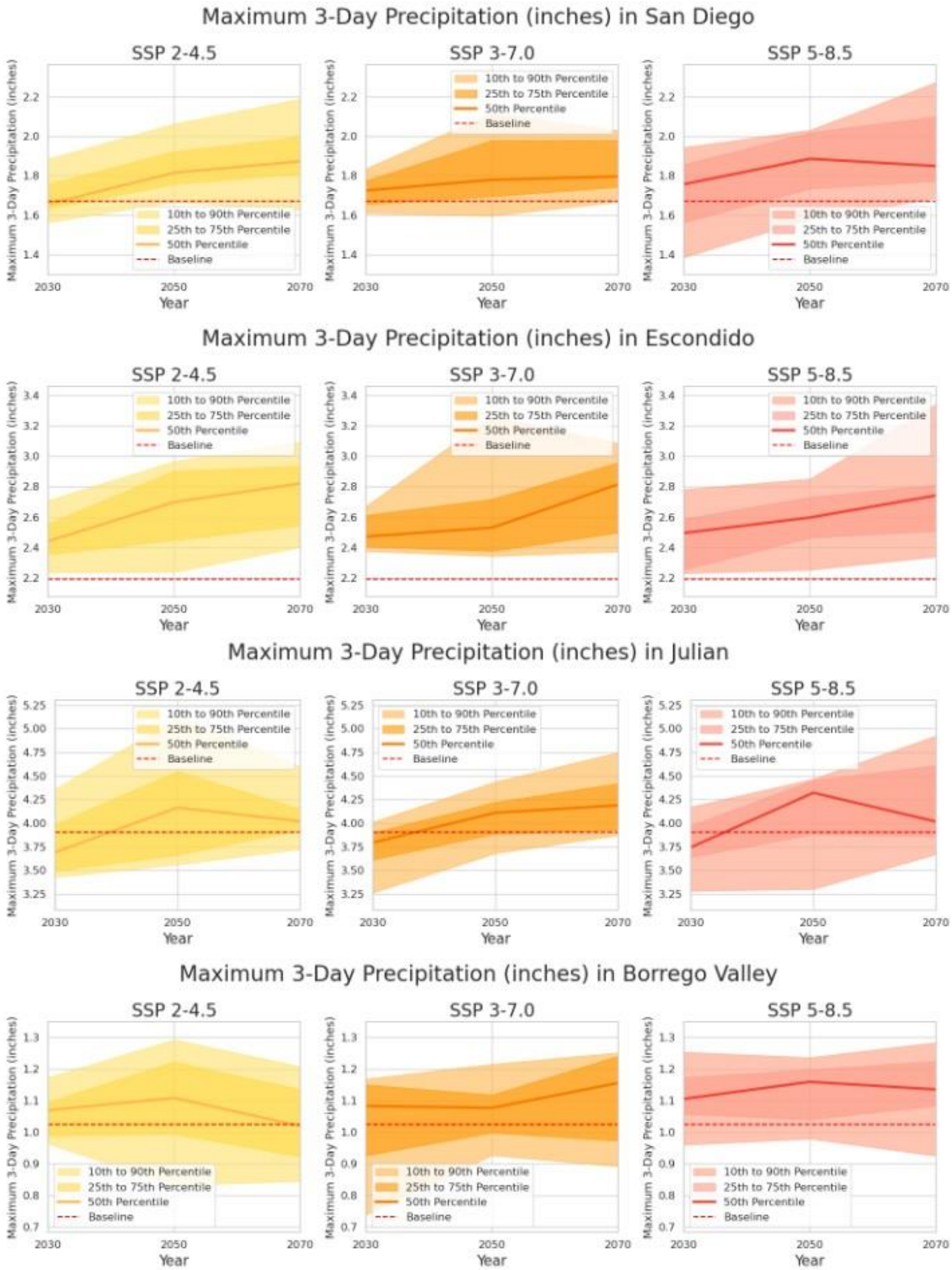
Projected change is relative to the baseline.

Location	Variable	Baseline	Year	Projected change from baseline*
San Diego (Coastal)	Maximum 3-day precipitation	1.7 inches	2030	0.05 inches (-0.1 to +0.3 inches)
			2050	0.08 inches (-0.04 to +0.33 inches)
			2070	0.09 inches (-0.08 to +0.6 inches)
Escondido (Inland)	Maximum 3-day precipitation	2.2 inches	2030	0.3 inches (0.03 to 0.55 inches)
			2050	0.3 inches (0.03 to 0.65 inches)
			2070	0.6 inches (0.2 to 1.14 inches)
Julian (Mountain)	Maximum 3-day precipitation	3.9 inches	2030	0.25 inches (-0.45 inches to +0.25 inches)
			2050	0.2 inches (-0.35 to +0.56 inches)
			2070	0.3 inches (-0.18 to +1 inches)
		1.02 inches	2030	0.05 inches (-0.05 to +0.2 inches)

Borrego Valley (Desert)	Maximum 3-day precipitation		2050	0.05 inches (-0.2 to +0.21 inches)
			2070	0.13 inches (-0.2 to +0.26 inches)
* The value presented represents SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use median-year (time-P50) projections.				

Figure 33. *Maximum 3-day Precipitation in inches for four San Diego County locations*

Projected values represent 2030, 2050, and 2070 in three SSP scenarios of SSP2-4.5, SSP3-7.0, and SSP5-8.5 for median-year projections (time-P50).



Overall, climate models project the changes outlined below for extreme-year projections (time-P95) (Table 41, Figure 34).

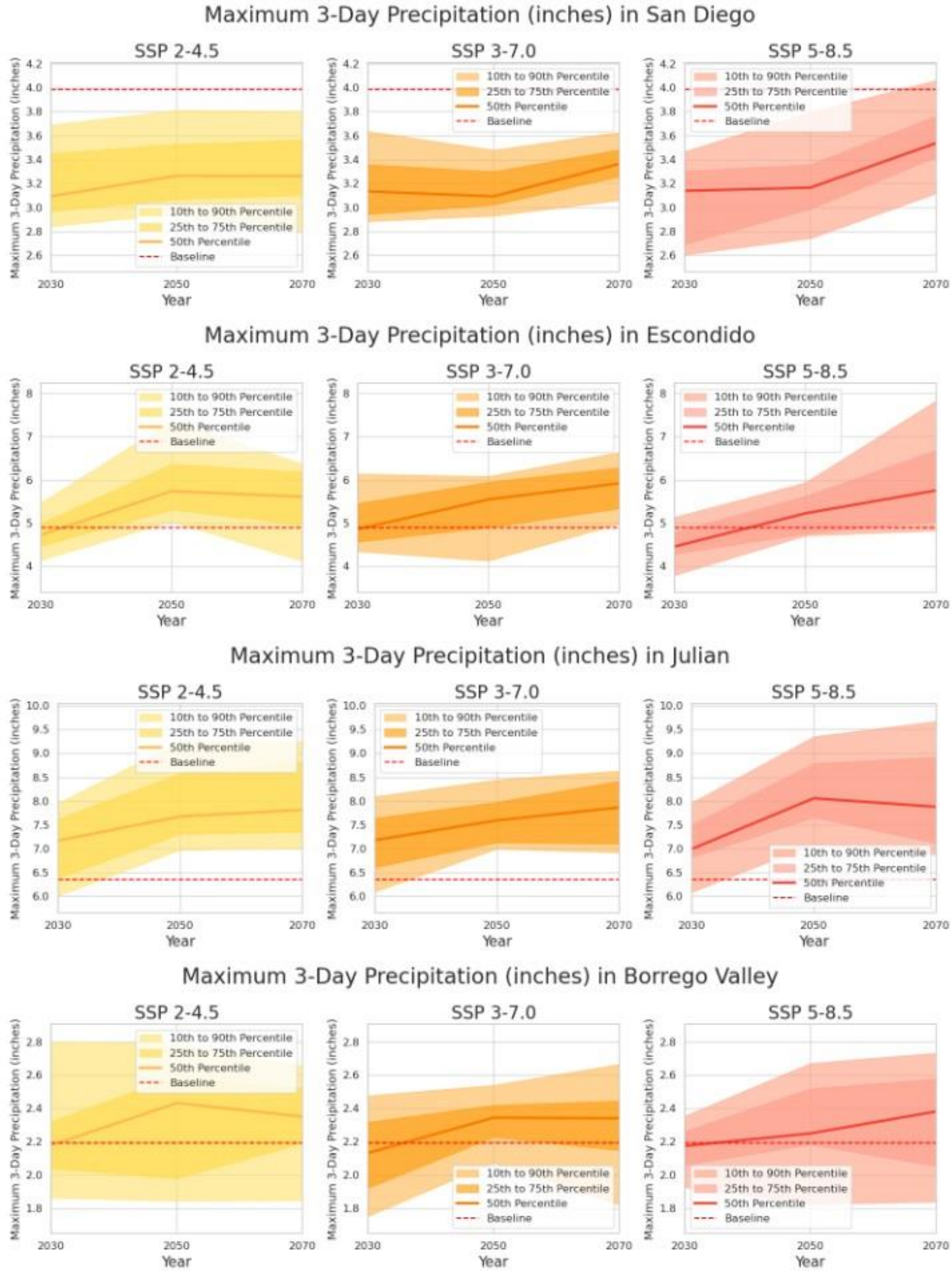
Table 41. *Overview of model projections for extreme-year (time-P95)*

Projected change is relative to the baseline.

Location	Variable	Baseline	Year	Projected change from baseline*
San Diego (Coastal)	Maximum 3-day precipitation	4 inches	2030	-0.85 inches (-1.15 to -0.5 inches)
			2050	-0.91 inches (-1.06 to -0.21 inches)
			2070	-0.64 inches (-1.2 to +0.05 inches)
Escondido (Inland)	Maximum 3-day precipitation	4.9 inches	2030	0 inches (-0.9 to -1 inches)
			2050	0.6 inches (+0.12 to +1.03 inches)
			2070	1 inch (-0.78 to +2.9 inches)
Julian (Mountain)	Maximum 3-day precipitation	6.35 inches	2030	0.8 inches (-0.4 to +1.6 inches)
			2050	1.25 inches (0.31 to 2.98 inches)
			2070	1.45 inches (0.65 to 3.25 inches)
Borrego Valley (Desert)	Maximum 3-day precipitation	2.2 inches	2030	-0.05 inches (-0.36 to 0.15 inches)
			2050	0.1 inches (-0.36 to +0.47 inches
			2070	0.1 inches (-0.36 to +0.53 inches)
* The value presented represents SSP3-7.0 50th percentile (model-P50) result with the range from SSP2-4.5 10th percentile (model-P10) to SSP5-8.5 90th percentile (model-P90) is given in parentheses. These use extreme-year (time-P95) projections.				

Figure 34. *Maximum 3-day Precipitation in inches for four San Diego County locations*

Projected values represent 2030, 2050, and 2070 in three SSP scenarios of SSP2-4.5, SSP3-7.0, and SSP5-8.5 for extreme-year projections (time-P95).



3.2.3.1 Exposure Scores

Exposure Approach

For inland flooding, the following variables were used for asset exposure.[50]

- Annual Maximum 1-day Runoff
- Annual Maximum 3-day Precipitation

Inland flooding thresholds were developed for exposure score bucketing using LOCA2-CA-forced VIC simulation of annual maximum 1-day runoff and annual maximum 3-day precipitation variables. Table 42 show asset-specific exposure thresholds used to bucket inland flooding scores.

Table 42. *Asset-specific exposure thresholds for the inland flooding hazard using annual maximum 1-day runoff and annual maximum 3-day precipitation*

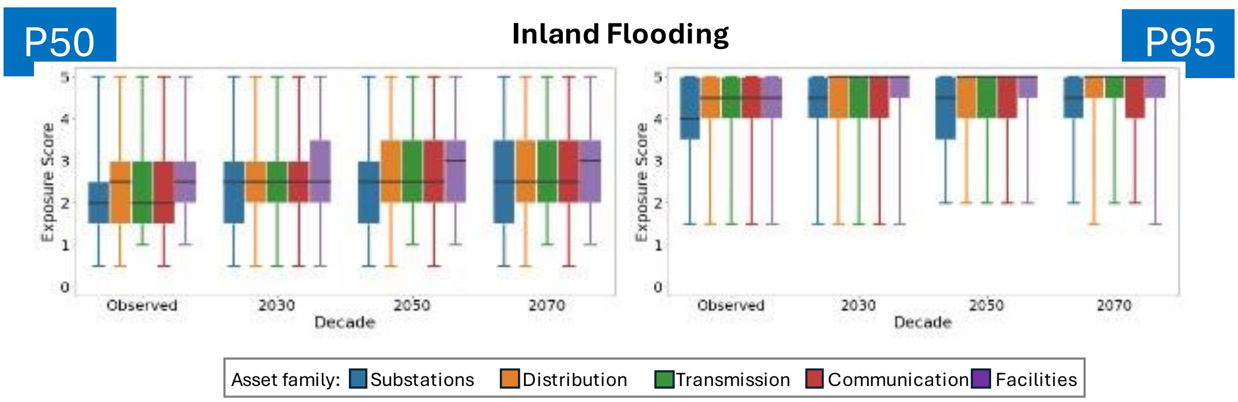
Hazard	Inland Flooding			
Asset Type	All assets			
Weighting	50%		50%	
Variable	**Annual maximum 1-day runoff**		**Annual maximum 3-day precipitation**	
Thresholds	*Runoff (mm)*	*Exposure Score*	*Precipitation (mm)*	*Exposure Score*
	0 mm	0	< 26 mm	0
	>0 – 1 mm	1	> 26 – 48 mm	1
	>1 – 2 mm	2	> 48 – 61 mm	2
	>2 – 4 mm	3	> 61 – 71 mm	3
	>4 – 6 mm	4	> 71 – 88 mm	4
	> 6 mm	5	> 88 mm	5

3.2.3.1.1 Exposure Summary

Exposure to inland flooding is projected to increase across the service territory in the Coastal, Inland, and Mountain regions through the 21st century, with the highest exposure scores in the Mountain and Inland regions. Increases in exposure are projected to be lower-magnitude relative to increases in exposure to temperature and wildfire, with consistent increases across all regions except the Desert region. The Desert region is projected to experience minimal change in exposure to inland flooding. Figure 35 shows boxplots for the full-service territory distribution (minimum, 25th percentile, 50th percentile, 75th percentile, and maximum values) of inland flood exposure scores for each asset family across time under the SSP3-7.0 50th percentile scenario. Across all asset families, inland flood exposure scores are projected to slightly increase over time. The model-median (model-P50) of median-year (model-P50) inland flood exposure scores across most asset families is projected to increase from 2-2.5 in the observed period to 2.5–3 by 2070. On average, the model-median (model-P50) of extreme-year (time-P95) inland flood exposure scores is projected to increase from 4-4.5 in the observed period to 4.5–5 by 2070. Under median-year (time-P50) inland flood exposure scores, the communication and facilities asset families experience the greatest change in exposure magnitudes, while transmission and substations experience the greatest change in extreme-year (time-P95) exposure magnitudes. Exposure score distributions by region are provided in Appendix II – Regional median-year (time-P50) exposure boxplots.

Figure 35. *Inland flood exposure by asset family*

Inland flood exposure score distributions for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 model-median (model-P50) scenario. Exposure score distributions are shown for median-year and extreme-year (time-P50 and time-P95) for each time horizon.

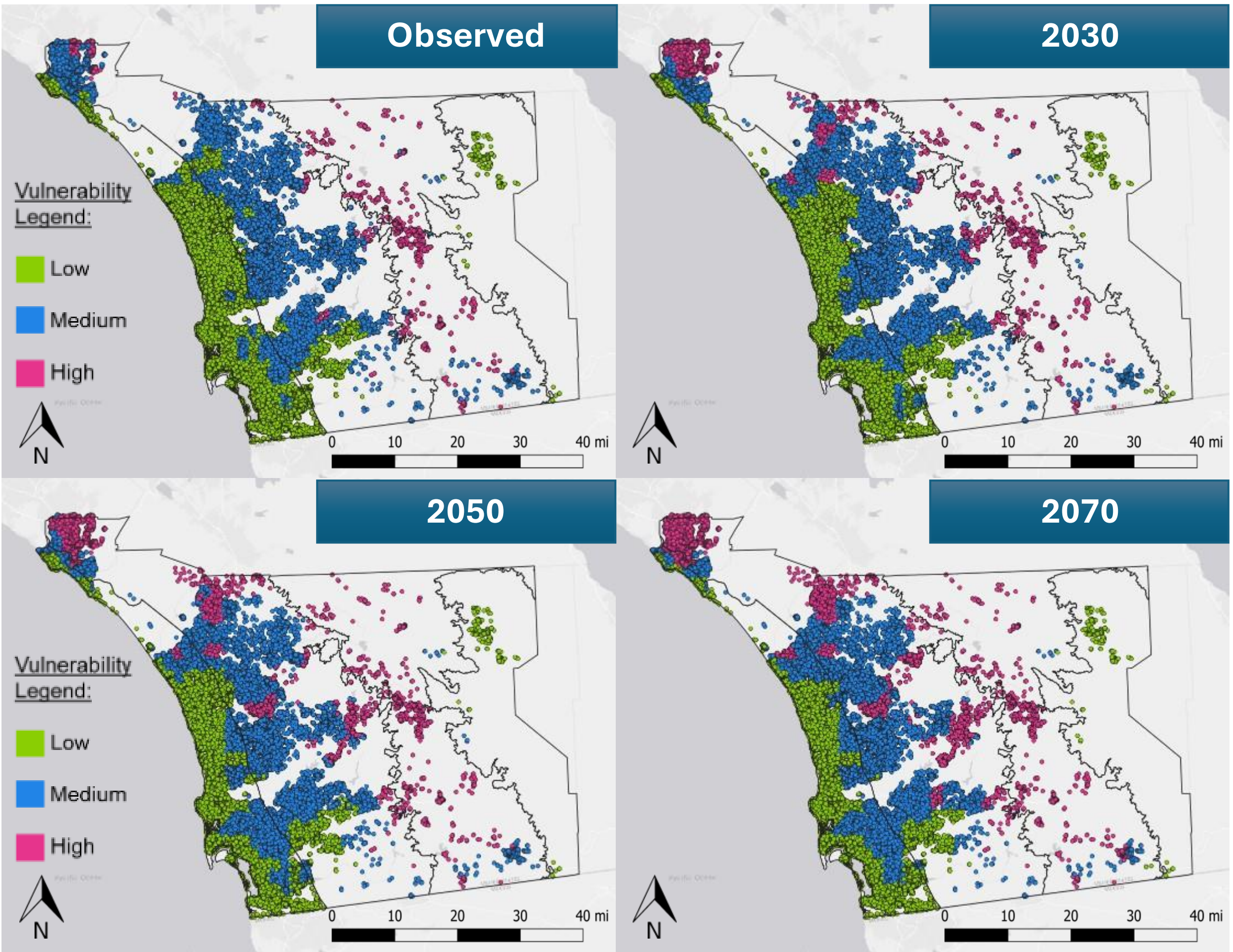


3.2.3.2 Sensitivity and Vulnerability Scores

Inland flooding poses a significant threat to assets, as a majority of both gas and electrical assets experience medium vulnerability in the baseline period. By 2070, inland flooding is projected to have an even larger impact on assets, with shifts towards higher asset vulnerability across the mountain, inland, and coastal regions. These shifts in vulnerability and regionality are illustrated in the maps below (Figure 36), which show vulnerability for pad-mounted transformers and inland in the present day, 2030, 2050, and 2070.

Figure 36. *Map of pad-mounted transformers & vulnerability to inland flooding*

Present day, 2030, 2050, and 2070 for model-P50 and time-P50 under SSP3-7.0.



3.2.3.2.1 Transmission

Sensitivity Scores

Out of all transmission asset types, underground line sub segments and poles and towers are all moderately sensitive to inland flooding. In the case of underground line sub segments (cable), transmission systems are generally designed to be submersible and can withstand surface flooding events, yet in extreme events with heavy inundation of soil, the load bearing capacity of the soil can be weakened and potentially cause damage to underground transmission as well as increased risk of landslides. In the case of poles and towers, erosion, scouring of the ground near pole bases due to extreme precipitation (especially near existing watercourses), and water exposure can weaken the structural integrity of transmission line structures due to soil saturation. Cascading effects of flooding and landslides can exacerbate the impact. Floating debris in moving water also may cause structural damage if high-velocity contact occurs. Overhead line segments have minimal sensitivity to inland flooding. The sensitivity of overhead line segments stems from the risk posed to the accessibility of assets in the case of flooding, which may impact the ability of operations and maintenance crews to access assets and potentially delay restoration activity. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 43. All transmission overhead line assets have low vulnerability to inland flooding across all time periods and scenarios. The percentage of underground line assets with medium vulnerability increases over time, from 17% in the baseline to 26% in 2030, 36% in 2050, and 38% in 2070 under SSP3-7.0 median-model (model-P50) and median-year (time-P50). Under the same scenario, the percentage of overhead structure assets with medium vulnerability to inland flooding rises from 25% in the baseline to 36% in 2030, 41% in 2050, and 42% in 2070. Under SSP3-7.0 extreme-year (time-P95) percentile, there is a large percentage of underground line and overhead structure assets with a high vulnerability: 34% of transmission underground line assets in the baseline, compared to 41% in 2030 and 2050 and 45% in 2070; and 39% of overhead structure assets in the baseline, compared to 50% in 2030 and 2050 and 53% in 2070.

Table 43. *Transmission assets and projected vulnerability to inland flooding*
By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Transmission						
	Transmission Overhead Line					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Transmission Underground Line					
Baseline	83%	17%	0%	4%	62%	34%
2030	74%	26%	0%	10%	49%	41%

2050	64%	36%	0%	10%	49%	41%
2070	62%	38%	0%	1%	55%	45%
	Overhead Structures (Transmission)					
Baseline	73%	25%	2%	9%	52%	39%
2030	61%	36%	3%	5%	44%	50%
2050	55%	41%	4%	6%	44%	50%
2070	54%	42%	4%	4%	43%	53%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.3.2.2 Distribution

Sensitivity Scores

Out of all distribution asset types, pad-mounted transformer and dynamic protective device assets (fault interrupters, reclosers, auto-throwovers, switches, and fuses) have severe sensitivity to inland flooding. Rapid debris flows aggravated by fast moving floods and landslides can exacerbate the impact due to the cascading hazards. Pad-mounted transformer assets are typically elevated several inches above ground level, such that flooding above the level of the pad may result in damage. If submersion occurs, de-energizing will be necessary, and floating debris in moving water can cause structural damage if high-velocity contact occurs. In the case of dynamic protection device assets, electromechanical and microprocessor relays can be sensitive to precipitation-induced flooding. Water exposure may corrode and damage microprocessors and moving components of electromechanical relays, and debris may be deposited in enclosures.

Poles, primary underground conductors, and subsurface transformer assets are found to have moderate sensitivity to inland flooding. For poles, erosion, scouring of the ground near pole bases, or pole rot from standing water or higher water tables associated with increased precipitation can compromise structural integrity—particularly in the case of wooden poles. As previously raised, floating debris can also cause structural damage in the instance of high-velocity contact. For primary underground conductor assets, the sensitivity comes from heavy inundations potentially weakening the load bearing capacity of soil. Additionally, conductors and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. For subsurface transformer assets, the moderate sensitivity comes from transformers and associated structures being sometimes subject to corrosion, particularly in the case of existing damage or faulty sealing. As with other assets, maintenance can also be impeded due to floodwater. Finally, for primary overhead conductor, overhead transformer, voltage regulator, and pole-mounted capacitor assets, the sensitivity to inland flooding is minimal. For all these assets, there is still a risk for the accessibility of assets to be hindered, in turn resulting in delays in restoration. Despite voltage regulators being found in sealed enclosures that reduce their sensitivity to extreme precipitation or pole-mounted capacitors being commonly made from hermetically sealed steel enclosures that make them resistant to water intrusion, they still remain vulnerable, for instance. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 44**.** Primary overhead conductors, overhead transformers, and voltage regulator assets have low vulnerability to inland flooding throughout all time periods and scenarios.

Overhead structures, primary underground conductors, pad-mounted transformers, subsurface transformers, and dynamic protective device assets all experience an increase in the percentage of their assets with medium to high vulnerability under the SSP3-7.0 median-model (model-P50) and median-year (time-P50) views. For example, 77% of dynamic protection devices have a low vulnerability in the baseline to inland flooding, but that percentage is projected to fall to 71% in 2030, 69% in 2050, and 68% in 2070. At the same time, the percentage of those assets with high vulnerability increases from 2% in the baseline to 5% in 2030, 6% in 2050, and 7% in 2070. Under the SSP3-7.0 extreme-year (time-P95) view, the proportion of overhead structure and primary underground conductor assets with medium vulnerability to inland flooding remains relatively stable: it retreats from 78% in the baseline to 77% in 2030, 2050, and 2070 for the former; and from 80% in the baseline to 79% in 2030, 78% in 2050, and 79% in 2070 for the latter. At the same time, overhead structures, primary underground conductors, pad-mounted transformers, subsurface transformers, dynamic protection devices, pad-mounted switches, and underground switches all see an increase in the share of their assets with high vulnerability to inland flooding between now and 2070. For example, while 80% of pad-mounted transformers have high vulnerability in the baseline to inland flooding under the SSP3-7.0 extreme-year (time-P95) view, this share reaches 87% in 2030, 2050, and 2070. Similarly, the percentage of pad-mounted switches assets with high vulnerability to inland flooding grows from 77% in the baseline, to 88% in 2030, 86% in 2050, and 88% in 2070 under that scenario.

Table 44. *Distribution assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Distribution						
	Overhead Structures (Distribution)					
Baseline	79%	21%	0%	10%	78%	12%
2030	67%	33%	0%	8%	77%	15%
2050	59%	41%	0%	9%	77%	14%
2070	58%	42%	1%	7%	77%	15%
	Primary Overhead Conductor					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Primary Underground Conductor					
Baseline	90%	10%	0%	11%	80%	9%
2030	78%	22%	0%	10%	79%	12%
2050	70%	29%	0%	11%	78%	11%
2070	69%	30%	0%	8%	79%	13%
	Overhead Transformer					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Pad-mounted Transformer					
Baseline	55%	43%	2%	0%	20%	80%
2030	44%	47%	9%	0%	13%	87%
2050	40%	50%	11%	0%	13%	87%
2070	36%	50%	14%	0%	13%	87%
	Subsurface Transformer					
Baseline	93%	7%	0%	3%	76%	21%
2030	82%	18%	0%	38%	36%	26%

2050	77%	23%	0%	38%	36%	26%
2070	74%	26%	0%	2%	70%	28%
	Voltage Regulator					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Dynamic Protection Devices					
Baseline	77%	22%	2%	43%	12%	45%
2030	71%	25%	5%	43%	9%	48%
2050	69%	25%	6%	43%	11%	47%
2070	68%	25%	7%	43%	9%	47%
	Pad-mounted Switches					
Baseline	65%	33%	2%	0%	23%	77%
2030	51%	41%	8%	0%	12%	88%
2050	47%	44%	9%	0%	14%	86%
2070	45%	45%	10%	0%	12%	88%
	Underground Switches					
Baseline	95%	5%	0%	5%	73%	22%
2030	84%	16%	0%	26%	45%	29%
2050	81%	19%	0%	27%	45%	28%
2070	79%	21%	0%	1%	68%	31%
	Overhead Switches					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Distribution Capacitors					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.3.2.3 Substation

Sensitivity Scores

All substation asset types have moderate sensitivity to inland flooding. Substation transformer assets are hermetically sealed such that extreme precipitation is unlikely to impact transformer windings and interior components, but auxiliary systems may be damaged and the removal of vegetation to reduce wildfire risk can increase susceptibility to erosion or flooding. Voltage regulator assets are also hermetically sealed, but flooding may seep through cracks or faulty seals and damage interior components. For substation reactor assets, flooding may impact radiators, fans, pumps, and external wiring connections, although it remains unlikely that extreme precipitation would impact reactors. For protection control devices, electromechanical and microprocessor relays can be vulnerable to flooding from precipitation and water exposure may corrode or damage microprocessors and moving components of electromechanical relays. Circuit breaker and switchgear assets installed at grade level can be damaged by flooding, with floodwaters potentially corroding electrical and mechanical components impacting operation and leading to future failure. Extreme cases of flooding can compromise the electrical insulation leading to catastrophic failure. Finally, despite capacitor banks being traditionally elevated above grade, water reaching the insulators of the capacitor cans could result in capacitor outage and possible damage, while switchgear installed at grade level can be damaged by flooding with floodwaters potentially corroding electrical and mechanical components and impacting operation and leading to future failure. In extreme cases of flooding, floodwater can compromise the electrical insulation leading to catastrophic failure. Floating debris may physically damage the assets, including circuit breakers, switchgears, and capacitor banks. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 45. Substation DPD assets have the lowest percentage of medium or high vulnerability to inland flooding across time horizons and scenarios. Under SSP3-7.0 median-model (model-P50) and median-year (time-P50), 100% of those assets have low vulnerability in the baseline to inland flooding which remains constant in 2030, 2050, and 2070. At the same time, under SSP3-7.0 extreme-year (time-P95), the percentage of assets with low vulnerability remains stable at 77% between the baseline and across 2030, 2050, and 2070.

It is notable that substation transformer, circuit breaker, switchgear, and capacitor bank assets all follow a relatively similar vulnerability trend. For instance, 90% of circuit breaker assets have low vulnerability in the baseline to inland flooding under SSP3-7.0 median-year (time-P50), compared to 81% in 2030, 77% in 2050, and 76% in 2070. Under that scenario, the percentage of those assets with medium vulnerability grows from 10% in the baseline to 19% in 2030, and 22% in 2050 and 2070. Under SSP3-7.0 extreme-year (time-P95), the percentage of circuit breaker assets with low vulnerability to inland flooding drops from 19% in the baseline to 17% in 2030, 16% and 2050, and 11% in 2070, while the percentage of assets with medium vulnerability fluctuates from 70% in the baseline to 67% in 2030, 68% in 2050, and 72% in 2070.

Finally, substation voltage regulators see a drop in the percentage of their assets with low vulnerability to inland flooding under SSP3-7.0 median-year (time-P50), with 89% in the baseline and 78% in 2030, 2050, and 2070. Under that scenario, it is notable that the percentage of substation voltage regulator assets with medium vulnerability rises from 11% in the baseline to 22% in 2030, 2050, and 2070, but that the share of assets with high vulnerability remains at 0% between now and 2070. Under SSP3-7.0 extreme-year (time-P95), the share of substation voltage regulator assets with low vulnerability to inland flooding drops from 30% in the baseline in 2030 and in 2050 to 27% in 2070, compared to a share of substation reactor assets with low vulnerability which fluctuates from 18% in the baseline, to 17% in 2030, 23% in 2050, and 10% in 2070 under that scenario. For those respective asset types, the share of assets with medium vulnerability to inland flooding respectively evolves from 70% in the baseline and in 2030 and 2050 to 73% in 2070, and from 81% in the baseline to 82% in 2030, 77% in 2050, 89% in 2070.

Table 45. *Substation assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Substation						
	Substation Transformer					
Baseline	96%	4%	0%	26%	72%	2%
2030	84%	17%	0%	22%	76%	3%
2050	78%	22%	0%	26%	72%	3%
2070	76%	24%	0%	16%	81%	3%
	Substation Voltage Regulator					
Baseline	89%	11%	0%	30%	70%	0%

2030	78%	22%	0%	30%	70%	0%
2050	78%	22%	0%	30%	70%	0%
2070	78%	22%	0%	27%	73%	0%
	Substation Reactor					
Baseline	93%	7%	0%	18%	81%	1%
2030	78%	22%	0%	17%	82%	1%
2050	73%	27%	0%	23%	77%	1%
2070	73%	27%	0%	10%	89%	1%
	Substation DPD					
Baseline	100%	0%	0%	77%	23%	0%
2030	100%	0%	0%	77%	23%	0%
2050	100%	0%	0%	77%	23%	0%
2070	100%	0%	0%	77%	23%	0%
	Circuit Breakers					
Baseline	90%	10%	1%	19%	70%	11%
2030	81%	19%	1%	17%	67%	16%
2050	77%	22%	1%	16%	68%	16%
2070	76%	22%	2%	11%	72%	16%
	Switchgear					
Baseline	90%	10%	1%	19%	70%	11%
2030	81%	19%	1%	17%	67%	16%
2050	77%	22%	1%	16%	68%	16%
2070	76%	22%	2%	11%	72%	16%
	Capacitor Banks					
Baseline	90%	10%	1%	19%	70%	11%
2030	81%	19%	1%	17%	67%	16%
2050	77%	22%	1%	16%	68%	16%
2070	76%	22%	2%	11%	72%	16%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.3.2.4 Communication

Sensitivity Scores

Out of all communication asset types, underground fiber, underground copper, overhead structure, and SCADA RTU assets all have low sensitivity to inland flooding. In the case of underground fiber and copper assets, cables traditionally include features to resist water ingress, yet sustained exposure to water due to flooding can impact them by causing water to infiltrate ducts or conduits and potentially leading to physical damage and signal loss. Water can corrode the cables' coating and damage the core glass or the cables themselves if the seals are compromised. For communication poles, erosion, scouring of the ground near pole bases, and pole rot from extreme precipitation and higher water tables can compromise structural integrity. Because communication poles are built with robust foundations, standing water effects are expected only when the inundation is long-term; the impact will be greatest from moving water. SCADA RTU assets have enclosures that are commonly sealed and resistant to extreme weather, which reduces their sensitivity to extreme precipitation and inland flooding; however, restoration activities can be impeded due to sustained flooding. Floating debris in moving water could also cause structural damage if high-velocity contact occurs. On the other hand, the sensitivity of overhead fiber and copper assets to inland flooding is minimal, with flooding still potentially hindering the accessibility of assets and causing restoration delays. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 46, overhead fiber and copper assets have low vulnerability to inland flooding throughout all time periods and scenarios. However, while the majority of underground fiber, underground copper, overhead structure, and SCADA RTU assets have low vulnerability in the baseline under SSP3-7.0 men-model (model-P50) and median-year (time-P50), vulnerability is projected to increase in the coming decades. For example, the percentage of SCADA RTU assets with medium vulnerability is projected to increase from 14% in the baseline to 24% in 2030, 33% in 2050, and 34% in 2070. Under SPPS 3-7.0 extreme-year (time-95), the share of those assets with medium vulnerability to inland flooding fluctuates from 87% in the baseline to 89% in 2030, 88% in 2050, and 89% in 2070.

Table 46. *Communication assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Communication						
	Overhead Fiber					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Overhead Copper					
Baseline	100%	0%	0%	100%	0%	0%
2030	100%	0%	0%	100%	0%	0%
2050	100%	0%	0%	100%	0%	0%
2070	100%	0%	0%	100%	0%	0%
	Underground Fiber					
Baseline	97%	3%	0%	27%	73%	0%
2030	94%	6%	0%	25%	75%	0%
2050	77%	23%	0%	27%	73%	0%
2070	81%	19%	0%	19%	81%	0%
	Underground Copper					
Baseline	96%	4%	0%	35%	65%	0%
2030	91%	9%	0%	34%	66%	0%
2050	81%	19%	0%	35%	65%	0%
2070	84%	16%	0%	32%	68%	0%
	Overhead Structures (Communication)					
Baseline	88%	12%	0%	31%	69%	0%
2030	78%	22%	0%	31%	69%	0%
2050	72%	28%	0%	32%	68%	0%
2070	71%	29%	0%	29%	71%	0%
	SCADA RTU					
Baseline	86%	14%	0%	13%	87%	0%
2030	76%	24%	0%	12%	89%	0%

2050	67%	33%	0%	12%	88%	0%
2070	66%	34%	0%	11%	89%	0%
	Antennas					
Baseline	88%	12%	0%	10%	90%	0%
2030	78%	23%	0%	9%	91%	0%
2050	68%	32%	0%	10%	91%	0%
2070	68%	32%	0%	8%	92%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.3.2.5 Facilities

Sensitivity Scores

Out of all facilities asset types, only critical facilities have a high sensitivity to inland flooding. That is because flooding could damage critical equipment (e.g., servers and power supply) or supporting systems (e.g., HVAC and backup generators) and make these facilities inoperable. Additionally, if flooding blocks road access, it may restrict access to some sites and make them inoperable or understaffed. On equipment itself, it is important to note that some servers and cabling under raised floor could get damaged by flooding and that other equipment mounted on raised floors would still be sensitive if reached by floodwaters. Communication centers, which are unmanned and out in the elements in remote areas, have a moderate sensitivity, for some components within could be impacted by flooding. Finally, office buildings (e.g., headquarters, call centers, training centers, and warehouses) and construction and operation centers have low sensitivity to inland flooding. For the former, sensitivity to extreme precipitation and inland flooding is determined based on a combination of building factors and site operations. Flooding could damage equipment and restrict access; due to the critical nature of these facilities, some operations may be temporarily modified or suspended during flooding events while others may be modified or relocated. For the latter, flooding could damage equipment and restrict access to asset critical facilities, making them inoperable or understaffed. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 47**,** most office buildings and construction and operation center assets have low vulnerability to inland flooding under SSP3-7.0 median-model (model-P50) and median-year (time-P50) regardless of the time period. Under SSP3-7.0 extreme-year (time-P95), 88% of office buildings have medium vulnerability to inland flooding in the baseline and in 2030, 2050, and

2070. At the same time, the proportion of construction and operation center assets with medium vulnerability increases under that scenario, from 82% in the baseline to 91% in 2030, 2050, and 2070. For communication centers, the share of assets with high vulnerability to inland flooding is projected to increase in the coming decades, particularly under SSP3-7.0 extreme-year (time-P95). Indeed, in that scenario the share of those assets with high vulnerability grows from 43% in the baseline, to 57% in 2030 and 2050, and 59% in 2070. Finally, 100% of critical facility assets have a medium vulnerability to inland flooding across all time periods under SSP3-7.0 median-year (time-P50). Notably, under SSP3-7.0 extreme-year (time-P95), 100% of those assets have a high vulnerability to inland flooding under all time periods.

Table 47. *Facility assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Facilities						
	Office Buildings					
Baseline	100%	0%	0%	13%	88%	0%
2030	100%	0%	0%	13%	88%	0%
2050	88%	13%	0%	13%	88%	0%
2070	88%	13%	0%	13%	88%	0%
	Construction and Operation Centers					
Baseline	91%	9%	0%	18%	82%	0%
2030	82%	18%	0%	9%	91%	0%
2050	82%	18%	0%	9%	91%	0%
2070	82%	18%	0%	9%	91%	0%
	Communication Centers					
Baseline	55%	39%	5%	11%	46%	43%
2030	54%	41%	5%	13%	30%	57%
2050	46%	43%	11%	13%	30%	57%
2070	48%	41%	11%	13%	29%	59%
	Asset Critical Facilities					
Baseline	0%	100%	0%	0%	0%	100%

2030	0%	100%	0%	0%	0%	100%
2050	0%	100%	0%	0%	0%	100%
2070	0%	100%	0%	0%	0%	100%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

3.2.3.2.6 Gas Assets

Sensitivity Scores

Regulators, compressors, and valves have the highest overall sensitivity to inland flooding among gas assets. As these assets are above ground, they are most likely to be exposed to extreme precipitation. Additionally, water intrusion into compressors or valves can result in elevated regulator pressure and lead to a line rupture.

Often buried below ground, high- and medium-pressure pipes typically have a lower sensitivity to inland flooding than regulators and compressors, with high-pressure pipes being marginally more sensitive than medium-pressure pipes. While high- and medium-pressure pipes may not be directly exposed to extreme precipitation associated with inland flooding, they can still be indirectly impacted by soil displacement and erosion. Additionally, access to these pipes for critical repairs may be impeded by flooding due to extreme precipitation.

Sensitivity scores for gas assets were determined by SCG SMEs and were used to determine the asset vulnerabilities shown in the tables below (Table 51, Table 52, Table 53).

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for inland flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 48, Table 49, and Table 50. Medium-pressure pipe assets have a low percentage of medium or high vulnerability to inland flooding across time horizons under SSP3-7.0 median-model (model-P50) and median-year (model-P50), with 100% of assets having low vulnerability in the baseline to inland flooding, compared to 99% in 2030, and 98% in 2050 and 2070. At the same time, under SSP3-7.0 extreme-year (time-P95), the percentage of those assets with low vulnerability fluctuates from 53% now to 41% in 2030, 43% in 2050, and 38% in 2070.

It is notable that controllable gas valves and high-pressure pipes follow a relatively similar vulnerability trend. For instance, 88% of high-pressure pipe assets have low vulnerability in the baseline to inland flooding under SSP3-7.0 median-year (time-P50), compared to 74% in 2030, and 70% in 2050 and 2070. Under that scenario, the percentage of assets with medium vulnerability grows from 12% in the baseline to 26% in 2030, and 30% in 2050 and 2070. Under SSP3-7.0 extreme-year (time-P95), the percentage of high-pressure pipe assets with low vulnerability to inland flooding follows a downward trend, from 17% in the baseline to 13% in 2030, 14% in 2050, and 12% in 2070, while the share of assets with medium vulnerability rises from 75% in the baseline to 77% in 2030, 2050, and 2070.

Finally, regulator assets also see a notable drop in the percentage of their assets with low vulnerability to inland flooding under SSP3-7.0 median-year (time-P50), with 70% in the baseline, 58% in 2030, 56% in 2050, and 52% in 2070. Under that scenario, it is notable that the percentage of regulator assets with high vulnerability grows from 0% in the baseline and in 2030, to 1% in 2050 and 2% in 2070. Under SSP3-7.0 extreme-year (time-P95), the share of regulator assets with low vulnerability to inland flooding is only 3% in the baseline, 6% in 2030 and 2050, and to 1% in 2070. The share of those assets with medium vulnerability to inland flooding under SSP3-7.0 extreme-year (time-P95) fluctuates from 56% in the baseline to 44% in 2030, 42% in 2050, and 44% in 2070, while that of assets with high vulnerability grows from 41% in the baseline, to 50% in 2030, 52% in 2050, and 55% in 2070.

Table 48. *High-pressure pipe assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0- time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
High-Pressure Pipes (HPPs)						
	HPP					
Baseline	88%	12%	0%	17%	75%	7%
2030	74%	26%	0%	13%	77%	10%
2050	70%	30%	0%	14%	77%	10%
2070	70%	30%	0%	12%	77%	11%
	HP Service Pipes					
Baseline	99%	1%	0%	72%	28%	0%
2030	93%	8%	0%	69%	30%	0%
2050	91%	9%	0%	69%	31%	0%
2070	90%	10%	0%	66%	34%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

Table 49. *Medium-pressure pipe assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Medium-Pressure Pipes (MPPs)						
	MPP					
Baseline	100%	0%	0%	53%	47%	0%
2030	99%	1%	0%	41%	59%	0%
2050	98%	2%	0%	43%	58%	0%
2070	98%	2%	0%	38%	62%	0%
	MP Service Pipes					
Baseline	100%	0%	0%	69%	31%	0%
2030	100%	0%	0%	55%	45%	0%
2050	100%	0%	0%	57%	43%	0%
2070	100%	0%	0%	50%	50%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 50. *Regulator, compressor, & valve assets and projected vulnerability to inland flooding*

By % of total number of assets of each type for median-model (model-P50) and both median-year and extreme-year (time-P50 and time-P95).

Time Horizon	Vulnerability Levels (SSP3-7.0 time-P50, model-P50)			Vulnerability Levels (SSP3-7.0 time-P95, model-P50)		
	Low	Medium	High	Low	Medium	High
Regulators, Compressors, Valves						
	Controllable Gas Valve					
Baseline	86%	14%	0%	13%	70%	17%
2030	77%	23%	0%	12%	67%	21%
2050	68%	32%	0%	13%	66%	21%
2070	70%	30%	0%	10%	67%	23%
	Non-Controllable Gas Valve					

Baseline	98%	2%	0%	70%	27%	3%
2030	94%	6%	0%	69%	28%	3%
2050	89%	11%	0%	69%	28%	3%
2070	91%	9%	0%	69%	28%	3%
	Regulator					
Baseline	70%	30%	0%	3%	56%	41%
2030	58%	41%	0%	6%	44%	50%
2050	56%	44%	1%	6%	42%	52%
2070	52%	46%	2%	1%	44%	55%
	Compressor Station*					
Baseline	0%	100%	0%	-	-	-
2030	0%	100%	0%	-	-	-
2050	0%	100%	0%	-	-	-
2070	0%	100%	0%	-	-	-

Note: Due to rounding, vulnerability level percentages for certain assets may not equal 100%

**Vulnerability scores for the Moreno compressor station come from the SCG study*

3.2.3.2.7 Gas Assets – Landslides

Landslides were a hazard of particular interest to SMEs when reviewing gas assets, especially above-ground equipment, warranting a deeper dive into asset vulnerability. In the present-day, there are a limited amount of assets with high vulnerability to landslides, mainly within in the coastal and inland regions. While there is not a drastic change in vulnerability scores for landslides, from observed to 2070, there are localized changes from low to medium and medium to high vulnerability. The map below (Figure 37) visualizes these localized changes in vulnerability for high-pressure pipes for observed, 2030, 2050, and 2070.

Figure 37. *Map of high-pressure pipes & vulnerability to landslides in the present day, 2030, 2050, and 2070 model-P50 and time-P50 under SSP3-7.0*

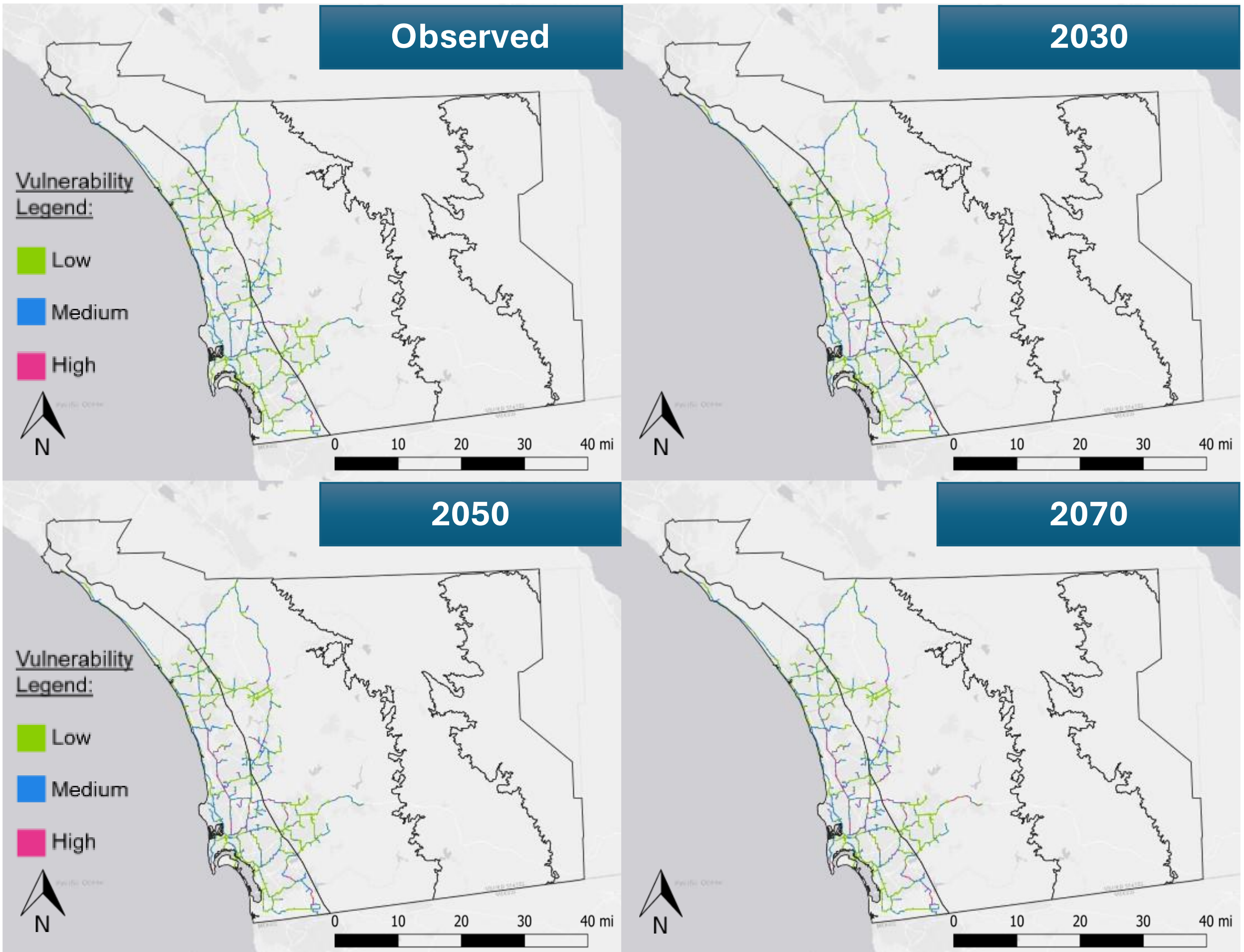


Table 51. *High-pressure pipe assets and projected vulnerability to landslides (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Under SSP3-7.0)		
	Low	Medium	High
High-Pressure Pipes (HPPs)			
	HPP		
Baseline	69%	29%	2%
2030	66%	30%	4%
2050	65%	31%	4%
2070	65%	29%	6%
	HP Service Pipe		

Baseline	93%	8%	0%
2030	93%	8%	0%
2050	92%	8%	0%
2070	89%	11%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 52. *Medium-pressure pipe assets and projected vulnerability to landslides (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Under SSP3-7.0)		
	Low	**Medium**	**High**
Medium-Pressure Pipes (MPPs)			
	MPP		
Baseline	85.2%	14.7%	0.1%
2030	84.5%	15.4%	0.1%
2050	82.4%	17.5%	0.2%
2070	79.3%	20.4%	0.3%
	MP Service Pipe		
Baseline	99.3%	0.7%	0.0%
2030	99.0%	1.0%	0.0%
2050	98.5%	1.5%	0.0%
2070	97.5%	2.5%	0.0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 53. *Regulator, compressor, & valve assets and projected vulnerability to landslides (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Under SSP3-7.0)		
	Low	**Medium**	**High**
Regulators, Compressors, Valves			
	Controllable Gas Valve		
Baseline	86.1%	13.6%	0.3%
2030	86.0%	13.6%	0.4%
2050	85.5%	14.0%	0.5%
2070	84.8%	14.1%	1.1%

	Non-Controllable Gas Valve		
Baseline	92.8%	6.9%	0.3%
2030	91.7%	8.0%	0.3%
2050	91.9%	7.8%	0.4%
2070	87.7%	11.9%	0.4%
	Regulator		
Baseline	80.3%	19.2%	0.5%
2030	78.8%	20.6%	0.6%
2050	78.1%	20.9%	1.1%
2070	77.3%	20.1%	2.6%
	Compressor Station		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.3.3 Vulnerability of Operations & Services

SDG&E characterized the vulnerability of its operations and services to inland flooding by considering the exposure of SDG&E's service territory to the hazard and the sensitivity of each operation and service.

Exposure to inland flooding is projected to increase across all regions of the SDG&E service territory in the future. For example, maximum 3-day precipitation in the Julian region is projected to increase by 1.45 inches relative to baseline by 2070. The heightened exposure of the service territory to inland flooding is likely to impact SDG&E's operations and services in direct and indirect ways. It could, for instance, prevent access to critical underground distribution and transmission lines that would be submerged, thereby directly affecting asset management. At the same time, SDG&E has noted that underground distribution connectors and saturated cables have faulted when dried out after flood events, which could indirectly affect reliability planning.

To understand the sensitivity of operations and services to inland flooding, the SDG&E characterized their current resilience to this hazard. As described in 3.1.1.3 Adaptive Capacity, the SDG&E scored operational maturity from 0 to 5 by assessing five topics associated with resilience practices. Across each of these topics, the operations and services received a score of 0 to 1, with 1 representing a high compliance with the resilience practice. Operational maturity is used as a proxy for operational sensitivity to derive operational vulnerability.

The output of the operational maturity scoring is presented in Table 54.

Table 54. *Operational maturity scores of SDG&E's operations and services for inland flooding*

	Historical and projected extreme weather	Investment in new technology	Performance metrics	Stakeholder engagement	Personnel Training	TOTAL (out of 5)
Asset Management	0.5	0.5	0.5	0.5	0.5	**2.5**
Vegetation Management	0.5	0.5	0.5	N/A	N/A	**2.5**
Emergency Response	0.5	1	1	1	0.5	**4**
Comms.	0.5	0.5	0.5	0.5	0.5	**2.5**
Safety Operations	0.5	0.5	1	1	1	**4**
Reliability Planning	0.5	1	1	1	1	**4.5**
Supply Management	0.5	0.5	0.5	0.5	0.5	**2.5**

Based on the limited increase in exposure of the SDG&E's service territory to inland flooding and on the operational maturity scores obtained, asset management, vegetation management, communications, and supply management have the highest projected operational vulnerability to the hazard. In each case, resilience practices are not currently fully incorporated.

Emergency response and safety operations appear to be in better standing. For the former, investments in technologies and innovation, tracking of teams' performance through specific metrics, and diverse and external stakeholder communication and feedback are well incorporated. For the latter, there is similar tracking of teams' performance and diverse and external stakeholder communication and feedback, in addition to the personnel being regularly trained. The strong integration of these different resilience practices makes these operations and services less sensitive to inland flooding.

Finally, reliability planning is least vulnerable across all operations and services by assimilating all the practices mentioned previously.

These results are summarized in Figure 38 below.

Figure 38. *Graphical representation of the vulnerability of SDG&E's operations and services to inland flooding*

3.2.4 Coastal Flooding

Hazard characterization

The majority of sea level rise occurs from melting ice sheets and glaciers and thermal expansion of water—both of which are triggered by warming temperatures. SLR also amplifies the impacts of the 1% annual chance (100-year) storm surge. This poses a threat to coastal infrastructure and communities. Along the San Diego coast, sea levels are expected to rise approximately 1 foot by 2050, which is at a substantially faster rate than historically observed. As levels increase, current thresholds of extremes will become more frequent and occur for longer durations, although the most extreme SLR events will likely occur in short bursts during El Niño conditions.[33] Coastal flooding associated with the 100-year storm surge will likely also worsen as sea levels rise.[35]

SLR can exacerbate coastal flooding and accelerate coastal erosion by increasing the frequency and intensity of flooding events and eroding beaches, cliffs, and dunes. SLR can also lead to more powerful waves and storm surges that remove sediment and weaken coastal structures. This process causes the shoreline to retreat inland, threatening natural landscapes, infrastructure, and communities.

Coastal flooding can be experienced as king tides, which are periodic, anomalously high tides well above normal levels. SLR from climate change could amplify the impact of king tides in California, increasing baseline water levels and making king tides stronger and potentially more destructive absent adaptation and resilience efforts. This could lead to more frequent and severe coastal flooding, which can inundate low-lying areas, erode beaches and cliffs, and raise coastal groundwater levels. The combination of higher sea levels and king tides also leads to cascading impacts that exacerbates storm surges, resulting in more extensive and damaging flooding events.

Variables and methods

The following climate variable was analyzed to determine present day and future exposure to inland flooding:

- Inundation from SLR with 100-Year and 20-Year Storm Surge

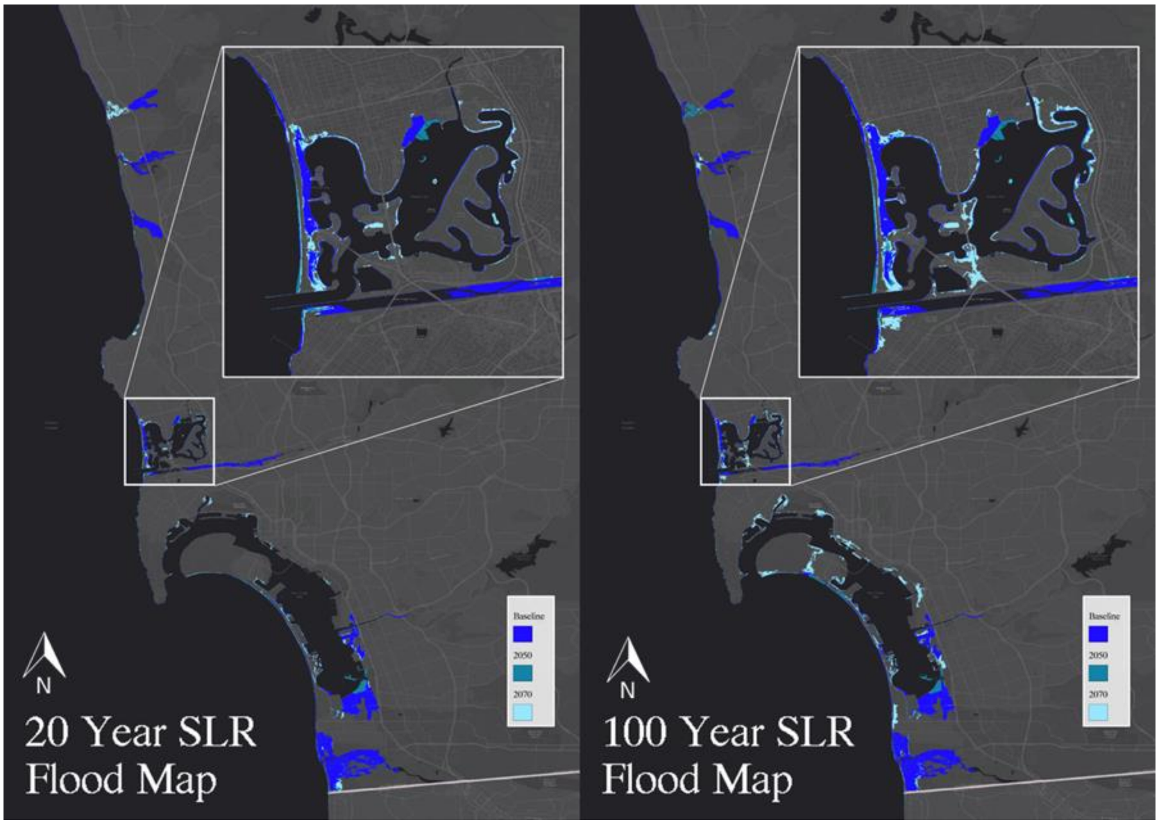
This variable was calculated from the Coastal Storm Modeling System (CoSMoS) storm and updated CMIP6 tide gauge SLR projections for the southern California coast at La Jolla tide gauge. The CoSMoS models inundation depths as a result of SLR and the 100-year and 20-year storms (note that as such, the baseline/0 SLR just shows the 100-year or 20-year storm) for 2030, 2050, and 2070 SLR scenarios. CoSMoS inundation depth layers are available in 25 cm (~10 inches) SLR increments. The closest SLR depth layer is used for each SLR scenario. SLR increments chosen for the study correspond with the updated 2024 California State Guidance for San Diego under the intermediate-high risk aversion scenario using CMIP6 projections.[51]

Projected Change across the SDG&E Service Territory

Figure 39 shows the inundation from SLR and the storm surge associated with 20-year and 100-year storm events at baseline, 2050, and 2070 SLR scenarios. For 2030, SLR is similar to 2050 leading to identical inundation and extents. Under a 20-year storm surge and SLR scenario, floodplains are projected to expand in future time horizons to inundate more of Mission Bay, river outlets north toward Del Mar, portions of San Diego Bay, and Tijuana River Valley (just north of Tijuana, Mexico). These projected trends are exacerbated under a 100-year storm surge + SLR scenario, with inundation expanding farther into normally dry land in and around Mission Bay, downtown San Diego, and into more of San Diego Bay.

Figure 39. *Inundation from sea level rise and storm surge at baseline, 2050, and 2070 (20- and 100-year events)*

For 2030, SLR is similar to 2050 leading to identical inundation and extents (not shown). The inset portion of the map shows inundation at Mission Bay, San Diego.



3.2.4.1 Exposure Scores

Exposure Approach

Coastal flooding thresholds were developed for exposure score bucketing using coastal inundation depth from the 100-year and 20-year storm surge plus SLR. Table 55 shows asset-specific exposure thresholds used to bucket coastal flooding scores.

Table 55. *Exposure scoring for SLR variables*

Hazard	Coastal Flooding	
Asset Type	All assets	
Weighting	50%	50%
Variable	**Inundation from SLR + 100-Year Storm Surge**	**Inundation from SLR + 20-Year Storm Surge**

	Inundation Level	Exposure Score	Inundation Level	Exposure Score
Thresholds	No inundation	0	No inundation	0
	>0 – 36 cm	1	>0 – 36 cm	1
	>36 – 70 cm	2	>36 – 73 cm	2
	>70 – 110 cm	3	>73 – 111 cm	3
	>110 – 161 cm	4	>111 – 159 cm	4
	>161 cm	5	>159 cm	5

3.2.4.1.1 Exposure Summary

The proportion of assets exposed to coastal flooding in either 20-year or 100-year coastal floodplains is summarized below in Table 56 and the extent is shown in Figure 40. Only a small percentage of assets are exposed to coastal flooding across all asset families during the baseline period. However, by 2070, the percentage of exposed assets is projected to more than double, especially in low-lying areas located around Mission Bay, San Diego Bay (including parts of Point Loma, Chula Vista, National City, and Imperial Beach), Coronado Island, and Silver Strand. Substations are expected to experience the most significant increase in exposure, rising from 0.3% of assets in the baseline period to 2.2% by 2070.

Table 56. *Asset counts with coastal flood exposure ≥1 by asset family (baseline–2070)*

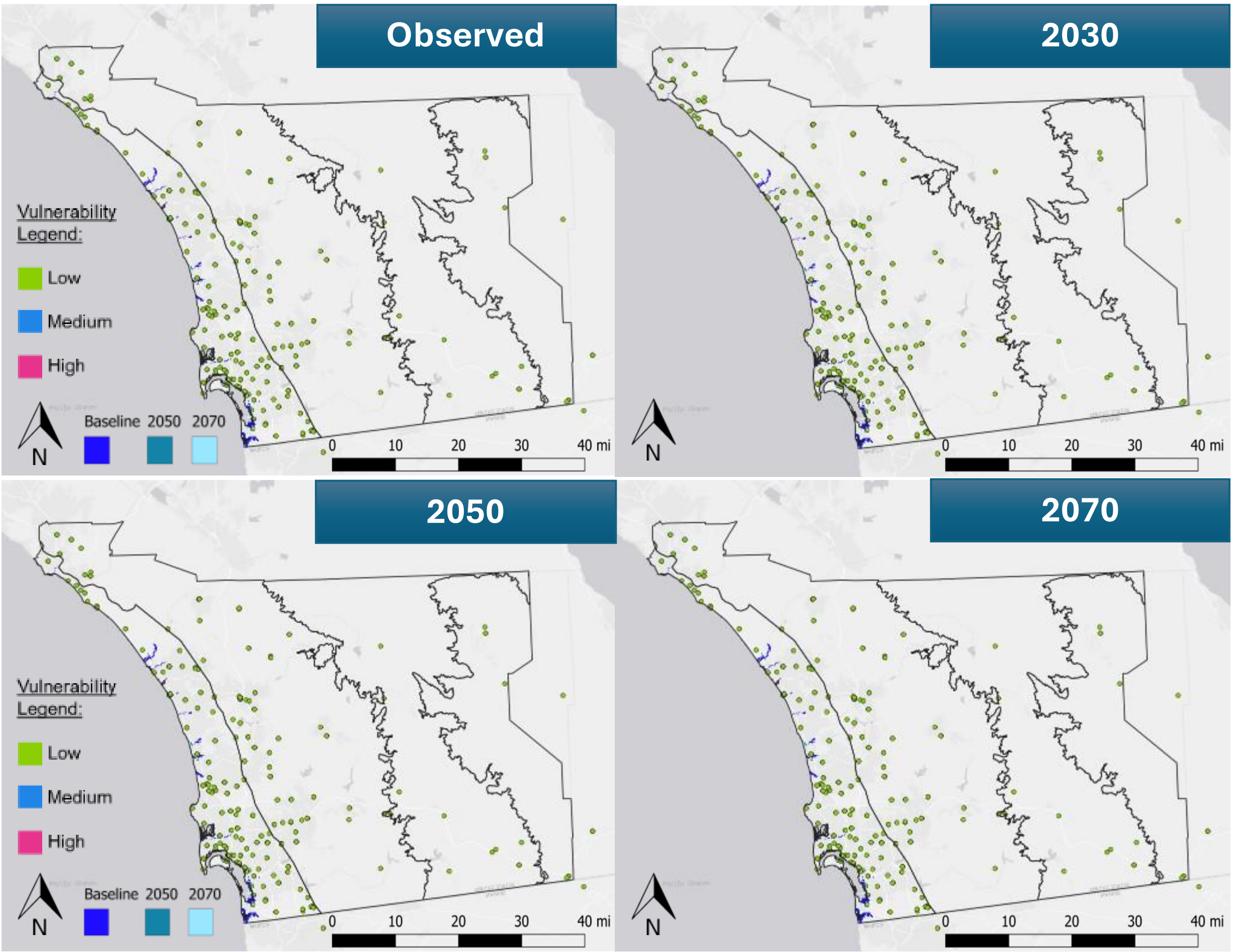
Asset count with exposure scores of 1 or above (inundated by 20-year or 100-year floodplains) for coastal flooding by asset family during baseline, 2030, 2050, and 2070.

Asset Family	Baseline	2030	2050	2070
Distribution	1,540	1,835	1,835	4,175
Transmission	165	171	171	343
Substations	5	5	5	34
Communication	80	82	82	221
Facilities	0	0	0	0

3.2.4.2 Sensitivity and Vulnerability Scores

While the sensitivity and vulnerability scores for other climate hazards were determined under two climate scenarios (SSP3-7.0 model-P50 under time-P50 & time-P95), coastal resilience sensitivity and vulnerability was only calculated under one SLR scenario: Intermediate-High. This SLR scenario aligns with California Ocean Protection Council (OPC) guidance[52] for medium-high risk aversion. The majority of assets experience low vulnerability to coastal flooding regardless of time period. For example, 100% of substation transformers experience low vulnerability in the baseline, 2030, 2050, and 2070 (Figure 40).

Figure 40. *Map of substation transformers & vulnerability to coastal flooding in the observed, 2030, 2050, and 2070*



3.2.4.2.1 Transmission

Sensitivity Scores

Out of all transmission asset types, poles and towers have a high sensitivity to coastal flooding. Erosion, scouring of the ground near pole bases, and saline water exposure from rising sea levels can compromise the structural integrity of line structures and accelerate corrosion of structural members. In addition, wave action and floating debris could cause structural damage if high-velocity contact occurs. Consecutively, high tides or king tides during such flooding events can exacerbate the impact and even affect assets that are further inland. Underground line sub-segment assets (cables) have a low sensitivity to coastal flooding. While they are generally designed to be submersible and can withstand flooding events, extreme flooding can still compromise the durability of those assets. In extreme events, heavy inundation of soil, especially if compounded by wave impacts, can weaken the load bearing capacity of soil, potentially causing damage to underground transmission. Finally, overhead line segments have a minimal sensitivity to coastal flooding largely due to the fact that, while they may not be directly damaged by coastal flooding, operations and maintenance crews may be unable to access these assets and thereby cause delay in restoration activity. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 57. All transmission overhead line assets and almost all (99.9%) of overhead transmission structure assets are projected to have low vulnerability to coastal flooding in the baseline period and across all time periods (2030, 2050, and 2070). It is notable that the remaining 0.1% of overhead transmission structure assets have medium vulnerability. For underground transmission lines, 99.3% of the asset locations are projected to have low vulnerability to coastal flooding in the baseline period, 2030, and 2050, but this proportion will decrease slightly to 97.6% in 2070. In response, the proportions of the underground transmission line assets with medium and high vulnerability are projected to increase from 0.3% and 0.4% to 1.6% and 0.8% by 2070, respectively. The underground transmission line assets with high vulnerability to coastal flooding in the baseline periods, 2030, and 2050 are located near San Luis Rey River, San Diego River, and Sweetwater River, and by 2070 an underground transmission line asset in the San Diego Bay near San Diego Convention Center is projected to reach high vulnerability.

Table 57. *Transmission assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
Transmission			
	Transmission Overhead Line		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Transmission Underground Line		

Observed	99.3%	0.4%	0.4%
2030	99.3%	0.3%	0.4%
2050	99.3%	0.3%	0.4%
2070	97.6%	1.6%	0.8%
	Overhead Structures (Transmission)		
Observed	99.9%	0.1%	0.0%
2030	99.9%	0.1%	0.0%
2050	99.9%	0.1%	0.0%
2070	99.9%	0.1%	0.0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.2 Distribution

Sensitivity Scores

Pad-mounted transformers and dynamic protective devices (fault-interrupters, reclosers, auto-throwovers, switches, fuses) have severe sensitivity to coastal flooding. While pad-mounted transformers are typically elevated several inches above ground level on concrete pads, flooding above that level may result in damage. Furthermore, even if elevated, a high amount of coastal storm surge may cause mount damage, although de-energization will only be necessary in the case of submersion. Eroded coasts due to SLR can degrade structural integrity, while king tides during storm surges can result in cascading impacts which can contribute to increased sensitivity. In the case of dynamic protective device assets, electromechanical and microprocessor relays can be vulnerable to flooding and SLR. Water exposure may corrode and damage microprocessors and moving components of electromechanical relays, and debris can be deposited in component enclosures, potentially causing failure.

Poles have high sensitivity to coastal flooding. Along with erosion, scouring of the ground near pole bases and saline water exposure from rising sea levels have the potential to compromise the structural integrity of transmission line structures and accelerate the corrosion of structural members. Wave action and floating debris could also cause structural damage if high-velocity contact occurs. As per primary underground conductors, which also have moderate sensitivity to coastal flooding, conductors and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. Flooding may also impede operations and maintenance. Subsurface transformer assets, which also have a moderate sensitivity to coastal flooding with their traditional submersible design does not fully prevent them from being subject to corrosion, particularly in the case of existing damage or faulty sealing. As with other asset types, maintenance can be impeded due to floodwaters. Finally, primary overhead conductor, overhead transformer, and voltage regulator assets have minimal sensitivity to coastal flooding. In all cases, coastal flooding could make those assets inaccessible, which would result in an inability for operation and maintenance crews to perform the necessary restoration activities on time. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 58**.** The majority of distribution assets have a low vulnerability to coastal flooding across time periods. There are some exceptions. For instance, while 0.0% of overhead structure assets have medium vulnerability to coastal flooding in the baseline, in 2030, and in 2050, this share increases to 0.1% by 2070. The same pattern is observable for pad-mounted transformers, with 0.1% of assets projected to have medium vulnerability in 2070 compared to 0.0% up until then. Similarly, while 0.0% of dynamic protection devices have medium vulnerability to coastal flooding in the baseline, in 2030, and in 2050, 0.2% of those assets are projected to have medium vulnerability in 2070. Across all asset types, the percentage of assets with high vulnerability to coastal flooding remains 0% throughout.

Table 58. *Distribution assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	**Medium**	**High**
Distribution			
	Overhead Structures (Distribution)		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%
	Primary Overhead Conductor		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%

	Primary Underground Conductor		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%
	Overhead Transformer		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Pad-mounted Transformer		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%
	Subsurface Transformer		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Voltage Regulator		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Dynamic Protection Devices		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.8%	0.2%	0.0%
	Pad-mount Switches		
Observed	100.0%	0.0%	0.0%
2030	99.9%	0.1%	0.0%
2050	99.9%	0.1%	0.0%
2070	99.9%	0.1%	0.0%

	Underground Switches		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Overhead Switches		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Distribution Capacitors		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.3 Substation

Sensitivity Scores

For coastal flooding, depth data is available such that SDG&E was able to derive a depth-dependent sensitivity scoring. Table 59 lists the flood depth levels (in feet) and the corresponding sensitivity scores.

Table 59. *Flood depths (feet) and corresponding sensitivity scores for coastal flooding*

Flood depth (feet)	Sensitivity Score
<1	0
1 - 2	1
>2 - 3	1
>3 - 4	4
> 4	5

Based on the scoring table, voltage regulator, substation reactor, and protection control device assets are severely sensitive to coastal flooding. In all cases, floating debris and wave action have the potential to physically damage assets. In addition, and in the case of voltage regulator and substation reactors, flooding can damage cores and windings, while wave impacts on coastal installations may compromise foundation integrity. For protection control device assets, electromechanical and microprocessor relays can be vulnerable to flooding, and water exposure may corrode or damage microprocessors and moving components of electromechanical relays.

Substation transformer and circuit breaker assets are highly sensitive to coastal flooding. While the former are hermetically sealed and generally resilient against flooding, brackish water intrusion through faulty seals, wave impact, and floating debris might cause damage. In addition, auxiliary systems may be damaged and the removal of vegetation to reduce wildfire risk may increase the susceptibility of the assets to erosion or flooding. In the case of the latter, those installed at grade level can be damaged by flooding as floodwaters can corrode electrical and mechanical components, impact operations, and lead to future failure. Wave action may physically damage breakers and, in extreme cases of flooding, floodwaters can compromise electrical insulation.

Both switchgear and capacitor bank assets have moderate sensitivity to coastal flooding. For switchgears installed at grade level, floodwaters can corrode electrical and mechanical components, leading to potential asset failure. Impact from wave action may damage equipment leading to completely disabling the equipment. On the other hand, capacitors are usually elevated above grade, but water reaching the insulators of the capacitor cans could result in outage and possibly damage. In addition, non-waterproof electrical components may be damaged by exposure to flooding and floating debris and wave action can physically damage the assets.

The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 60. Almost all asset types have low vulnerability to coastal flooding regardless of the time period. For circuit breakers, switchgears, and capacitor banks, 0.3% of assets have medium vulnerability in the baseline to coastal flooding, a percentage that remains stable across 2030 and 2050 before reaching 0.5% in 2070. For these asset types, only 0.3% of assets are expected to have high vulnerability to coastal flooding in 2070, compared to 0.0% in the baseline, in 2030, and in 2050.

Table 60. *Substation assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
Substation			
	Substation Transformer		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Substation Voltage Regulator		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Substation Reactor		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Substation DPD		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Circuit Breakers		
Observed	99.7%	0.3%	0.0%
2030	99.7%	0.3%	0.0%
2050	99.7%	0.3%	0.0%
2070	99.2%	0.5%	0.3%
	Switchgear		
Observed	99.7%	0.3%	0.0%
2030	99.7%	0.3%	0.0%
2050	99.7%	0.3%	0.0%

2070	99.2%	0.5%	0.3%
	Capacitor Banks		
Observed	99.7%	0.3%	0.0%
2030	99.7%	0.3%	0.0%
2050	99.7%	0.3%	0.0%
2070	99.2%	0.5%	0.3%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.4 Communication

Sensitivity Scores

Out of all communication asset types, antennas have a high sensitivity to coastal flooding, as they are not built to be resistant to salt-water spray. Both underground fiber and copper assets have moderate sensitivity to coastal flooding. Despite cables having features to resist water ingress, sustained exposure to water due to flooding can infiltrate ducts or conduits and potentially lead to physical damage and signal loss. Moreover, the inability for operations and maintenance crews to access these assets may lead to delays in restoration activity, and in the case of underground copper assets water can corrode the cables' coating and damage them if seals are compromised. SCADA (RTU) assets also have moderate sensitivity to coastal flooding. While enclosures are commonly sealed and resistant to extreme weather, sustained flooding can impede access for restoration activities. Floating debris in moving water and wave action could also cause structural damage if high-velocity contact occurs. Communication poles have a low sensitivity to coastal flooding due to their robust foundations. Still, erosion and scouring of the ground near pole bases, particularly if compounded by wave impacts, can compromise structural integrity. Impacts are the greatest from moving water and standing water impacts are only expected when inundations are long-term. Finally, overhead fiber and copper assets have minimal sensitivity to coastal flooding. This is due to the remaining risk of the accessibility of assets becoming hindered, which could make operations and maintenance crews unable to access the assets and delay restoration activity. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 61. The majority of communication assets have low vulnerability to coastal flooding under all future climate scenarios and time periods. Exceptions include underground fiber assets, with 0.1% of assets having medium vulnerability in the baseline and this share increasing to 0.3% in

2030 and 2050, and 0.6% in 2070. Additionally, while 0.0% of underground copper, SCADA RTU, and antenna assets have medium vulnerability in the baseline to coastal flooding and in 2030 and 2050, this percentage increases to 0.1% in 2070.

Table 61. *Communication assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	**Medium**	**High**
Communication			
	Overhead Fiber		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Overhead Copper		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Underground Fiber		
Observed	99.9%	0.1%	0.0%
2030	99.7%	0.3%	0.0%
2050	99.7%	0.3%	0.0%
2070	99.4%	0.6%	0.0%
	Underground Copper		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%
	Overhead Structures (Communication)		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%

2070	100.0%	0.0%	0.0%
	SCADA RTU		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%
	Antennas		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	99.9%	0.1%	0.0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.5 Facilities

Sensitivity Scores

Out of all facilities asset types, critical facilities have a high sensitivity to coastal water. This is because flooding could damage critical equipment (servers, power supply, etc.) or supporting systems (HVAC, backup generators, etc.) and make them inoperable. If flooding blocks road access, it may also restrict access to these sites and make them inoperable or understaffed. Furthermore, some servers and cabling under the raised floor would get damaged from flooding and some equipment that is mounted on raised floors could still be sensitive depending on the level of floodwater. Communication centers have a moderate sensitivity to coastal flooding, specifically the components within and despite these locations being unmanned and out in the elements in remote areas. Finally, both office building (headquarters, call centers, training centers, warehouses) and command and operation center assets have low sensitivity to coastal flooding. In the case of office buildings, flooding could damage facility equipment and completely restrict access to asset critical facility locations, effectively closing them, while some operations may be temporarily modified or relocated. In the case of command and operation centers, flooding could critically damage facility equipment (like meters, IT equipment, or maintenance vehicles) and restrict access to asset critical facility locations, effectively closing them. The sensitivity scoring for these asset types is further detailed in Appendix I – Sensitivity Scoring Results.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 62. All facilities assets have low vulnerability to coastal flooding across all time periods.

Table 62. *Facility assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
Facilities			
	Office Buildings		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Construction and Operation Centers		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Communication Centers		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%
	Asset Critical Facilities		
Observed	100.0%	0.0%	0.0%
2030	100.0%	0.0%	0.0%
2050	100.0%	0.0%	0.0%
2070	100.0%	0.0%	0.0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.6 Gas Assets

Sensitivity Scores

High-pressure pipes, regulators, compressors, and valves have high sensitivity to coastal flooding. As regulators, compressors, and valves are typically above ground, they have the potential to be directly exposed to flooding. Additionally, water intrusion into compressors or valves can result in elevated regulator pressure and lead to a line rupture. While high- and medium-pressure pipes are typically below ground, they can still be indirectly impacted by soil displacement and erosion caused by coastal flooding. Additionally, access to these pipes for critical repairs may be impeded by flooding due to SLR. Sensitivity scores for gas assets were determined by SCG SMEs and used to determine the asset vulnerabilities shown in the tables below.

Vulnerability Scores

Based on the exposure, sensitivity, and adaptive capacity scoring methodology for coastal flooding in Section 3.1.1, the resulting vulnerability scores are presented in Table 63, Table 64, and Table 65. The majority of gas assets have low vulnerability to coastal flooding under all future climate scenarios and time periods. One exception is high pressure pipe assets, with 0.3% of assets having medium vulnerability in the baseline, a percentage projected to increase to 0.4% in 2030, 2050, and 2070. Additionally, while 0.0% of controllable gas valve assets have medium vulnerability in the baseline to coastal flooding, in 2030, and in 2050, this percentage is projected to rise to 0.1% in 2070.

Table 63. *High pressure pipe assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
High Pressure Pipes (HPPs)			
	HPP		
Baseline	99.7%	0.3%	0.0%
2030	99.6%	0.4%	0.0%
2050	99.6%	0.4%	0.0%
2070	99.5%	0.4%	0.0%
	HP Service Pipe		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 64. *Medium pressure pipe assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
Medium Pressure Pipes (MPPs)			
	MPP		
Observed	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	MP Service Pipe		
Observed	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 65. *Regulator, compressor, & valve assets and projected vulnerability to coastal flooding (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
Regulators, Compressors, Valves			
	Controllable Gas Valve		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	99.9%	0.1%	0.0%
	Non-Controllable Gas Valve		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	Regulator		

Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	Compressor Station		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.2.7 Gas Assets – Coastal Erosion

Coastal erosion was a hazard of particular interest to SCG SMEs for above-ground gas assets. However, the vulnerability of gas assets is minimal in both the present day and 2070. Non-controllable gas valves are the only assets which display higher vulnerability, with 0.1% projected to have medium vulnerability to coastal erosion by 2070 (Table 66, Table 67, Table 68).

Table 66. *High pressure pipe assets and projected vulnerability to coastal erosion (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	Medium	High
High Pressure Pipes (HPPs)			
	HPP		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	HP Service Pipe		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 67. *Medium pressure pipe assets and projected vulnerability to coastal erosion (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	**Medium**	**High**
Medium Pressure Pipes (MPPs)			
	MPP		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	MP Service Pipe		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

Table 68. *Regulator, compressor, & valve assets and projected vulnerability to coastal erosion (by % of total number of assets of each type)*

Time Horizon	Vulnerability Levels (Intermediate-High SLR Scenario)		
	Low	**Medium**	**High**
Regulators, Compressors, Valves			
	Controllable Gas Valve		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	Non-Controllable Gas Valve		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	99.9%	0.1%	0.0%
2070	99.9%	0.1%	0.0%
	Regulator		

Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%
	Compressor Station		
Baseline	100%	0%	0%
2030	100%	0%	0%
2050	100%	0%	0%
2070	100%	0%	0%

Note: Due to rounding, vulnerability level percentages for certain assets may exceed 100%

3.2.4.3 Vulnerability of Operations & Services

SDG&E characterized the vulnerability of its operations and services to coastal flooding by considering the exposure of SDG&E's service territory to the hazard and the sensitivity of each operation and service.

While exposure to coastal flooding is generally projected to remain low across the SDG&E service territory in the future, floodplains are projected to expand in future time horizons, inundating more of Mission Bay and other coastal regions within the service territory leading to an increased exposure for certain assets. A heightened exposure of the service territory to coastal flooding would likely impact SDG&E's operations and services in direct and indirect ways. It could, for instance, prevent access to critical underground distribution and transmission lines that would be submerged, thereby directly affecting asset management. At the same time, SDG&E has noted that underground distribution connectors and saturated cables have faulted when dried out after flood events, which could indirectly affect reliability planning.

To understand the sensitivity of operations and services to coastal flooding, SDG&E characterized their current resilience to this hazard. The output of the operational maturity scoring is presented in Table 69.

Table 69. *Operational maturity scores of SDG&E's operations and services for coastal flooding*

	Historical & projected extreme weather	Investment in new technology	Performance metrics	Stakeholder engagement	Personnel Training	TOTAL (out of 5)
Asset Management	0.5	0.5	0.5	0.5	0.5	**2.5**
Vegetation Management	0.5	0.5	0.5	0.5	1	**3**
Emergency Response	0.5	1	0.5	0.5	1	**3.5**
Comms.	0.5	0.5	0.5	0.5	0.5	**2.5**
Safety Operations	0.5	1	0.5	0.5	1	**3.5**
Reliability Planning	0.5	1	1	0.5	1	**4**
Supply Management	0.5	0.5	0.5	0.5	0.5	**2.5**

Based on the limited increase in exposure of the SDG&E's service territory to coastal flooding and on the operational maturity scores obtained, asset management, communications, and supply management have the highest projected operational vulnerability to the hazard. In each case, resilience practices are not currently fully incorporated.

Vegetation management appears to be in better standing, due to the regular training of personnel towards flexibility, collaboration, and the prioritization of safety in the preparation of coastal flooding events.

Emergency response and safety operations are further less vulnerable to coastal flooding, due to existing investments in new technologies and innovations designed to deliver better or to improve performance efficiency.

Finally, reliability planning is least vulnerable across all operations and services by assimilating all the practices mentioned previously and the incorporation of performance metrics to track the teams' performance.

These results are summarized in Figure 41, below.

Figure 41. *Graphical representation of the vulnerability of SDG&E's operations and services to coastal flooding*

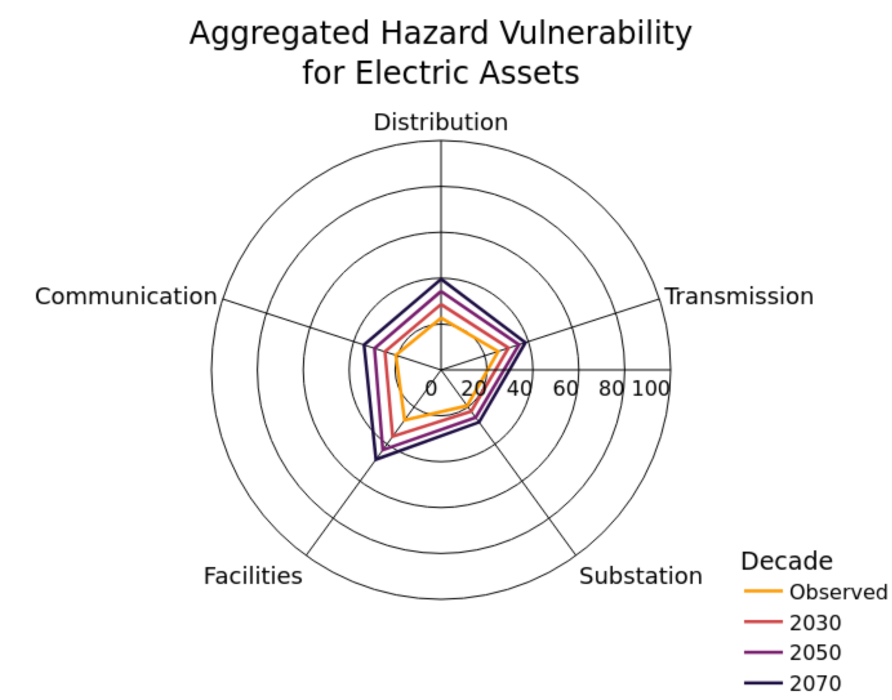
3.2.5 All-Climate Hazards Summary

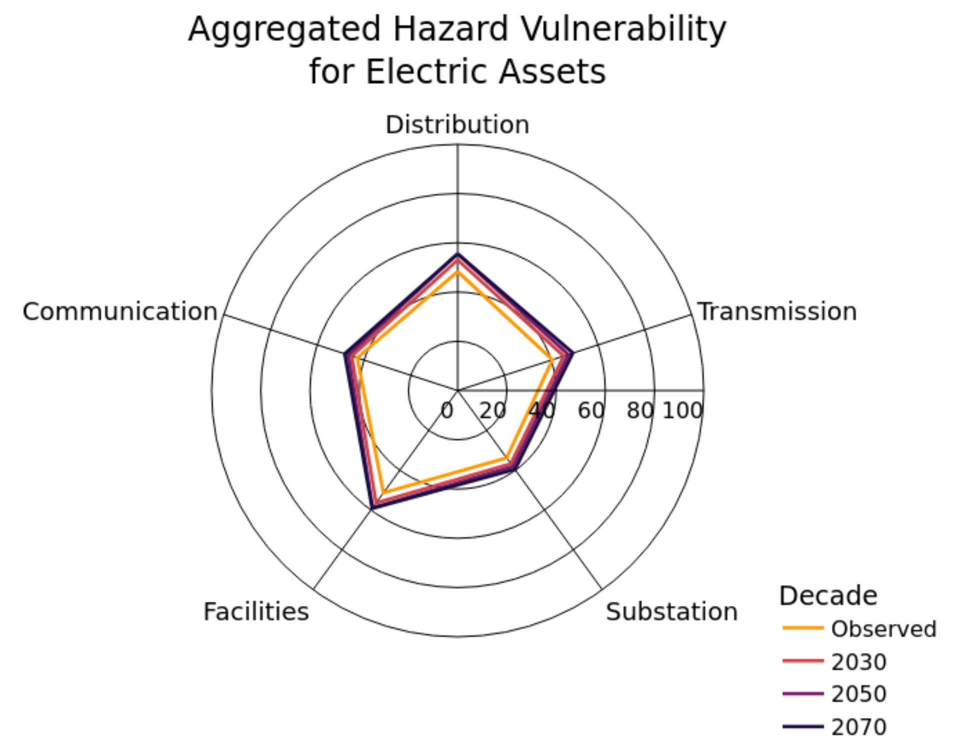
To assess the vulnerability of the entirety of SDG&E's asset portfolio across all climate hazards, an aggregated vulnerability score was calculated for each asset class (of family) and asset type (or component). To calculate these aggregated scores, the model-P50 under time-P50 and time-P95 vulnerability scores for each asset-hazard combination was selected and summed, resulting in one vulnerability score for each asset type to all hazards.

Since vulnerability was scored on a scale of 0-25, and electrical asset vulnerability was studied for four hazards (extreme heat, wildfire, inland flooding, and coastal flooding), the maximum aggregated score is 100. Since gas asset vulnerability was studied across five hazards (inland flooding, wildfire, landslides, coastal erosion, and coastal flooding) the resulting maximum aggregated score is 125. This score was normalized to a scale of 100 to remain consistent with electrical assets.

These aggregated scores for each asset type and hazard were plotted together in spider charts in Figure 42 and Figure 43, with separate lines for each time horizon, visualizing the rise in vulnerability over all time frames for all hazards and asset types. For electrical assets, facilities exhibit the highest aggregated vulnerability, followed by distribution and transmission assets. There is a notable increase in vulnerability scores, increasing by around 50% in 2030 and approximately doubling by 2050 compared to the observed timeframe. There is a smaller increase between 2050 and 2070. The plots below illustrate the vulnerability using median (time-P50) and extreme (time-P95) climate exposure values (please see Section 3.1.1.1 for the percentiles being used in the current CAVA report).[53] Using the median-year (time-P50) view values, the increase in aggregate vulnerability happens in relatively even intervals throughout all timeframes. Using the extreme-year (time-P95) view values, there is a sudden increase between the observed timeframe and 2030 and minimal increase from 2030 through 2070. This highlights the importance of preparing for the extreme-year (time-P95) values, as they are likely to have a disproportionately large impact on the most vulnerable assets in the near-term compared to the median years. Highly exposed assets reaching maximum exposure scores by 2030 results in consistently high vulnerability scores among time-P95 projections by mid- and late-century.

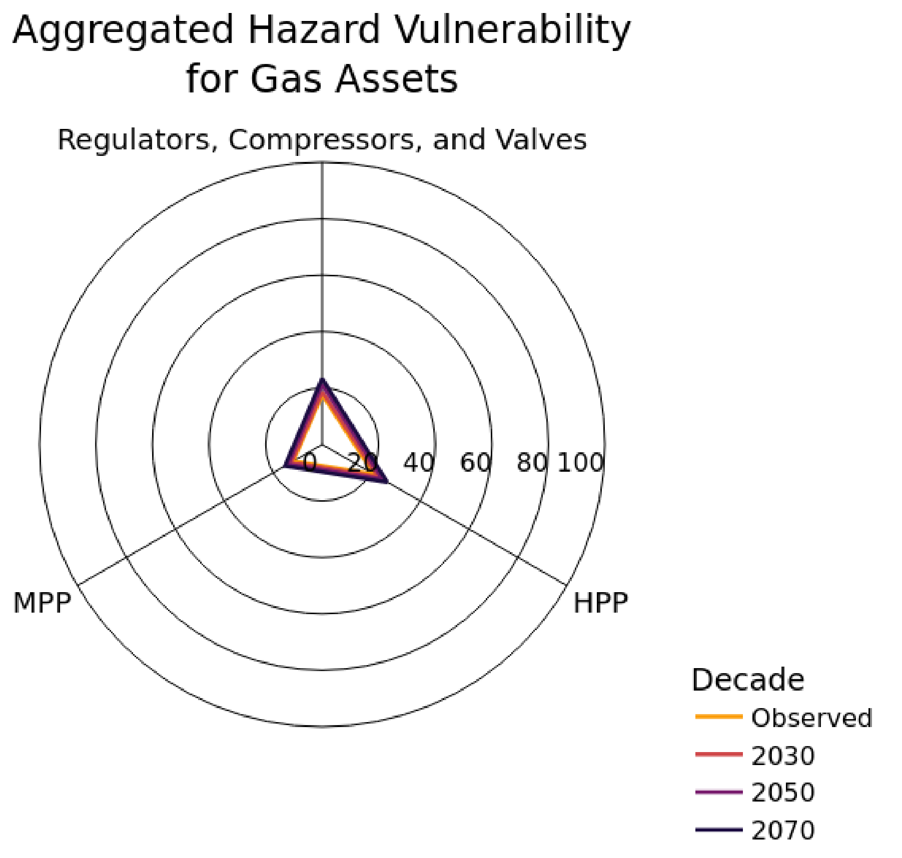
Figure 42. *Aggregate vulnerabilities for electrical assets showing 20-year time 50th and 95th percentile (time-P50 and time-P95) and SSP3-7.0 50th percentile (model-P50)*

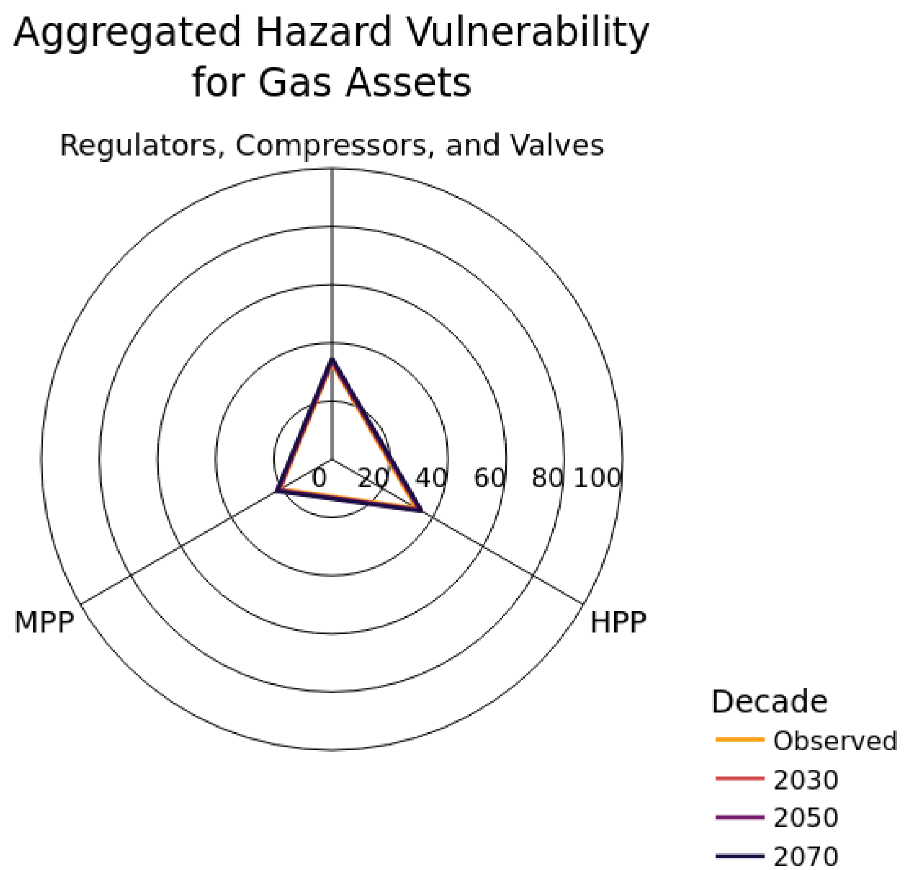
Median (time-P50)	

Extreme (time-P95)	

For gas assets, high pressure pipes have the highest observed aggregated vulnerability and are projected to have the most significant rise in vulnerability, followed closely by regulator, compressor, and valve assets. Under time-P50, the vulnerability scores are very close throughout time horizons. Under time-P95, there is an increase in aggregated vulnerability in all asset classes by 2030, before remaining relatively stable through 2050 and 2070.

Figure 43. *Aggregate vulnerability for gas assets showing 20-year time 50th and 95th percentile (time-P50 and time-P95) and SSP3-7.0 50th percentile (model-P50)*

Median (time-P50)	

Extreme (time-P95)	

For a more detailed view of the aggregated vulnerability, spider plots for each individual asset class are in Appendix IX – Aggregated Vulnerability.

3.2.6 Winter Weather

Hazard characterization

Traditional winter weather hazards are historically rare in San Diego and there are only a few instances with significant snowfall in the lowlands of San Diego County. However, the mountains and higher elevation regions around San Diego are more prone to such events, with snowstorms occurring most of the years. For instance, the Palomar Observatory on Palomar Mountain receives an average annual snow total of ~35 inches, Mount Laguna receives an average annual snow fall of 21.6 inches, and Cuyamaca Rancho State Park gets an average annual snow fall of 31.5 inches.[54]

Winter weather events such as heavy snowfall and freezing rain could affect utility equipment and assets in a variety of different ways. For example, icing events can lead to radial ice accumulation on equipment which can cause heavy loading and subsequent equipment damage or failure. Snow and ice events can also impede access to equipment and hinder efforts to address damage or failures associated with loading. Additionally, snow and ice accumulation on trees and other vegetation can lead to bending or breaking of branches which can result in vegetation coming in contact with equipment which in turn can lead to damage or equipment failure.

Exposure

Winter weather exposure is not quantitatively characterized because the San Diego region experiences winter weather over isolated areas at high elevations. Climate model datasets typically have a coarse spatial grid spacing, making it difficult to accurately capture precipitation patterns that can vary significantly over short distances due to factors like topography and local climate. Additionally, freezing rain and other frozen precipitation types rely on complex processes that occur at scales smaller than the grid size of most climate models. For these reasons, winter weather exposure is characterized by using a detailed review of scientific literature.

One of the most reliable indicators of climate change is the persistent rise in temperatures. Generally, warmer temperatures are expected to drive a global decrease in the frequency and intensity of snowfall and freezing precipitation (e.g., freezing rain). However, warmer atmospheric temperatures also mean that the atmosphere can retain more water, leading to more intense precipitation.[55] If this precipitation falls under specific environmental conditions, it can fall as either ice or snow.

While most analyses of the impacts of climate change to winter hazards in California focus on the Sierra Nevada range and other higher elevation mountains and ranges across the state, these projected trends are also broadly relevant to the higher elevation peaks in Southern California and near San Diego. Across California, snowpack has been declining and is expected to continue to decline with very high confidence. Additionally, the proportion of precipitation falling as snow is decreasing and the average snow-water equivalent (SWE) is projected to decline to less than two-thirds of its historical average by 2050 (when averaged over several model projections under both moderate and high emissions scenarios).[56] However, the decline in projected snowfall does not preclude the occurrence of icing and heavy snow events, particularly in the near-term. In San Diego, winter precipitation is projected to be highly variable with wetter winters and more intense individual precipitation events.[57] In the mountains, this precipitation may fall as ice or snow, particularly in the near term, suggesting that the mountains around San Diego may experience episodes of heavy icing and snow events.

Additionally, rapid warming of the Arctic in a process known as Arctic amplification has implications for winter weather in mid-latitude regions. Some evidence suggests that this Arctic warming can drive more extreme weather at the mid-latitude regions, including increasing cold snap events and winter storms,[58] which may bring more icing and cold weather events to lower latitude regions. Some research suggests that rapid warming in the Arctic has likely played a role in increasing the frequency of extremely cold winter weather in the U.S. over the last four decades.[59]

Most of the heaviest precipitation events in California occur during the passage of synoptic-scale winter storms, which often bring with them atmospheric rivers (or large and intense streams of water vapor) from the Pacific Ocean.[60] Just a few intense atmospheric rivers can contribute up to 50% of the state's total annual precipitation, and atmospheric rivers are projected to become more intense and frequent due to warming temperatures and climate change.[61] If these atmospheric river events coincide with colder temperatures, particularly during winter months, they could create conditions primed for freezing rain and icing events, particularly in the mountains near San Diego where temperatures remain colder at higher elevations. Some research further suggests climate change could intensify freezing rain events related to atmospheric rivers on the west coast of North America.[62] This also aligns with similar research of freezing rain and icing in the northeast U.S., which shows modest increases in the number of freezing rain days and radial icing between present-day and midcentury.[63]

In addition to more frequent and severe atmospheric river events, California is also expected to experience more intense extreme weather patterns and a "climate whiplash",[64] which describes a possibility that one year the state may experience heavy snowfall or icing across mountainous regions while the next year might bring a severe drought with little to no snowfall. More variable and intense extreme events mean that while the longer-term trend in California will be toward warmer temperatures and fewer icing and heavy snow events, in the near-term icing and heavy snow events in the higher elevation mountains around San Diego are still possible and important to be prepared for given the expected increase in extreme events.

The projected increases in the frequency and intensity of precipitation as well as the increase in precipitation variability in California and specifically San Diego suggests that although snow and icing events are projected to become less frequent due to climate change in the long-term, winter weather such as snow and ice may be more intense in the near- to medium-term.

3.2.7 Cascading Impacts

Cascading impacts are multifaceted weather and climate events that occur in succession and can lead to more significant impacts than when they occur individually. These events often include complex, compounding extreme events, such as enhanced warming exacerbating extreme drought and wildfire, debris flow events with heavy precipitation leading to flooding after wildfire events, rain-on-snow events, coastal storms coinciding with long-period swells or king tides, and other events driven by interacting physical processes. The analysis explores several event scenarios that may increase in likelihood in the future due to climate change.

Severe flooding from an atmospheric river event

Hazard characterization

An atmospheric river is a meteorological phenomenon describing a long, narrow region of high-water vapor content in the atmosphere.[65] Typically, atmospheric rivers originate due to the evaporation of warm ocean water and are transported eastward by strong atmospheric winds. These can produce heavy precipitation, high winds, and large waves on the U.S. west coast when making landfall. Typical atmospheric rivers can be very beneficial, providing much needed rainfall - as much as 50% of the total annual rainfall in California - for drought-ridden areas.[66] However, they can also be destructive, producing flash flooding and mudslides, particularly over burn scars after wildfires. Moreover, when multiple atmospheric rivers move over California in succession, the effects become more extreme. A recent example of this occurred during January 2023 when atmospheric rivers made landfall in California leading to extreme flooding during the wettest three-day period in San Francisco over the last 160 years.[67] The second atmospheric river yielded a heavy rainfall band over the San Diego region, which led to the San Diego River reaching a moderate flood stage and caused severe flash flooding overnight.[68] In North County, the heavy precipitation resulted in mudslides, rockslides, downed power lines, and sink holes.[69] This type of cascading event would be characterized by a strong atmospheric river making landfall over Southern California, leading to significant flooding, mudslides, and rockslides.

Exposure

Increasing sea surface temperatures (SSTs) and a projected shift in the subtropical jet that could steer moisture and storms toward California could increase the likelihood of higher-intensity atmospheric rivers in the San Diego region. Warmer SSTs increase the amount of evaporation over the Pacific Ocean, which leads to higher concentrations of water vapor in the atmosphere thereby increasing atmospheric river intensity. California has one of the highest year-to-year precipitation variability of any place in the U.S.[70] In effect, overall precipitation in California during the cold season is projected to increase leading to an increasingly volatile climate.[71] In addition, while there has been a recent historical trend of a poleward shift in atmospheric rivers, future projections suggest that climate change could drive more frequent atmospheric rivers in the California region of the Noth Pacific.[72] As the climate warms and creates a shift in the subtropical jet, atmospheric rivers that affect California are projected to shift equatorward leading to more landfalling atmospheric rivers and an increase in precipitation rates in southern California.[73] Downscaled GCMs also project a substantial increase of 10-40% in precipitation associated with atmospheric river events.[74] With this increase in precipitation, each atmospheric river event could result in more extreme flooding and mudslides. This, in combination with high winds and significant ocean waves associated with the atmospheric river, could expose assets to increased levels of inundation and flood extent, especially for assets already exposed to the flooding hazard (see section 3.2.3).

Extreme precipitation following a wildfire event (debris flow)

Hazard characterization

In addition to the immediate impacts of wildfires, such as burned trees and damage to property and infrastructure, wildfire burn scars can significantly increase the risks of flooding and post-fire debris flows in the following months and years. Wildfires disrupt the natural system of plants and structures that stabilize slopes and create more impermeable soil. Post-fire debris flows occur when heavy precipitation falls on a burn scar, carrying downed trees, rocks, mud, and other debris down a slope. These debris flows can amplify the effects of localized flooding during significant precipitation events, potentially damaging infrastructure and cutting off access to asset critical facilities.[75]

For example, the Thomas Fire in Southern California, which burned in late 2017 through early 2018 and became one of the largest wildfires in U.S. history at the time, weakened the slopes in the Ventura and Santa Barbara hills. On January 9, 2018, a significant precipitation event struck Montecito, California, triggering post-fire debris flows that killed 23 people and damaged approximately 400 homes.[76]

In the San Diego region, the threat of post-fire debris flows is highest in the mountains, where wildfire burn probability is high and extreme precipitation is more common. Specifically, burn scars with south-facing slopes and igneous or sedimentary-based bedrock are most likely to result in post-fire runoff-generated debris flow events.[77] This type of cascading event is characterized by significant precipitation falling on a previous wildfire burn scar, leading to damaging debris flows.

Exposure

The increasing likelihood of wildfires and extreme precipitation is expected to lead to a rise in the number of post-fire debris-flow events. For instance, one study examined current conditions and future projections for precipitation, fire, fuels, and geologic conditions. It found that both burn area and storm intensity are projected to increase across most of the San Diego area, potentially exposing roadways to 2-4 times the risk compared to present-day conditions.[78]

Another study focused on identifying which component of a post-fire debris flow event has been and will continue to be the most impactful. The findings suggest that post-fire debris flow activity is more sensitive to increases in precipitation intensity than to fire frequency and severity in Southern California.[79] This conclusion, combined with the potential for an increase in extreme precipitation as discussed in Section 3.2.2 and 3.2.3, highlights the growing risk of post-fire debris flows in a changing climate.

Post-fire debris flows are expected to continue damaging road access and infrastructure within SDG&E's service territory. As burn areas expand and storm intensities increase, the exposure of critical infrastructure to these hazardous events could also rise. This highlights the urgent need for proactive measures to mitigate the impacts of post-fire debris flows, such as improved land management practices, enhanced early warning systems, and robust infrastructure design to withstand these events.

In summary, the interplay between increasing wildfire likelihood and extreme precipitation is set to exacerbate the frequency and severity of post-fire debris flows. This poses a significant threat to infrastructure and public safety, necessitating comprehensive strategies to address these evolving risks.

Coastal storms coinciding with long-period swells or king tides

Hazard characterization

Coastal storms typically consist of tropical and extratropical cyclones, which can lead to significant storm surge, extreme winds, and extensive rainfall and inland flooding. Landfalling tropical cyclones with at least tropical storm force winds are exceedingly rare in southern California and have only occurred approximately 7 times since 1850 (Table 70).[80] Tropical cyclones in the Eastern Pacific Ocean rarely make landfall over California due to mean atmospheric circulation in the tropical Pacific (east-to-west) steering storms out to sea and the lower SSTs of the eastern Pacific relative to those of the coastal western Atlantic. However, a landfalling tropical cyclone over San Diego is not unprecedented, such as the San Diego Hurricane of 1858 leading to the only documented occurrence of hurricane-force winds in the service territory on record.[81] It is hypothesized that warmer than average SSTs contributed to the hurricane's development as it approached the region.[82]

Table 70. *Notable Historical Tropical Storms Impacting Southern California. Note that these events are illustrative and not a comprehensive set of historical events*

Date	Hurricane	Impacts
October 2, 1858	The San Diego Hurricane of 1858	Category 1 (75 mph winds), wind damage to properties along coast, significant rainfall, only known hurricane to directly impact southern California.
September 24-25, 1939	Unnamed Tropical Storm	50 mph winds, over 10 inches of rainfall, significant damage to coastal structures and crops, 2 feet inundation in eastern Coachella Valley.
September 17-19, 1963	Tropical Storm Katherine	Coastal flooding and erosion in San Bernardino, heavy rainfall up to 6.5 inches in mountains.
October 6, 1972	Tropical Storm Joanne	Rainfall up to 2 inches, landfall in northern Baja California.
September 9-12, 1976	Tropical Storm Kathleen	Rainfall up to 14+ inches in mountains, at least a 1-in-160 year flood event, 1 inch of rainfall in San Diego, Imperial Valley flooded, significant property damage.
September 24-26, 1997	Tropical Storm Nora	Rainfall up to 5+ inches, flooding in Palm Springs, Borrego Springs, and Spring Valley.

September 7, 2022	Hurricane Kay	Category 1 (75 mph), landfall in western central Baja California
August 19-21, 2023	Hurricane Hilary	Peaked at Category 4, weakened to tropical storm status upon landfall in Baja California. Wind speeds of up to 84 mph in San Diego County and a daily rainfall record in San Diego of 1.82 inches.

Storm surge from a landfalling tropical cyclone or severe coastal storm is particularly severe during a high tide event, such as long-period swells or king tides. Long-period swells are prolonged periods with a series of waves impacting a coastline, often the result of an offshore low-pressure system or storm (e.g., a tropical storm) producing strong winds over a large area of the ocean's surface. King tides are the highest tides of the year in the San Diego region. Both events increase the potential for flooding under an exacerbating circumstance, such as landfalling tropical cyclones. This type of cascading event would be characterized by a landfalling tropical cyclone over or near San Diego County during a high tide event, leading to significant coastal flooding and wind damage in the service territory.

Exposure

Warming SSTs could increase the likelihood of tropical storm formation or lead to storm intensification near the coast of southern California. Globally, hurricane intensification has already been attributed to climate change and warming temperatures.[83] Warmer SSTs provide energy in the form of heat for developing tropical cyclones, which act to fuel tropical cyclone intensification in the form of increased wind speeds and moisture. GCMs project that warming atmospheric and SSTs will likely invigorate hurricanes both globally and throughout the eastern Pacific to become more intense and have higher rainfall amounts relative to historical hurricanes.[84] Increasing storm intensities also indicate stronger hurricane winds and, in turn, coastal storm surge, which could exacerbate flooding from existing king tides and long-period swells.

SLR may also lead to greater flood extent from king tides or long-period swells. SLR and storm-driven flooding will impact a relatively small number of assets relative to other climate hazards in the region. However, the increase in exposure could be more significant if exacerbated by a high tide event or landfalling tropical cyclone. As demonstrated below, flood extent and inundation in San Diego during a high impact and low likelihood storm surge event would increase substantially as sea level rises. The modeled scenarios account for water level changes due to astronomic tides, winds, sea level pressure, steric effects, and SLR when simulating high return period storm surge. It is important to note, however, that bathymetry and coastal topography of San Diego and the surrounding region could limit the potential cascading impacts from this type of event primarily to the coastline.

Enhanced warming exacerbating extreme drought and wildfire

Hazard characterization

Drought is driven by prolonged periods of dry weather conditions, little to no precipitation and warm temperatures, drying out surface soils and vegetation. Heat waves are associated with anomalously hot temperatures and generally occur when large high-pressure systems become stagnant over a region for an extended period. It is well-documented that increases in wildfire frequency and burned area respond directly to increases in drought severity and frequency in forested regions of western North America.[85] Warming temperatures act to further dry out surface fuels (e.g., flammable soils and vegetation) by increasing atmospheric demand (increased potential evapotranspiration) and surface evapotranspiration, leading to more severe drought and more favorable conditions for fuels to ignite. This type of cascading event would be characterized by a period of extreme drought conditions exacerbated by an extreme heat wave, increasing both fire weather conditions and the risk of large wildfires in the service territory.

Exposure

San Diego is at risk for increased exposure to enhanced warming exacerbating extreme drought and wildfire. The region has already seen increased drought conditions caused by climate change such as the drought of 2012-2016.[86] By late century, the occurrence of extreme droughts could increase 3-15 times its present-day levels in California, based on downscaled GCM projections.[87] Megadroughts are exceptional and prolonged periods of drought lasting multiple decades, often associated with La Niña conditions in the tropical Pacific.[88] The intensity of recent megadroughts have already been exacerbated by warming temperatures and enhanced evapotranspiration[89] and are projected to become more intense in the future.[90] This will increase the potential for megadrought events in the service area. Further, increased drought conditions are highly predictive of wildfire events, and any future increase in droughts is likely to increase the probability of wildfire.[91] The scientific literature, taken together with the projections for increased warming and increased environmental conditions for wildfire (such as drought) as demonstrated in Sections 3.2.1 and 3.2.2, outlines the potential for an increase in the severity of drought and wildfire.

4 Community Vulnerability

In fulfillment of the previously outlined OIR requirements, to enhance SDG&E's ability to make community-informed, equity-centric decisions, and to better understand and characterize the nuances of community vulnerability, SDG&E concentrated on multiple approaches that highlight diverse sources and types of data. SDG&E recognizes that quantitative metrics alongside feedback that reflects the lived experiences of communities work together to support the incorporation of a more accurate and equitable community vulnerability characterization.

Within the CAVA process, SDG&E utilized two main avenues to accomplish this complimentary approach, the Community Vulnerability Index (CVI) and community outreach and engagement. The CVI is an enhanced and expanded community vulnerability measurement that builds upon the existing DVC definition in the original OIR ruling to achieve greater utility operationalization (more on this in section 4.1). Community outreach and engagement is foremost centered on relationship and trust building. Through intentional efforts that reflected this focus, SDG&E's outreach and engagement included feedback from surveys, workshops, advisory groups, interviews, and event participation and support, among others. In tandem, these approaches enable SDG&E to both measure community vulnerability and to work towards building adaptive capacity throughout and beyond the CAVA process.

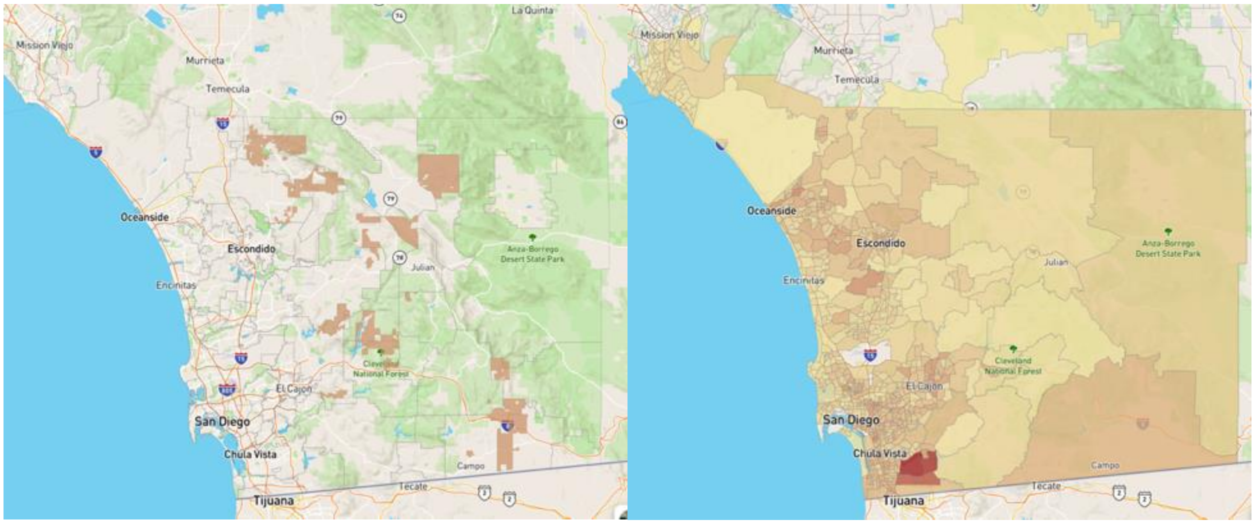
4.1 Community Vulnerability Index (CVI)

4.1.1 SDG&E's CVI Methodology Explained

A comprehensive DVC methodology, as outlined in the CAVA OIR, aims to identify populations at heightened risk and increased sensitivity to climate change due to limited resources for coping, adapting, or recovery. This includes identifying populations at elevated risk due to physical, social, and economic factors exacerbated by climate impacts.

CVI builds on the definition of DVCs using indicators from CalEnviroScreen 4.0[92] as a starting point with the addition of median household income, tribal lands, 3 key types of community critical facilities, and AFN customers to capture vulnerable populations in the service area Figure 44.

Figure 44. *Raw components of the DVC. Tribal (Left), AFN (right)*



This section outlines the construction of the CVI, beginning with updates to the CalEnviroScreen 4.0 methodology, such as adopting a higher-resolution geospatial analysis and a temporal refresh of population characteristics. This is followed by expanding DVC criteria to include AFN customers and community critical facilities, to build a more holistic view of community vulnerability and adaptive capacity.

Figure 46 provides a visual overview of the CVI methodology. For a more detailed explanation of indicators included in the final CVI, please refer to Appendix IV - SDG&E Climate Community Vulnerability Index (CVI).

4.1.1.1 Application of the Existing CalEnviroScreen 4.0 Methodology

Key updates to the methodology include adopting a finer geospatial scale using Uber H3 hexbins (approximately 0.85 square kilometers), updating existing indicators, and introducing two new ones in the CVI's construction.[93] These enhancements allow for more precise identification of variations within communities and population characteristics, which might be missed at a coarser scale. This granular approach better identifies potential DVCs and informs the development of targeted strategies to enhance adaptive capacity.[94]

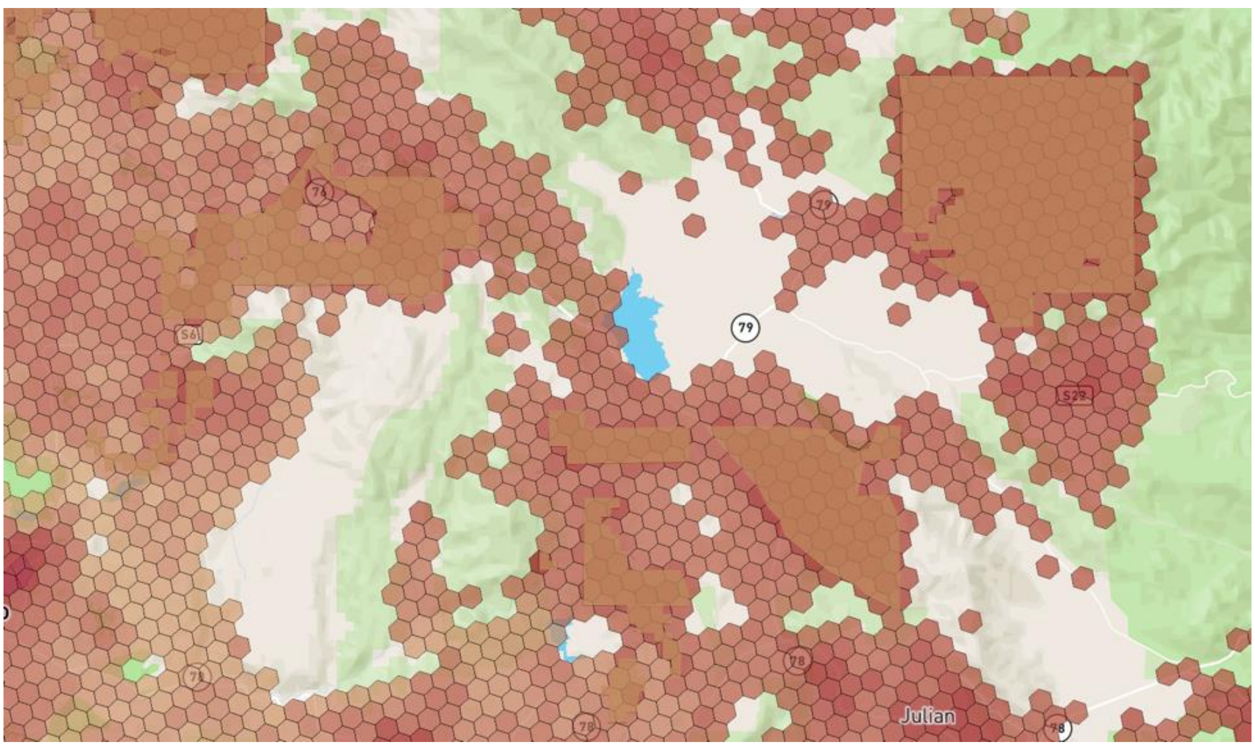
The index was constructed at the Uber H3 Resolution 8 hexbins (approximately 0.85skm)[95] as opposed to the census tract level to enhance spatial resolution across the SDG&E service area. The added benefit of constructing the CVI at the hexbin level is introducing a level of geospatial uniformity when comparing different areas. Census tracts vary in size across the service area and as a result cannot always be directly compared to one another. This finer scale improves the identification of DVCs by capturing local variations, such as population density, and enables more precise evaluation of proximity to grid assets and relevant critical facilities that serve the community. See Appendix IV - SDG&E Climate Community Vulnerability Index (CVI) for detailed methodology used to construct CVI such as types of community critical facilities used as inputs.

4.1.1.2 Additional CAVA OIR Requirements Beyond CalEnviroScreen 4.0

Tribal Land Score

A Tribal land score was introduced to address gaps in the current methodology and align with CAVA OIR requirements. This score captures the unique vulnerabilities of tribal communities by integrating factors reflective of their cultural, historical, and socioeconomic contexts, ensuring a more equitable and inclusive assessment framework. The tribal score identifies and ranks how much of a hexbin is tribal. Figure 45 below illustrates how tribal is defined. Construction of the tribal indicator is based on how much of the tribal area (brown) is overlapping with the individual hexbins (red). Certain hexbins are completely covered while others are partially covered or empty.

Figure 45. *Example illustration of primary layers involved in tribal indicator construction*



Median Household Income Indicator (MHI)

A Median Household Income indicator was introduced to capture economic vulnerability, focusing on hexbins where income levels fall below 60% of the state median, in line with CAVA OIR definitions. This addition helps identify communities that may lack resources to adapt to climate impacts.

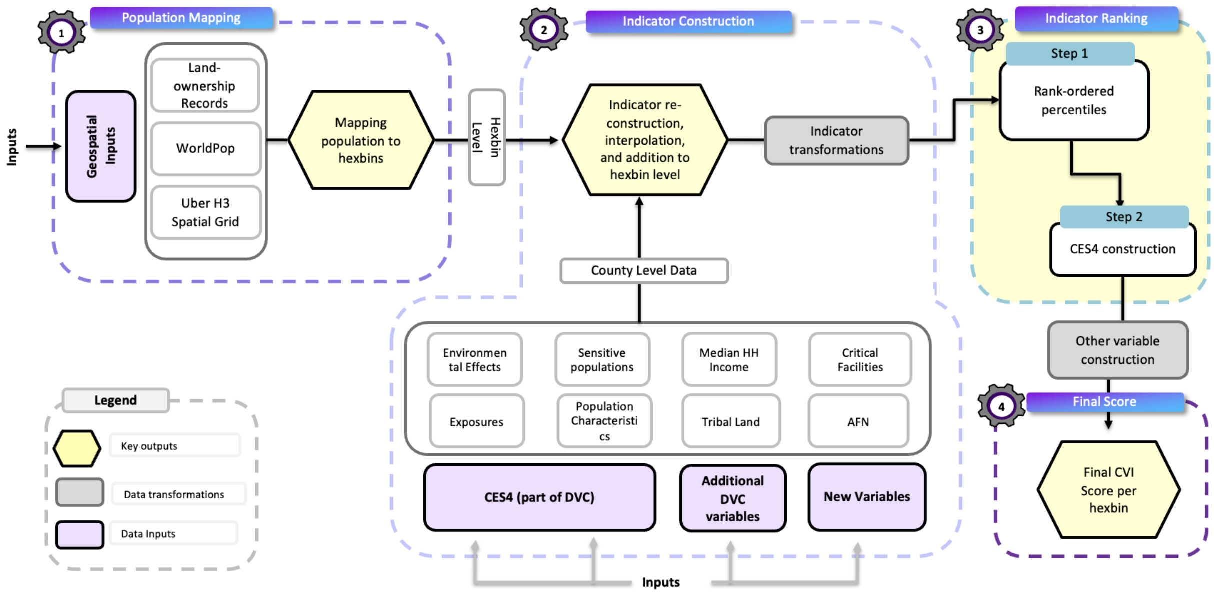
4.1.1.3 Additional Indicators Beyond DVC

Two SDG&E specific components were added: 3 sectors of community critical facilities and AFN customers counts. The community critical facilities indicator measures essential infrastructure availability and accessibility, while the AFN customer indicator identifies areas with significant populations requiring special support. These additions provide a more comprehensive score that captures both the distribution and density of populations and the location of critical services, enhancing the coverage of potential DVCs and the development of localized adaptive strategies.

4.1.1.4 Indicator Normalization

SDG&E explored multiple methodologies to normalize indicators of varying units, with the objective of reducing the influence of outliers and enhancing the representativeness and accuracy of the underlying data during the indicator construction phase. Specifically, SDG&E evaluated two approaches: the robust median z-score method, which adjusts values based on their distance from the median to minimize the impact of extreme values, and the rank-ordered percentile approach, which ranks data points and assigns percentiles for equitable distribution. After an extended analysis, SDG&E opted for the rank-ordered percentile approach for a more balanced and representative normalization process, addressing key challenges associated with high geospatial resolution, disparate data scales, and allowing for easy transition to a 0-5 scale. Figure 46 outlines the methodology and inputs of the CVI. For a detailed explanation of these methods and their application, please refer to Appendix IV - SDG&E Climate Community Vulnerability Index (CVI).

Figure 46. *Outline of the CVI framework*



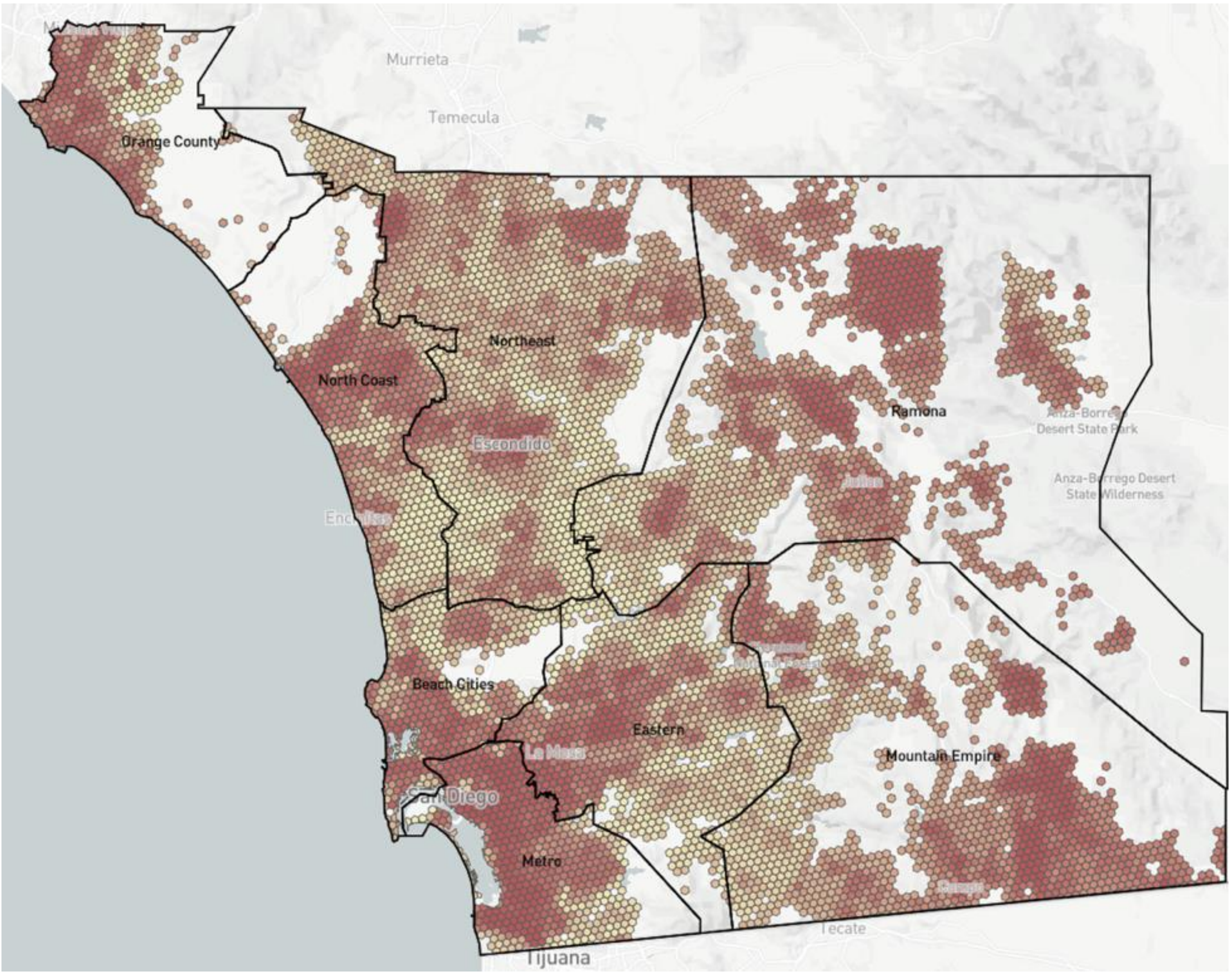
4.1.2 CVI Results & Application

The CVI methodology builds on the DVC definition (and expands the indicator set to include AFN customers and community critical facilities) by incorporating higher-resolution geospatial analysis and updated socioeconomic indicators. This results in a representative assessment of community vulnerability and adaptive capacity**.** Figure 47 illustrates the SDG&E service area, showing a rank-ordered comparison of DVCs by hexbins. A higher CVI indicates greater vulnerability, reflecting a combination of potential impacts from indicators such as high pollution burden, population sensitivity, socioeconomic challenges, limited access to critical facilities within the community, higher concentration of AFN customers, and classification as tribal land.

Hexbins in lighter colors represent communities with lower vulnerability, while those in darker shades indicate areas with higher vulnerability within the SDG&E service area. The distribution reveals notable clusters of high vulnerability (dark red) concentrated in urban cores and more remote inland areas— including portions of the City of San Diego, Mountain Empire, and Ramona. In contrast, many suburban and transitional areas appear to have moderate vulnerability. Overall, vulnerability tends to increase in more remote or dispersed regions, particularly those with limited proximity to infrastructure and essential resources. This variation reflects the diverse factors influencing community resilience including proximity to essential facilities, population density, exposure to environmental hazards, and socioeconomic characteristics. Furthermore, of the 12,976 hexbins analyzed, approximately

28% are flagged as DVC hexbins for further vulnerability analysis.[96] SDG&E intends to prioritize the engagement for better understanding of community vulnerability and evaluate for potential prioritization of adaptation options at those top ranked vulnerable areas. This exercise will be done in conjunction with assessments of climate hazard exposures and asset sensitivity at these communities.

Figure 47. *Overview of CVI rank-ordered percentiles across the SDG&E service area*



4.1.3 Steps for Incorporating New Data and Insights into Future Assessments

To further enhance the understanding of community adaptive capacity within the service area, SDG&E plans to integrate additional data sources, such as those provided by the Justice40 (J40) Initiative and the San Diego Climate Equity Index into the CVI. SDG&E also plans to explore alternative data sources—like advanced satellite imagery segmentation to detect distributed resilience indicators (for example, identifying EV parking, solar panels, and potential battery capacity at single-family homes)—to further enrich resilience assessments. Wherever possible, SDG&E intends to incorporate additional indicators through high resolution reconstruction. This approach helps expand the understanding of community vulnerabilities and improves the effectiveness of targeted climate adaptation strategies. Refer to Appendix IV - SDG&E Climate Community Vulnerability Index (CVI) below for a comparative analysis of the different indicators SDG&E is currently using and the proposed sources for future iterations.

4.1.3.1 Justice 40

Incorporating indicators from frameworks like J40[97] into future assessments can augment the CVI by integrating additional dimensions of vulnerability, such as transportation insecurity and resilience burdens, which are yet to be extensively explored in CVI. J40 provides a framework for understanding broad patterns of vulnerability and resilience at a national scale. J40's broad-level insights can guide state, regional, and local policymakers in addressing multi-scale challenges.

4.1.3.2 San Diego Climate Equity Index (CEI)

CEI developed by the City of San Diego, measures the access to opportunity and potential impact of climate change on different communities within the city, focusing on localized environmental, socioeconomic, mobility, and health factors. CEI can help augment CVI with additional localized indicators that affect community vulnerability, such as mobility (e.g., access to public transit, pedestrian access, and bike-ability) and specific environmental risks (e.g., flood risk, fire risk, and tree coverage). It also includes indicators such as housing cost burden and digital access, offering a nuanced understanding of socioeconomic and infrastructural challenges. CEI offers granular, *neighborhood-specific* insights that can help refine and implement strategies at a local level. Going forward SDG&E plans on including indicators in CEI by refreshing the data and scaling it to the hexbin level.

SDG&E plans to explore the indicators in blue (Table 71) in future iterations of CVI. While J40 provides a federal-level framework, CEI provides the detailed local context needed for implementing effective and equitable climate adaptation measures. By combining J40 with CEI, an index such as CVI can better capture the full spectrum of community vulnerabilities and adaptive capacities, and effectively identify resources for adaptations.

Table 71. *Comparative analysis of indicators across different studies*

Indicators	CVI	J40	CEI
PM2.5	✓	✓	✓
Asthma Rates	✓	✓	✓
Educational Attainment	✓	✓	✓

Indicators	CVI	J40	CEI
Poverty Rate	✓	✓	✓
Unemployment	✓	✓	✓
Linguistic Isolation	✓	✓	
Low Birth Weight	✓	✓	
Low Income	✓	✓	✓
Transportation Barriers		✓	✓
Energy Cost		✓	✓
Ozone Concentration	✓		
Diesel Particulate Matter Emissions	✓		
Drinking Water Contaminants	✓		
Lead Risk from Housing	✓		
Pesticide Use	✓		
Toxic Releases from Facilities	✓		
Traffic Density	✓		
Cleanup Sites	✓		
Groundwater Threats	✓		
Hazardous Waste Facilities and Generators	✓		
Impaired Water Bodies	✓		
Cardiovascular Disease Rates	✓	✓	
Housing-Burdened Low-Income Households	✓		
Expected Agricultural Loss Rate		✓	
Expected Building Loss Rate		✓	
Expected Population Loss Rate		✓	
Historical/Projected Flood Risk		✓	✓
Projected Wildfire Risk		✓	✓
Diabetes		✓	
Low Life Expectancy		✓	
Underground Storage Tanks and Releases		✓	
Wastewater Discharge		✓	
Historic Underinvestment (Redlining)		✓	
Low Median Income	✓	✓	
Tribal Lands	✓		
Community Critical Facilities	✓		
Access and Functional Needs (AFN) Customers	✓		

Indicators	CVI	J40	CEI
Resilience Benefits		✓	
Resilience Burdens		✓	
Community Involvement		✓	
Inclusive Engagement		✓	
Public Benefit Consideration		✓	
Tree Coverage			✓
Urban Heat Island Index			✓
Proximity to Community Recreation Areas			✓
Electric Vehicle Charging Infrastructure			✓
Pedestrian Access			✓
Transportation/Commuting Cost Burden			✓
Disability			✓
Street Conditions			✓
Bike-ability			✓
Access to Public Transit			✓
Housing Cost Burden			✓
Over-crowdedness			✓
Digital Access			✓
Solar Photovoltaic Systems			✓

4.1.4 Looking Forward: Evolving CVI with Strategic Enhancements

Vulnerable communities disproportionately bear the impacts of climate change, facing systemic inequities in access to resources and infrastructure. These disparities, combined with heightened exposure to climate hazards and barriers to recovery, necessitate tools and frameworks that prioritize equity and adapt to emerging challenges. The CVI has been helpful in integrating social and environmental indicators to inform resilience planning. Looking ahead, there are clear opportunities to enhance the CVI's capabilities while aligning with industry best practices.

4.1.4.1 Advancing Temporal Integration

The CVI's inclusion of recent socio-economic inputs has been a notable step forward. However, a critical next area of focus is incorporating forecasted socio-economic values alongside climate projections. This approach would provide a dynamic, forward-looking perspective that enhances confidence in planning outcomes. By aligning temporal scales between socio-economic forecasts and climate models, the CVI could offer a more robust framework for long-term resilience planning.

4.1.4.2 Enhanced Geospatial Resolution

The CVI's geospatial resolution is among the most refined in the industry, yet there is potential for further advancement. Current climate downscaling approaches in California typically resolve at approximately 3 km, but breaking through this barrier to achieve resolutions at the block level — typically 80 to 100 meters — could potentially yield next-level insights. Such granularity would allow for the identification of vulnerability at a hyper-local level, capturing nuances that can vary significantly within short distances, such as across a single street. These refinements could help improve decision-making for localized interventions.

4.1.4.3 Expanding Dimensions of Vulnerability

Complex frameworks, such as the Electric Power Research Institute's (EPRI) Climate READi[98] and the Governor's Office of Land Use and Climate Innovation's Vulnerable Communities Platform (VCP),[99] integrate socioeconomic and environmental data. For instance, the VCP overlays climate hazard data with metrics such as food insecurity and internet access, allowing planners to assess vulnerabilities at both present and future scenarios (e.g., projections for 2050). These tools set a high standard for holistic resilience planning by addressing systemic inequities while providing actionable insights.

Exploring additional dimensions of vulnerability could further enrich the CVI's utility. For example, including factors such as social cohesion, access to education, and institutional support might provide a more holistic view of resilience. While this concept requires careful consideration for translation to applicability, it represents a promising area for future innovation.

4.1.4.4 Improving Environmental and Pollution Indicators

Challenges in downscaling certain environmental and pollution metrics have constrained the CVI's ability to capture localized exposure. Investing in improved methodologies for these indicators could enhance the index's comprehensiveness. For instance, more precise mapping of air quality and water contamination data at finer resolutions would strengthen the CVI's capacity to inform targeted interventions.

4.1.4.5 Collaborating with Communities

Community engagement remains central to refining the CVI. Future efforts should focus on validating methodologies through pilot programs and co-creation initiatives with vulnerable communities. Programs such as the Governor's Office of Land Use and Climate Innovation's Community Pilot Program—which trains local governments and organizations in vulnerability assessment—highlight the value of incorporating lived experiences into resilience planning.[100] By integrating community feedback, the CVI can evolve to address real-world challenges more effectively.

4.1.4.6 Standardizing Definitions and Roles

The workshop underscored the need for greater standardization in defining vulnerability and resilience, particularly concerning the roles of utilities, local governments, and community organizations. Establishing clear, consistent frameworks will facilitate collaboration across stakeholders and enhance the CVI's applicability in diverse contexts.

By focusing on temporal advancements, geospatial precision, expanded dimensions of vulnerability, and improved environmental metrics, the CVI can continue to evolve as a pioneering tool in resilience planning. These enhancements, coupled with meaningful community collaboration and standardized approaches, will position the CVI to address emerging challenges while aligning with industry best practices. The goal is not to redefine resilience planning for stakeholders but to provide actionable, equity-driven insights that support their efforts in building a sustainable, resilient future.

4.2 Community Engagement and Outreach

4.2.1 The Approach

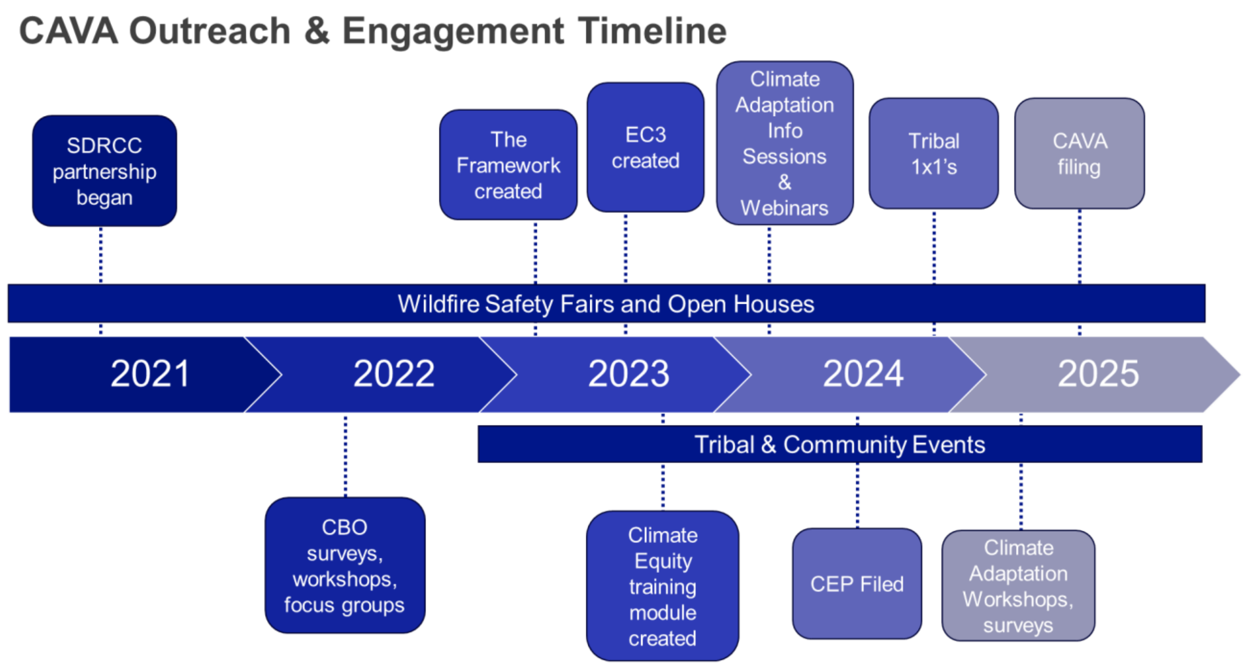
SDG&E's climate adaptation community outreach and engagement efforts followed two complimentary approaches: (1) building sustainable, and long-term community partnerships, and (2) actively engaging and facilitating direct opportunities for specific community feedback. The goal of the first approach is to establish, strengthen, and enhance a foundation for relationships from which to continue building upon for this specific engagement process and others in the future. Consequently, many of these relationships were built and developed prior to the CAVA process through a suite of efforts led by SDG&E across multiple departments and programs, including customer relations, wildfire safety fairs, vegetation management, and customer outreach. The CEP was developed in partnership with diverse experts and organizations from across the area to support the CAVA as well as SDG&E's climate adaptation and community impact efforts that transcend the CAVA's regulatory requirements.

The second approach focuses on facilitating and garnering targeted feedback specific to the CAVA's regulatory components. Three questions guided the design and implementation of this outreach:

1. *What are the impacts of regionally relevant climate hazards on you and your community?*
2. *What are the impacts of unplanned and planned outages on you and your community?*
3. *What adaptation and/or resilience investments would you like to see in your community?*

Critically, this approach would not have been possible without the relationships and knowledge fostered through the first approach. Figure 48 summarizes the major milestones associated with the outreach and engagement efforts during the CAVA process. One of the most critical components of this effort was the creation of the Equity-First Community Climate Coalition (EC3) in 2023, which currently consists of 11 member organizations (see Appendix V – Community Engagement Plan (CEP) for more information). The EC3 has provided guidance to the CAVA process such as helping SDG&E to identify community events and opportunities for engagement.

Figure 48. *Timeline of CAVA outreach and engagement efforts*



The CEP, filed May 15, 2024, details the outreach and engagement efforts and results prior to May, 2024. The CEP is included in this CAVA in Appendix V – Community Engagement Plan (CEP). The following sections will summarize outreach efforts post-CEP filing during the implementation phase, as this feedback is not previously outlined in the CEP. In addition to the below implementation efforts, SDG&E also created two community newsletters designed to provide updates on the CAVA and outreach and engagement efforts, as planned in the

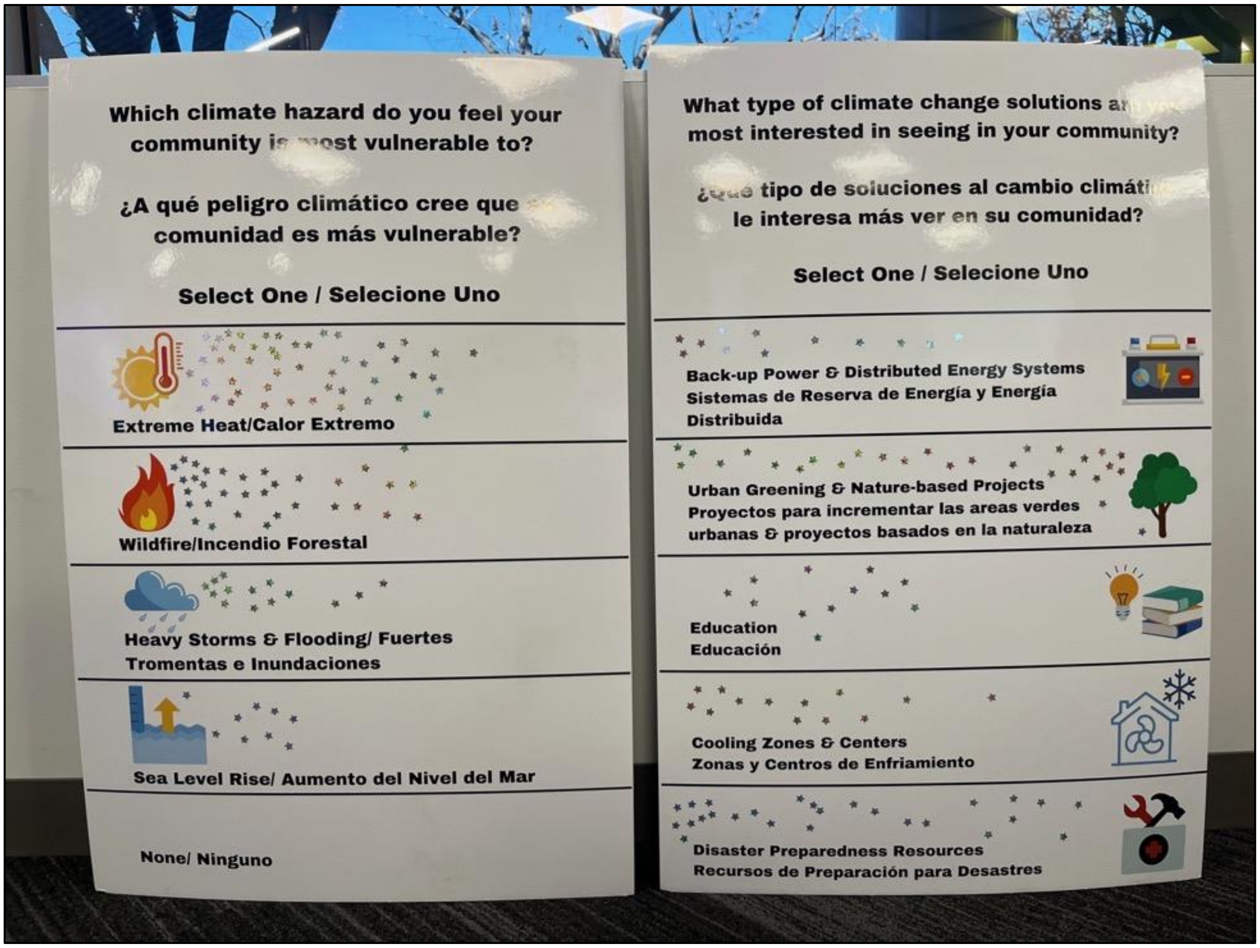
CEP. The first newsletter was created in Spring 2024, and the second in Fall 2024. The newsletter was released to the EC3, SDRCC, and SDG&E's Climate Advisory Group (CAG).

4.2.2 Methods

4.2.2.1 Sticker board Surveys

To facilitate accessible and low-burden feedback on priority topics areas, SDG&E utilized sticker boards to ask community members two multiple choice questions (Figure 49). These boards displayed the core questions in English and Spanish, to align with the most common languages in SDG&E's service area, and the sticker boards also included small visual graphics for support. For high volume and high traffic events, these two core questions were converted to a digital and print survey that was administered on an iPad, with a support team member present to facilitate the survey and information gathering as well as discuss and answer additional community questions. Surveys and sticker boards were completed at community events such as wildfire preparedness fairs, community resource fairs, Balboa Parks winter nights festival, and San Diego Children's Discovery Museum "fun animal Fridays" to garner feedback from diverse populations from relevant DVCs.

Figure 49. *Sticker boards used for community outreach*



In total, 492 residents were surveyed (492 responses to Q1 and 416 responses to Q2) from November 2024 to January 2025, and 79% of participants surveyed lived in a non-tribal DVC. For a complete list of all events attended throughout the CAVA process, including events for the sticker board surveys, please see Appendix VI – Community Engagement Events & Activities Tracking (Updated).

4.2.2.2 Community Climate Adaptation Workshops

SDG&E worked with community organizations to co-host and facilitate three workshops, held in relevant DVC areas (Table 72).

Table 72. *Community workshops summary description*

	DVC Region	CBO Partners	Date	Venue	# Attendees	Presentation Language
Workshop #1	South San Diego – San Ysidro	Casa Familiar, San Ysidro Health	December 10th, 2024	Casa Familiar	45	Spanish
Workshop #2	South Central San Diego	MAAC, SDUSC	December 13th, 2024	MAAC	35	English
Workshop #3	Southeast S an Diego	SDUSC	January 28 th, 2025	Malcolm X Library	30	English

For each workshop, SDG&E partnered with 1-2 local CBO's in the creation, planning, and execution of each workshop. A major role of the CBO's was to connect with and leverage their community networks to spread word of the event. To support this, social media templates were created and provided to the CBO's to aid in communication. This partnered approach was a direct result of feedback received through previous outreach efforts and EC3 guidance during the creation of the CEP, as partnerships are crucial to the success of community events. Although format and content varied between workshops due to their co-created nature and the specific needs of the community being served, two core concepts were addressed and discussed at each event:

1. Understanding the specific and place-based impacts of both unplanned and planned power outages on the community.
2. Understanding community perceptions of and levels of concerns with their vulnerability to specific climate hazards

Best practices that were initially outlined in the CEP were followed, such as providing food, hosting at accessible locations, and offering childcare options (for a full breakdown of event details and best practices followed, please see Appendix V – Community Engagement Plan (CEP) section 5).

4.2.2.3 Tribal Representative Interviews

SDG&E is privileged to serve 17 sovereign Tribal Nations (18 reservations) and respects their autonomy and strives for tribe-by-tribe engagement. Additionally, to effectively and respectfully engage the Tribal Nations in SDG&E's service area, the climate adaptation team works closely with SDG&E's Tribal Relations team. It is important to underscore tribes are on these remote reservations not by choice, but rather through forced relocation. Many tribal members feel companies like SDG&E have historically played a significant role in perpetuating inequities, and feel SDG&E has some responsibility to provide support to reduce this equity gap.

As a result of the feedback received from the Tribal Working Group comprised of tribal leaders and government staff members received during the CEP creation phase (See Appendix V – Community Engagement Plan (CEP) Section 5), and internal expertise from the Tribal Relations team, SDG&E conducted individual 1x1's with representatives from each Tribe to facilitate feedback and foster further partnership. The first ten minutes were dedicated to reviewing climate exposure results from CMIP6 projections for extreme heat, precipitation, and wildfire. The remainder of the time was spent discussing all three guiding questions outlined in 4.2.1. From November 2024 – February 2025, seven 1x1's were conducted, outlined in Table 73**.** The Tribes provided a range of perspectives due to their varying geographies, size, resources, and capacities.

Table 73. *Tribal 1x1's conducted*

Tribe	Rep Roles	Date
La Jolla	Staff	05/23/2025 & 1/23/2025
Los Coyotes	Staff and elected leadership	11/12/2024
Mesa Grande	Elected leadership	11/01/2024
Pala	Staff	11/05/2024
INSY	Staff	11/04/2024
Rincon	Staff	02/14/2025
Campo	Staff	02/21/2025

Some tribes have completed their own vulnerability assessments and climate adaptation plans, which SDG&E relied upon for additional supplemental information to the Tribal 1x1 interviews.

4.2.3 Results and Application

Results from the implementation efforts described above are organized and summarized below into the three feedback topics.

4.2.3.1 Impacts of Climate Hazards

The climate hazard most commonly indicated as resident's top climate concern when considering the entire SDG&E service area is wildfire. The second most prevalent concern is extreme heat (Table 74).

Table 74. *Respondents' top climate hazards of concern*

Top Climate Concern	Number of Respondents
Wildfire	205
Extreme Heat	150
Heavy Storms & Flooding	74
Sea Level Rise	37
None	26

However, when responses are broken down into outreach areas as seen in Figure 50 (refer to Figure 51 for a map and key of outreach areas and refer to CEP, Appendix V – Community Engagement Plan (CEP) Section 3 for more details on outreach area selection), there is a notable geographical pattern.

Figure 50. *Proportion of residents by outreach area with indicated climate concern*

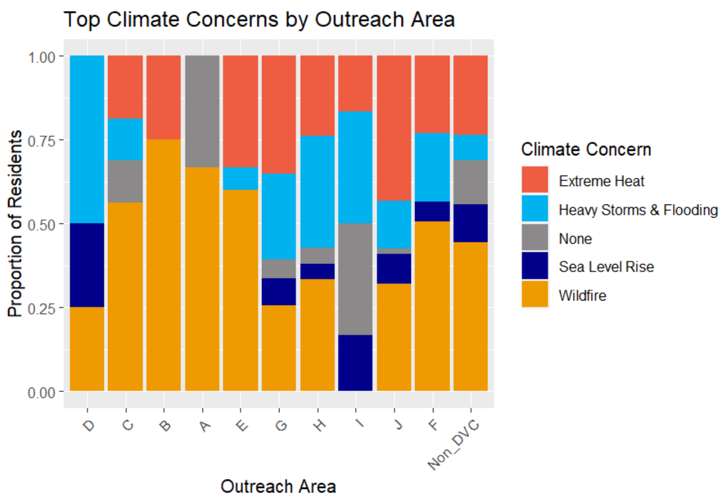
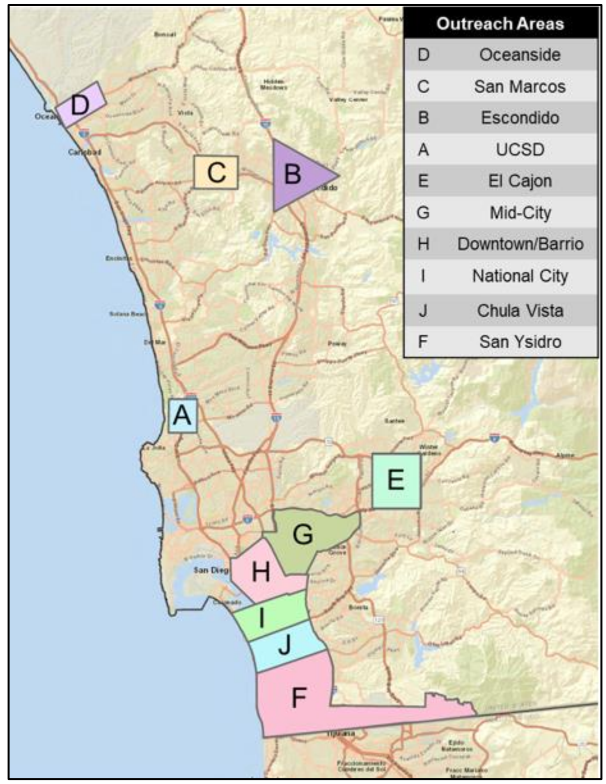


Figure 51. *Outreach areas*



Wildfire is of most concern in areas that are located closer to CPUC HFTDs[101] Conversely, flooding and sea level rise become more of a top concern in communities that are located by the coast, with flooding of most concern in areas that experienced significant flood damage in the January 2024 flooding event.[102] Ultimately, survey participants' perceived climate hazards of concern are generally consistent with actual climate hazards of concern in that area.

Community Adaptive Capacity

Research indicates that accurate perceptions of climate risk correspond to stronger adaptation intentions compared to underestimated or no perceptions. This conclusion indicates that overall, DVC communities in SDG&E's service area demonstrate a component of adaptive capacity, supported by their accurate perception of current climate exposure. However, this is only one possible component, of many, that comprise community adaptive capacity.

Source: Abid, M., Scheffran, J., Schneider, U.A. et al. Farmer Perceptions of Climate Change, Observed Trends and Adaptation of Agriculture in Pakistan. (2019).

Comments from community members help to illuminate why these climate hazards are a concern. For wildfire, losing homes, vegetation, and animals/pets was top of mind, along with the impact that wildfire smoke has on the air quality, and the concern that there is no place to evacuate to. Questions also emerged, such as, "why do the fires start, how much of the area is covered by invasive plants, and how can we get faster water access to fight fires"? For flooding, the most prevalent concern centered on the impact to transportation and roads. Community members expressed the worry that roadways and streets do not have proper drainage and upkeep, leading to flooded roads and their inability to evacuate, get to work, school, and medical facilities. Housing damage and relocation were also mentioned, with one resident mentioning that some of the people from the January 2024 floods are still living in temporary housing. For extreme heat, concerns included the lack of air conditioning available in homes or the impact on energy affordability if they did use an air conditioner. Community members expressed worry over health and safety, indicating that extreme heat could lead to dehydration, fainting, and heat stroke, particularly for the elderly or heat sensitive populations. Unlike the other climate hazards of concern, extreme heat was discussed in tandem with other hazards such as wildfire and drought, highlighting the cascading impacts motivated by extreme heat.

4.2.3.1.1 Tribes

Each 1x1 illuminated tribal-specific concerns, priorities, and challenges. However, patterns of common sentiments and major concerns across tribes emerged and are summarized and highlighted below.

One of the biggest concerns that tribes mentioned in response to climate hazards was the impacts on cultural resources, such as materials needed for basket weaving. Loss of habitat diversity and shifting location and season threaten tribes' lifeways. Water was also a central topic of discussion, as temperature and drought has impacted water supply for some and if water supply is limited, it poses a secondary concern as there may not be enough supply to combat wildfires when they occur. Many tribes are located in remote areas with limited access in, out, or through the reservation, which can pose a danger to residents during a flood or fire if evacuation avenues are cut off or backed up. For example, one tribe mentioned that they have one road through the reservation, and during floods, it gets washed out and is unnavigable. Additionally, tribes mentioned that they have significant elderly or medical needs populations that are vulnerable, especially during periods of extreme heat and cold fronts.

4.2.3.2 Impacts of Unplanned and Planned Outages

Community concerns around impacts of unplanned outages were grouped into 6 categories: Economic, Health & Safety, Mental Well-being, Transportation, Communication & information, and Education. Concerns around impact varied widely across these categories. Economic concerns included the impact of food spoiling and lost work hours due to unplanned outages. The impact of unplanned outages on health and safety ranges from the inability to run critical medical equipment, the lack of light during dark hours, a loss of function of air filters, an inability to regulate household temperatures, among other impacts. Related to this, mental well-being can be affected by unplanned outages, which create stress and frustration, can impede social interactions, elevate fear and anxiety, and disrupt daily social routines. Transportation is another impacted category, and unplanned outages can curtail the ability to charge electric vehicles as well as cause delays in public transportation. All of these impact categories could be further compounded by the difficulty of communication and information sharing during outages due to lost Wi-Fi networks and the inability to power communication devices. Finally, unplanned outages affect education and can result in school delays or cancellations.

When asked about the impacts of planned outages, community members indicated many of the same concerns as discussed for unplanned outages. However, participants also talked about the ability to plan, and how that was a positive contributor to their ability to cope with the outage. Community members mentioned they would buy or ready ice, coolers, batteries, flashlights, candles, and bottles of water. They also indicated that they would unplug and/or charge devices such as phones and cook perishable food ahead of the outage.

4.2.3.2.1 **Tribes**

Each 1x1 illuminated tribal-specific concerns, priorities, and challenges. However, patterns of common sentiments and major concerns across tribes emerged and are summarized and highlighted below.

One of the biggest outage impacts for tribes is the loss of food. Tribes are located in very remote areas of the SDG&E service area, infrequently traveling long distances to purchase groceries thereby relying on freezers to stock months' worth of food. Additionally, water pumps are often tied to energy supply within the reservations. Consequently, water treatment and supply are negatively affected by outages, leading to a lack of water during an outage. Similar to other DVC's sentiments, the lack of internet during an outage is a concern; however, tribal reservations are some of the most remote communities and may not have cell service, making access to internet even more vital for communication and information exchange. Outages can have cascading impacts, as illustrated through a conversation with one tribal member who mentioned that outages impact student education when kids cannot go to school. If the kids are unable to attend school, then various programs that fund and support kids to go to school are at risk due to an attendance threshold requirement tied to the funding. Ultimately, planned outages allow for planning whereas unplanned outages require more support and resources. However, even in areas that have backup generators, they may not have the support to start and maintain them, nor can they afford the fuel required for longer outages.

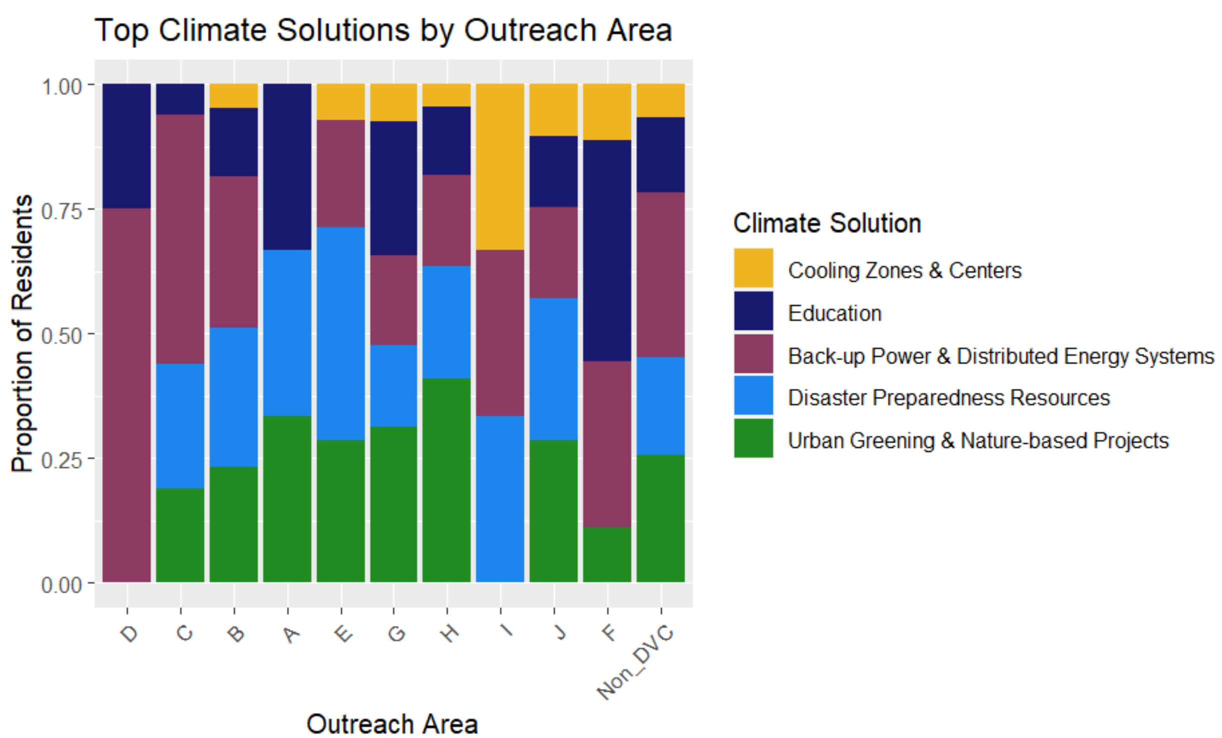
4.2.3.3 Resilience Solutions

The resilience solution most commonly indicated as resident's top choice when considering the entire SDG&E service area is Urban Greening & Nature-based Projects. The second most desirable solution is Back-up Power & Distributed Energy Systems (Table 75).

Table 75. *Respondents' top choice for resilience solutions*

Top Resilience Solution	Number of Respondents
Urban Greening & Nature-based Projects	112
Back-up Power & Distributed Energy Systems	106
Disaster Preparedness Resources	98
Education	68
Cooling Zones & Centers	32

Figure 52. *Proportion of residents by outreach area with indicated climate solution*



When responses are broken down into outreach areas (Figure 52**)**, there isn't as clear of a geographical divide as responses of concern over climate hazards. However, Cooling Zones & Centers was the least popular choice across almost all outreach areas.

It is important to note that this lack of a clear signal might be due to the design of the survey, as cooling zones would be a solution to extreme heat but not necessarily flooding or wildfire, possibly skewing the responses. It is possible that cooling zone preference might have fared better if the survey asked for a top climate solution by specific hazard rather than to climate hazards in general. Note that solutions selected for this activity are not comprehensive. They were selected to represent a diversity of potential solutions and to encompass solutions the community may already associate with SDG&E to help facilitate deeper dialogue with the community members surveyed.

4.2.3.3.1 Tribes

Each 1x1 illuminated tribal-specific concerns, priorities, and challenges. However, patterns of common sentiments and major concerns across tribes emerged and are summarized and highlighted below.

The most common and highest priority resilience solution mentioned by the Tribes was the desire for undergrounding. They acknowledge the wildfire risk reduction benefits of what has already been undergrounded and want to see it continue. Another common theme was the discussion around the ability to reduce energy use, especially during peak demand in order to help support the grid and reduce household energy costs. Home weatherization and upgrades could help in this effort; however, more support is needed to achieve this goal. Lastly, the desire for a microgrid was mentioned by a few Tribes, and backup generators were a common solution. However, they do not see the current diesel generators as a long-term solution, as a cleaner alternative away from diesel and more support in maintenance and management is needed. Through these discussions, other desirable solutions included household additions of AC, air purifiers, solar additions, and increasing safety and preparedness education and resources.

4.2.4 Ongoing Engagement

As indicated in the CEP, SDG&E is committed to supporting sustainable and ongoing community engagement and will continue to convene EC3 meetings to discuss lessons learned and guidance on applications of community feedback. SDG&E will also continue to implement best practices and share community feedback with relevant collaborators to more efficiently align efforts and utilize community, regional, and utility time and resources. As part of the dedication to feedback loops alongside the fulfillment of the CA OIR Phase II requirements (Decision 24-08-005), SDG&E hosted a public workshop 90 days before filing to educate attendees on climate change terms and to communicate process and results of the vulnerability assessment and community engagement efforts. The workshop slides were also made available on the SDG&E Climate Adaptation website with an option to comment or provide feedback. Verbal feedback from various stakeholders in attendance was positive, however, no informal stakeholder comments were received.

5 Adaptation Measures & Building Resilience

Building on this foundation of collaborative engagement, SDG&E has remained focused on developing granular resilience planning tools designed to address potential vulnerabilities in its operations and assets. To meet regulatory requirements and protect critical infrastructure and communities from emerging climate challenges, the company is enhancing its resilience framework to improve its ability to face the climate hazards analyzed in this assessment. More specifically, to translate these insights into actionable strategies, SDG&E has developed a Climate Intelligence Platform (CIP), leveraging its digital twin capabilities that integrate and visualize multiple data sources—including climate scenarios, infrastructure details, and community vulnerability indicators.

One of the primary drivers behind CIP was to leverage the underlying data and vulnerability visualization to facilitate community engagement that inform resilience planning at the grid and community level, while also validating the insights from the CIP datasets by integrating real-world observations with lived experiences. SDG&E begins by displaying hazard-specific scenarios over various timeframes to observe potential impacts on assets and operations in the coming decades. These scenarios are then overlaid onto asset maps to highlight areas of elevated risk that may require further analysis or reinforcement. In addition, community-level scores, such as those for DVCs and AFN customers within the CVI, are displayed alongside asset vulnerabilities to visualize where targeted actions supporting grid resilience and operational changes may deliver benefit.

A key objective of SDG&E's resilience strategy is to move beyond static assessments and leverage extensive climate, asset, and community data for informed decision-making. As a next step, SDG&E hopes to leverage artificial intelligence (AI) and advanced analytics to transform these descriptive indicators into forecasting insights. By processing vast amounts of data currently in the CIP, predictive analytics will help unpack emerging patterns and ways to model future hazards, supporting a framework that adapts to shifting temperature thresholds and multi-hazard interactions.

Building on these data visualization and predictive analytics approaches, SDG&E is also exploring climate-informed forecasting. By combining projected temperature increases, humidity trends, and broader climate scenarios with existing operational data, SDG&E hopes to understand future energy demand more accurately. This will help anticipate where load growth may be most sensitive to rising temperatures or other climate impacts, allowing us to optimize capacity planning, manage peak demand more effectively, and prioritize resilience investments in areas most susceptible to future load stresses.

In parallel, granular geospatial analysis will be employed to identify areas where hazards, assets, and vulnerable communities intersect, guiding resource allocation for reinforcing critical infrastructure and expanding outreach. Alongside this geospatial approach, SDG&E is developing enhanced situational awareness tools and training programs. These initiatives will help field personnel and operations teams with updated data and scenario-based exercises to respond during extreme weather events. By integrating up-to-date climate intelligence into daily workflows, SDG&E can make more agile decisions, reduce operational delays, and strengthen overall emergency preparedness.

All these analytical outputs will feed into SDG&E's digital transformation framework for monitoring, interactive dashboards, and automated reporting—transitioning the approach from a static view of hazards to a dynamic model that incorporates new data. Within this digital transformation initiative, SDG&E is also working on integrated community communication applications and dashboards that share relevant climate and operational data with local stakeholders. These user-friendly platforms will allow community leaders, emergency responders, and residents to track localized hazards, improving awareness and fostering collaboration when critical decisions need to be made.

By combining data-driven insights, predictive analytics, and robust digital tools, SDG&E's resilience strategy hopes to help address both regulatory obligations and community needs. This holistic approach not only identifies priority areas for grid hardening and operational improvements but also addresses the broader social and economic impacts on the most vulnerable communities. Ultimately, SDG&E's vision is to develop a flexible, forward-looking resilience strategy that safeguards critical infrastructure, supports our customers, and adapts to the ever-changing climate landscape.

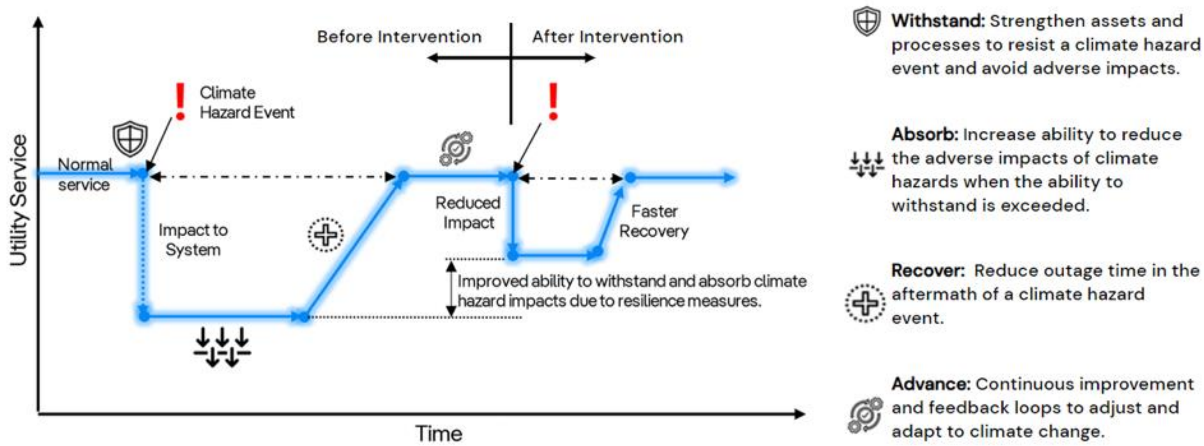
The following are examples of measures that can contribute to mitigating the impactful threats posed to its assets and operations. While SDG&E has been proactive in pursuing fit for purpose resilience measures by connecting the dots across multiple regulatory requirements and grid hardening decisions (e.g. WMP, Microgrids etc.), final approval from regulators will be required for incremental investable measures and feasible solutions that adhere to the latest industry design standards. The measures listed here are intended for application in an all-climate hazard context. SDG&E used the resilience measures framework depicted in

Figure 53 to identify measures that are aligned with the following four key resilience objectives:

- *Strengthen* assets and operations to *withstand* the adverse impacts of a climate hazard event,
- Increase the system's ability to *anticipate* when a climate hazard event may occur and *absorb* its effects,

- Bolster the system's ability to quickly *respond* and *recover* in the aftermath of a climate hazard event,
- *Advance* and *adapt* the system to address a continuously changing threat landscape and perpetually improve resilience.

Figure 53 – *Resilience measures framework*



The related measures are presented below and grouped by hazard, in table formats. Table 76, Table 77, Table 78, Table 79, and Table 80 identify the applicable asset family, resilience measure type (physical or operational), relevant resilience dimension (i.e., withstand, absorb, recover, and adapt), and whether the action is a Nature-based solution.

Icon Key	
Withstand	Recover
Absorb	Advance
Nature-based solution	

Table 76. *Resilience measures to mitigate impact of extreme heat on assets*

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Distribution	Increase sectionalization with reclosers and install Fault Location, Isolation, and Service Restoration (FLISR) solutions to automatically restore as many customers as possible	Physical	
	Update transformer specifications for higher ambient temperature ratings	Operational	
	Install additional cooling systems to control the temperature of sensitive components	Physical	
	When new transformers are scheduled for replacement, integrate projected ambient temperatures in the equipment design	Physical	
	Increase portfolio of flexible grid solutions to reduce loading, such as: demand response programs, solar and energy storage, combined heat power	Physical, Operational	
	Install additional feeder(s) to reduce loading in existing conductors	Physical	
	Microgrids: both customer-controlled Behind-The-Meter (BTM) and utility-controlled In-Front-of-the-Meter (IFM)	Physical	
Transmission	Install Dynamic Line Rating (DLR) technologies and methodologies to determine real-time current-carrying capacity limits	Physical, Operational	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
	Increase portfolio of flexible grid solutions to reduce loading, such as: demand response programs, solar and energy storage, combined heat power	Physical, Operational	
	Install additional feeder(s) to reduce loading in existing conductors	Physical	
	Use High Temperature Low Sag (HTLS) conductor on rebuild	Physical	
	Microgrids: utility-controlled IFM	Physical	
Substations	Upgrade cooling systems in substations (e.g. cooling loops and HVAC systems)	Physical	
	Use projected ambient temperatures for design specifications for substation transformers, regulators, reactors, and circuit breakers	Operational	
	Replace substation transformers with higher ambient temperature capability	Physical	
	Install additional transformers or substations to reduce loading	Physical	
	Install temperature data collection equipment to allow for real-time rating and operations decisions	Physical	
	Increase portfolio of flexible grid solutions to reduce loading, such as: demand response programs, solar and energy storage, combined heat power	Physical, Operational	
	Microgrids: utility-controlled IFM	Physical	
Communications	Install thermoelectric cooling systems in sensitive electrical enclosures	Physical	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Facilities	Upgrade HVAC systems as needed considering projected temperatures	Physical	
	Consider the installation of green roofs and enhance vegetation cover	Physical	
	Integrate projected temperatures for new buildings and retrofit existing buildings envelopes as needed	Physical, Operational	
Legend: Withstand, Absorb, Recover, Advance, Nature-based solution			

Table 77. *Resilience measures to mitigate the impact of wildfire on assets*

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Distribution	Create ties between circuits in fire hazard areas for increased operational flexibility	Physical	
	Maintain leading position in meteorology, remote inspection technology, LiDAR & Satellite Imagery by staying aware of improvements that may be available	Operational	
	Fire retardant coating or wraps on poles	Physical	
	Fire hardened design with steel poles and wider conductor spacing	Physical	
	Targeted undergrounding	Physical	
	Targeted ground-to-sky trimming	Operational	
	Introducing mixed vegetation that may serve as fire retardants	Physical	
Transmission	Fire retardant coating or wraps on poles	Physical	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
	Fire hardened design with steel poles and wider conductor spacing	Physical	
	Increase inspections, vegetation management, and tower clearing to reduce the likelihood of fire damage	Operational	
	Targeted undergrounding	Physical	
	Maintain leading position in meteorology, remote inspection technology, LiDAR & Satellite Imagery by staying aware of improvements that may be available	Operational	
Substations	Maintain cutbacks around substations and inspection of firewalls	Operational	
	Increase fire protection redundancy for substations within high-probability wildfire areas	Physical	
Communications	Targeted undergrounding of communication cables	Physical	
	Use fire resistive enclosures for electronic equipment in high-fire threat districts	Physical	
Facilities	Maintain vegetation clearance around facilities in remote areas	Operational	
	Increase fire protection redundancy for substations within high-probability wildfire areas	Physical	
	Use vegetation control, such as fencing and vegetation clearing or trimming to mitigate wildfire risk	Physical	
	Consider burying aboveground infrastructure if the risk of wildfire damage is high	Physical	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Gas	Investigate aboveground pipelines after wildfire to determine whether there is a breach	Operational	Withstand
	Coordinate and train with the fire department to safely control the flow of gas when a wildfire impacts structures to mitigate the "tiki torch" burning that may result when structures are gone	Operational	Withstand
	Enclose susceptible equipment	Physical	Withstand, Advance
	Replace plastic markers along pipelines after being destroyed by wildfire	Physical	Absorb, Recover

Legend: Withstand, Absorb, Recover, Advance, Nature-based solution

Table 78. *Resilience measures to mitigate the impact of inland flooding on assets*

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Distribution	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas	Operational	Advance
	Increase foundation robustness and design class of distribution poles in flood-prone areas to resist water load and potential debris impact	Physical	Withstand
Transmission	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas	Operational	Advance
	Increase foundation robustness and design class of distribution poles in flood-prone areas to resist water load and potential debris impact	Physical	Withstand

Substations	Develop flood-safe de-energization and recovery protocols	Operational	
	Elevate critical assets above projected flood elevation	Physical	
	Upgrade to waterproof enclosures for critical equipment enclosures	Physical	
	Integrate projected floodplains during the replacement design of new substations. Build away from floodplains or above projected flood elevation	Operational	
	Erosion protection and drainage upgrade program in flood-prone areas	Operational	
	Perimeter protection (temporary barriers or permanent flood wall)	Physical, Operational	
Communications	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas, including the integration of bioswales where feasible.	Operational, Physical	
	Increase foundation robustness and design class of distribution poles in flood-prone areas to resist water load and potential debris impact	Physical	
Facilities	Elevate critical assets above projected flood elevation	Physical	
	Upgrade waterproof enclosures for critical equipment enclosures	Physical	
	Integrate projected floodplains during the replacement design of new substations. Build away from floodplains or above projected flood elevation	Operational	
	Perimeter protection (temporary barriers or permanent flood wall)	Physical, Operational	

Gas	Elevate infrastructure susceptible to flood inundation	Physical, Operational	
	Relocate when the risk of damage or failure due to flood inundation or erosion is too high	Physical, Operational	
	Bury pipelines deeper in areas prone to flooding, erosion, and scour	Physical, Operational	
	Consider sump pumps for flood-prone buildings	Physical, Operational	
	Use information on depth of cover, area, slope, property of materials, catchment area, and precipitation levels to calculate flood height and scour depths when designing pipelines	Operational	
Legend: Withstand, Absorb, Recover, Advance, Nature-based solution			

Table 79. *Resilience measures to mitigate the impact of coastal flooding on assets*

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Distribution	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas	Operational	
	Increase foundation robustness and design class of distribution poles in flood-prone areas to resist water load and potential debris impact	Physical	
Transmission	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas, including the integration of vegetation to reduce surge speed and wave action.	Operational and Physical	
	Increase foundation robustness and design class of distribution poles in	Physical	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
	flood-prone areas to resist water load and potential debris impact		
Substations	Develop flood-safe de-energization and recovery protocols	Operational	
	Elevate critical assets above projected flood elevation	Physical	
	Upgrade to waterproof enclosures for critical equipment enclosures	Physical	
	Integrate projected floodplains during the replacement design of new substations. Build away from floodplains or above projected flood elevation	Operational	
	Erosion protection and drainage upgrade program in flood-prone areas	Operational	
	Perimeter protection (temporary barriers or permanent flood wall)	Physical, Operational	
Communications	Develop erosion protection and drainage upgrade standards for structures in flood-prone areas	Operational	
	Increase foundation robustness and design class of distribution poles in flood-prone areas to resist water load and potential debris impact	Physical	
Facilities	Elevate critical assets above projected flood elevation	Physical	
	Upgrade waterproof enclosures for critical equipment enclosures	Physical	
	Integrate projected floodplains during the replacement design of new substations. Build away from floodplains or above projected flood elevation	Operational	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
	Perimeter protection (temporary barriers or permanent flood wall)	Physical, Operational	
Gas	Relocate coastal infrastructure when the risk of damage or failure due to coastal hazards is too high	Physical, Operational	
	Elevate infrastructure susceptible to flood inundation	Physical, Operational	
	Use flood protection design codes for flood-prone facilities; ensure designs account for these impacts for coastal areas prone to wave action	Operational	

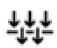
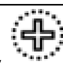
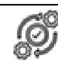
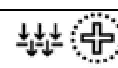
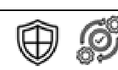
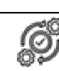
Legend:  Withstand,  Absorb,  Recover,  Advance,  Nature-based solution

Table 80. *Resilience measures to mitigate the impact of landslides on assets*

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
Gas	Install fiber optics with equipment that can measure the integrity of slopes; this can help mitigate impacts from landslides on pipelines	Physical, Operational	
	Open the trench, visually inspect the pipe, and, if needed, cut the pipe to release the strain for pipelines affected by subsidence or slope movement	Physical, Operational	
	Place rock or landscaping grid to stabilize a slope; add retaining walls where warranted as landslide mitigation options at buildings	Physical, Operational	
	Add strain gauges to pipes	Physical, Operational	

Asset Family	Resilience Measure	Resilience Measure Type	Resilience Dimension
	Explore options including attaching piles to the underlying bedrock for buildings prone to slope movement	Physical	Advance
	Consider design options (e.g., using extra support or redirecting water) in areas vulnerable to landslide; compare with operational solutions such as relying on valves upstream	Physical	Withstand, Advance
	Develop a plan for how to shut down in the event of a rupture and how to maintain service for customers for areas particularly vulnerable to slope movement	Operational	Absorb, Recover
	Stabilize slopes for infrastructure in landslide-prone areas	Physical, Operational	Withstand
	Enhance the capacity of stormwater drainage systems in geohazard-prone areas	Physical	Withstand
	Use bend joints or similar measures on pipelines prone to landslide	Physical, Operational	Withstand, Advance
Legend: Withstand, Absorb, Recover, Advance			

Climate data integration into load forecasting:

SDG&E is committed to embedding climate considerations into all aspects of enterprise-wide strategic decision-making. To support this overarching goal, the company is pursuing and refining resilience and adaptation measures, including incorporating climate model projections into grid planning efforts. The integration of climate data into load forecasting is critical to account for the impact of projected temperature changes on future energy usage. While load-forecasting models traditionally rely on the relationship between historical weather and energy demand, incorporating climate projections allows utilities to anticipate shifts in consumption patterns and adjust resources more effectively. SDG&E is working on integrating bias-corrected LOCA2-CA climate projections into these models. This involves calculating heating and cooling degree days at various thresholds using the heat index,[103] which provides a more accurate measure of how humans perceive temperature by considering both temperature and relative humidity.

One significant challenge in this integration is reconciling the inherent differences between climate models and the operational needs of grid planning. Climate models are designed to offer long-term projections for trend analysis rather than precise day-to-day forecasting of conditions. Load forecasting requires high-resolution, near-term data that can capture daily and seasonal variability, making the direct application of climate data a complex task. Beyond data integration, integrating climate data into forecasting methods must retain some level of alignment with previous sales forecasts and modeling approaches. Because load forecasting plays a crucial role in grid planning efforts, a transition to a more robust and climate-informed approach must be carefully managed to ensure continuity while also improving long-term planning accuracy by incorporating changes due to climate change.

To ensure this approach is effective, modeled results that incorporate climate change must be rigorously evaluated against observed data to verify improvements in forecasting accuracy. Addressing these challenges will require ongoing research and collaboration across the industry to establish best practices for integrating climate data into utility planning processes.

6 Conclusion and Next Steps

SDG&E recognizes that climate threats are no longer a distant concern—they are a pressing reality. Taking decisive action, the company launched its Wildfire and Climate Resilience Center in October 2024. This state-of-the-art facility serves as a cornerstone for community engagement, fostering collaboration in research, development, and implementation of forward-thinking solutions. The Center's mission is clear: to envision and build an energy system resilient to the escalating impacts of climate change while prioritizing community safety and preparedness. Please see Appendix VII – WCRC Outreach and Engagement for more information on WCRC outreach and engagement.

In addition to its role in outreach and innovation, the Wildfire and Climate Resilience Center houses SDG&E's Emergency Operations Center. This dual-purpose facility not only provides cutting-edge situational awareness tools, such as advanced weather modeling, but also serves as a critical hub for regional coordination during extreme weather events and disasters. By combining technology, expertise, and community partnership, the Center is driving innovations that ensure the energy system is prepared for the challenges of today and tomorrow. Leading examples of innovations include:

- Advanced weather monitoring through SDG&E's weather stations, which offer real-time data to better anticipate and address weather-related threats. The company's systems use millions of historical weather data points going back to 2010 to assist in training AI-based wind forecasting models, including one of the first AI-trained Santa Ana wind gust forecast models in the industry

- AI and machine learning to help predict and mitigate wildfire impacts on the energy grid. For example, SDG&E conducts more than 10 million virtual wildfire simulations daily to inform operational wildfire risk models, and uses more than 3.8 million drone images of company infrastructure to train AI-based inspection models

- Collaboration with climate science experts at academic institutions and national labs to evaluate extreme weather events, study fuel moisture levels, detect wildfires using real-time satellite imaging, analyze fire potential and inform climate adaptation planning (See Appendix VIII – 2025 Academic Partnerships)

- Workforce training and community engagement to achieve a more inclusive and effective climate resilience plan and equip SDG&E's current and future workforce to manage and maintain a resilient grid

To help minimize its impact on the environment, the center was constructed with sustainable materials throughout, efficient water fixtures to reduce water consumption and rooftop solar panels to support its operation through renewable energy generation. It received U.S. Green Building Council LEED® Platinum certification in December 2024.

As of March 1. 2025, 1,546 external visitors and over 399 organizations have toured the WCRC. Majority of the visitors were students (390) and industry partners (160) interested in learning more about SDG&E's wildfire resilience journey, preparedness actions and situational awareness capabilities. Additionally, 65 CBO's and 10 Tribal communities have engaged in the Center since its opening.

6.1 Leveraging Digital Twin Capabilities for Enhanced Resilience

In addition to launching the WCRC in 2024, which exemplifies SDG&E's commitment to innovation and resilience, this spirit of preparedness is further demonstrated through cutting-edge solutions like digital twin capabilities that were discussed in section 5 (Adaptation Measures & Building Resilience). As a pivotal tool in translating CAVA into actionable strategies, digital twin technology stands out as one of the most promising approaches for informing mitigation solutions and enhancing grid resilience.

Leveraging Digital Twin Capabilities for Resilience

A digital twin is essentially a digital replica of a physical system that is continuously informed by data that captures the real-world, which can be aggregated and simulated into scenarios to help visualize outcomes.

In practical terms, it allows SDG&E to create a high-resolution geospatial view of its grid operations in relationship to climate and community. Planners and engineers can then safely explore this digital environment and seek inputs to their "what-if" analysis, better understand potential impacts, and devise optimal resilience measures. This data-driven approach provides an interactive environment for accelerated decision-making, enabling data-driven approaches to harden the grid against future climate hazards. By bridging the gap between abstract climate projections and tangible operational and community insights, digital twins serve as a critical tool for climate adaptation planning and operationalization.

Climate Intelligence Platform (CIP): From Assessment to Action

The CIP integrates multiple data streams – including downscaled climate exposures, infrastructure asset vulnerabilities, and a community vulnerability index – into a unified and interactive geospatial model of SDG&E's service area. Importantly, the platform runs on a fine-grained hexagonal grid (Uber's H3 at resolution 8), which divides the region into uniform cells at ~0.85 km^2 each. This high-resolution *"hexbin"* approach allows for granular analysis of local climate risks and vulnerabilities compared to traditional census tract or circuit-wide assessments.

By layering climate exposure, asset vulnerability, and community vulnerability and adaptive capacity in one geospatial view, the CIP helps identify "hotspots" where critical infrastructure and at-risk communities coincide. These insights directly inform planning decisions and prioritization: for instance, the platform can flag a cluster of transformers serving a vulnerable community that are projected to face high extreme heat danger, indicating a prime candidate for grid hardening or enhanced emergency planning. In this way, the CIP operationalizes the CAVA findings – moving from static analysis to an interactive planning tool that guides where, what, and when to implement resilience measures.

Equally important is how dynamic and forward-looking the CIP is. Unlike a one-time report, the CIP is aimed to become a living resilience platform that can be updated continuously with new data, emerging conditions, and evolving climate science. Planners can adjust parameters or input up-to-date information (such as the latest climate models or real-time weather feeds) to see how risk profiles shift, allowing SDG&E to adapt its strategies in near-real time.

Looking ahead, the CIP will remain a cornerstone of SDG&E's climate resilience strategy – providing the granular analytics, cross-functional coordination, and continuous improvement feedback loop needed to help safeguard both the grid and the community in a changing climate.

6.1 Next Steps

SDG&E conducted a detailed and collaborative process to better understand its exposure to climate hazards across its electric and gas assets, operations, and services. Taking a granular approach to understanding community vulnerabilities, downscaling climate projections, incorporating subject matter expert input, and detailed asset health and operational maturity allowed us to identify specific vulnerabilities and locations where targeted interventions, including focused engagement, could reduce potential impacts.

The assessment found that SDG&E's operations and services are well prepared to address wildfire risks through robust resilience practices and system-hardening investments currently in place. Examples include the application of extensive wildfire mitigation plans, continuous personnel training in all-hazards tabletop exercises and simulations of extreme weather events led by Emergency Management experts. However, the assessment also identified areas such as communication, vegetation management, asset management, and supply management that warrant further analysis to strengthen resilience against inland and coastal flooding, as well as extreme heat.

Utilizing location-specific and asset-specific insights from this assessment, SDG&E is positioned to detail resilience projects and programs aimed at reducing system vulnerabilities. The selection of such projects, however, lies beyond the scope of this climate adaptation vulnerability assessment and will be addressed in other regulatory proceedings, including WMP, EPIC, S-MAP, RAMP, and GRC. These efforts must consider additional factors — such as detailed cost-benefit analyses, community feedback on vulnerability and solution effectiveness, adaptive capacity metrics, and precise rate impacts — to identify the most impactful resilience projects that enhance both grid reliability and community adaptability.

Moving forward, SDG&E intends to leverage the current CAVA governance structure to elevate these findings to the Climate Advisory Group and Chief Safety Office. It is essential for cross-functional and interdisciplinary teams across the organization to remain actively engaged in the design and implementation of grid resilience measures. Moreover, the findings of this CAVA will continue to inform other regulatory filings, such as the WMP, IEPR

Load Forecast (informing IRP, TPP, and DPP), EPIC, S-MAP, RAMP, and GRC. SDG&E acknowledges the importance of regularly updating this assessment to reflect changes in high-impact weather patterns, system infrastructure, operations, and regulatory requirements.

In conclusion, adapting to evolving climate hazards demands embedding climate considerations into enterprise-wide strategic decision-making processes. While past experiences provide valuable insights, they must be complemented by dynamic and science-driven approaches. By incorporating the best available climate projection data into resilience actions, as detailed in this assessment, SDG&E is well positioned to deliver solutions that are both pragmatic and transformative.

6.2 Acknowledgements

This SDG&E CAVA filing would not have been possible without contributions from SMEs across SDG&E. We also thank SMEs from SCG that provided guidance on the vulnerability analysis of SDG&E's gas assets. We are grateful to ICF for help with climate science guidance and analysis; Accenture for design of the Community Vulnerability Index and development of the Climate Intelligence Tool; and San Diego Regional Climate Collaborative (SDRCC) for community outreach & engagement and climate equity expertise. In addition, SDG&E would like to acknowledge State of California Energy Division staff for hosting and facilitating multi-stakeholder workshops. We also thank Southern California Gas (SCG), Pacific Gas & Electric (PG&E), and Southern California Edison (SCE) climate adaptation teams for numerous alignment meetings; and Cal-Adapt: Analytics Engine team (Eagle Rock Analytics, Pyregence Consortium, University of California Los Angeles, University of California Merced, University of California, San Diego) for producing climate projection datasets that are used for the current SDG&E CAVA analysis.

7 Appendices

7.1 Appendix I – Sensitivity Scoring Results

Table 81. *Sensitivity scores and scoring justifications by asset type and hazard*

Extreme Heat

Asset Type	Sensitivity Score (0-5)	Justification
Transmission & Extreme Heat		
Overhead Line Segment	4	High ambient temperature conditions reduce the ability of conductors to dissipate heat and are frequently associated with higher demand because of customers' use of air conditioning. Transmission conductors are subject to derating under high temperature conditions. If lines are not deloaded, conductors may sag beyond design standards which can increase the risk of vegetation contact and may also result in loss of material strength.
Underground Line Sub Segment (Cable)	1	Ground temperatures are relatively stable, particularly at the burial depths of transmission feeders.
Poles & Towers	0	Overhead transmission structures including poles and towers are not considered sensitive to extreme temperatures and heat waves.
Distribution & Extreme Heat		
Poles	0	Distribution poles are not considered sensitive to

		extreme temperatures and heat waves.
Primary Underground Conductor	2	Ground temperatures are relatively stable, however, under prolonged conditions of high load and high temperatures, such as occur during heat waves, the ground surrounding underground cable may accumulate heat, prevent overnight cooling, and exacerbate thermal runaway conditions.
Primary Overhead Conductor	4	High ambient temperature conditions reduce the ability of conductor to dissipate heat and are frequently associated with higher demand because of customers' use of air conditioning. High conductor temperatures may exacerbate line sag, increasing potential interaction with trees. High conductor temperatures can increase conductor aging rate and risk of damage.
Transformer (Overhead)	4	Extreme temperatures reduce transformer capacity. Increasing frequency, severity and duration of heat waves have the potential to accelerate aging. High equipment temperatures may result in protective device

		operation (CSP transformers) or sudden failure.
Transformer (Pad-mount)	4	Higher ambient temperatures reduce transformer capacity. Increasing frequency, severity and duration of heat waves has the potential to accelerate aging. High equipment temperatures may result in higher risk of failure.
Transformer (Subsurface)	4	Higher ambient temperatures reduce transformer capacity. Increasing frequency, severity and duration of heat waves has the potential to accelerate aging. High equipment temperatures may result in higher risk of failure. SDG&E is no longer using subsurface equipment in new constructions and converting to pad-mount on a case-by-case basis.
Voltage Regulator	3	Extreme temperatures reduce regulator capacity. Increasing frequency, severity and duration of heat waves have the potential to accelerate aging.
Dynamic Protective Device (Fault interrupters, reclosers, auto-throwovers, switches)	2	The design ambient temperature of protective devices varies by type of insulation and can range from 40C to 55C. However, high temperatures may result in accelerated aging and risk of failure.

Capacitors (Pole mounted)	3	Design ambient temperatures for overhead capacitors are typically around 55C. However, high temperatures may result in accelerated aging and risk of failure.
Substations & Extreme Heat		
Substation Transformer	3	Extreme temperatures reduce transformer capacity which, when coupled with high loads, may require load relief actions. However, SDG&E typically does not load transformers to the maximum name plate. This headroom decreases the sensitivity to extreme heat. Increasing frequency, severity and duration of heat waves have the potential to accelerate aging, but it is not expected to result in asset failure.
Voltage Regulator	4	Extreme temperatures reduce regulator capacity. Increasing frequency, severity and duration of heat waves have the potential to accelerate aging, but it is not expected to result in asset failure.
Substation Reactor	3	Oil immersed shunt reactors are typically rated for a specific ambient temperature. Shunt reactors cannot be de-loaded, so temperatures above design may accelerate material

		aging, but not expected to result in failure.
Protection Control Devices	2	The design ambient temperature of protective devices varies by type of insulation and can range from -40 to 85C. High temperatures may result in accelerated aging and risk of failure. High temperatures may result in accelerated aging and risk of failure, but most assets of this type are in a control shelter with climate control, further reducing the asset sensitivity.
Circuit breakers	2	Extreme heat can impede the dissipation of heat, causing circuit breakers to overheat, leading to degraded insulation and higher risk of failure.
Switchgear	2	Extreme heat can impede the dissipation of heat, causing switchgear to overheat, leading to degraded insulation and higher risk of failure.
Capacitor Banks	2	Extreme heat can cause capacitor banks to overheat, leading to reduced efficiency, shorter lifespan, and potential failure of internal components.
Communication & Extreme Heat		
Overhead Fiber	0	The outer sheaths of aerial fiber are typically designed for exposure to temperatures

		of around 158F, thus such cables are not sensitive to extreme heat. Also, unlike power cables, communications cables do not produce substantial heat in operation.
Overhead Copper	0	The outer sheaths of aerial copper cables are typically designed for exposure to temperatures of around 158F, thus such cables are not sensitive to extreme heat. Also, unlike power cables, communications cables do not produce substantial heat in operation.
Underground Fiber	0	Ground temperatures in the U.S. are typically no greater than 95F (summer ground temperatures, Southern and Western states). The outer sheaths of underground fiber are typically designed for exposure to temperatures of around 158F, thus such cables are not sensitive to extreme heat. Also, unlike power cables, communications cables do not produce substantial heat in operation.
Underground Copper	0	Ground temperatures in the U.S. are typically no greater than 95F (summer ground temperatures, Southern and Western states). The outer sheaths of direct buried

		copper communications cables are typically designed for exposure to temperatures of around 158F, thus such cables are not sensitive to extreme heat.
Communication Poles	0	Communication poles are not considered sensitive to extreme temperatures and heat waves.
Antennas	3	Antennas might experience overheating, which may damage internal electronic components, reduce their operational lifespan, and impair their performance. This can lead to unreliable data transmission and increased maintenance needs.
SCADA (RTU)	3	RTUs might experience overheating, which may damage internal electronic components, reduce their operational lifespan, and impair their performance. This can lead to unreliable data transmission and increased maintenance needs.
Facilities & Extreme Heat		
Office Buildings	2	An office building's sensitivity is determined based on its ability to stay cool internally during extreme heat. Indoor temperatures are a result of a combination of HVAC system age, building structure & insulation, and additional

		adaptive measures (cool roof, shading, window coverings). Since maintenance and the upgrading cooling options such as HVAC systems, insulation, and window blinds can be addressed easily through regular building maintenance, sensitivity for these assets to extreme heat is considered low.
Construction & Operation	2	Since C&O centers are typically housed indoors, their sensitivity to extreme heat is the same as office buildings given the ease of adaptive measures.
Asset Critical Facilities	2	The equipment in these facilities requires extensive temperature control to prevent equipment overheating. SDG&E has invested in hardening asset critical facilities, so the sensitivity is considered to be lower.
Communication Centers	3	The equipment within requires extensive temperature control to prevent equipment overheating. They are typically in unmanned climate-controlled enclosures. If the HVAC system was compromised, the equipment would be

		impacted by high temperatures.

Wildfire

Asset Type	Sensitivity Score (0-5)	Justification
Transmission & Wildfire		
Overhead Line Segment	3	Transmission conductors are sensitive to wildfire but tend to be located above the level of the fire and are higher than distribution conductors. Vegetation management programs work to prevent encroachment with transmission lines. Clearances are state-mandated, always greater than the minimum, and are always trimmed to over 4ft (10-12ft and greater) to prevent encroachment with transmission lines. Additionally, innovative practices like LIDAR and satellite imagery help augment data analytic modeling with wildfire team to help predict areas for trimming. Still, conductors can be impacted by wildfires. Heavy smoke from nearby wildfires can affect conductors and cause electrical arcs, thus de-energizing conductors.
Underground Line Sub Segment (Cable)	0	Being underground, this type of asset is essentially protected from wildfire risk.
Poles & Towers	3 (2)	Fire in the direct vicinity of a transmission tower may threaten the tower's integrity. Steel transmission may have a marginally lower sensitivity to wildfire (2). In addition, vegetation management practices reduce the likelihood that fires that may reach transmission structures.
Distribution & Wildfire		
Poles	5 (2)	Fire in the direct vicinity of a distribution pole may threaten pole integrity. Distribution poles tend to be lower than transmission and are usually wooden, consequently placing them at higher risk if unprotected.

		Vegetation trimming requirements are less stringent than transmission lines. The sensitivity is lower for steel poles.
Primary Underground Conductor	0	Being underground, essentially protected from wildfire risk.
Primary Overhead Conductor	5	Distribution conductors are sensitive to fire and are generally more exposed to wildfire conditions by being closer to the ground than transmission conductors and closer to tall vegetation.
Transformer (Overhead)	5	Distribution transformers are at the same height as distribution conductors and so are at similar risk.
Transformer (Pad-mount)	5	Pad mounted transformers, being at grade level, are susceptible to damage from wildfire.
Transformer (Subsurface)	0	Being underground, essentially protected from wildfire risk.
Voltage Regulator	5	Voltage regulators are sensitive to fire and can be exposed to wildfire conditions by being placed along distribution circuits.
Dynamic Protective Devices (Fault interrupters, reclosers, auto-throwovers, switches)	5	Dynamic protective devices are sensitive to fire and can be exposed to wildfire conditions.
Capacitors (Pole mounted)	5	Capacitors are sensitive to fire and can be exposed to wildfire conditions by being placed along distribution circuits.
Substations & Wildfire		
Substation Transformer	2	Cutbacks around substations help reduce sensitivity to wildfire. Therefore, all components within the boundary of a substation have the same sensitivity to wildfire. A moderate sensitivity is preserved because substation components are still sensitive to fire in the event of exposure.
Voltage Regulator	2	
Substation Reactor	2	

Protection Control Devices	2	
Circuit Breakers	2	
Switchgear	2	
Capacitor Banks	2	
Communication & Wildfire		
Overhead Fiber	5	Wildfires can impact the protective sheathing around the fiber cables, leading to exposure and potential damage to the fibers themselves.
Overhead Copper	5	Intense heat from wildfires may damage conductor insulation and lead to short-circuits or conductor failure.
Underground Fiber	0	Being underground, essentially protected from wildfire risk.
Underground Copper	0	Being underground, essentially protected from wildfire risk.
Telcom Poles	2	Fire in the direct vicinity of communication poles may threaten pole integrity, however they are all made of steel.
SCADA (RTU)	5	RTUs are sensitive to fire and can be exposed to wildfire conditions by being placed near the location of distribution transformers. Sensitivity is lower for SCADA units within substations.
Antennas	5	Antennas are sensitive to fire and can be exposed to wildfire conditions. Even if there is no direct contact, the components are sensitive to the heat of the fire.
Facilities & Wildfire		
Office Buildings	3	Sensitivity to wildfires for commercial real estate is determined by (a) building material & roof type (brick, steel/metal, or concrete); (b) NFPA Hazard Class (typically class C: live electrical equipment); (c) Surrounding landscape out to 1 mile (urban/industrial/agricultural/wetland, grassland/hills/desert, shrub/forest); (d) Vegetation within 200ft of structure (bare/rock, urban/landscaping/agricultural, grassland,

		shrubland/forest); (e) Proximity of emergency services (>=5 mi, >=20 mi, >=50 mi) Assuming a vast majority of SDG&E's office buildings are located within urban/suburban areas, distance from emergency centers and surrounding vegetation levels are assumed to be low. In addition, adhering to the San Diego County Fire Code regarding surrounding vegetation and fire protection minimizes the risk of ignition. However, operations and access may be affected by larger wildfires moving through the area.
Construction & Operation Centers	3 (2)	Maintaining safe clearances of surrounding vegetation and adhering to fire protection codes minimizes the risk of ignition. However, operations and access may be affected by larger wildfires moving through the area. Wildfire could critically damage facility equipment (such as servers, and IT or HVAC equipment) and completely restrict access. Lower sensitivity (2) can be assigned to newer facilities due to having better fire-protection systems.
Communication Centers	4	Most are in remote locations that are hard to access, so maintaining safe clearances of surrounding vegetation is challenging. Being unmanned, fire protection is less stringent. Additionally, operations and access may be affected by larger wildfires moving through the area. Wildfire could critically damage facility equipment (such as servers, and IT or HVAC equipment) and completely restrict access to communication centers.
Asset Critical Facilities	2	Maintaining safe clearances of surrounding vegetation and adhering to fire protection codes minimizes the risk of ignition. However, operations and access may be affected by larger wildfires moving through the area.

		Wildfire could critically damage facility equipment (such as servers, and IT or HVAC equipment) and completely restrict access.

Inland Flooding

Asset Type	Sensitivity Score (0-5)	Justification
Transmission & Inland Flooding		
Overhead Line Segment	1	Overhead transmission lines have limited sensitivity to inland flooding, however, if accessibility of assets becomes hindered, the inability for operations and maintenance crews to access these assets may lead to delays in restoration activity.
Underground Line Sub Segment (Cable)	3	Underground transmission systems are generally designed to be submersible and can withstand surface flooding events. In extreme events, heavy inundation of soil can weaken the load bearing capacity of soil, potentially causing damage to underground transmission.
Poles & Towers	3	Erosion, scouring of the ground near pole bases due to extreme precipitation (especially near existing watercourses), and water exposure can weaken the structural integrity of transmission line structures due to soil saturation. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Distribution & Inland Flooding		
Poles	3	Erosion, scouring of the ground near pole bases, or pole rot from standing water or higher water tables associated with increased precipitation can compromise structural integrity, particularly for wooden poles. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Primary Underground Conductor	3	The majority of SDG&E's underground distribution conductor assets are designed to be submersible. In extreme events, heavy inundation can weaken the load

		bearing capacity of soil, potentially causing damage. Conductors and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. Flooding can also impede operations and maintenance. There have been issues with underground distribution conductors and flooding as connectors and saturated cables have faulted when they dry out.
Primary Overhead Conductor	1	Overhead distribution lines have limited sensitivity to inland flooding, however, if accessibility of assets becomes hindered, the inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Transformer (Overhead)	1	Overhead transformers are in sealed enclosures that reduce their sensitivity to extreme precipitation. However, sustained flooding can impede access for restoration activities.
Transformer (Pad-mount)	5	Pad mounted transformers are typically elevated several inches above ground level on the concrete pad. However, rain-induced flooding above the level of the concrete pad may result in damage to pad mount transformers. Needs to be de-energized if submerged. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Transformer (Subsurface)	3	Underground transformers are typically designed to be submersible. However, in some cases transformers and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. Maintenance can also be impeded due to floodwaters.
Voltage Regulator	1	Voltage regulators are in sealed enclosures that reduce their sensitivity to extreme precipitation. However, sustained flooding can impede access for restoration activities.
Dynamic Protective Device (Fault	5	Both electromechanical and microprocessor relays can be vulnerable to precipitation induced flooding. Water exposure may corrode and damage microprocessors

interrupters, reclosers, auto-throwovers, switches)		and moving components of electromechanical relays. Debris can also be deposited in component enclosures, potentially causing failure.
Capacitors (Pole mounted)	1	Capacitors are commonly made from hermetically sealed steel enclosures, making them resistant to water intrusion. However, sustained flooding can impede access for restoration activities.
Substations & Inland Flooding		
Substation Transformer	See depth-dependent sensitivity table	Because substation transformers are hermetically sealed, extreme precipitation is unlikely to impact the transformer windings and other interior components. Although auxiliary systems such as pump fan controls, control cabinets, radiators, external wiring connections, and other accessories may be damaged. SDG&E Civil Site Development designs storm water control for substations to manage storm/rain. Additionally, control cabinets on transformers & other equipment is usually elevated at 3-4 feet from ground level of substation. Vegetation is typically removed in efforts to reduce wildfire risk; this could result in increased susceptibility to erosion/flooding.
Voltage Regulator	See depth-dependent sensitivity table	Because voltage regulators tend to be hermetically sealed, extreme precipitation is unlikely to impact the transformer windings and other interior components, however flooding may seep through cracks and faulty seals and damage interior components. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Substation Reactor	See depth-dependent sensitivity table	Extreme precipitation is unlikely to impact reactors, however flooding may impact radiators, fans, pumps, and external wiring connections. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.

Protection Control Devices	See depth-dependent sensitivity table	Both electromechanical and microprocessor relays can be vulnerable to flooding due to precipitation. Water exposure may corrode and damage microprocessors and moving components of electromechanical relays. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Circuit Breakers	See depth-dependent sensitivity table	Equipment installed at grade level can be damaged by flooding. Floodwaters can corrode electrical & mechanical components impacting operation and leading to future failure.
Switchgear	See depth-dependent sensitivity table	In extreme cases of flooding floodwaters can compromise the electrical insulation leading to catastrophic failure. Floating debris may physically damage the asset.
Capacitor Banks	See depth-dependent sensitivity table	Capacitor banks are usually elevated above grade. However, water reaching the insulators of the capacitor cans could result in capacitor outage and possibly damage.
Communication & Inland Flooding		
Overhead Fiber	1	Overhead fiber may be sensitive to inland flooding in the event that accessibility of assets becomes hindered. Inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Overhead Copper	1	Overhead copper lines may be sensitive to inland flooding in the event that accessibility of assets becomes hindered. Inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Underground Fiber	2	Underground fiber cables include features to resist water ingress. However, sustained exposure to water due to flooding can impact underground fiber cables by causing water to infiltrate ducts or conduits, potentially leading to physical damage and signal loss. Water can corrode the cable's coating and damage the core glass if seals are compromised.

Underground Copper	2	Underground copper cables include features to resist water ingress. However, sustained exposure to water due to flooding can infiltrate ducts or conduits, potentially leading to physical damage and signal loss. Water can corrode the cable's coating and damage the cable if seals are compromised.
Communication Poles	2	Erosion, scouring of the ground near pole bases, and pole rot from extreme precipitation and higher water tables can compromise structural integrity. Impacts are greatest from moving water; standing water impacts are expected only when inundation is long-term. However, communication poles are built with robust foundations.
Antennas	2	Most of them are on communication poles and or distribution poles. They are made to be resistant to rain.
SCADA (RTU)	2	SCADA enclosures are commonly sealed and resistant to extreme weather, reducing their sensitivity to extreme precipitation and inland flooding. However, sustained flooding can impede access for restoration activities. Floating debris in moving water could also cause structural damage if high-velocity contact occurs.
Facilities & Inland Flooding		
Office Buildings	2	Sensitivity to extreme precipitation and inland flooding is determined based on a combination of (a) building factors: roof age, drainage issues, and points of standing water and; (b) site operations: storm water plan and whether storm water is released off site. Flooding could damage equipment and restrict access. Due to the critical nature of these facilities, during flood events, some operations may be temporarily modified or suspended. Some operations may be temporarily modified or relocated (e.g. remote work for office workers).
Construction & Operation Centers	2	Flooding could damage equipment and restrict access to asset critical facilities, making them inoperable or

		understaffed. Site work has taken place at these locations for water control.
Communication Centers	3	These locations are unmanned and out in the elements in remote areas. The components within could be impacted by flooding.
Asset Critical Facilities	4	Flooding could damage critical equipment (servers, power supply, etc.) or supporting systems (HVAC, backup generators, etc.), making them inoperable. If flooding blocks road access, it may also restrict access to these sites making them inoperable or understaffed. There are servers and cabling under raised floor that would get damaged by flooding. Some equipment is mounted on raised floors but would be sensitive if reached by floodwaters.

Coastal Flooding

Asset Type	Sensitivity Score (0-5)	Justification
Transmission & Coastal Flooding		
Overhead Line Segment	1	Overhead transmission lines have limited sensitivity to coastal flooding, however, in the event that accessibility of assets becomes hindered, the inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Underground Line Sub Segment (Cable)	2	While underground transmission systems are generally designed to be submersible and can withstand flooding events, extreme flooding can compromise asset durability. In extreme events, heavy inundation of soil, particularly if compounded by wave impacts, can weaken the load bearing capacity of soil, potentially causing damage to underground transmission.
Poles & Towers	4	Erosion, scouring of the ground near pole bases, and saline water exposure from rising sea levels can compromise the structural integrity of transmission line structures and accelerate corrosion of structural members. Wave action

		and floating debris could also cause structural damage if high-velocity contact occurs.
Distribution & Coastal Flooding		
Poles	4	Erosion, scouring of the ground near pole bases, and saline water exposure from rising sea levels can compromise the structural integrity of transmission line structures and accelerate corrosion of structural members. Wave action and floating debris could also cause structural damage if high-velocity contact occurs.
Primary Underground Conductor	3	Underground distribution conductors are typically designed to be submersible. However, in some cases conductors and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. Flooding can also impede operations and maintenance. There is a probable increase in failure due to saltwater corrosion. There have been issues with underground distribution conductors and flooding as connectors and saturated cables have faulted when they dry out.
Primary Overhead Conductor	1	Overhead distribution lines have limited sensitivity to inland flooding in the event that accessibility of assets becomes hindered. Inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Transformer (Overhead)	1	Overhead transformers are typically above flood level and thus have low sensitivity to flood waters. However, sustained flooding can impede access for restoration activities.
Transformer (Pad-mount)	5	Pad mounted transformers are typically elevated several inches above ground level on the concrete pad. However, flooding above the level of the concrete pad may result in damage to pad mount transformers. Furthermore, even if elevated, high amount of coastal storm surge may cause mount damage. During flood events the pad is impacted but not the overhead transformers. Needs to be de-energized if submersed

Transformer (Subsurface)	3	Underground transformers are typically designed to be submersible. However, in some cases transformers and associated structures could be subject to corrosion, particularly in the case of existing damage or faulty sealing. Maintenance can also be impeded due to floodwaters.
Voltage Regulator	1	Overhead regulators are unlikely to be exposed to flood waters. However, sustained flooding can impede access for restoration activities.
Dynamic Protective Device (Fault interrupters, reclosers, auto-throwovers, switches)	5	Both electromechanical and microprocessor relays can be vulnerable flooding and SLR. Water exposure may corrode and damage microprocessors and moving components of electromechanical relays. Debris can also be deposited in component enclosures, potentially causing failure
Capacitors (Pole mounted)	1	Pole mounted capacitors are above flood level and so are not exposed to flooding. However, sustained flooding can impede access for restoration activities.
Substations & Coastal Flooding		
Substation Transformer	See depth-dependent sensitivity table	Substation transformers are hermetically sealed and generally resilient against flooding. However brackish water intrusion through faulty seals, wave impact, and floating debris might damage the transformer. Auxiliary systems such as pump fan controls, control cabinets, radiators, external wiring connections, and other accessories may be damaged.
Voltage Regulator	See depth-dependent sensitivity table	Flooding can damage cores and windings. Floating debris and wave action may physically damage the asset. Wave impacts on coastal installations may compromise foundation integrity.
Substation Reactor	See depth-dependent	

	sensitivity table	
Protection Control Devices	See depth-dependent sensitivity table	Both electromechanical and microprocessor relays can be vulnerable to flooding. Water exposure may corrode and damage microprocessors and moving components of electromechanical relays. Floating debris and wave action may physically damage the asset.
Circuit Breakers	See depth-dependent sensitivity table	Equipment installed at grade level can be damaged by flooding. Floodwaters can corrode electrical & mechanical components impacting operation and leading to future failure. In extreme cases of flooding floodwaters can compromise the electrical insulation leading to catastrophic failure. Wave action may physically damage the asset.
Switchgear	See depth-dependent sensitivity table	
Capacitor Banks	See depth-dependent sensitivity table	
Communication & Coastal Flooding		
Overhead Fiber	1	Overhead fiber may be sensitive to coastal flooding in the event that accessibility of assets becomes hindered. Inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Overhead Copper	1	Overhead copper lines may be sensitive to coastal flooding in the event that accessibility of assets becomes hindered. Inability for operations and maintenance crews to access these assets may lead to delay in restoration activity.
Underground Fiber	3	Underground fiber cables include features to resist water ingress. However, sustained exposure to water due to flooding can infiltrate ducts or conduits, potentially leading to physical damage and signal loss. Water can

		corrode the cable's coating and damage the core glass if seals are compromised.
Underground Copper	3	Underground copper cables include features to resist water ingress. However, sustained exposure to water due to flooding can infiltrate ducts or conduits, potentially leading to physical damage and signal loss. Water can corrode the cable's coating and damage the cable if seals are compromised.
Telcom Poles	2	Erosion, scouring of the ground near pole bases, particularly if compounded by wave impacts, which can compromise structural integrity. Impacts are greatest from moving water; standing water impacts are expected only when inundation is long-term. Robust foundations make them have a reduced sensitivity.
Antennas	4	Antennas and their components are not built to be resistant to salt-water spray. Therefore, they are more sensitive to coastal flooding.
SCADA (RTU)	3	SCADA enclosures are commonly sealed and resistant to extreme weather, reducing their sensitivity to coastal flooding. However, sustained flooding can impede access for restoration activities. Floating debris in moving water and wave action could also cause structural damage if high-velocity contact occurs.
Facilities & Coastal Flooding		
Office Buildings	2	Flooding could damage facility equipment and completely restrict access to critical facility locations, effectively closing them. Some operations may be temporarily modified or relocated (e.g. remote work for office workers).
Command & Operation Centers	2	Flooding could critically damage facility equipment (such as meters, IT equipment, or maintenance vehicles) and completely restrict access to critical facility locations, effectively closing them.
Communication Centers	3	These locations are unmanned and out in the elements in remote areas. The components within could be impacted by flooding.

Asset Critical Facilities	4	Flooding could damage critical equipment (servers, power supply, etc.) or supporting systems (HVAC, backup generators, etc.), making them inoperable. If flooding blocks road access, it may also restrict access to these sites making them inoperable or understaffed. There are servers and cabling under raised floor that would get damaged by flooding. Some equipment is mounted on raised floors but would be sensitive if reached by floodwaters.

7.2 Appendix II – Regional median-year (time-P50) exposure boxplots

The plots below show exposure score distribution boxplots for asset family for observed, 2030, 2050, and 2070 by region (Coastal, Inland, Mountain, Desert, and Out of Service Territory). The plots below demonstrate model-P50 and time-P50 values for the SSP3-7.0 emissions scenario.

Coastal Region

Figure 54. *Temperature exposure score distributions across the Coastal region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50) The median-year (time-P50) exposure scores for each time horizon are shown.*

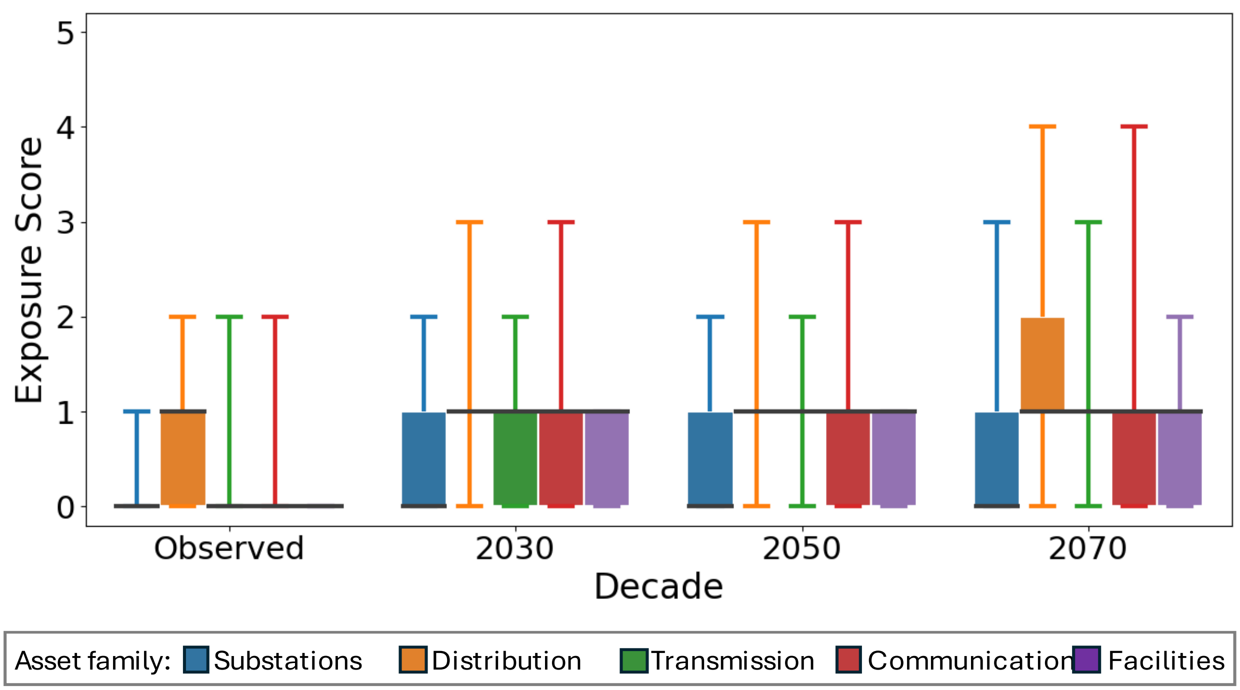


Figure 55. *Wildfire exposure score distributions across the Coastal region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

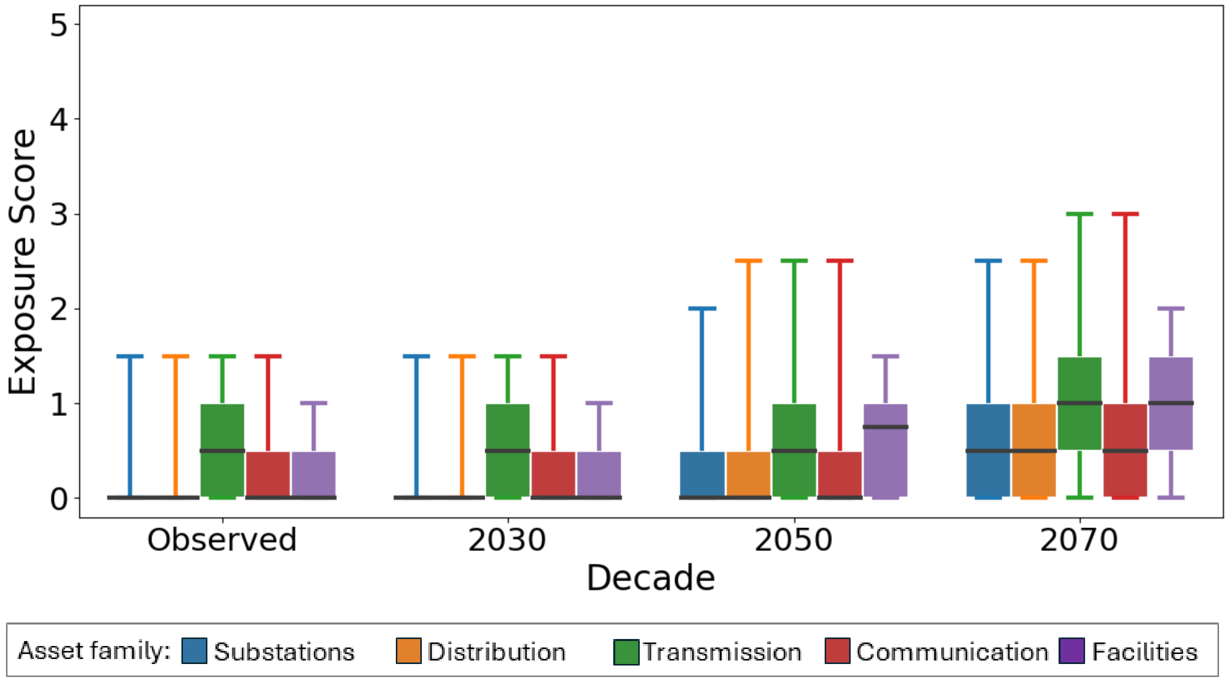
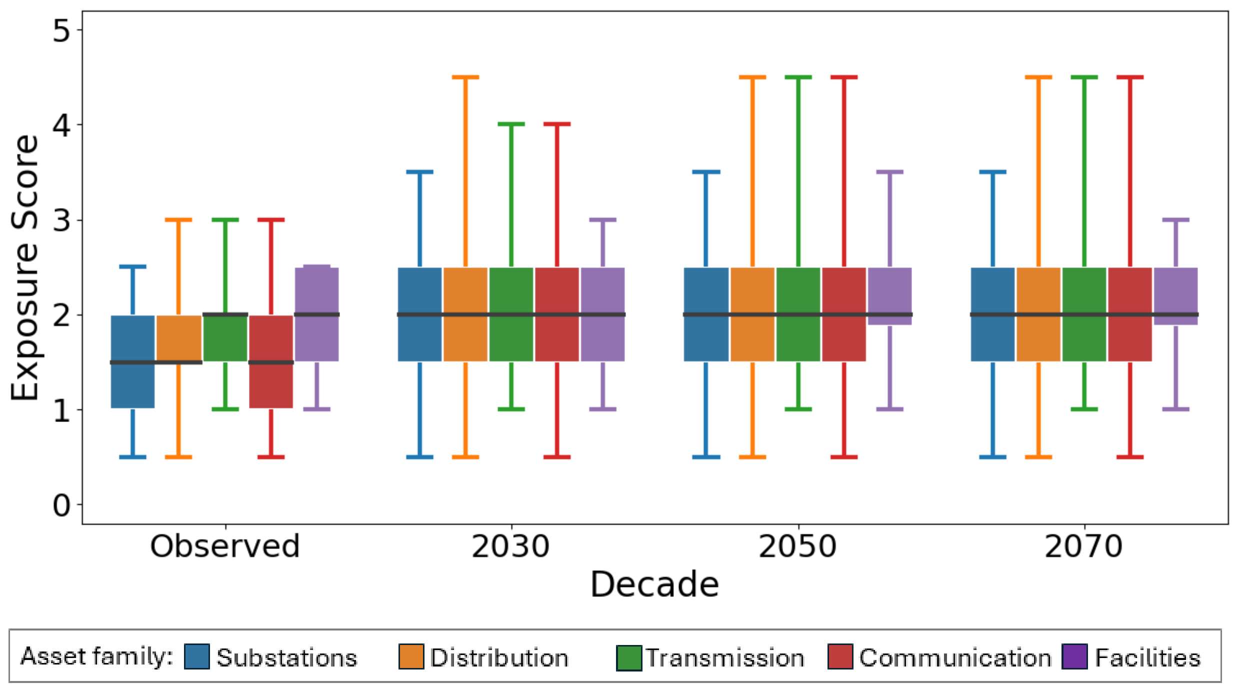


Figure 56. *Inland flood exposure score distributions across the Coastal region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50) The median-year (time-P50) exposure scores for each time horizon are shown.*



Inland Region

Figure 57. *Temperature exposure score distributions across the Inland region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50) The median-year (time-P50) exposure scores for each time horizon are shown.*

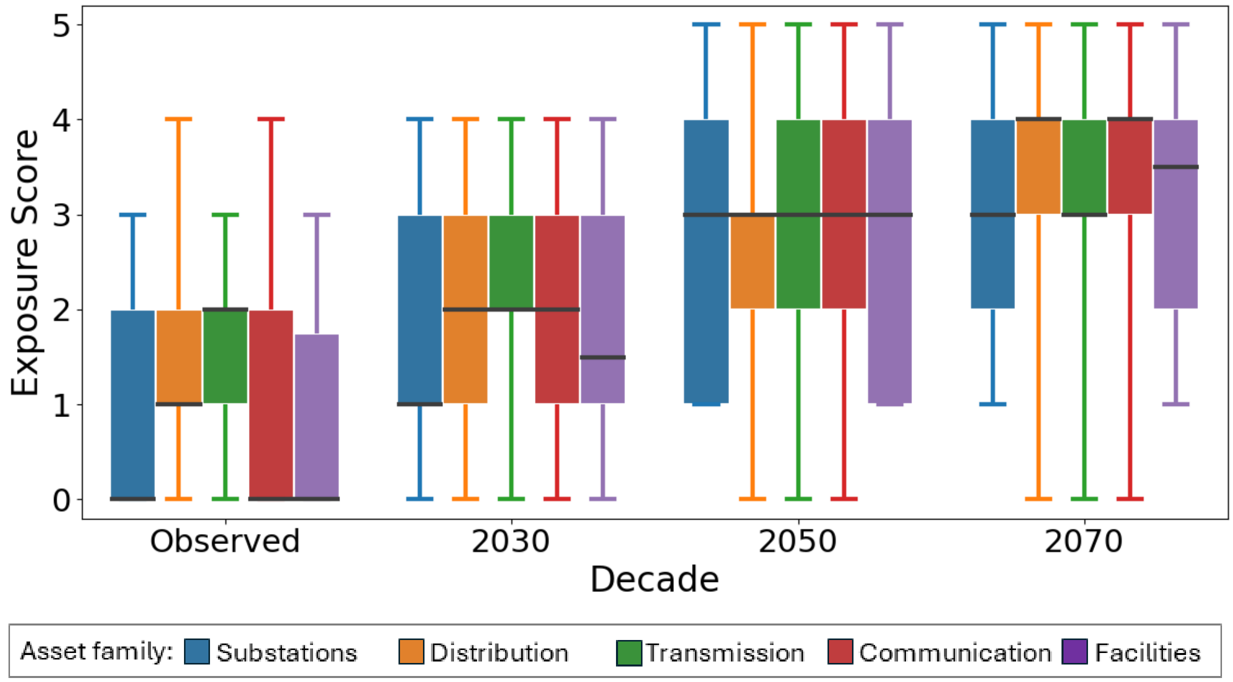


Figure 58. *Wildfire exposure score distributions across the Inland region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

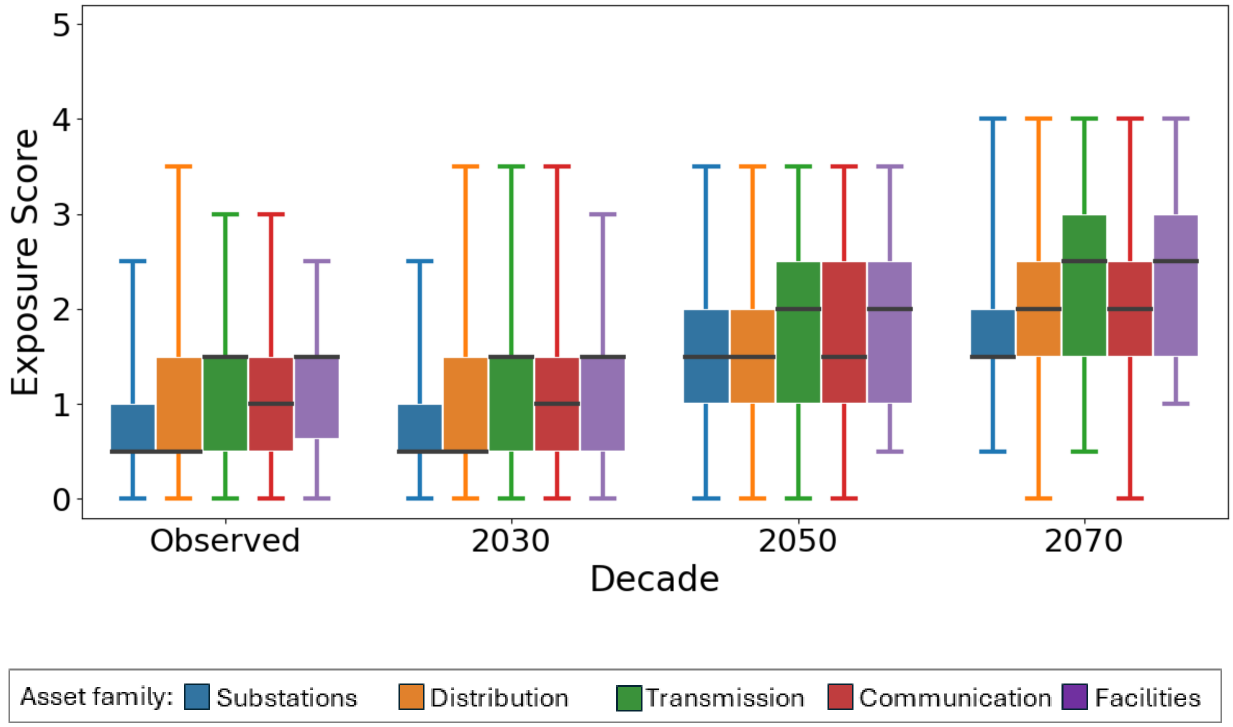
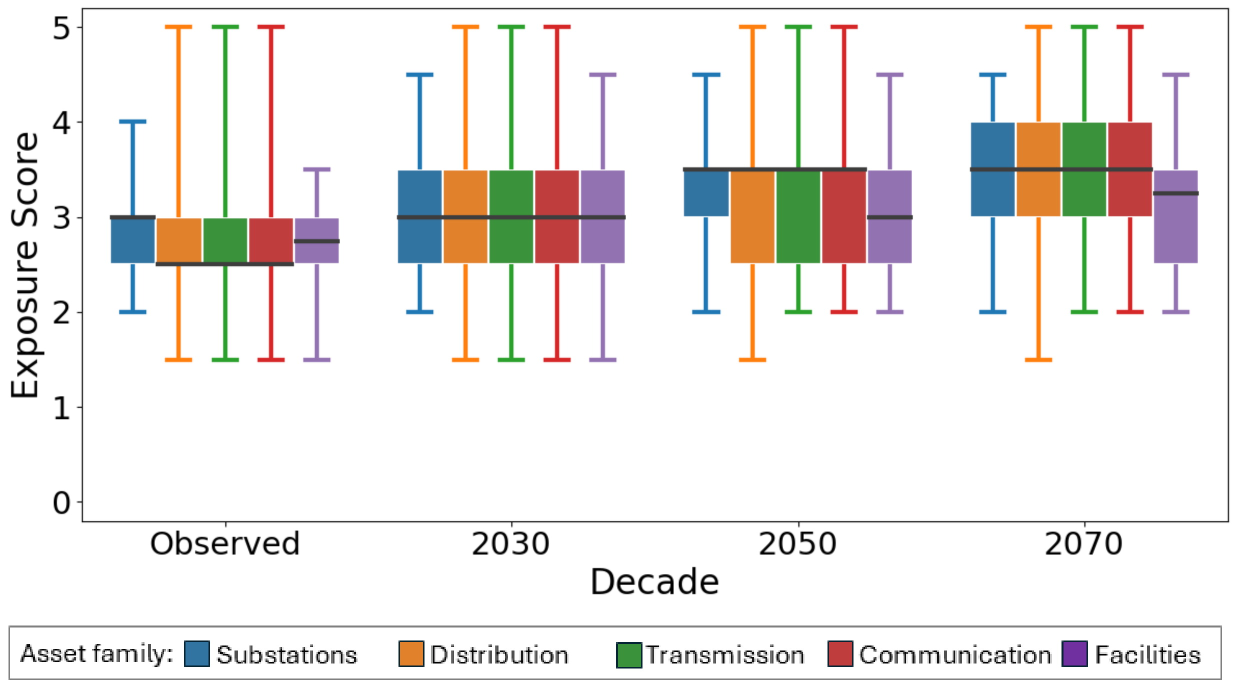


Figure 59. *Inland flood exposure score distributions across the Inland region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.



Mountain Region

Figure 60. *Temperature exposure score distributions across the Mountain region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50) The median-year (time-P50) exposure scores for each time horizon are shown.*

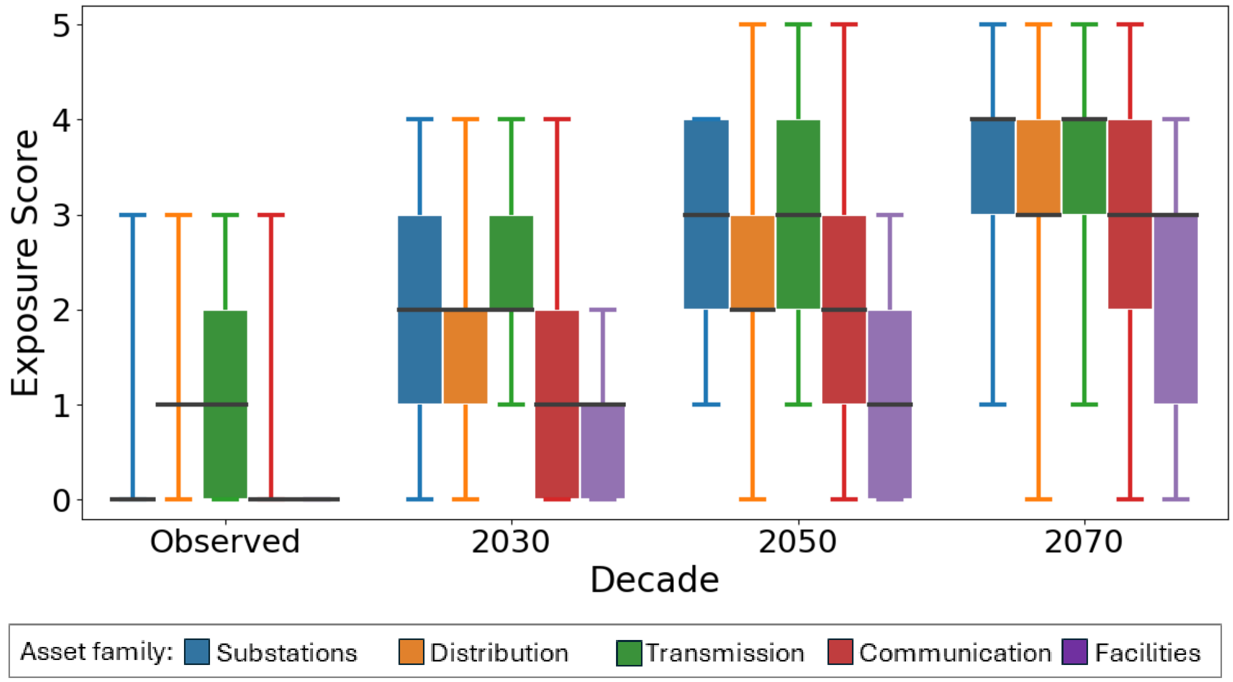


Figure 61. *Wildfire exposure score distributions across the Mountain region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

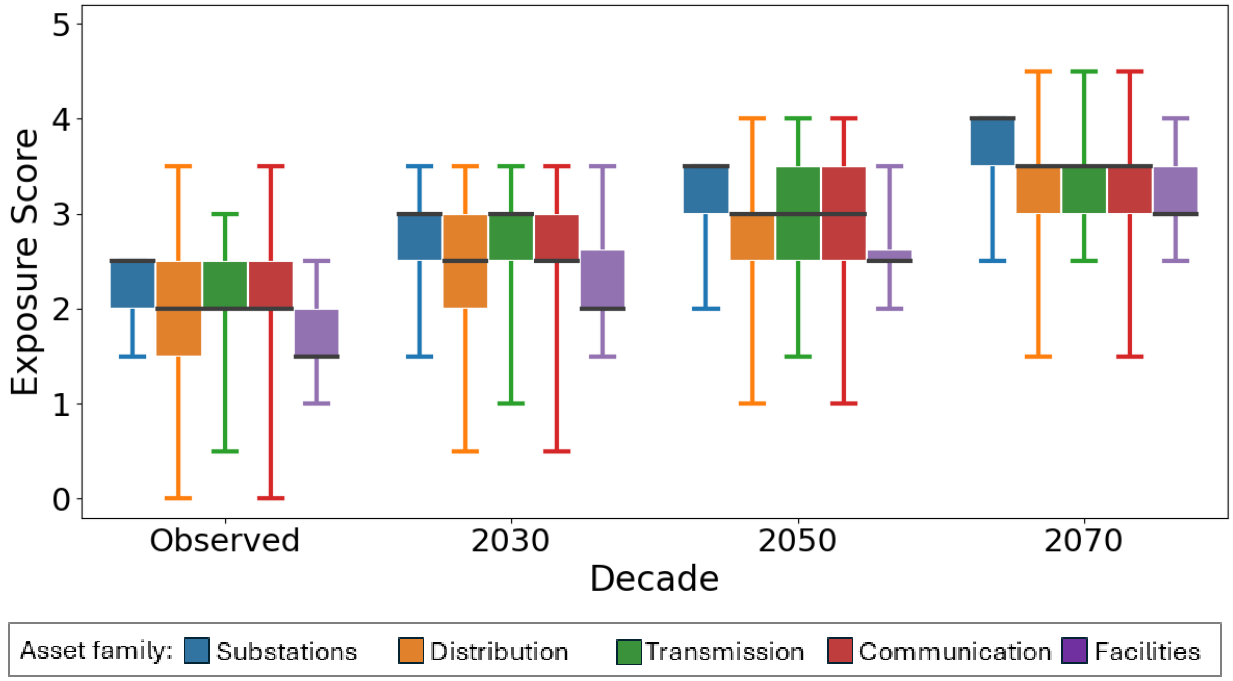
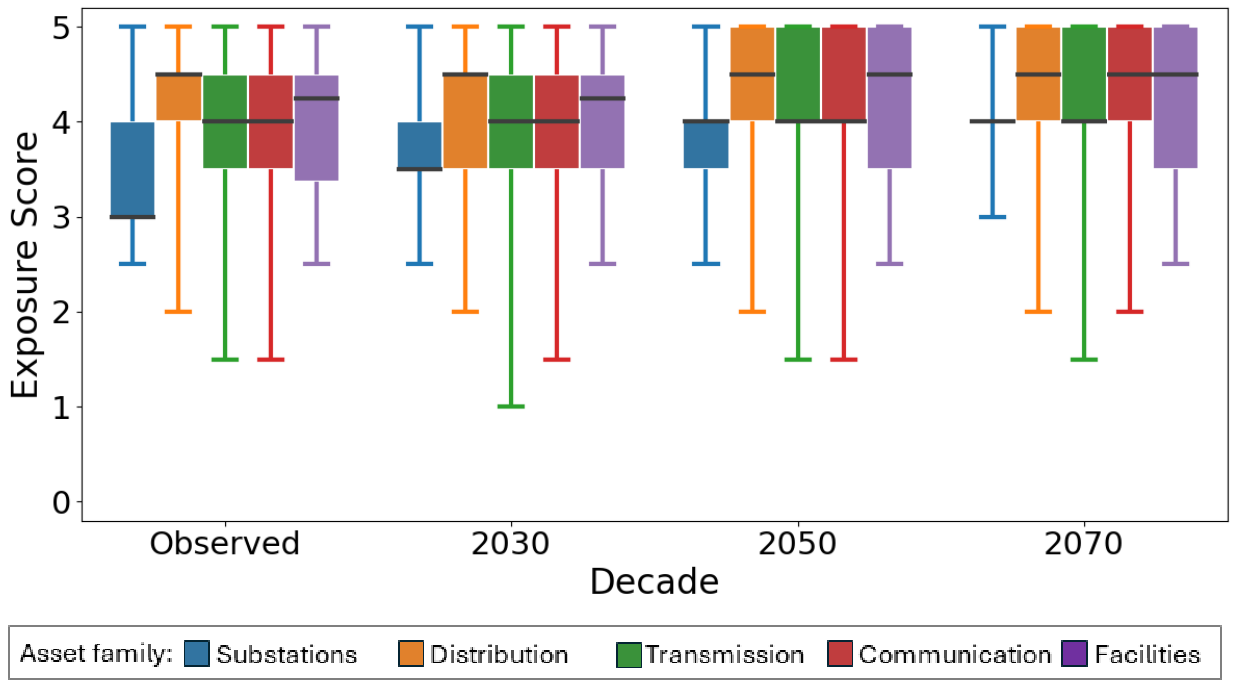


Figure 62. *Inland flood exposure score distributions across the Mountain region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.



Desert Region

Figure 63. *Temperature exposure score distributions across the Desert region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50) The median-year (time-P50) exposure scores for each time horizon are shown.*

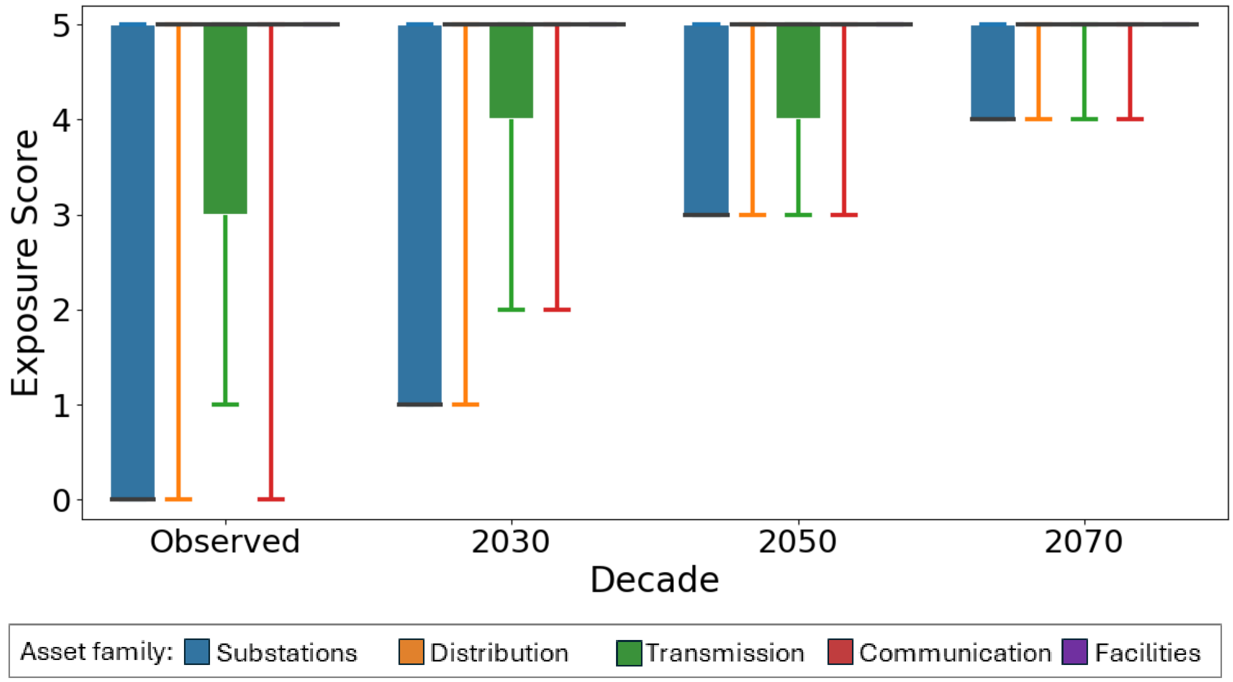


Figure 64. *Wildfire exposure score distributions across the Desert region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

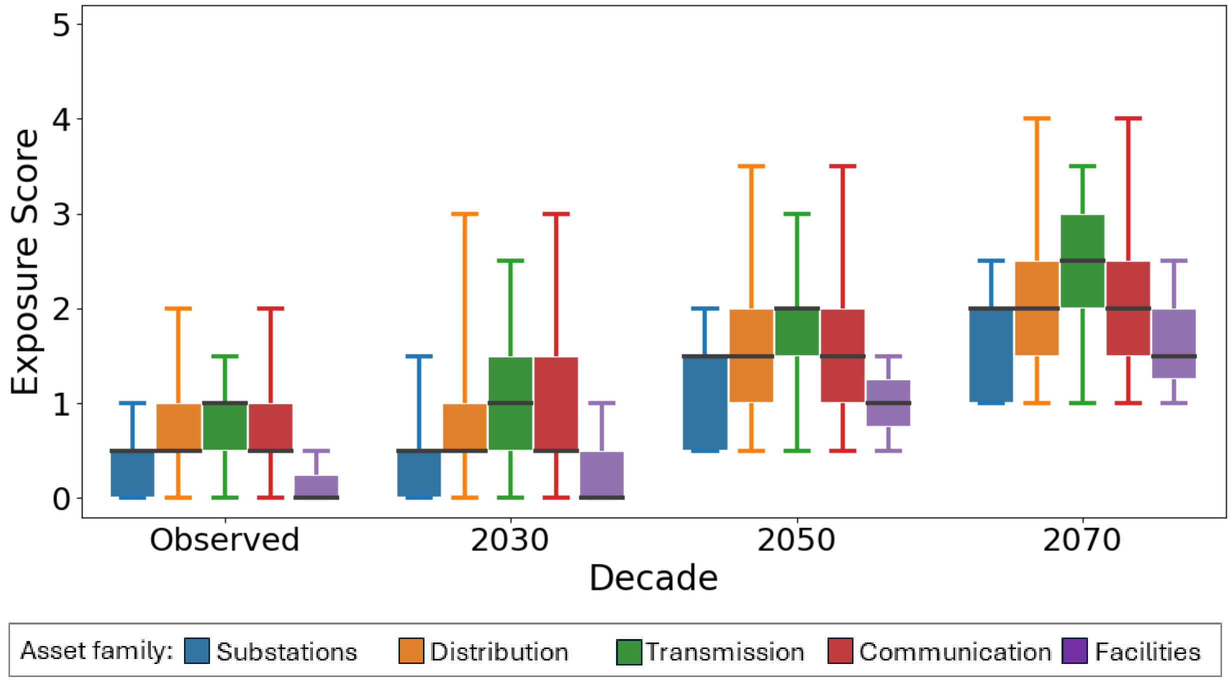
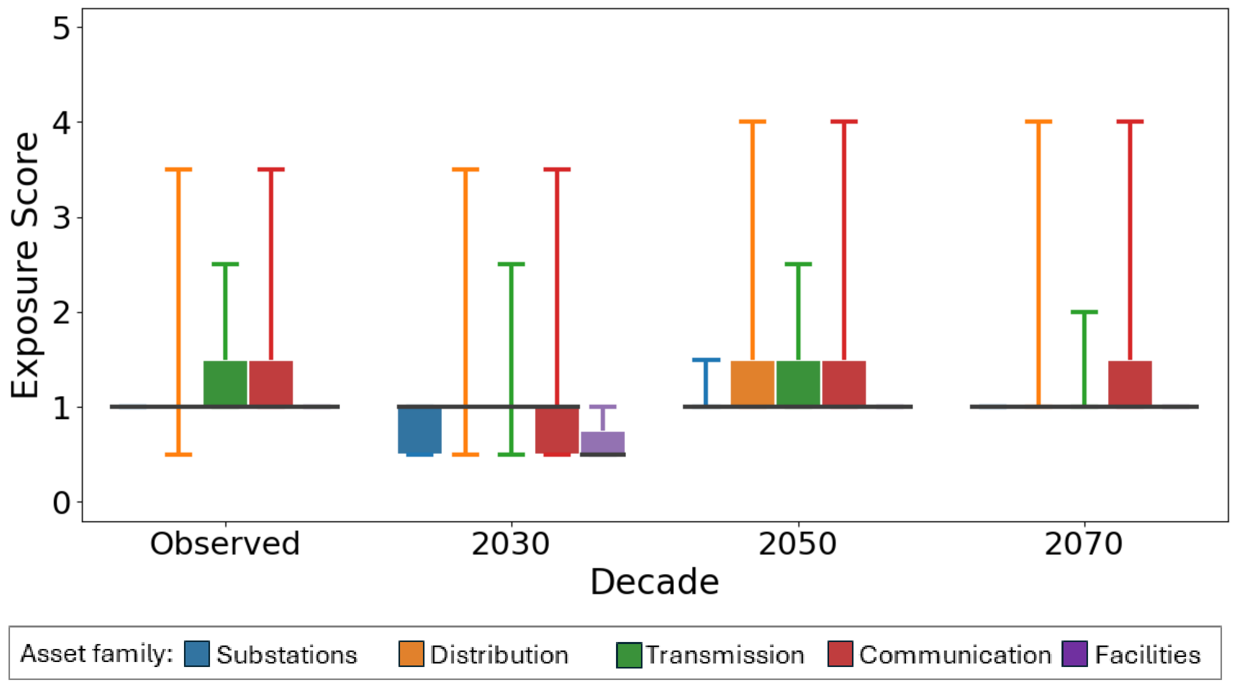


Figure 65. *Inland flood exposure score distributions across the Desert region for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.



Assets Outside of SDG&E Service Territory

Figure 66. *Temperature exposure score distributions for assets outside of the SDG&E service territory for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

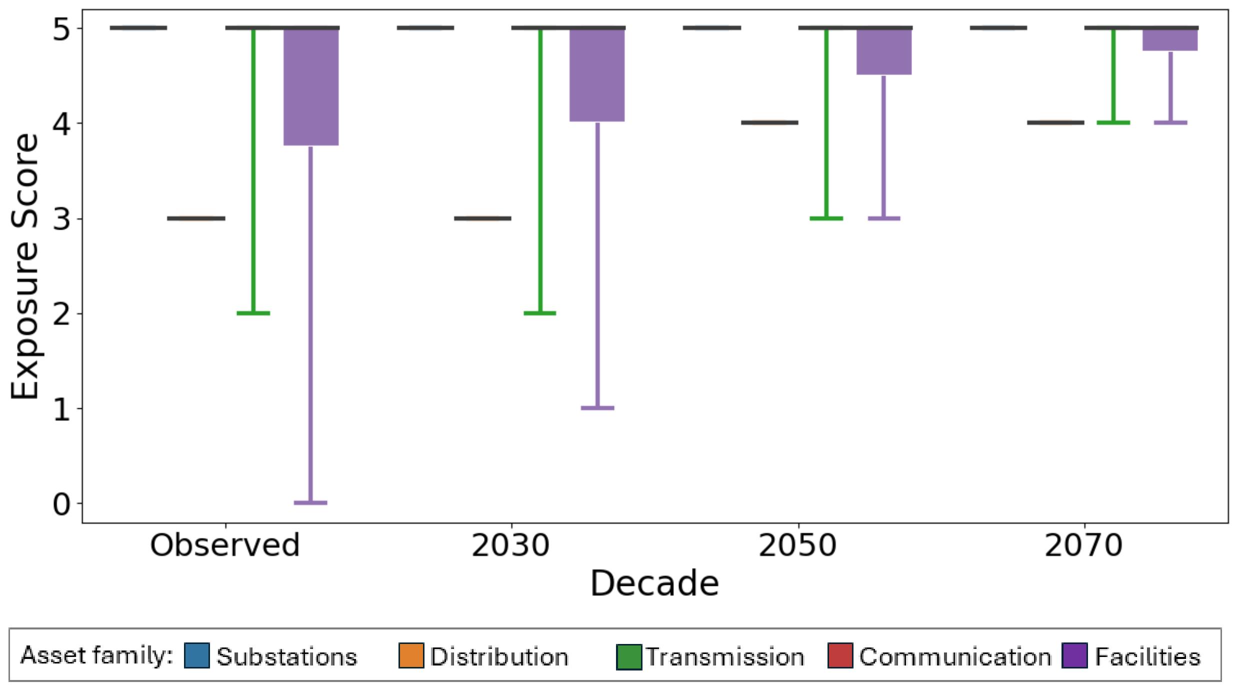


Figure 67. *Wildfire exposure score distributions for assets outside of the SDG&E service territory for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.

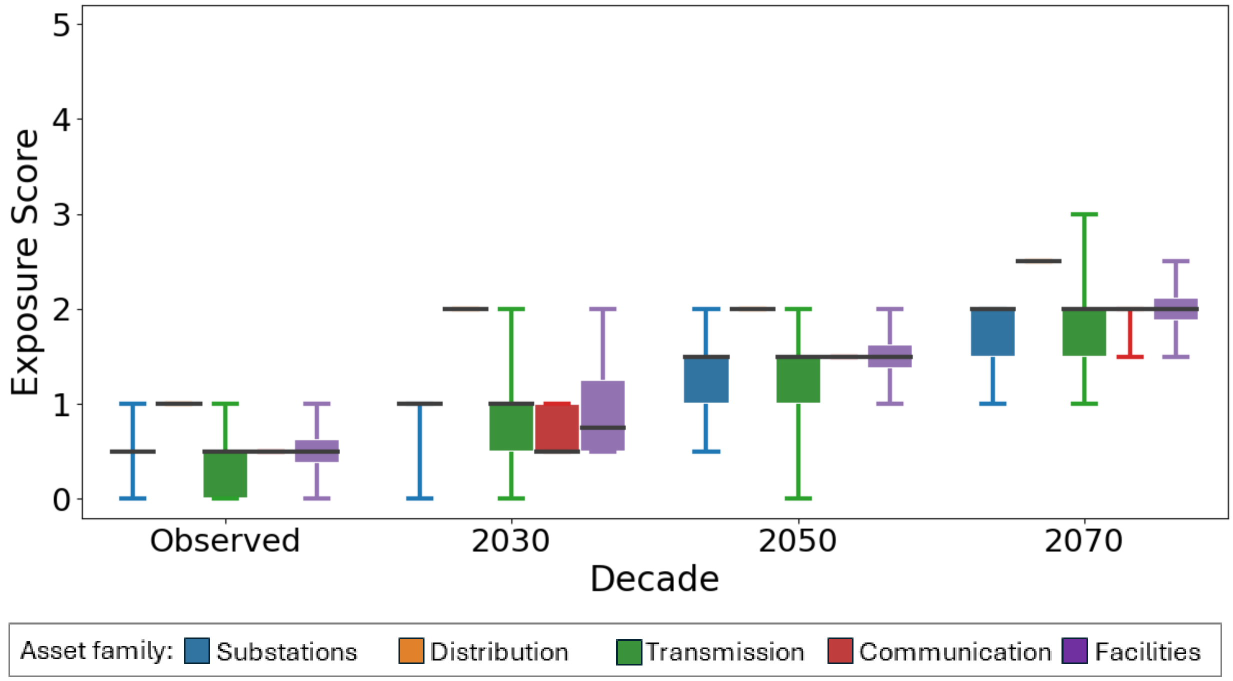
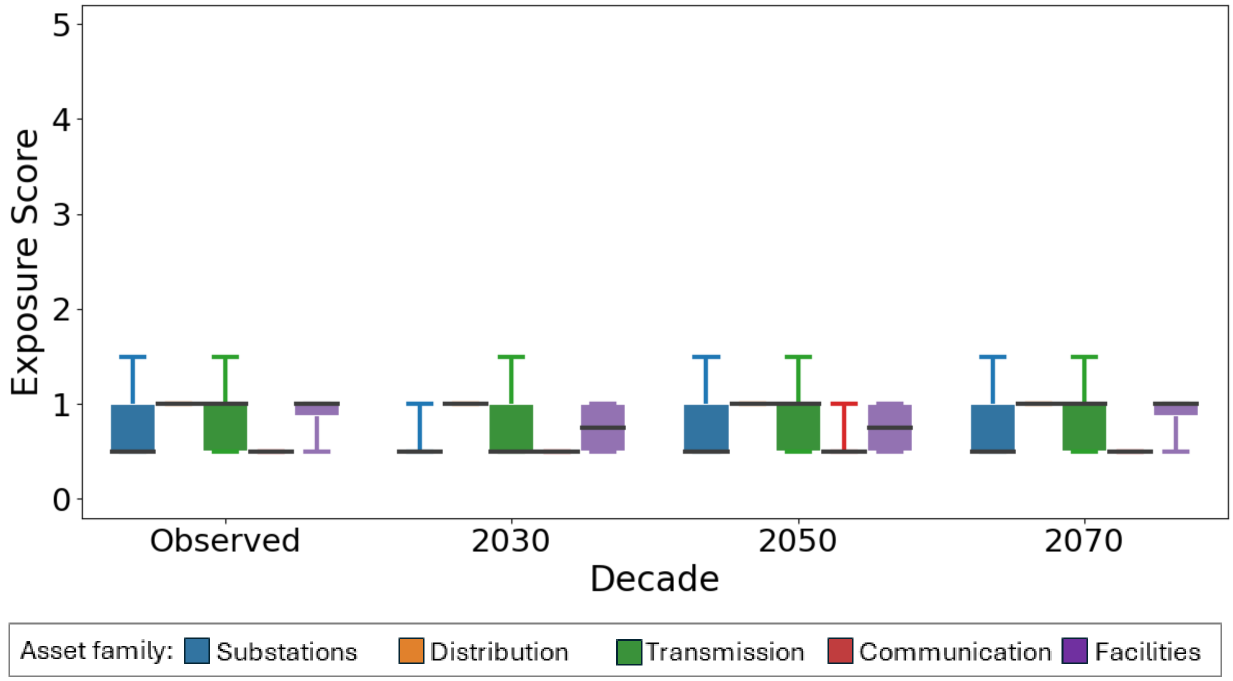


Figure 68. *Inland flood exposure score distributions for assets outside of the SDG&E service territory for each asset family for observed, 2030, 2050, and 2070 for SSP3-7.0 median-model (model-P50)*

The median-year (time-P50) exposure scores for each time horizon are shown.



7.3 Appendix III – Maps of median-year (time-P50) climate projections for 2070

Mapped projections for each metric variable are presented below using the 20-year band between 2060-2079 for 2070. The mapped projections below demonstrate the observed 1995-2014 period and 2070 model-P50 and model-P90 for the time-P50 values across three emissions scenarios (SSP2-4.5, SSP3-7.0, and SSP5-8.5).

Figure 69. *Observed and projected changes in the number of days with daily average temperature above 77 °F. Projected values represent 2070 SSP2-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*

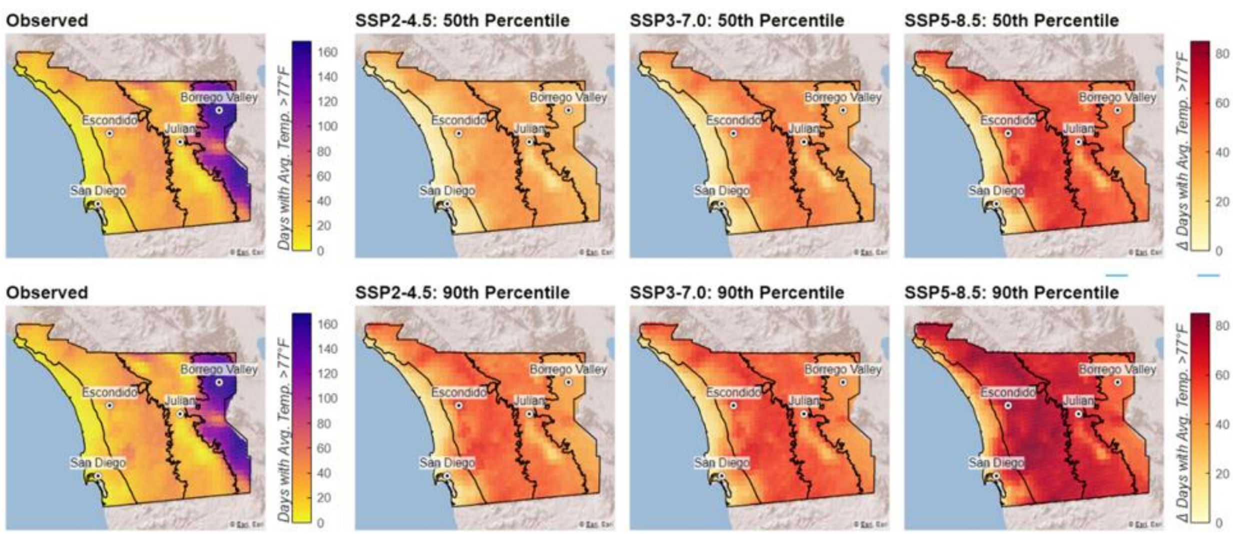


Figure 70. *Observed and projected change in the number of days with daily maximum temperature above 100.4 °F. Projected values represent 2070 SSP2-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*

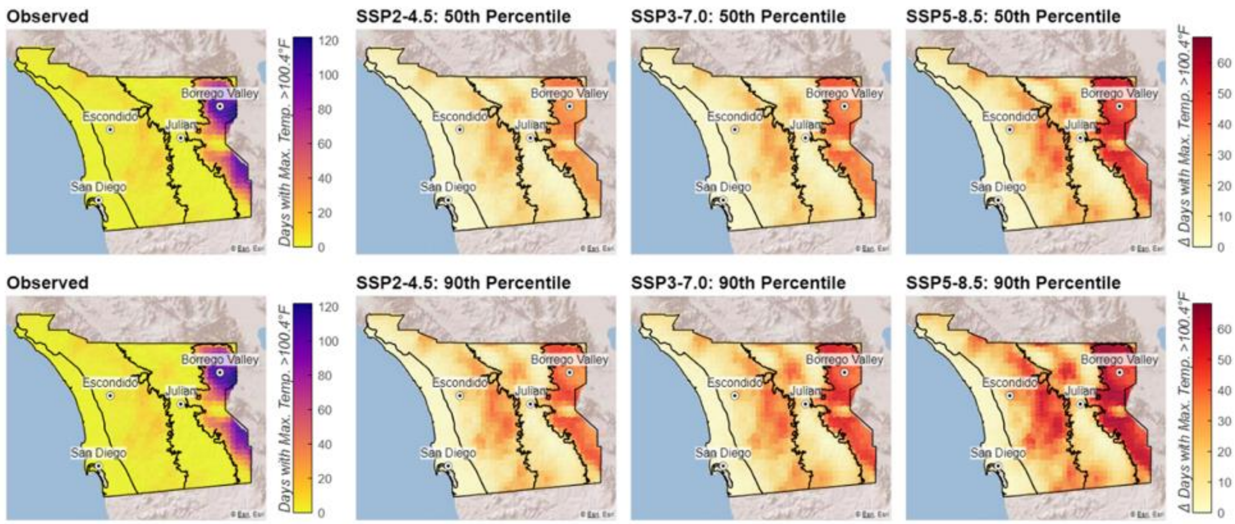


Figure 71. *Observed and projected change in the number of days with daily maximum temperature above 104 °F. Projected values represent 2070 SSP2-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*

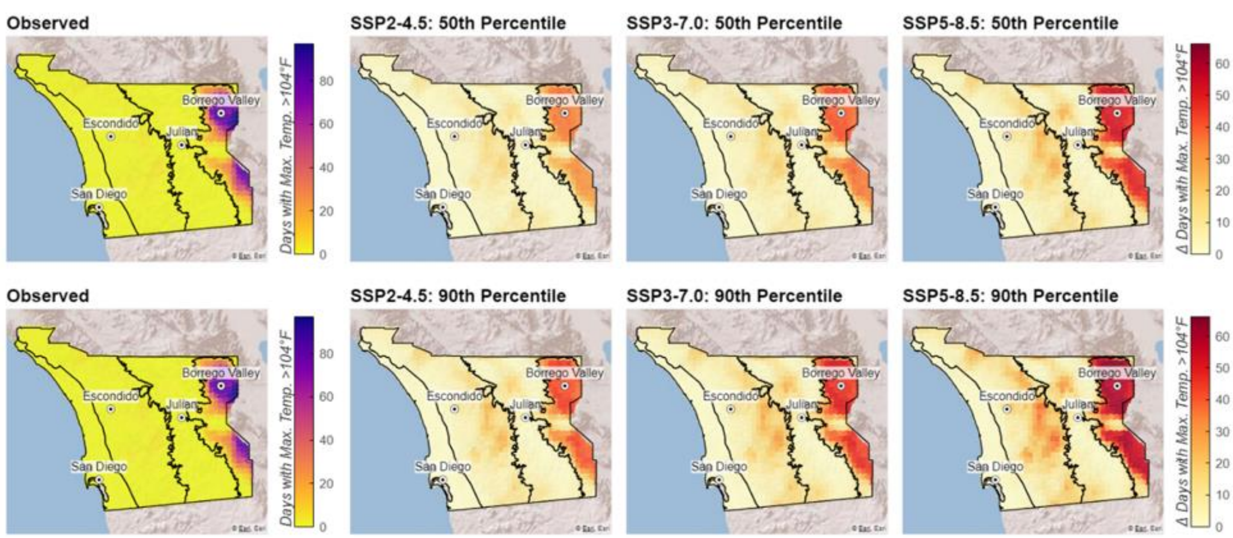


Figure 72. *Observed and projected change in the number of days with FWI above the Historical 95th Percentile FWI value. Projected values represent 2070 SSP2-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*

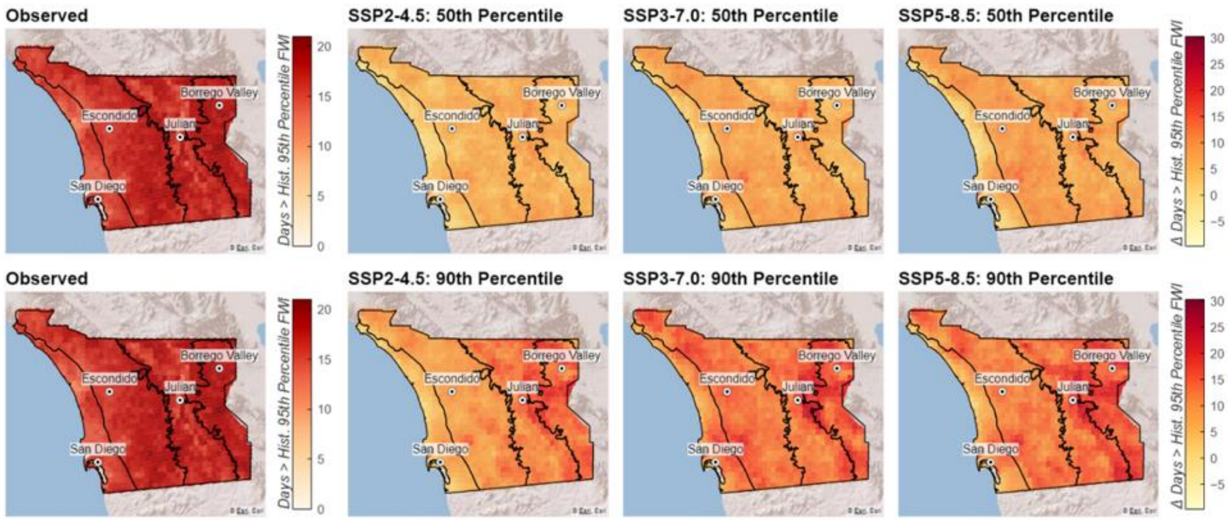


Figure 73. *Observed and projected change in annual maximum 1-day runoff. Projected values represent 2070 SSP2-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*

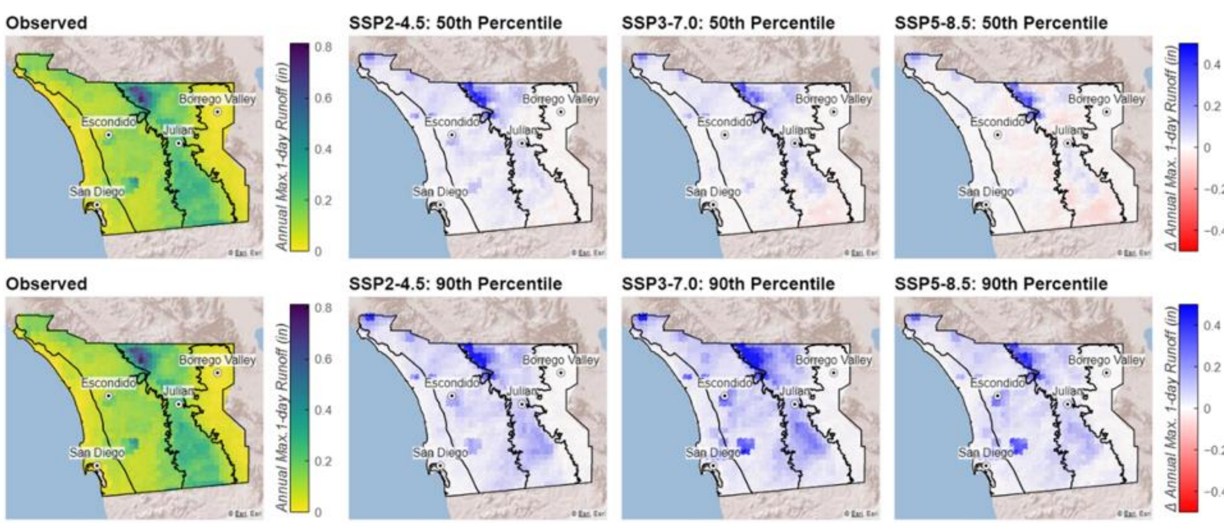
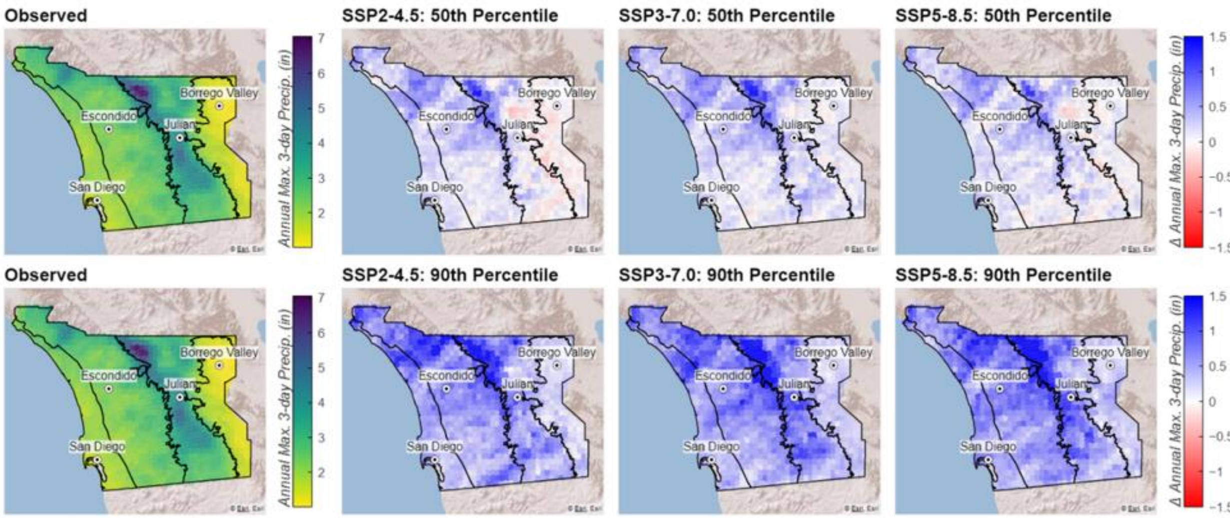


Figure 74. *Observed and projected change in annual maximum 3-day precipitation. Projected values represent 2070 SSP4-4.5, SSP3-7.0, and SSP5-8.5 median-model and extreme-model (model-P50 and model-P90) under median-year (time-P50)*



7.4 Appendix IV - SDG&E Climate Community Vulnerability Index (CVI)

Appendix IV details the methodology for constructing CVI, beginning with the initial mapping exercise that serves as the basis for rescaling, reconstructing, and adding indicators. It then outlines the steps for creating indicators, normalizing them across the service area, and calculating the final CVI.[104]

Step 1. Higher-Resolution Geospatial Downscaling

SDG&E's methodology utilizes a higher-resolution geospatial grid based on the Uber H3 Resolution 8 hexbins. This uniform grid system allows for granular identification of DVCs by capturing local variations, such as population density differences, while serving as a common geospatial grid to interconnect all indicators originated from different geospatial resolutions. Three types of downscaling techniques are used to process different indicators to the H3 hexbins: *area-based nearest-neighbor assignment, area-based downscaling,* and *population-density based downscaling*. Table 82 provides a breakdown of area-based nearest-neighbor assignment, area-based downscaling, and population-density-based downscaling indicators.

Area-Based Nearest-Neighbor Assignment

Area-based *nearest-neighbor assignment* calculates the proportional overlap of census tracts with hexbins to assign indicators such as pollution burden based on proximity of a hexbin to a specific census tract.

Area-Based Downscaling

Census tracts were overlaid onto hexbins within the service area, and the proportion of each hexbin within a given census tract was calculated. For hexbins that intersected multiple census tracts, the proportion was based on the area of the hexbin relative to the total area of the tract. This area-weighted method enables the translation of indicators related to pollution burden and population sensitivity from the census tract scale to the hexbin scale.

Population-Density-Based Downscaling Using WorldPop Population Density Data[12]

SDG&E utilized WorldPop population density data to enable downscaling of population-based indicators. The WorldPop dataset captures localized variations in population density using a combination of Census population data as inputs and combined with satellite imagery and Random Forest based machine learning to derive population density at one-kilometer resolution.[105] Such high-resolution population density data brings much needed geospatial insights that are often not available through other means. By overlaying this data, population values were assigned to hexbins based on density.[106] If a hexbin showed no population density, no population values will be computed for this hexbin. This method enables a consistent high-resolution representation of population distribution regardless of the availability of such high resolution population-based data from their original data sources.

Research conducted at institutions such as Cornell University highlights the robustness and reliability of WorldPop's high-resolution population data. For instance, Tiecke et al. (2017) utilized WorldPop data to map global population distributions at a building level, achieving high precision and recall rates in building identification and generating reliable population estimates.[107] This underscores the dataset's broad applicability in detailed population mapping and its ability to provide granular geospatial insights.
Additionally, Neal et al. (2021) compared census-independent population estimation methods using representation learning with existing population products, including WorldPop.[108] Their findings demonstrated that WorldPop's data matched the most accurate population maps available, further validating its reliability and widespread use in rigorous research methodologies.

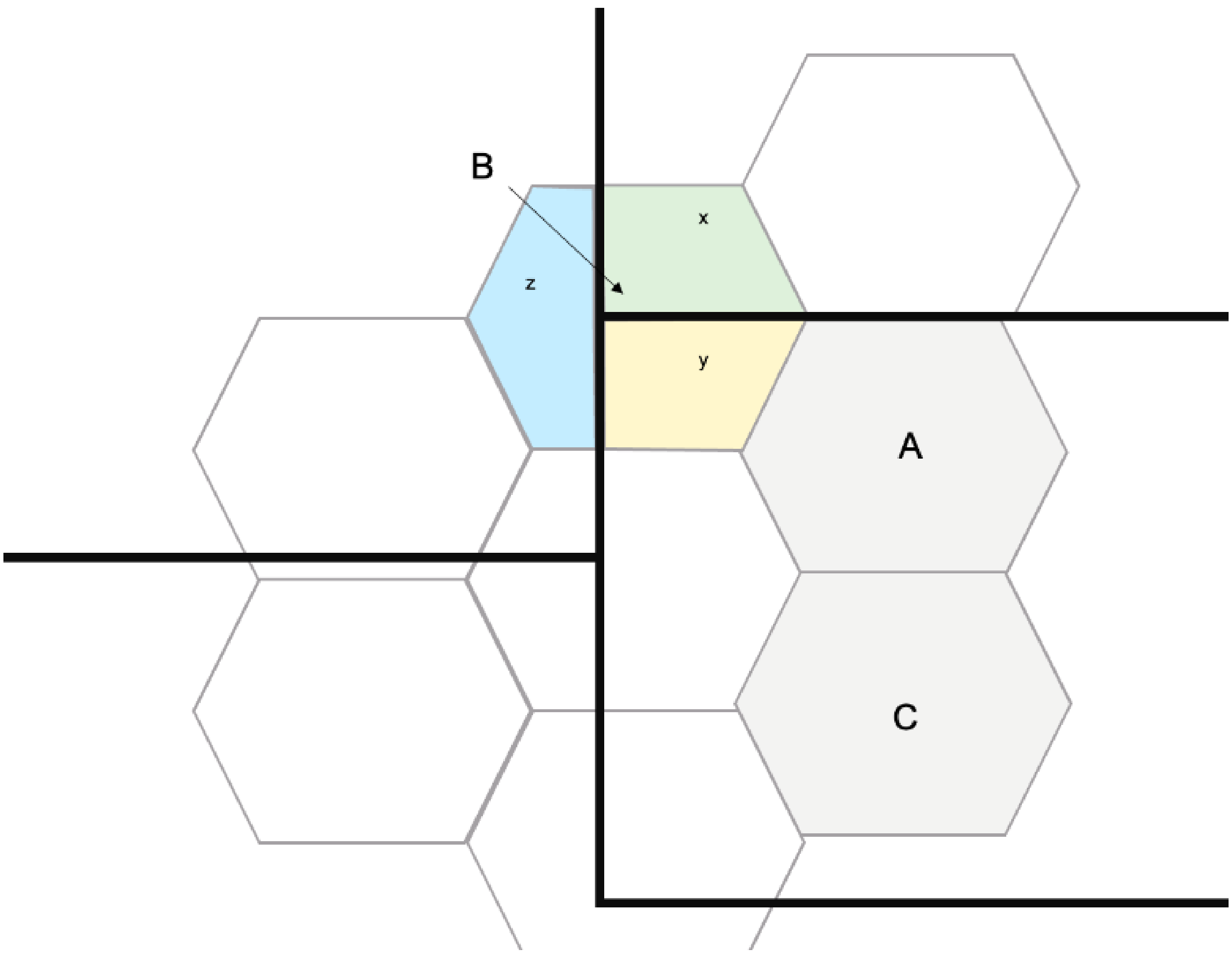
Additional Population Density Checks
To run checks on the accuracy of WorldPop data, additional verification was conducted using landownership data for the local government. This step allowed us to cross-check areas of no or low population density identified by WorldPop against land use classifications, ensuring that these areas corresponded to non-populated regions, such as government-owned lands, protected natural areas, or other non-residential zones. By incorporating this verification process, SDG&E aims to build a robust final sample of populated areas, effectively excluding any non-populated territories. This approach enhances the reliability of the population density estimates.

Figure 75 and Figure 76 illustrate the methods for area-based downscaling and population-density based downscaling and provide classifications for indicators.

The figure below illustrates the relationship between census tracts (outlined in black) and the hexbins (outlined in grey) used. Hexbins A and C are entirely contained within their respective census tracts, meaning their assigned area will be solely based on the area of that single census tract. In contrast, Hexbin B overlaps with three different census tracts (highlighted in blue, green, and yellow), so its area assignment is proportionally divided among these three tracts. The proportions for Hexbin B are calculated based on the ratios of the intersecting areas (x, y, and z) of each census tract it overlaps with, ensuring that each contributing tract's area is accurately represented.

Area-based nearest-neighbor assignment is similar in nature, however instead of assigning values based on proportionality, the value is assigned based on the tract that has the greatest overlap. So, if x covers the largest area, it will be assigned the value of x to that Hexbin.

Figure 75. *Illustration of hexbin-to census tract assignment methods using proportional and nearest-neighbor approaches*



For indicators that require population-density-based downscaling, population values are assigned to hexbins based on where the population density (in pink) is concentrated within each census tract. For hexbins with no overlapping WorldPop population density verified after the landownership exercise (lacking gradation of pink area), no population density ratio was assigned. In the example below, as the WorldPop density does not overlap with Hexbin A, therefore this hexbin is assigned a value of zero for population density.

This method allows for population-based indicators to accurately reflect the distribution of people across the hexbins, corresponding to the actual population density patterns within each census tract.

Figure 76. *Population-density-based downscaling with WorldPop density data*

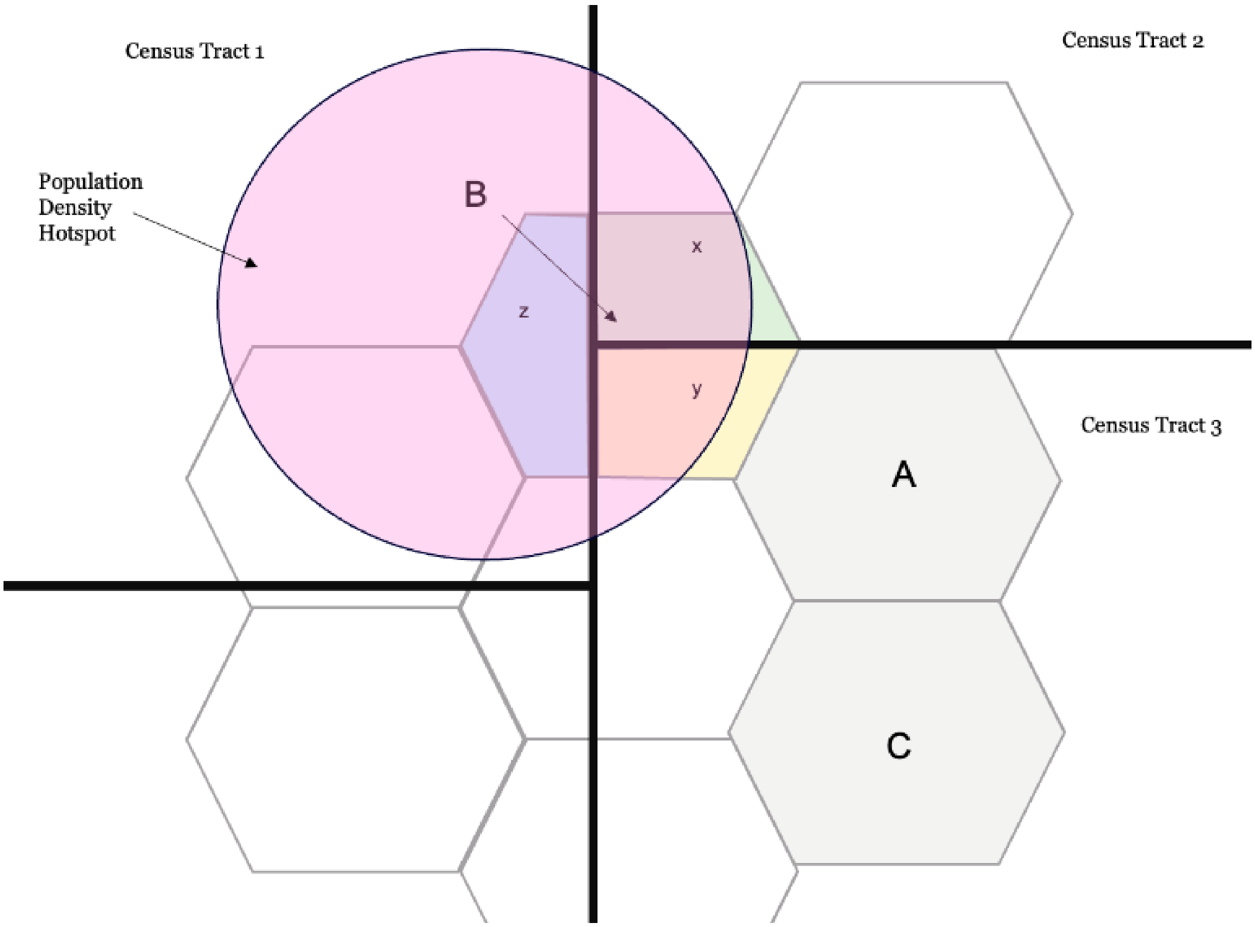


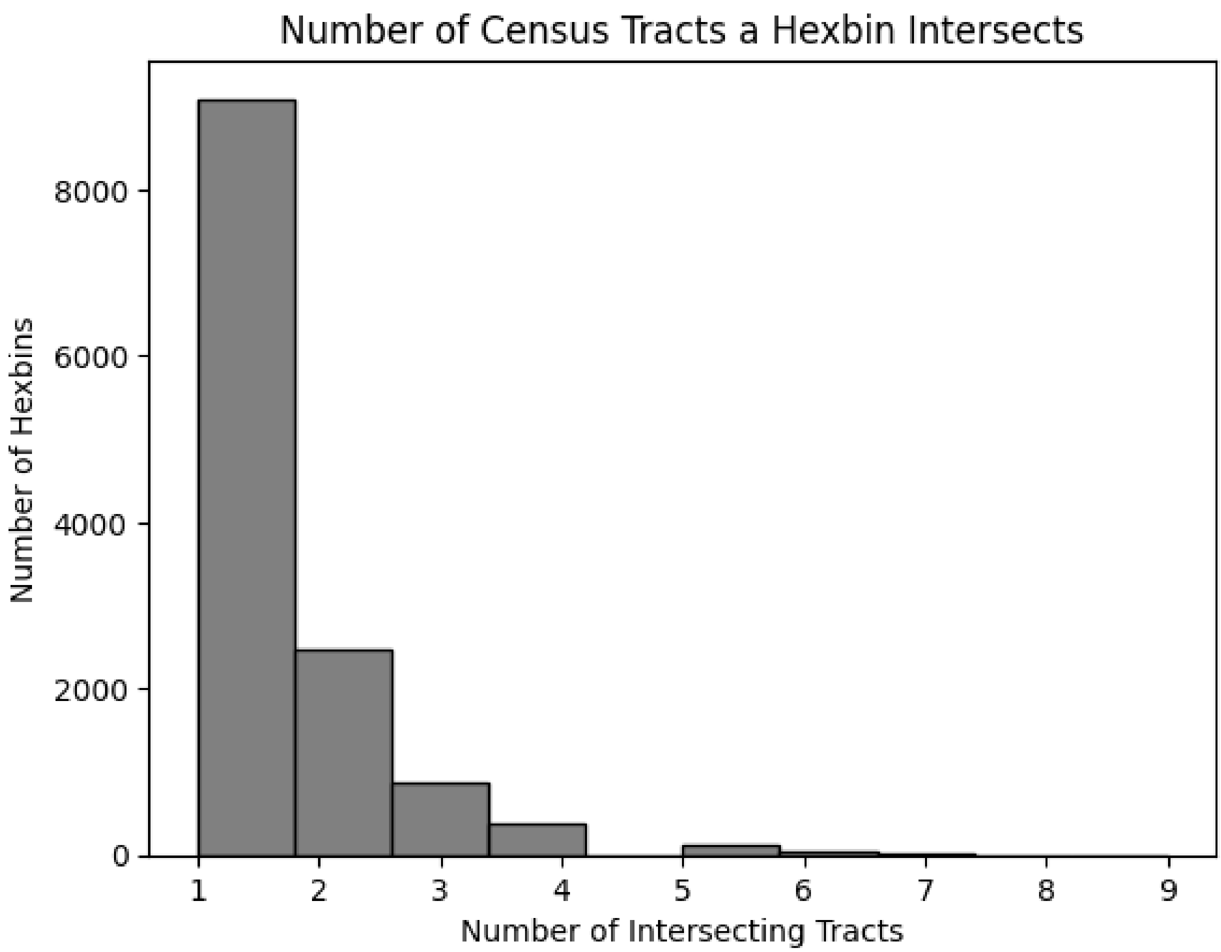
Table 82. *Classification of geospatial approach used for indicators*[109]

<table>
<tr><th>Data</th><th>Area-Nearest-Neighbor Assignment</th><th>Area-Based Downscaling</th><th>Population-Based Downscaling</th></tr>
<tr><td>CalEnviroScreen 4.0</td><td>Ozone
PM2.5</td><td>Diesel PM
Pesticide Use
Toxic Release
Traffic Impacts
Cleanup Sites
Groundwater Threats
Hazardous Waste
Impaired Water Bodies
Solid Waste Sites and Facilities</td><td>Educational Attainment
Housing-Burdened Low-Income Households
Linguistic Isolation
Poverty
Unemployment
Drinking Water Contamination
Children’s Lead Risk from Housing
Asthma
Cardiovascular Disease
Low Birth Weight</td></tr>
<tr><td>Tribal Land</td><td></td><td>Tribal land</td><td></td></tr>
<tr><td>Household Income</td><td></td><td></td><td>Below 60% State-wide Median Household Income</td></tr>
<tr><td>Community Critical Facilities</td><td colspan="3" rowspan="2">Aggregated to hexbins using available longitude-latitude coordinates</td></tr>
<tr><td>AFN Customers</td></tr>
</table>

Descriptive Statistics

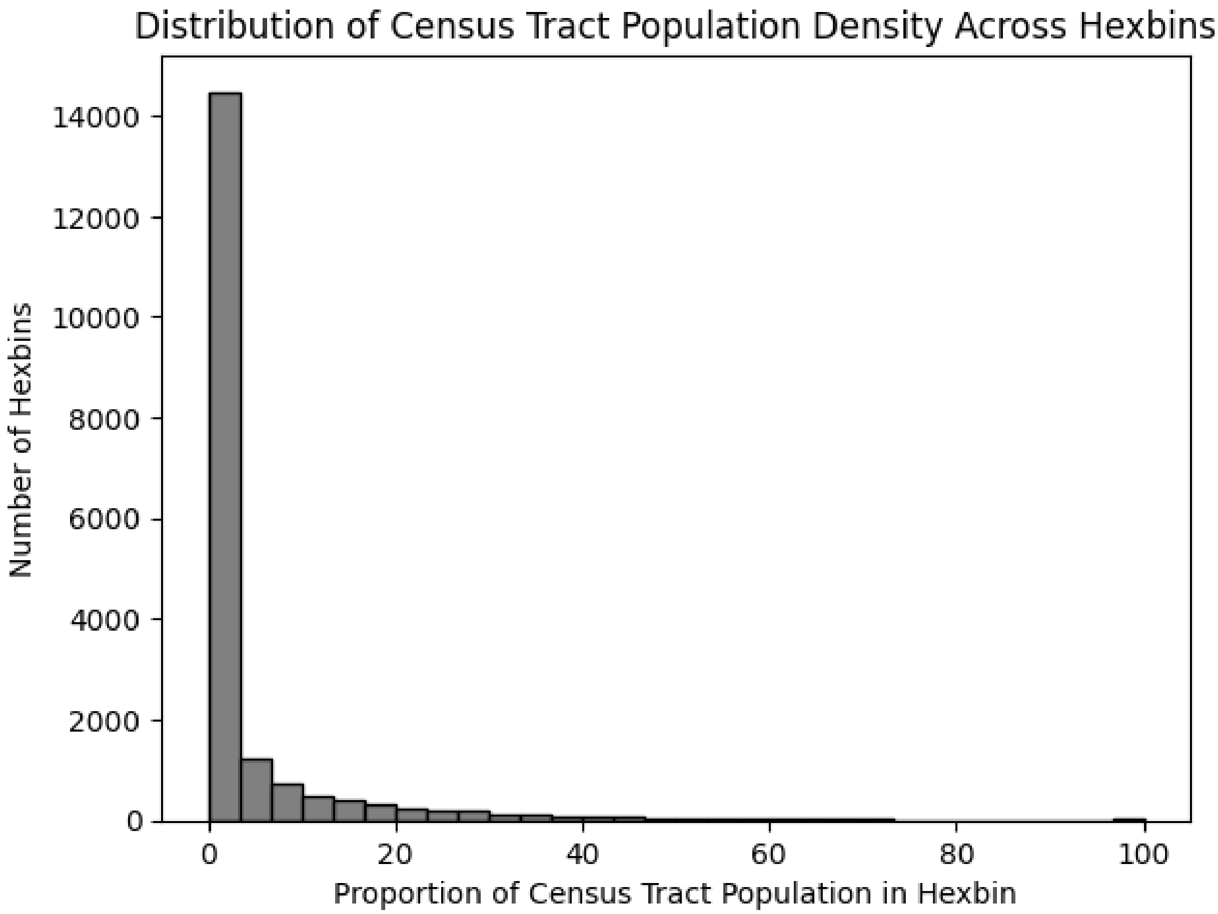
The SDG&E service area consists of 816 census 2020 tracts with 12,976 hexbins within it.[110] The histograms below provide details on the average intersections between hexbins and census tracts and the population distribution across hexbins (Figure 77).

Figure 77. *Number of census tracts a hexbin intersects*



As hexbins can intersect with more than one census tract, the histogram below illustrates the distribution of intersections between census tracts and hexbins and is not unique at the hexbin level (Figure 78).

Figure 78. *Distribution of census tract population density across hexbins*



Step 2. Indicator Construction

2.1 Downscaled Indicators (CalEnviroScreen 4.0) – Pollution Burden and Sensitive Population Indicators

The existing CalEnviroScreen 4.0 indicators under the categories of pollution burden and population sensitivity were downscaled using nearest-neighbor, area- or population-based ratios to provide a more accurate reflection at the hexbin level. The nearest-neighbor based ratios were applied to indicators such as ozone or PM2.5, area-based ratios were applied to indicators such as impaired water bodies and diesel particulate matter, while population-based ratios were used for indicators directly tied to human exposure, such as drinking water contaminants and lead risk.

2.2 Downscaled Indicators (CalEnviroScreen 4.0 + Median Household Income) – Socioeconomic Indicators

The socioeconomic indicators were reconstructed using the most recent Census data, applying a three-year average from 2020-2022 to capture current demographic and socioeconomic conditions. The updated indicators such as poverty rate, educational attainment, and unemployment are reflective of the latest population dynamics, social vulnerabilities, and economic factors. Such approach enables a reflection of the post-COVID socioeconomic dynamics. Additionally, incorporating the most recent population-based data is crucial for accurately assessing adaptive capacity, as it helps identify communities most in need of support and resources in response to climate-related challenges. These refinements are essential for developing adaptive strategies that are responsive to current and evolving conditions and can effectively mitigate risks for the most vulnerable communities.

For hexbins with unreliable populations (determined by the WorldPop population density value <1) that do not receive a full CVI and have a pollution burden and sensitive population score within the top 5%, SDG&E follows the DVC definition of backfilling the value with the pollution burden score for that hexbin.

2.3 *Additionally Constructed Indicators*

2.3.1 Tribal Land Indicator (Part of DVC requirement)

The Tribal Land Indicator was developed to provide a more nuanced understanding of tribal lands within the service area.[111] Initially a binary indicator for whether a hexbin was within a tribal territory, this measure was refined into a continuous indicator by calculating the percentage of each hexbin's area that overlaps with tribal lands. Using data from the SANDAG GIS layer (aligned with Bureau of Indian Affairs data with additional inputs and validations by SANDAG), this indicator captures varying levels of tribal land presence within hexbins. This approach enables a more precise differentiation between areas with partial or full overlap with tribal territories, ensuring that the unique needs and vulnerabilities of tribal communities are adequately represented in alignment with CPUC requirements.

2.3.2 AFN Customers (Additional Indicator):

The AFN customer indicator was developed to identify areas with significant populations requiring specific functional support, such as older adults, individuals with disabilities, and other functional need groups. According to CPUC definitions, AFN customers include those who may have had additional needs before, during, and after an incident in areas such as communication, medical care, independence, supervision, and transportation. In constructing the AFN customer indicator, SDG&E utilized customer data from the service area to pinpoint locations where such populations are based. By incorporating AFN customers into the index, the CVI framework provides a more comprehensive view of vulnerability that includes those who are often most affected by climate change and other hazards on an access and functional need basis.

2.3.3 SDG&E's Community Critical Facilities (Additional Indicator):

The original SDG&E PSPS community critical facilities dataset includes 38 categories of critical facilities grouped into nine sectors, such as Emergency Services, Healthcare, Energy, and Transportation Systems. For the purposes of the CVI, SDG&E focused on three key sectors essential for supporting communities during times of crisis: the Emergency Services Sector, the Healthcare and Public Health Sector, and the Transportation Systems Sector. These sectors were selected for their critical role in ensuring public safety, preserving health, and maintaining mobility during emergencies.

Within the Emergency Services Sector, key facilities such as police stations, fire stations, and emergency operations centers serve as the backbone of immediate crisis response. Tribal government providers and public safety answering points further enhance localized emergency management, ensuring that diverse community needs are met through coordinated and efficient responses.

The Healthcare and Public Health Sector encompasses a diverse array of facilities essential for protecting health and well-being. These include public health departments, hospitals, skilled nursing facilities, and dialysis centers, as well as specialized facilities such as blood banks and hospice centers. Temporary facilities established during public health emergencies, along with cooling and warming centers, provide critical relief during extreme weather events and safeguard vulnerable populations, including the elderly and those with medical conditions.

The Transportation Systems Sector plays a vital role in ensuring civilian and military mobility, featuring facilities associated with automobile, rail, aviation, maritime transportation, and major public transit systems. These are supported by traffic management systems, which allow for the efficient flow of people and goods during emergencies. This infrastructure is particularly critical during large-scale evacuations, ensuring timely and safe movement while minimizing disruption.

Together, these sectors form the foundation of community resilience. By addressing the immediate needs of safety, health, and mobility, they create opportunities for effective responses to crises, sustain essential services, and support the recovery of affected populations. This holistic approach helps communities withstand and adapt to a wide range of emergencies.

The indicator is constructed using two primary metrics: availability and accessibility.

Availability measures how many essential services, such as schools and hospitals, are accessible within each hexbin. To analyze this, SDG&E stratified hexbins and plotted the distribution of distances to each type of essential service. Using this data, SDG&E calculated the boundary distance as 2 standard deviations from the epicenter of the hexbin ensuring that meaningful boundaries are identified without overfitting to rare, extreme deviations. This boundary distance determines the number of community critical facilities available to each hexbin within each sector. Finally, the number of facilities across all sectors is averaged to derive a comprehensive availability score for each hexbin.

Accessibility is calculated as the average distance from each hexbin's centroid to the nearest community critical facility identified as available in each sector. The final accessibility score for a hexbin is the average of these nearest distances across all sectors. This combined scoring method evaluates both the proximity and availability of critical services, providing a comprehensive measure of community resilience and access to infrastructure. The community critical facilities indicator is essential for understanding a community's ability to respond to and recover from emergencies, enhancing fair access to critical services for all, as emphasized by CPUC.

Step 3. Normalization Across Indicators

The rank order percentile of indicators was used to normalize indicators before they were aggregated to construction the final CVI score. This step helps improve representation across the hexbin grid, essential for the final CVI.

Step 4. Aggregation of Rank-Ordered Percentiles for Final CVI Score

To compute the final CVI score, rank-ordered percentiles for all CalEnviroScreen 4.0 indicators were first calculated and normalized by taking each indicator's percentile (from 0 to 100), with 0 representing the least vulnerable and 100 representing the most vulnerable. Each CalEnviroScreen 4.0 indicator, both under the categories of Pollution Burden (e.g., ozone, PM2.5, diesel PM, and drinking water contaminants) and Population Characteristics (e.g., asthma rates, cardiovascular disease, and low birth weight), was then weighted according to the original CalEnviroScreen 4.0 methodology. Pollution Burden indicators were assigned a weight of 50%, with equal weights given to Exposure and Environmental Effects, while

Population Characteristics were also weighted at 50%, divided equally between sensitive populations and socioeconomic factors.

These normalized scores were aggregated by multiplying the weighted pollution burden score by the weighted population characteristics score, providing a cumulative CalEnviroScreen 4.0 score for each geographic unit.

Subsequently, additional indicators, such as median household income below 60%, tribal land percentage, AFN customers concentration, and community critical facilities were added to the index. Each of these additional indicators were assigned an equal weight alongside the combined CalEnviroScreen 4.0 score. The composite score was calculated by averaging these weighted scores, resulting in a comprehensive measure of community vulnerability and adaptive capacity. Finally, the resulting CVI scores were rank-ordered by percentile, allowing for comparative analysis among the hexbins to identify the most vulnerable communities effectively.

7.5 Appendix V – Community Engagement Plan (CEP)

Climate Adaptation Community Engagement Plan

May 15, 2024

Table of Contents

1. Executive Summary

San Diego Gas & Electric Company (SDG&E, or the Company) is committed to understanding and mitigating the effects of climate change on our infrastructure, operations, services, and ultimately our communities. To accomplish this, SDG&E is conducting a Climate Adaptation Vulnerability Assessment (CAVA) which will help the Company understand the potential impacts climate change brings to our service area and begin to identify potential solutions and adaptation options. To do this holistically and equitably, however, it is critical that SDG&E effectively engages with its communities to deepen partnerships and expand communications pathways. To this end, SDG&E has developed the Community Engagement Plan (CEP) to outline how it will effectively engage with its communities.

This CEP explores SDG&E's work to date in developing these pathways as well as its commitment to treat it as a "living plan" that encompasses community feedback. The effective execution of this plan will create robust regional engagement and solutions that contribute to a more equitable, sustainable, and resilient future for the San Diego region.

Through the implementation of this plan, SDG&E aims to accomplish the following key objectives:

1. Ensure an Equity-First approach at the forefront of engagement measures
2. Increase public knowledge of SDG&E's climate adaptation efforts
3. Activate a network of engaged, diverse, community partners, and SDG&E staff
4. Identify resilience investments informed by community guidance
5. Increase its adaptive capacity[1] and that of the communities it serves

2. Introduction

One of the greatest risks facing California is climate change. The state is "one of the most 'climate challenged' regions of North America and must actively plan and implement strategies to prepare for and adapt to extreme events and shifts[2]." As such, it is critical that decision-makers across the state begin to understand the impacts that climate hazards pose and invest to mitigate those potential risks.

As part of Rulemaking 18-04-019 – Components of Climate Adaptation Community Engagement Plans, which was issued in September 2020, the CPUC (or Commission) recommended the inclusion of the specific components to detail how SDG&E plans to meet climate adaptation and community engagement objectives. SDG&E applauds the Commission's commitment to combatting the adverse effects of climate change and better preparing our communities for the future through the Climate Change Adaptation Order Instituting Rulemaking (Rulemaking). SDG&E views this as an opportunity to holistically understand how

[1] Defined as: "The broad range of responses and adjustments to daily and extreme climate change-related events available to communities. This includes the ability and resources communities have to moderate potential damages, take advantage of opportunities, and cope with consequences." – CPUC Rulemaking 18-04-019, pg. 16

[2] California's Fourth Climate Change Assessment: Statewide Summary Report, 2018, pg. 13

climate change will impact our company and our communities and begin to work regionally to develop sustainable solutions to these challenges.

In this Community Engagement Plan SDG&E addresses the following topics in the seven sections of this document:

> Sections (1-3) beginning with the regulatory background, describes the work to date in development of the CEP, as well as the framework for continuous engagement and integration of community input into adaptation planning
>
> Section (4) describes how SDG&E's CEP and climate adaptation outreach program was designed and the steps taken to ensure community input and equity guidance remains central to its climate adaptation process.
>
> Section (5) describes how SDG&E's CEP will utilize community informed best practices to ensure meaningful, equitable, and actionable engagement occurs between SDG&E and our customers.
>
> Section (6) describes how SDG&E plans on ensuring that the community engagement SDG&E executes with its communities is directly incorporated into the CAVA and adaptation planning processes.
>
> Section (7) outlines SDG&E's efforts to align both internally and externally to maximize utility and community resources.

3. Background

With the goal of providing safe and reliable energy for all Californians, the Commission issued a decision in 2020 mandating all IOUs to identify and assess the threats and vulnerabilities that climate change poses to their infrastructure, operations, and services, focusing on the CPUC-defined Disadvantaged Vulnerable Communities (DVCs) (See Section 3.1 for DVC definition).

The resulting product is the Climate Adaptation Vulnerability Assessment (CAVA), which considers the following climate hazards: temperature, precipitation, drought, wildfire, sea level rise, and cascading impacts (two successive climate hazards which exacerbate the impact of the events). Through initial analysis for development of SDG&E's CAVA, the Company is exploring the potential impacts of climate change to our assets, operations, and services.

Changes in SDG&E's infrastructure, operations, and services due to climate change also have a variety of effects on SDG&E's communities' resilience and adaptive capacity, specifically the Disadvantaged Vulnerable Communities in its service area. For example, nature-based solutions that mitigate risks to SDG&E's system can create co-benefits such as more shade and green space which could increase a community's adaptive capacity. As such, SDG&E is framing the CAVA analysis as an exploration of the intersection of climate change, its infrastructure, and the communities we serve.

To engage with communities effectively and equitably, pursuant to Commission Decision (D.) 20-08-046, the *Decision on Energy Utility Climate Change Vulnerability Assessments and Climate Adaptation in Disadvantaged Communities (Phase 1, Topics 4 and 5)* SDG&E is developing a CEP that supports the prioritization of DVCs in the CAVA. The CEP, developed with community and regional partner input, outlines how SDG&E will work to involve DVCs and other communities in the CAVA and adaptation processes. As a result, the CEP provides a roadmap that will enable SDG&E to engage with communities more effectively and directly throughout the scope analysis, goal development, implementation, administration, and review of the Company's CAVA.

3.1 Disadvantaged Vulnerable Communities (DVCs)

SDG&E's Climate Adaptation Vulnerability Assessment process entails a robust engagement with Disadvantaged Vulnerable Communities. The commission defines a DVC as[3]:

- Top 25% of census tracts according to CalEnviroScreen 4.0
- California Tribal lands
- Census tracts with median household incomes less than 60% of state median income
- Census tracts that score in the highest 5% of Pollution Burden within CalEnviroScreen 4.0, but do not receive an overall CalEnviroScreen 4.0 score due to unreliable public health and socioeconomic data

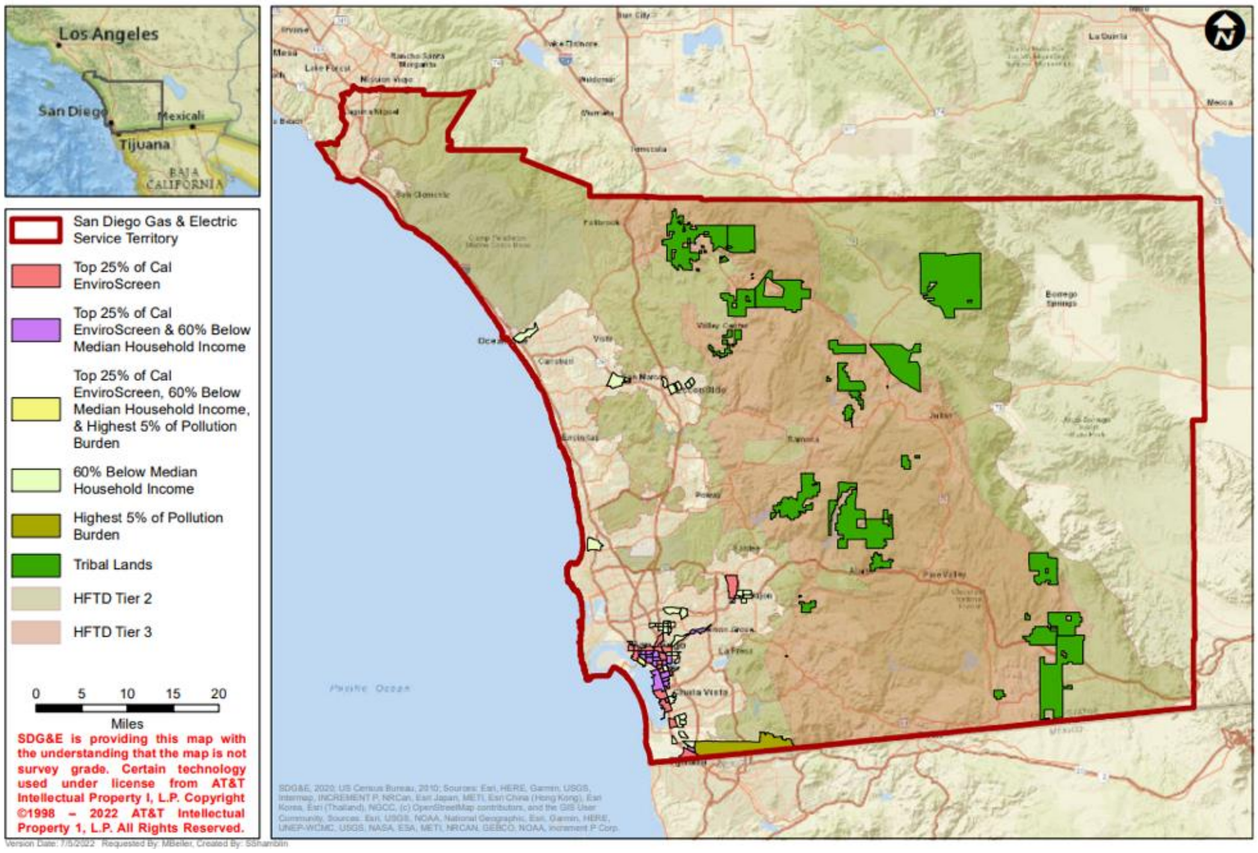
SDG&E recognizes that the current DVC definition may not fully capture or reflect all the communities of concern in the region, and SDG&E remains open to exploring expanded definitions.

The motivation for designating DVCs is that these "communities have been subjected to disproportionate impacts from one or more environmental hazards, socio-economic burdens, or both. Residents have been excluded in policy setting or decision-making processes and have lacked protections and benefits afforded to other communities by the implementation of environmental and other regulations, such as those enacted to control polluting activities."[4] As such, it is essential for SDG&E to acknowledge the historical inequities that impact our communities and to emphasize that the prioritization of resources, investments, and engagement in these areas is foundational to a more equitable and resilient future for our region.

Disadvantaged Vulnerable Communities in SDG&E's service area encompass an array of geographic, demographic, and socioeconomic settings (Figure 1).

[3] CPUC Decision 20-08-046, p. 108.
[4] https://www.cpuc.ca.gov/discom/

Figure 1: DVCs in SDG&E's Service Area



See Appendix C for a list of DVC locations and designation criteria within SDG&E's service area. Also see Appendix C for a map of DVC outreach areas within SDG&E's service area. DVC outreach areas were created by SDG&E through joining multiple near-by DVC census tracts into one larger geographic area for practical purposes of achieving targeted outreach and engagement. Tribal lands were not grouped into outreach areas as each tribe represents its own unique identity and history.

4. Methodology

In developing the Community Engagement Plan, SDG&E leveraged both internal and external partners, cultivating new partnerships where necessary, to ensure the development of a robust and equitable framework for the purposes of meaningful engagement. The approach outlined in this section chronicles the process and partnerships leveraged in developing the CEP.

To ensure equity is at the forefront of the Company's outreach and adaptation processes, SDG&E partnered with the San Diego Regional Climate Collaborative (SDRCC) and the Nonprofit Institute (NPI), located at the University of San Diego to develop a robust community engagement framework

("Framework") titled *Development & Recommendations for Equity-First Community Engagement for Climate Adaptation Planning Efforts* (visit SDG&E Climate Adaptation Framework.)

The Framework includes key recommendations for engagement processes and action and is the foundational document with which the CEP was created. Additional guidance for the contents of the CEP is the result of feedback from individual interviews with the Equity-First Community Climate Coalition (EC3) members, feedback from three Climate Readiness Information Sessions hosted by SDG&E, and lessons learned from SDG&E's 10+ years of wildfire resilience outreach and engagement efforts. These primary and secondary CEP sources are explained in further detail in the subsequent sections.

4.1 Equity-First Adaptation Framework

The Framework draws recommendations and best practices from SDRCC's *Equity-First Approach to Climate Adaptation* guidance document[5] ("Equity Guidance") as well as data from survey and focus groups with San Diego CBO's, local governments, and other partners, conducted in 2022.

The Equity Guidance synthesizes the latest academic literature, climate science, and regional, state, and national adaptation reports and provides best practices for designing, planning, and implementing equitable climate adaptation. The document assumes that equity is not an add on, but a fundamental part of building a climate-adapted future.

The survey and focus groups conducted in creating SDG&E's Framework were intended to solicit input and guidance from local leaders on the best practices for outreach and engagement in our communities, as well as gauge their interest in partnering with SDG&E in its climate adaptation activities. Additionally, survey responses helped determine the topics and participants of the focus groups. The main goal of the survey and focus groups was to identify strategies that ensure communities and Community-Based Organizations (CBOs) are involved in scope analysis, goal development, implementation, administration, and review of the Company's vulnerability assessments. Survey questions and results can be found in Appendix D.

4.2 Equity-First Community Climate Coalition (EC3)

As recommended in the Framework, SDG&E founded the Equity-First Community Climate Coalition (EC3) in 2023. The EC3 is a collective of local organizations collaborating to advance climate resilience and equity goals with SDG&E and the communities they serve. The coalition co-develops a range of different outreach opportunities to effectively incorporate community voices, needs, and feedback into SDG&E's CAVA and subsequent adaptation planning processes. The group consists of 10 members representing a range of geographic and demographic backgrounds.[6] The Company requests at least 10 hours per year from each EC3 member at an industry-benchmarked compensation rate for time participating in and preparing for meetings.

SDG&E is currently exploring expanding the EC3 to be more representative of the communities, specifically DVCs, for which the CEP is designed. SDG&E plans to seek out additional members to join the EC3 to facilitate more representative and robust engagement on the CAVA from DVCs.

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[5] An Equity-First Approach to Climate Adaptation, SDRCC, 2021.
[6] This number is subject to change as community and company needs and availability evolve.

4.3 Regional Entities

In addition to CBOs, SDG&E has engaged with local governments and other entities such as the San Diego Association of Governments (SANDAG) and the Port of San Diego to maximize alignment and create lasting collaborations. These organizations have unique experience in community organizing, infrastructure planning, and other relevant disciplines, which are central to climate adaptation efforts. Additionally, SDG&E recognizes that to truly advance the resilience of its service area, a regional approach is required.

SDG&E is also a member of SDRCC's Sea Level Rise Working Group, which meets quarterly, and the Adaptation Policy Working Group, which meets every month where the Sea Level Rise Working Group does not convene. These two working groups serve as crucial opportunities for innovation and information sharing as the region works to adapt together.

4.4 Wildfire Resilience

Over the course of more than 10 years, SDG&E has developed an industry-leading wildfire outreach and education program across the High-Fire Threat District (HFTD) within its service area. In 2023, their wildfire safety fairs reached over 3,300 customers and were recognized by County Supervisor Joel Anderson with a Certificate of Recognition for their "efforts to inform and educate our community on wildfire safety."

SDG&E continues to find creative ways to engage and receive feedback from the HFTD communities. The Schools for Resilience Program, launched in 2022, included development of a curriculum with Mt. Woodson Elementary School. The curriculum focused on youth education of high fire threats and evacuation preparedness. Not only was an activity booklet developed throughout the process, which can be used for other various wildfire events in the future, but also the process of developing a curriculum with an HFTD school reinforces that community feedback and climate adaptation can truly work together.

As SDG&E began its climate change adaptation outreach and engagement planning, the internal team leveraged the experience, relationships, and best practices from wildfire safety outreach efforts and customer outreach programs to optimize its approach. To see a more exhaustive list of these wildfire outreach efforts, please see SDG&E's Wildfire Mitigation Plan[7]. SDG&E plans to keep its climate adaptation and wildfire safety outreach and engagement closely aligned in the future.

4.5 Climate Readiness Information Sessions and Other Events

SDG&E hosted four Climate Readiness Information Sessions that educated residents about potential climate change impacts in the region, informed residents about SDG&E's work on the Climate Adaptation Vulnerability Assessment and Community Engagement Plan, and garnered feedback on topics of concern. These information sessions provided an opportunity to connect with the community face to face, which is a critical aspect of trust-building. The times and locations of the sessions were communicated to community participants through initial and follow-up SDG&E email invites and through CBOs communication networks. Additionally, interpretation services were provided at each event to help improve accessibility and open participation to community members with Access and Functional Needs.

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[7] SDG&E 2023-2025 Wildfire Mitigation Plan, Section 8.5.
https://www.sdge.com/sites/default/files/regulatory/2023-2025%20SDGE%20WMP%20with%20Attachments_Errata_10-23-23.pdf

This included American Sign Language interpretation at each event, and Spanish interpretation in Logan Heights and Chula Vista.

Table 1. Climate Readiness Information Sessions Held as of May 15, 2024

DVC	Date	Time	Venue	Attendees
Escondido	9/12/2023	5:30pm – 6:30 pm	Community Center	27
Logan Heights	10/2/2023	5:30pm – 6:30 pm	Library	7
Chula Vista	11/29/2023	5:30pm – 6:30 pm	Library	40
El Cajon	04/11/2024	5:30pm – 6:30 pm	Adult Education Center	30

From 2022 to 2023, SDG&E participated in an additional 15 events that served as touchpoints with residents on climate adaptation. Refer to Appendix E for a complete list of relevant events and activities.

4.6 Climate Adaptation Survey

To support climate adaptation efforts, the Company developed a short survey to assess the awareness of and concerns related to climate change and SDG&E's adaptation work. The survey is intended to remain live on SDG&E's website for the foreseeable future and serve as a long-term tracking mechanism and low-barrier engagement tool. As of February 1, 2024, 72 people have responded to the survey. Survey questions and results can be found in Appendix H. To take the survey, please visit SDG&E's climate adaptation webpage: sdge.com/climate-adaptation-sdge.

5. Meaningful and Continuous Engagement

SDG&E views outreach and engagement related to the CAVA and climate adaptation as a continuous and foundational programmatic pillar. In its outreach efforts, SDG&E endeavors to continually meet with local governments, CBOs, Tribal nations, academic partners, and customers to develop sustainable and lasting relationships which are necessary for holistic and equitable climate adaptation. Additionally, SDG&E is working to align its internal outreach activities to ensure maximization of utility and community resources and to avoid engagement fatigue within communities.

The following section outlines SDG&E's ongoing best practices in outreach activities, the feedback loops the Company is committed to developing, and a menu of contemplated outreach activities.

5.1 Guidance and Approach

The foundation built through the efforts outlined in Section 4, in addition to multiple iterations of CBO and community review, helped SDG&E identify the following components as critical to achieving the company's goal of meaningful and sustainable engagement with its communities.

SDG&E does not consider a "one-size-fits-all" approach to community engagement to be the most equitable or effective for the purposes of the CEP and CAVA processes. SDG&E's service area spans too many different geographic, socioeconomic, political, and cultural boundaries for a uniform approach to be effective. Therefore, to ensure meaningful engagement, SDG&E is using a tailored approach when interacting with local communities to make outreach accessible, equitable, and culturally sensitive.

The following components, heavily emphasized by EC3 members, are at the forefront of SDG&E's current community engagement approach:

1. Partner with trusted local CBOs to facilitate mutually beneficial networks and relationships.
    a. Appropriately compensate CBO partners for their time and efforts.
2. Consider the following when planning, attending, and hosting outreach events:
    a. Provide both in-person and virtual options.
    b. Provide food, especially if events occur during typical mealtimes. Where possible, support local food vendors.
    c. If possible, offer incentives such as giveaways or raffles. Items such as fans, gift cards, and emergency kits help support household resiliency and further signal to the community that SDG&E values their time.
    d. Provide a welcoming space for families and children by involving kids in the event or provide childcare or activities during the event.
    e. Host events at a variety of times in the same community to ensure robust participation.
    f. Leverage existing events in community through partnerships to maximize reach of SDG&E and its partners.
    g. Utilize trusted community spaces such as libraries and community centers. Ultimately, the highest priority is meeting the community where they are.
    h. Provide multi-language communication options such as interpreters and translated presentations and flyers. Selected languages are based off area of focus and partner recommendations.
    i. In partnership with local CBOs, create events that are culturally relevant to the community.
    j. Employ multiple information exchange means, taking into consideration customers with digital access and those without.
    k. Prioritize event locations that are ADA compliant, have ample parking, paved sidewalks or trails, and/or are accessible by transit.
    l. Locations should be rotated to increase participation.

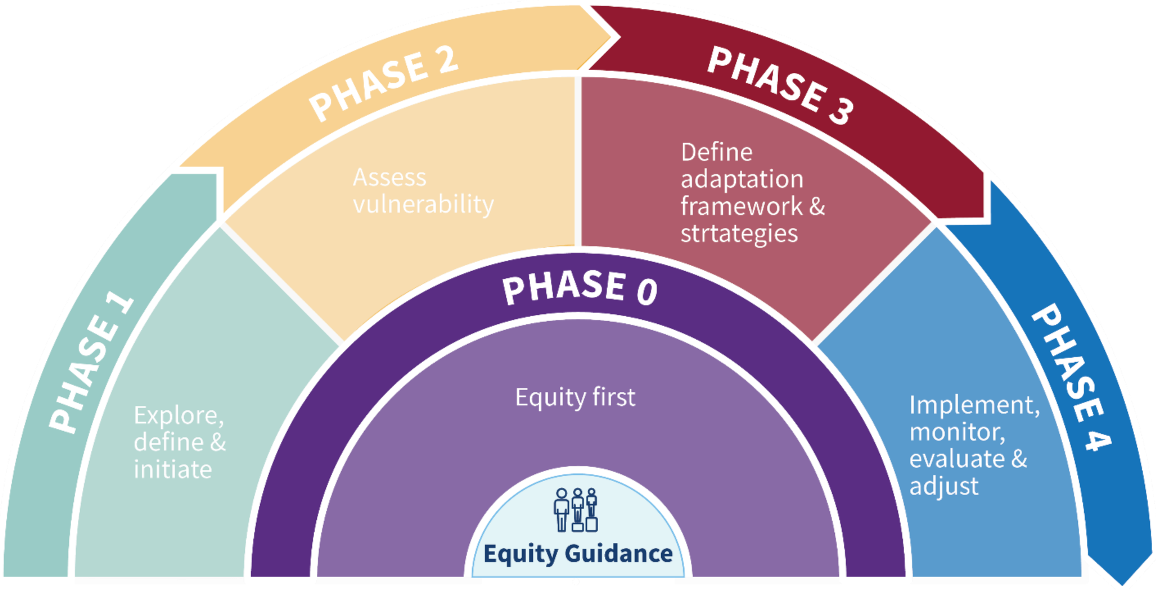
5.2 Feedback Loops

Feedback loops are critical in ensuring that equitable, generative, and sustainable processes and outcomes are achieved. SDG&E strives to create clear feedback loops for the CAVA and adaptation planning process. Informing communities and community partners about how their input was or wasn't used in SDG&E's CAVA or other adaptation processes is critical to long-term relationship and trust building. Figure 2 illustrates this process that centers feedback and accountability.[8] SDG&E intends to continually connect with these groups primarily through the EC3, SDG&E's Climate Adaptation website, ongoing newsletters, events, and meetings to ensure this information is shared and transparent. This transparency will outline

[8] SDRCC 2001

the challenges, opportunities, and limitations of SDG&E's climate adaptation efforts to ensure clear and reasonable expectations are held by both the utility and community.

Figure 2. Illustration of an Equity-First Approach, with equity guidance at the center of the process. Adapted from *An Equity First Approach to Climate Adaptation,* 2022.[9]



Where no engagement from CBOs, local governments, or other relevant state agencies exists, SDG&E plans to leverage its existing communication avenues (e.g., email, newsletters, website, social media) to promote events and other engagement opportunities for the community. Through these touchpoints, SDG&E intends to maintain contact with our customers and build communication pathways to the appropriate local entities for that area.

5.3 Implementation Mechanisms

SDG&E's implementation strategy is based on the practical considerations and guidance outlined in section 5.1 and 5.2 through community assets, new and existing SDG&E led community engagement programs, and innovative platforms. The following examples outline how SDG&E aims to achieve desired outcomes:

1. Leverage new and existing SDG&E-led community engagement
    a. Leverage SDG&E's state of the art Wildfire & Climate Resilience Center to host workshops, tours, and other engagement opportunities with our communities and partners.
    b. Expand upon the successful model of SDG&E's Wildfire Safety Fairs to other climate hazards of concern such as extreme heat.
2. Leverage community assets

[9] https://digital.sandiego.edu/cgi/viewcontent.cgi?article=1018&context=npi-sdclimate

a. Utilize EC3 to identify community-led events and activities that SDG&E can attend and/or support.

3. Innovative platforms

   a. Raise awareness of ongoing work through social media platforms – create ready-made toolkits for partners.

   b. Create and distribute a Climate Adaptation Newsletter to inform partners, customers, and to directly facilitate feedback loops.

5.4 Tribal Engagement

The Tribal Relations team at SDG&E offers dedicated support to the 17 tribal nations in San Diego County that SDG&E serves. The focus of the team is to increase safety, reliability, resiliency, and sustainability on tribal lands.

To effectively and respectfully engage the tribal nations in SDG&E's service area, the climate adaptation team works closely with SDG&E's Tribal Relations team.

SDG&E recognizes each tribe is its own sovereign nation and strives for one-on-one engagement with each. It is committed to providing opportunities for dialogue to foster partnerships and to mobilize around a shared vision to build a better future for all. Tribal knowledge provides a roadmap to protect both cultural and natural resources. Tribal partnerships and feedback are particularly valuable because they cultivate innovative solutions to increase resilience. This plan below outlines guidance on tribal engagement upon which SDG&E will draw as it engages local tribal nations on climate adaptation.

<u>Value-Driven Approach</u>

Core values that underpin any communication with tribes include:

- All land is ancestral tribal land. It is important to understand the historical injustices which precipitated present-day challenges and distrust. Certain topics can elicit emotionally charged comments and it is important to practice active listening, with care and compassion.
- Tribes are political entities. Each tribe has their own unique culture, language and sovereign government and that autonomy must be respected.
- Tribes also seek the same vision of a sustainable, equitable, and resilient future but with a deeply cultural foundation. It is important to respect their traditional knowledge and engage with a culturally sensitive approach.
- Engagement is a two-way exchange of information between SDG&E and tribes for which the foundation is reciprocity and respect. Each tribe is unique and meeting them where they are is important, particularly for the most remote and least resourced tribes.
- To build trust, it's important to deliver on actionable commitments by finding champions within the tribal government and the Company.

<u>Engagement Strategies</u>

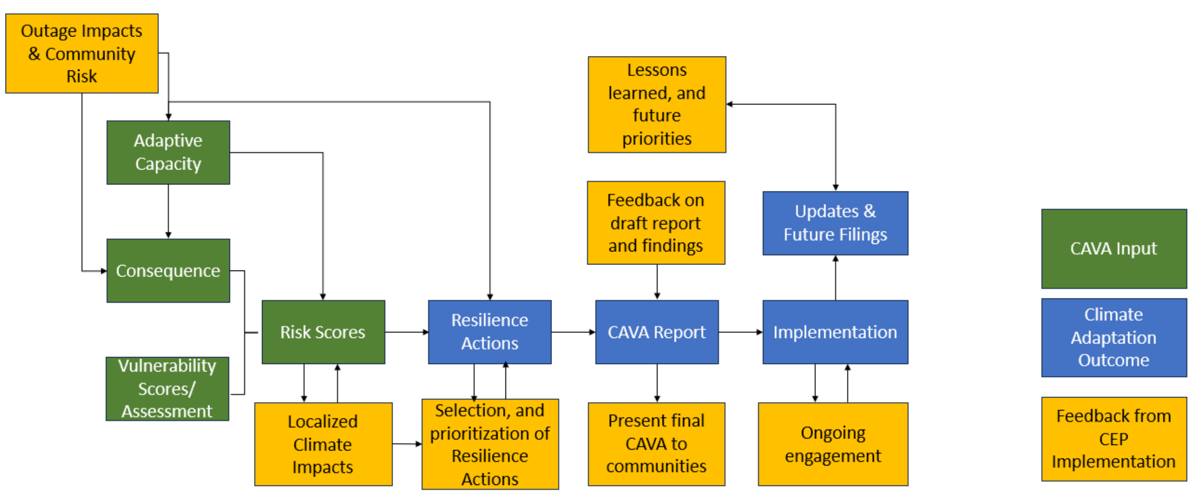
- When introducing new initiatives, engage the Southern California Tribal Chairmen's Association through a request to participate in monthly meetings.
- When engaging individual tribes at the leadership level, work with Tribal Administrators or similar staff members to seek time on council meeting agendas or to set up ad-hoc meetings.
- For complex projects or engagements, approach the tribal staff for an initial briefing to cultivate additional support to brief leadership.
- Partnering with CBOs is crucial as there are existing groups made up of tribal leaders and staff that meet regularly and can effectively introduce a project or initiative to gather feedback or source key advisors. CBOs are also great vehicles to fund tribal projects that align with SDG&E's goals and are a way to ensure reciprocity.

SDG&E's climate adaptation process will rely on these guiding principles and considerations as it strives for connected and culturally relevant collaboration between the Company and the tribal nations in its service area.

6. IOU's Use of Community Engagement

For community engagement outcomes and input to successfully inform adaptation planning, it is important to have clearly defined points of integration that can shape both outreach planning and CAVA analysis methodologies. Figure 3 illustrates the avenues through which community input will directly influence the Climate Adaptation Vulnerability Assessment and subsequent decision-making. Yellow boxes represent areas of community feedback and engagement. Blue boxes represent distinct steps or inputs in the adaptation process.

Figure 3. Incorporating Community Input into the CAVA Process



6.1 Tracking Progress

SDG&E recognizes the importance of leveraging the feedback and data from its engagement processes to monitor program development, improvement, maturity, and to build alignment with other regional adaptation practitioners. Furthermore, comprehensive tracking strategies help SDG&E remain accountable to its communities by tracking activities, actions, and progress.

Documentation will occur and has occurred in the following forms:

- Events, Meeting Schedules, and Notes Repository
  - All external events, activities, and meetings relevant to the CAVA outreach process will be documented as they occur.
  - Data and feedback from events will be reviewed by the climate adaptation team in a post-event briefing meeting.
- Survey Readouts (Data and Results)
  - Survey data will be reviewed and cataloged monthly by the climate adaptation team.
- Equity-First Framework
  - The Framework will be reviewed and updated on an annual basis.
- Interviews and Focus Groups
  - Interview and Focus Group outcomes will be shared with the climate adaptation team as they occur.

SDG&E will inform DVCs on whether their feedback influenced the CAVA through our above communication tools and touchpoints. Communication will identify what feedback was and was not integrated with explanations for why or why not. This feedback will be made available during engagement events in communities, through SDG&E's climate adaptation webpage, as well as via the quarterly newsletter. SDG&E is committed to communicating this at least once every six months.

Additionally, SDG&E plans to continue engaging DVCs after the CAVA is submitted. SDG&E intentionally designed the outreach and engagement approach to support longevity by building direct relationships between SDG&E's Climate Adaptation team and community and local government partners.

7. Alignment

7.1 Internal and IOU Alignment

Various departments within SDG&E such as Community Relations, Customer Outreach, and Regional Public Affairs, have strong relationships with and deep knowledge of the activities of local organizations and government entities. Additionally, at least 16 other separate regulatory proceedings currently involve SDG&E conducting outreach and engagement, some specific to Access & Functional Needs customers. Among these are the Public Safety Power Shutoff, Disconnection, Bill Debt, Percentage of Income Payment Plan Pilot, Microgrid, High Distributed Energy Resource, Electric Program Investment Charge (EPIC), and Wildfire Mitigation Plan proceedings. Given the relative novelty of the Rulemaking's outreach and engagement requirements, and the large number of proceedings that require outreach across the company, SDG&E will continue to collaborate and align to execute a variety of outreach and engagement efforts, including those related to climate adaptation.

This collaborative approach to community engagement will be coordinated with other internal engagement efforts through three mechanisms: the Outreach & Equity Steering Committee (OESC), the Climate Advisory Group (CAG), and the Adaptation Management Team (AMT).

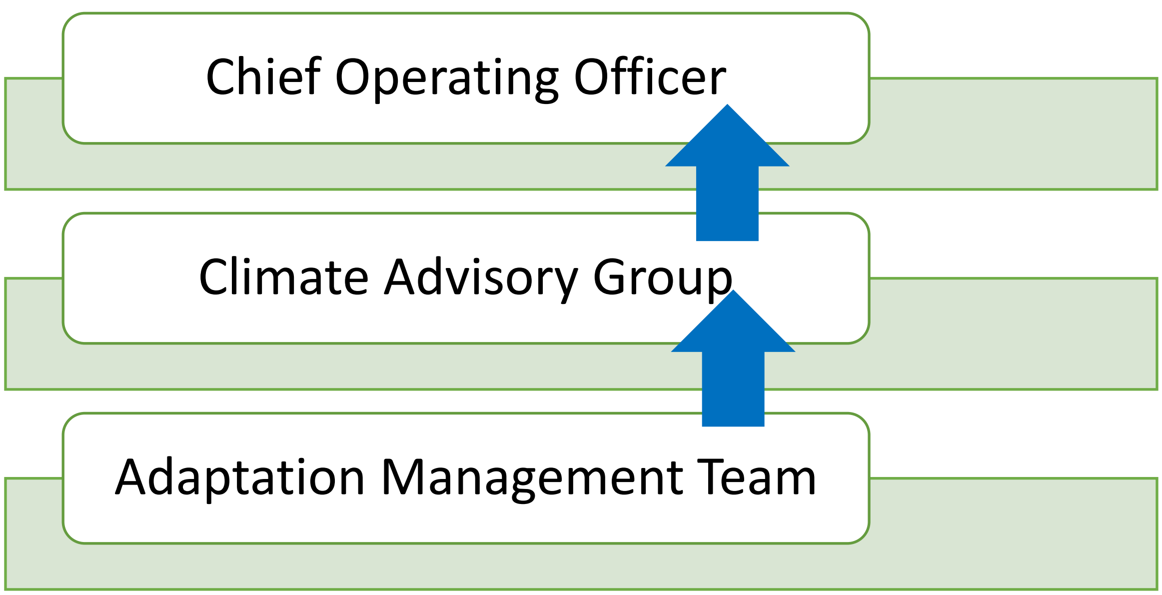
7.1.1 Outreach & Equity Steering Committee (OESC)

The Outreach & Equity Steering Committee, established in the second quarter of 2023, represents 10 departments across SDG&E and is a collaborative effort intended to foster increased alignment of relevant departments and teams conducting community engagement. The main purpose of the OESC is to align community outreach and engagement efforts across SDG&E. As outreach mandates and ambitions increase across the organization, it is crucial to align internal efforts to maximize both company and community resources.

7.1.2 Climate Advisory Group (CAG)

The Climate Advisory Group was established in 2020 to facilitate the communication of progress and foster alignment across the organization. The CAG consists of managers and directors, with 42 members from 40 different groups within SDG&E. The work of the CAG is reported to the Vice President of Wildfire and Climate Science and the Chief Operating Officer. The group meets quarterly and additional ad hoc engagements with members occur as needed. Figure 4 outlines the governance and reporting structure of the CAG.

Figure 4: Climate Advisory Group Governance Structure



7.1.3 Adaptation Management Team (AMT)

The Adaptation Management Team is a working group of members from 18 different SDG&E organizations with the purpose of supporting and enabling climate adaptation initiatives. As shown in Figure 4, the AMT sits below and reports to the CAG. The first AMT meeting was held in the second quarter of 2022 and convenes monthly. AMT meetings will continue as is deemed necessary and useful.

7.1.4 Investor-Owned Utility Collaboration

In addition to aligning locally and internally, consistent communication between adaptation practitioners across the state is integral to the success of SDG&E and its fellow IOU community engagement and climate adaptation goals. As exemplified by the success realized in SDG&E's collaborative Wildfire Safety Fair community engagement efforts, open communication across agencies drives results. To that end, SDG&E's Climate Adaptation team meets monthly with other California IOU climate adaptation teams. This regular engagement helps to ensure the sharing of best practices and lessons learned to continuously improve outreach, considerations of equity, and CAVA processes.

7.1.5 Climate Equity Training Module

Further demonstrating IOU collaboration, SDG&E, alongside its affiliate SCG, created a Climate Equity Training Module (CETM). This training program is required for any SDG&E employee participating in and supporting CAVA motivated outreach and engagement and will be completed annually by these practitioners. Additionally, the CETM is made available for any other SDG&E employee or consultant that could benefit from an equity and climate focused outreach and engagement training. Appendix G outlines the primary topics covered in the training.

Prior to the creation of the CETM, members of the SDG&E Climate Adaptation team were trained by experts at the San Diego Regional Climate Collaborative in equitable community engagement practices and principles. The team initially completed three training sessions totaling 4 hours.

7.2 Local Agency Alignment

Successful adaptation requires a truly regional approach and thus, outreach and engagement related to adaptation must strive for the same. To that end, SDG&E will continue to build upon its relationships with local governments and agencies such as through the Adaptation Policy and Sea Level Rise Working Groups. These networks will enhance alignment with local agencies on outreach events and programs related to adaptation and other community-relevant topics. This will not only give communities a better understanding of the overall approach to adaptation in the region but will also optimize community, utility, and local government resources. This approach can also lead to more collaborative adaptation initiatives, projects, and programs across SDG&E's service territory. Further, SDG&E is committed to sharing relevant information, such as appropriate community feedback and lessons learned, with relevant local agencies in order to enhance efficiency, shared understanding, and the equitability of the regional adaptation landscape. Where possible, SDG&E will also relay relevant community input to state agencies with which it interfaces, such as the CPUC.

7.3 CPUC Alignment

California's government is unique in the maturity of both climate change and equity integration into policy across sectors. SDG&E plans to build upon this foundational work through alignment with both the CPUC'S Environmental and Social Justice Action Plan (ESJAP) and the Disadvantaged Communities Advisory Group

(DACAG) Equity Framework. Both policies are invaluable to the equitable and resilient future the Commission and California IOUs are striving to realize.

Table 2. (below) shows how SDG&E is aligning its CEP, CAVA, and adaptation planning efforts with the goals of the CPUC's ESJAP.

CPUC Environmental and Social Justice Action Plan Goals	SDG&E Actions
1. Consistently integrate equity and access considerations throughout CPUC proceedings and other efforts.	SDG&E has partnered with local equity experts to ensure the outreach, engagement, and adaptation efforts of the Company have equity at their core rather than added on.
2. Increase investment in clean energy resources to benefit ESJ communities, especially to improve local air quality and public health.	Where possible, SDG&E'S climate adaptation outreach incorporates information from other programs within the company that increase access to clean energy technologies and other opportunities.
3. Strive to improve access to high-quality water, communications, and transportation services for ESJ communities	SDG&E has coordinated and plans to further engage decision-makers and leaders from regional entities, many of which serve other needs outside of energy to ensure alignment and create synergies in climate adaptation and associated engagement efforts.
4. Increase climate resiliency in ESJ communities.	As outlined in the Decision, SDG&E aims to prioritize equitable adaptation in Disadvantaged Vulnerable Communities by incorporating community needs and perspectives into any adaptation plans and investments.
5. Enhance outreach and public participation opportunities for ESJ communities to meaningfully participate in the CPUC's decision-making process and benefit from CPUC programs.	SDG&E is creating and driving consistent engagement with our communities and incorporating their perspectives and feedback into as many regulatory filings as possible to ensure community perspectives are reflected in decision making.
6. Enhance enforcement to ensure safety and consumer protections for ESJ communities.	The safety of its customers and communities is one of SDG&E's core principles and the Company plans to continue to ensure safety and consumer protections as it addresses the adaptation needs of our most disadvantaged communities.
7. Promote economic and workforce development opportunities in ESJ communities.	SDG&E compensates its community partners for their time and efforts and acquires services related to outreach and engagement from within the target communities wherever possible. Examples of this include venue rentals and catering.
8. Improve training and staff development related to ESJ issues within the CPUC's jurisdictions.	SDG&E and SCG have partnered to create an equitable outreach and engagement online training which all employees and contractors engaging with our communities are required to complete annually.
9. Monitor the CPUC's ESJ efforts to evaluate how they are achieving their objectives.	Ongoing engagement with its local communities and partners will help SDG&E foster trust and achieve equitable outcomes.

In addition to the CPUC's ESJAP, the DACAG has also shared guidance with which SDG&E will work to align through its climate adaptation process. The DACAG was formed as a result of Senate Bill 350, the Clean Energy and Pollution Reduction Act of 2015. The group's primary role is "to review [California Energy Commission] and CPUC clean energy programs and policies to ensure that disadvantaged communities…benefit from proposed clean energy and pollution reduction programs."[10] The DACAG equity framework is intended "to guide the [DACAG] as it moves forward in discussing and commenting on various proceedings… ensuring that access and adequate resources reach the implementation stage and benefit communities in a meaningful and measurable way."[11] The DACAG Equity Framework outlines five key areas of focus: Health & Safety, Access & Education, Financial Benefits, Economic Development, and Consumer Protection.

The five pillars of DACAG's equity framework align with SDG&E's mission to: do the right thing, champion people, and shape the future. These guiding principles support SDG&E's understanding and implementation of DACAG's framework both qualitatively and quantitatively.

Qualitatively, SDG&E similarly focuses on the five key areas of the DACAG framework when looking at potential projects, programs, or activities, especially Health & Safety, which is a core pillar of SDG&E. Climate change, and its potential impacts on energy infrastructure and communities, poses real challenges to preserving the health and safety of SDG&E's customers. SDG&E's climate actions aim to improve access and education as well as economic development in the most vulnerable communities in its service area.

SDG&E's Equity-First Community Engagement Plan will increase knowledge of SDG&E's climate adaptation efforts and develop a network of engaged and diverse community partners alongside SDG&E employees. Combining the enhanced knowledge of SDG&E efforts as well as engaged and diverse community partners results in the community's ability to provide valuable feedback in SDG&E's community and climate actions. With this community feedback, SDG&E can direct more financial benefits to DVC's and other communities of concern while also increasing consumer protection through identification of pressing issues to address.

Quantitatively, the current multi-attribute value framework (MAVF), which guides the Company's risk-driven investment decision-making, highlights safety, reliability, and financial value as the three major attributes of risk. Including data from CalEnviroScreen 4.0 and SDG&E DVCs into SDG&E's risk framework will inform health and safety, financial benefits, and workforce development in DVCs. SDG&E sees the CAVA results feeding into the MAVF framework, pursuant to the outcomes of the Safety Model Assessment Proceeding (S-MAP) and Phase II of the Rulemaking.

8. Feedback on Community Engagement Plan

SDG&E considers feedback and input from communities and other partners paramount to a robust, equitable, and successful CEP. Therefore, SDG&E worked with and sought input from DVCs, CBOs, Local

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[10] Disadvantaged Communities Advisory Group, California Energy Commission, https://www.energy.ca.gov/about/campaigns/equity-and-diversity/disadvantaged-communities-advisory-group

[11] Disadvantaged Communities Advisory Group Equity Framework, 2018, https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/infrastructure/disadvantaged-communities/dacag-equity-framework.pdf?sc_lang=en&hash=130F6FD0AEA89095CD0EAC455D0C60EE

Governments, Tribes, and others to ensure that feedback was central throughout the process and development of the Plan. . SDG&E also coordinated with State partners including Energy Division and the Disadvantaged Communities Advisory Group to seek feedback. The following section outlines the key themes of feedback heard through the development process as well as the feedback SDG&E heard on the draft plan distributed in March and April 2024. SDG&E will outline the feedback received, whether or not it was incorporated and the reasoning for that decision, as well as a brief response with references to sections in the CEP that now reflect the input.

8.1 Feedback Received During CEP Development

The feedback SDG&E heard during its CEP development process generally fell into five categories: Affordability, building knowledge, trust and capacity, sustainable engagement, the importance of feedback loops, and alignment.

1. The first learning area and most prevalent feedback SDG&E heard was centered on concerns about and related to affordability. In many outreach and engagement conversations, residents and community partners expressed worry about how investments related to climate change adaptation and resiliency might impact bills and affordability. They were also concerned about other costs related to climate change mitigation, such as electrification. SDG&E acknowledges that affordability needs to be kept front and center throughout climate adaptation efforts.
2. The second key learning was the need for building knowledge, trust, and capacity. SDG&E received feedback that in order to meaningfully engage, especially with a process such as the CAVA where benefits to the community and outcomes aren't immediately apparent, trust is essential. SDG&E also heard that limited knowledge on technical information and climate science was a perceived barrier to engagement. Limited capacity was an additional concern. (Feedback addressed in section 5.)
3. The third key learning centered on the importance of sustainable engagement. Community partners expressed the need for long-term, ongoing, and sustainable engagement to feel motivated to participate in long-term planning processes such as the CAVA. Consistency in SDG&E's efforts and collaboration was important to communities. Feedback also indicated that a central component of sustainable engagement is reciprocity, demonstrated by ensuring that it's a mutually beneficial relationship. (Feedback addressed in section 5.)
4. The fourth key learning is the importance of feedback loops. Feedback loops are critical in ensuring that equitable and sustainable processes and outcomes are achieved. Feedback focused on importance of clarity and accountability. Communities discussed the importance of clarity in how, where and when their feedback would be used, and emphasized that clarity in efforts and expectations are essential to a successful process. Accountability helps to show communities why participation is important. (Feedback addressed in section 5.2 and 6.)
5. The fifth key learning is the importance of alignment both internal and external. Many community partners have encouraged SDG&E to continue aligning internal outreach efforts. As more proceedings and utility operations highlight community engagement as a central tenet, it is critical that SDG&E collaborate and align within the company to maximize both community and utility

resources. This will also facilitate information sharing and create more holistic relationships and solutions. Additionally, Climate Adaptation is not unique to SDG&E and community partners have encouraged SDG&E to join and collaborate with existing efforts in the region in order to reach sustainable resilience solutions. (Feedback addressed in section 7.1 and 7.2)

8.2 Feedback Received During CEP Review Period

On March 1, 2024, SDG&E published a publicly available draft CEP on the SDG&E Climate Adaptation website with an accompanying comment form for communities, CBOs, local governments, and other partners to provide feedback. In addition, SDG&E utilized nine other avenues to widely distribute the CEP in order to increase accessibility and opportunity for feedback (see Table 3.)

Table 3. CEP distribution avenues, methods utilized, and the date(s) of deployment or occurrence

Distribution Avenue	Method	Date(s)
EC3	Presentation	3/4/2024
CSA Tribal Working Group Presentation	Presentation	3/7/2024
3 CEP Webinars	Presentation	3/14/24, 3/20/24, 3/26/24
Linda Vista Collaborative Meeting	Presentation	3/19/2024
Proceeding Service List	Email	4/1/2024
SDRCC Adaptation Working Group Email	Email	4/2/2024
Climate Readiness Info Session	Presentation	4/11/2024
DACAG Meeting	Presentation	4/19/2024
SDG&E Newsletter (Email and Physical Copies)	Newsletter	Ongoing
SDG&E Climate Adaptation Website Presence	Website	Ongoing

8.2.1 Public Comment

Comments from non-DACAG stakeholders during this public comment period were somewhat limited. Possible explanations for the limited number of comments could be partially due to community capacity issues, which was a common issue SDG&E heard from communities, or that the CEP process involved community partners throughout so they did not feel there were additional comments for feedback to provide. Feedback that was received, however, focused primarily on furthering the accessibility considerations of SDG&E's CAVA-related outreach and engagement. Some considerations included increasing the number of languages in which materials were created as well as ensuring those with visual or hearing impairments were able to participate in the process and events. SDG&E augmented section 5.1 Guidance and Approach, subsection k. to better capture this feedback.

Specifically, one CBO suggested that "the utility specifically identify people with disabilities in its [DVC] definition." SDG&E appreciates this comment and agrees that individuals with disabilities are more vulnerable to the effects of climate change and plans to advocate for an expanded definition that would allow for the inclusion of these individuals in Phase II of the Climate Change Adaptation Proceeding.

8.2.2 Disadvantaged Communities Advisory Group (DACAG) Meeting

On April 19, 2024, SDG&E had the opportunity to present its CEP and the feedback heard thus far to the DACAG for their comment. A copy of SDG&E's draft CEP was sent to the DACAG and Energy Division prior to this meeting for their advance review. SDG&E greatly appreciated the opportunity to share its progress on the CEP and, more importantly, hear from the DACAG on recommendations for CEP and engagement process improvements. The high level of engagement and feedback the utility received from the DACAG was helpful and encouraging.

Of the feedback heard from DACAG members, some comments were not in scope of the CEP due to their relevance to other aspects of the CAVA or other utility operations. However, those comments have been noted and will be shared across these other workstreams. The questions and recommendations raised by the DACAG and accompanying SDG&E responses are outlined below.

<u>Questions</u>

1. Are there any missing groups that aren't being engaged in service territories? How would utilities remedy missing groups?
    a. SDG&E acknowledges that the representation from communities and organizations can always be enhanced to build a more equitable process. In section 4.2, SDG&E added the commitment to identify new EC3 members to fill these gaps and onboard them in the next three months.
2. Regarding climate resiliency, do the utilities only consider utility-owned infrastructure investments or do they also consider community-owned resiliency?
    a. Although the scope of the CAVA and CEP analyze assets, operations, and services under utility control, as community priorities continue to emerge through engagement, SDG&E will incorporate community solutions into resilience planning where possible. Climate adaptation will necessitate new procedures, technologies, and partnerships and SDG&E will work closely with the Commission and other regional partners to enable the adoption and integration of those.

<u>Recommendations</u>

1. Provide communities with a roadmap that is inclusive of different agencies and levels of government and provide this as early as possible.
    a. SDG&E added to section 7.2 that it will work to include local governments and other relevant agencies in CAVA-related outreach initiatives.
    b. In section 7.2, SDG&E also added language outlining its commitment to work with local governments and other agencies to align efforts and to present a unified approach to communities.
2. Make process equitable for both utility and non-utility investments.
    a. SDG&E understands that it has an opportunity and responsibility to share relevant and appropriate input from communities to support other local agency outreach and

adaptation efforts To that end, SDG&E will be sure to leverage its existing partnerships and networks to facilitate this information sharing. A specific callout of this topic is now referenced in Section 7.2.

3. Respond to feedback through action.

    a. Where possible, SDG&E is committed to implementing actions and solutions prioritized by communities for both outreach and adaptation goals. One example of this in action is a request by the EC3 to place climate adaptation collateral in SDG&E field offices where many community members go in person to pay their bills. SDG&E took this recommendation on and in short order ensured that information was available in those facilities.

       A challenge to supporting this more broadly and outside of the outreach space is the current planning and investment horizons associated with the CAVA process. SDG&E is currently analyzing the climate risks to the utility in 2030, 2050, and 2070, with its general rate case being filed every four years, the next coming in 2026. A successful implementation of the CEP and integration into the CAVA should enable community input to inform resilient solutions in those filings. However, the lagging effect of their implementation creates an inherent barrier to immediate action. That said, where faster community-informed action is possible, SDG&E will work to implement those and share that with communities.

4. Be candid about what challenges utilities face in solutioning community issues.

    a. SDG&E agrees that transparency is paramount to building trust and creating more robust and equitable adaptation solutions for communities. In response to this recommendation, SDG&E has further expanded its section on feedback loops to include language about transparently sharing challenges utilities face in adaptation.

5. Think outside the box. A status-quo approach will not inspire trust to an issue that's been ongoing.

    a. By having an outreach approach that is ongoing and that prioritizes feedback, SDG&E hopes to be able to quickly respond to community preferences and industry best practices, regardless of their conformity to status-quo operations. Climate adaptation, in the scope of utilities, is a newer function and the ability to understand gaps and address them quickly will create a more equitable approach now and in the future. In response to this recommendation, SDG&E has added language within the conclusion of the CEP to ensure this concept is captured.

6. Ensure that maps, climate, and other data is accessible to communities.

    a. SDG&E is committed to transparency of process, data, and actions to enable education of climate impacts and potential vulnerabilities, to engender trust and accountability, and facilitate feedback loops. To support information accessibility, SDG&E utilizes the best practices for meaningful engagement outlined in section 5.

9. Conclusion

In summary, SDG&E is committed to equitably and sustainably engaging our communities, specifically those most vulnerable to climate change, with the goal of ensuring their input informs SDG&E's climate adaptation strategy and execution of fit-for-purpose mitigation plans. This CEP, informed through several rounds of community feedback and review, outlines how SDG&E will create a lasting and additive process to support the resilience of the underlying energy infrastructure and the communities it serves. In the spirit of continuous improvement, SDG&E will work to revisit this plan regularly and incorporate feedback and best practices as they evolve into the future. The best practices and capabilities of today may not be those of tomorrow, and some challenges climate change poses may require non-traditional or 'out of the box' efforts from communities, utilities, and the region. SDG&E will keep this top of mind throughout its engagement and adaptation processes. With the invaluable help of its partners, peers, and communities, SDG&E's climate adaptation process can enable a more equitable and resilient future for the region.

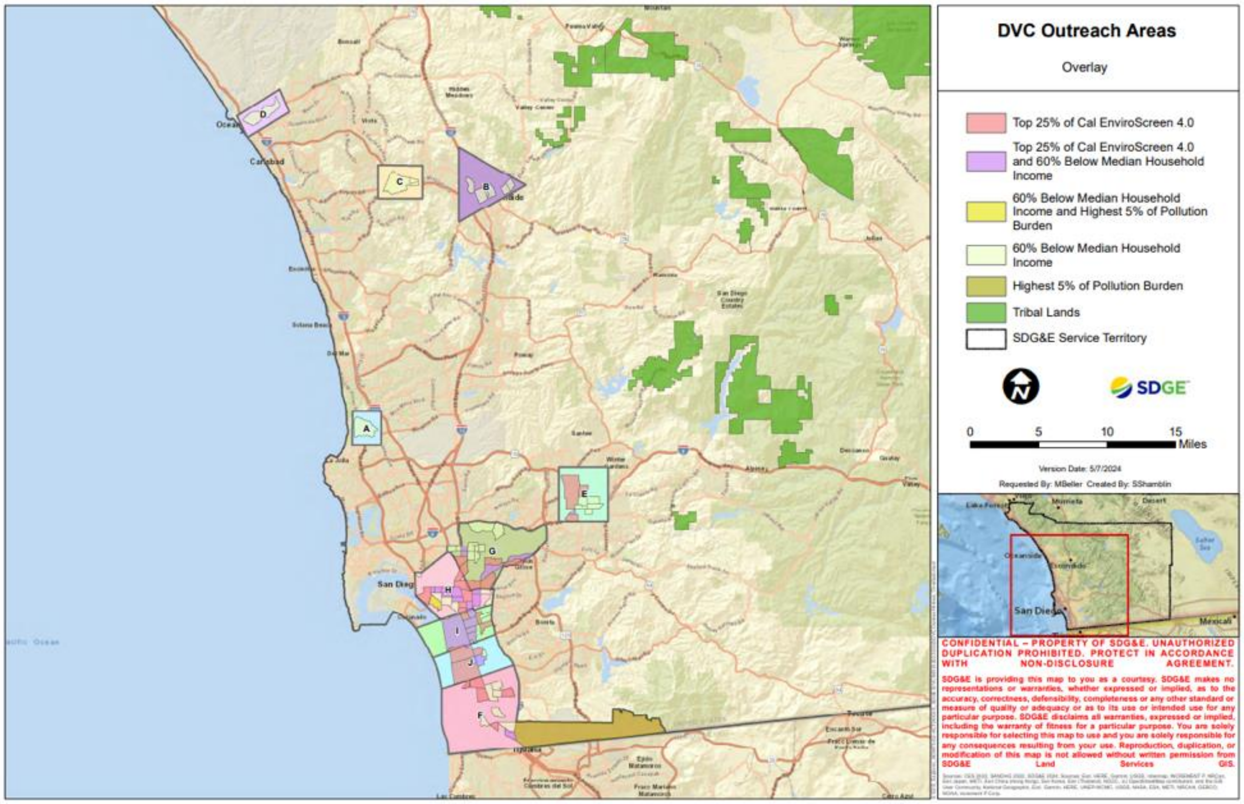
Appendix A. Timeline

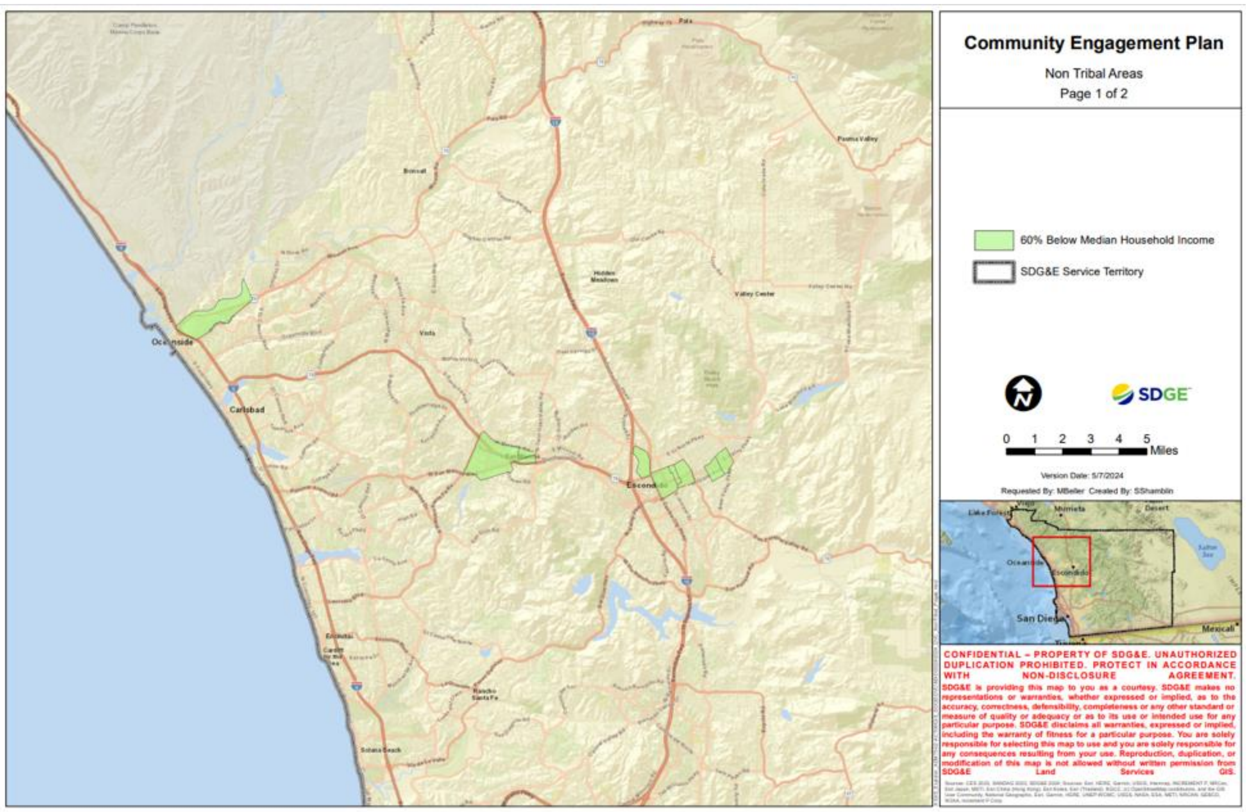
	2023	2024	2024	2024	2024	2025	2025
	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Community Engagement Plan Feedback							
Climate Vulnerability Information							
Vulnerability Assessment Review							
Adaptation Investment Input							

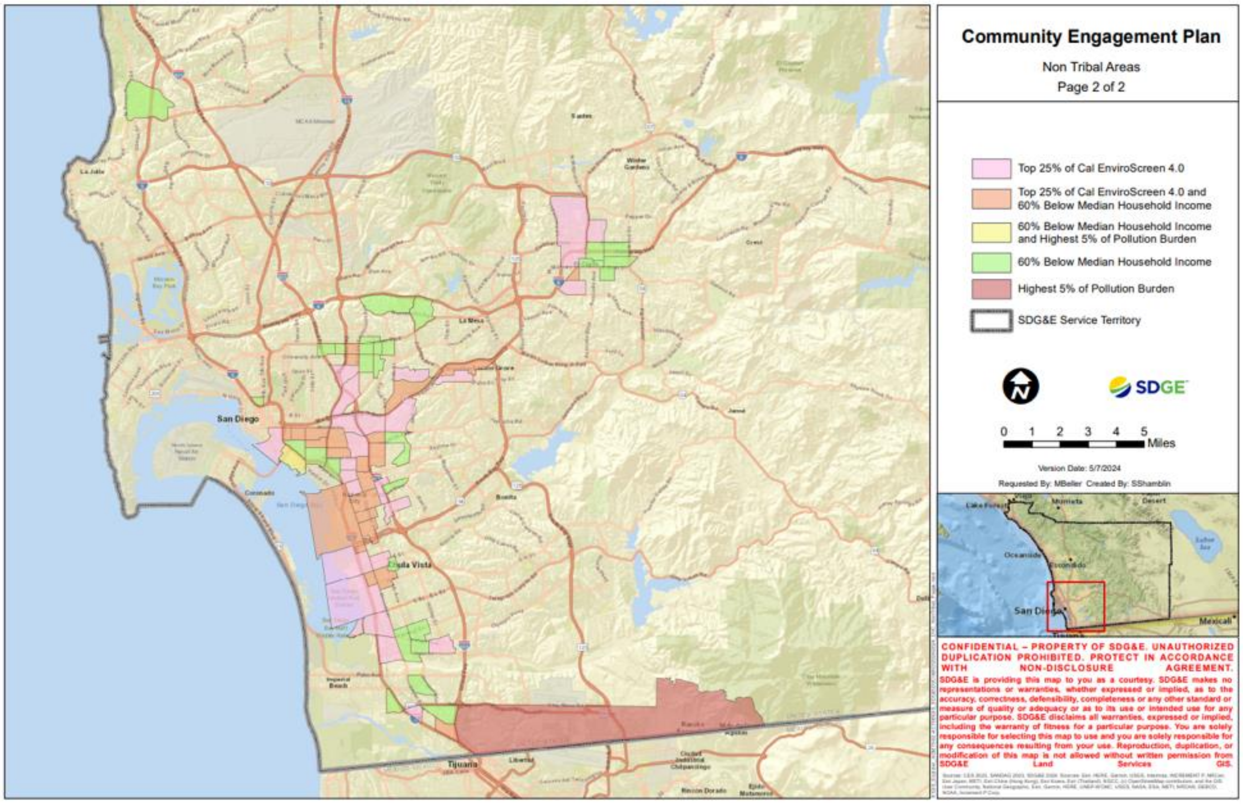
Appendix B. EC3 Members

EC3 CBO Members
Bayside Community Center
Climate Science Alliance
Metropolitan Area Advisory Committee on Anti-Poverty (MAAC)
San Diego Workforce Partnership
Casa Familiar
Jacobs Center for Neighborhood Innovation
San Ysidro Health

Appendix C. DVC Data and Maps







Land Area Representation ID	Land Area Representation Name	Census Tract	DVC Criteria	Outreach Area	Associated City
LAR0099	Barona LAR	016902	Tribal Lands		Ramona
LAR0113	Campo LAR	021100	Tribal Lands		Boulevard
LAR0114	Capitan Grande LAR	020902	Tribal Lands		Alpine
LAR0123	Cuyapaipe LAR	021100	Tribal Lands		Mount Laguna
LAR0136	Inaja and Cosmit LAR	020902	Tribal Lands		Julian
LAR0138	Jamul LAR	021304	Tribal Lands		Jamul
LAR0140	La Jolla LAR	019101	Tribal Lands		Pauma Valley
LAR0141	La Posta LAR	021100	Tribal Lands		Pine Valley
LAR0146	Los Coyotes LAR	020903	Tribal Lands		Warner Springs
LAR0149	Manzanita LAR	021100	Tribal Lands		Pine Valley
LAR0150	Mesa Grande LAR	020903	Tribal Lands		Ramona
LAR0156	Pala LAR	019101	Tribal Lands		Pala
LAR0158	Pauma and Yuima LAR	020903	Tribal Lands		Pauma Valley
LAR0159	Pechanga LAR	019002	Tribal Lands		Pala
LAR0168	Rincon LAR	019106	Tribal Lands		Valley Center
LAR0174	San Pasqual LAR	020103	Tribal Lands		Valley Center
LAR0178	Santa Ysabel LAR	020903	Tribal Lands		Santa Ysabel
LAR0187	Sycuan LAR	015502	Tribal Lands		El Cajon

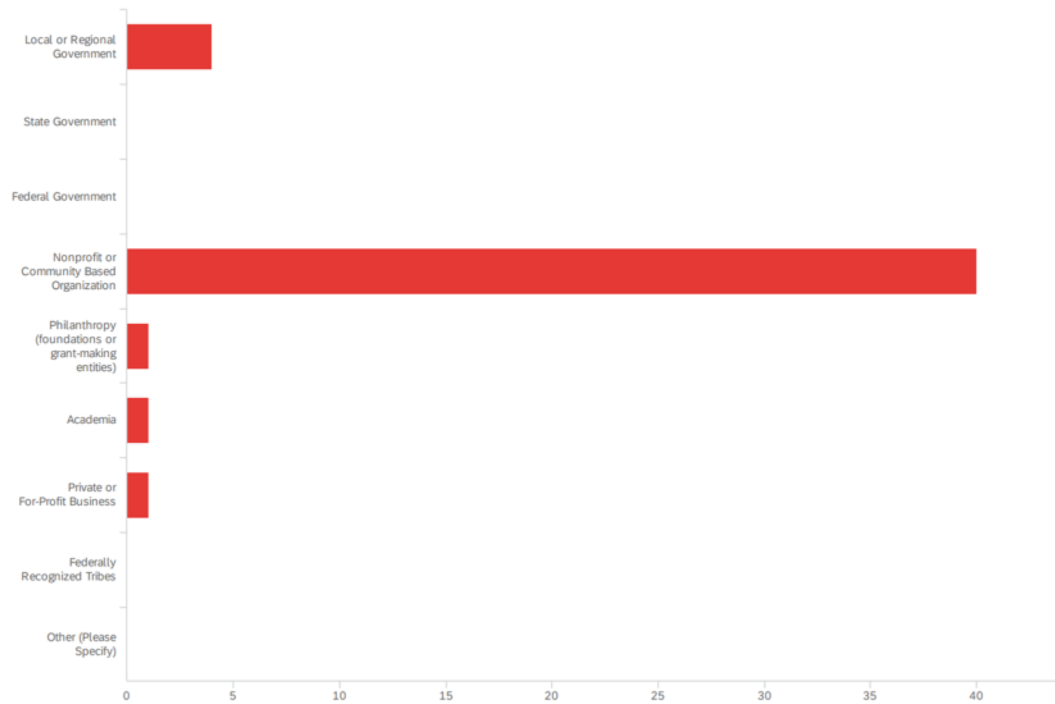
LAR0197	Viejas LAR	021202	Tribal Lands		Alpine
		020029	MHI	C	San Marcos
		015703	MHI	E	El Cajon
		018603	MHI	D	Oceanside
		001600	MHI	G	San Diego
		005000	MHI & Pollution	H	San Diego
		002301	MHI	G	San Diego
		002302	MHI	G	San Diego
		002402	MHI, CES2022	G	San Diego
		002707	MHI	G	San Diego
		002708	MHI	G	San Diego
		002709	MHI	G	San Diego
		014400	MHI, CES2022	G	Lemon Grove
		008305	MHI	A	San Diego
		020202	MHI	B	Escondido
		020207	MHI	B	Escondido
		002601	MHI	G	San Diego
		002801	MHI	G	San Diego
		010005	MHI	F	San Diego
		002201	MHI	G	San Diego
		002202	MHI, CES2022	G	San Diego
		020209	MHI	B	Escondido
		020308	MHI	B	Escondido
		002904	MHI	G	San Diego
		020213	MHI	B	Escondido
		020214	MHI	B	Escondido
		002712	MHI, CES2022	G	Lemon Grove
		003305	MHI, CES2022	H	San Diego
		010015	Pollution		San Diego
		020028	MHI	C	San Marcos
		016301	MHI	E	El Cajon
		016302	MHI	E	El Cajon
		003303	MHI, CES2022	H	San Diego
		003501	MHI, CES2022	H	San Diego
		003901	MHI, CES2022	H	San Diego
		003902	MHI	H	San Diego
		004000	MHI, CES2022	H	San Diego
		011601	MHI, CES2022	I	National City
		011602	MHI, CES2022	I	National City
		011700	MHI, CES2022	I	National City
		015701	MHI	E	El Cajon
		015801	MHI	E	El Cajon

		015901	MHI, CES2022	E	El Cajon
		004700	MHI, CES2022	H	San Diego
		004800	MHI, CES2022	H	San Diego
		004900	MHI	H	San Diego
		005700	MHI	H	San Diego
		011802	MHI, CES2022	I	National City
		012002	MHI	I	National City
		010010	MHI	F	San Diego
		010013	MHI, CES2022	F	San Diego
		012302	MHI	J	Chula Vista
		010112	MHI	F	San Diego
		012700	MHI, CES2022	J	Chula Vista
		013203	MHI	F	Chula Vista
		013204	MHI	F	Chula Vista
		013206	MHI	F	Chula Vista
		003601	MHI	H	San Diego
		003111	MHI	H	San Diego
		012501	MHI, CES2022	J	Chula Vista
		003304	MHI, CES2022	H	San Diego
		005100	CES2022	H	San Diego
		003301	CES2022	H	San Diego
		003603	CES2022	H	San Diego
		012502	CES2022	J	Chula Vista
		012402	CES2022	J	Chula Vista
		013205	CES2022	F	Chula Vista
		013103	CES2022	F	Chula Vista
		022000	CES2022	I	National City
		002711	CES2022	G	San Diego
		010111	CES2022	F	San Diego
		012600	CES2022	J	Chula Vista
		016504	CES2022	E	El Cajon
		012102	CES2022	I	National City
		003403	CES2022	H	San Diego
		015902	CES2022	E	El Cajon
		016202	CES2022	E	El Cajon
		011801	CES2022	I	National City
		013307	CES2022	F	Chula Vista
		003404	CES2022	G	San Diego
		003502	MHI, CES2022	H	San Diego
		003602	CES2022	H	San Diego
		002501	CES2022	G	San Diego
		014300	CES2022	G	Lemon Grove
		003001	CES2022	G	San Diego

		002502	CES2022	G	San Diego
		021900	MHI, CES2022	F	National City
		021900	MHI, CES2022	F	Chula Vista
		021900	MHI, CES2022	I	National City

Appendix D. 2022 CBO Survey Results

Q3 - What sector does your organization consider itself to be a part of?

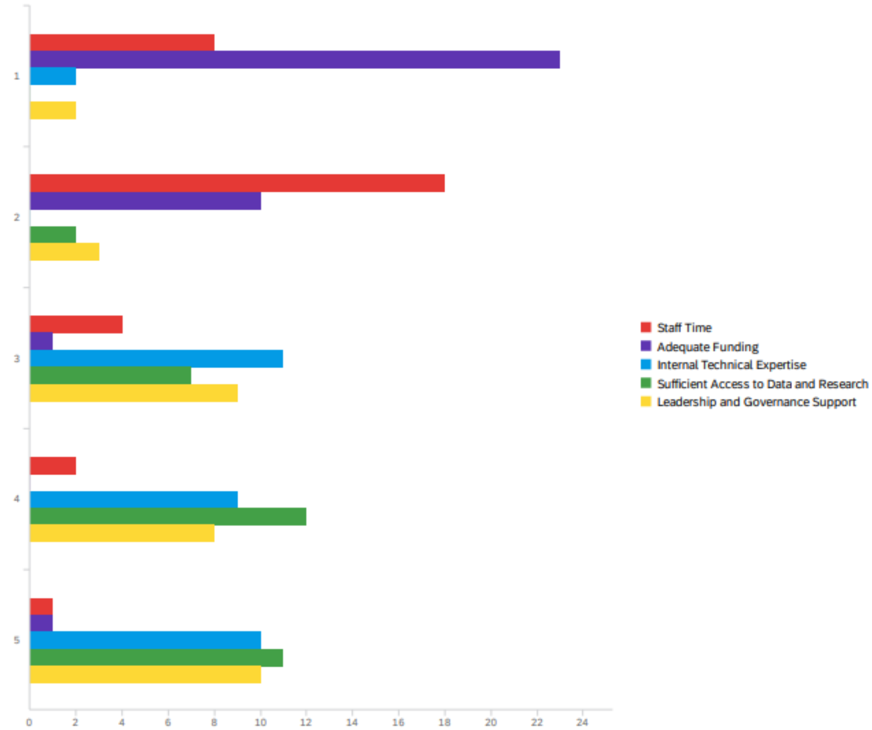


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What sector does your organization consider itself to be a part of? - Selected Choice	1.00	7.00	3.87	1.02	1.05	47

#	Field	Choice Count	
1	Local or Regional Government	8.51%	4
2	State Government	0.00%	0
3	Federal Government	0.00%	0
4	Nonprofit or Community Based Organization	85.11%	40
5	Philanthropy (foundations or grant-making entities)	2.13%	1
6	Academia	2.13%	1

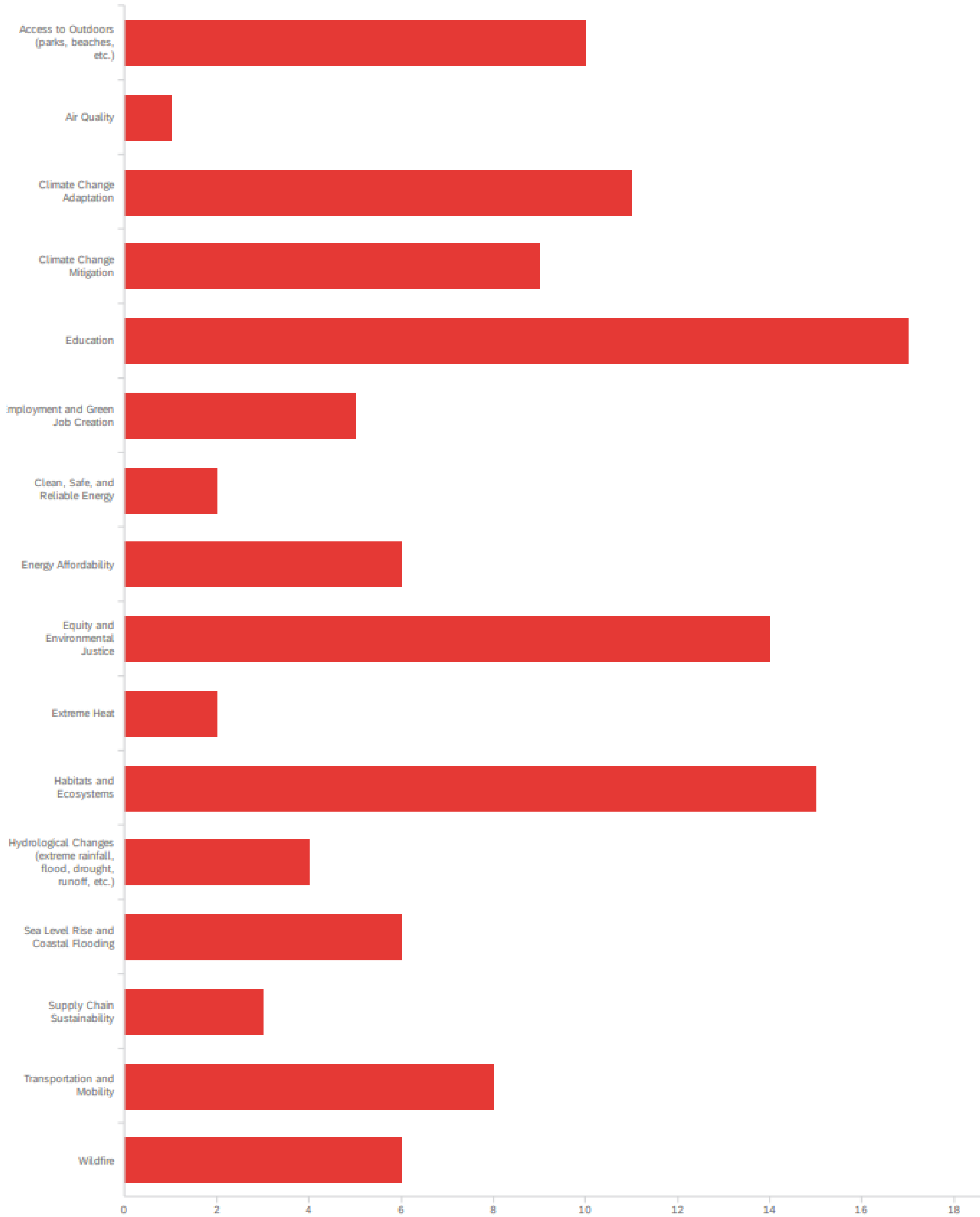
#	Field	Choice Count	
7	Private or For-Profit Business	2.13%	1
8	Federally Recognized Tribes	0.00%	0
9	Other (Please Specify)	0.00%	0
			47

Q32 - As it relates climate resilience efforts, please rank your organization's capacity needs, using numbers 1 through 5, from highest priority (1) to lowest priority (5).



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Staff Time	1.00	5.00	2.09	0.93	0.87	33
2	Adequate Funding	1.00	5.00	1.46	0.81	0.65	35
3	Internal Technical Expertise	1.00	5.00	3.78	1.08	1.17	32
4	Sufficient Access to Data and Research	2.00	5.00	4.00	0.90	0.81	32
5	Leadership and Governance Support	1.00	5.00	3.66	1.19	1.41	32

#	Field	1		2		3		4		5		Total
1	Staff Time	24.24%	8	54.55%	18	12.12%	4	6.06%	2	3.03%	1	33
2	Adequate Funding	65.71%	23	28.57%	10	2.86%	1	0.00%	0	2.86%	1	35
3	Internal Technical Expertise	6.25%	2	0.00%	0	34.38%	11	28.13%	9	31.25%	10	32
4	Sufficient Access to Data and Research	0.00%	0	6.25%	2	21.88%	7	37.50%	12	34.38%	11	32
5	Leadership and Governance Support	6.25%	2	9.38%	3	28.13%	9	25.00%	8	31.25%	10	32

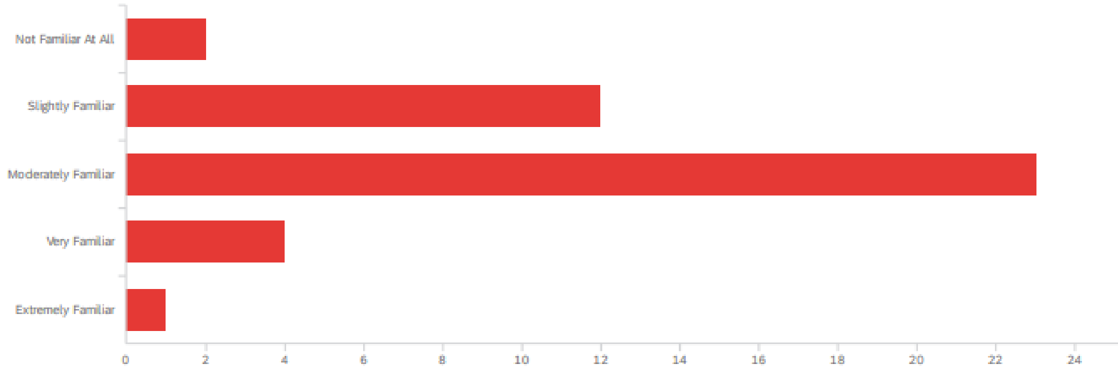


Access to Outdoors (parks, beaches, etc.)
Air Quality
Climate Change Adaptation
Climate Change Mitigation
Education
mployment and Green Job Creation
Clean, Safe, and Reliable Energy
Energy Affordability
Equity and Environmental Justice
Extreme Heat
Habitats and Ecosystems
Hydrological Changes (extreme rainfall, flood, drought, runoff, etc.)
Sea Level Rise and Coastal Flooding
Supply Chain Sustainability
Transportation and Mobility
Wildfire
0
2
4
6
8
10
12
14
16
18

#	Field	Choice Count	
1	Access to Outdoors (parks, beaches, etc.)	8.40%	10

#	Field	Choice Count	
2	Air Quality	0.84%	1
3	Climate Change Adaptation	9.24%	11
4	Climate Change Mitigation	7.56%	9
5	Education	14.29%	17
6	Employment and Green Job Creation	4.20%	5
7	Clean, Safe, and Reliable Energy	1.68%	2
8	Energy Affordability	5.04%	6
9	Equity and Environmental Justice	11.76%	14
10	Extreme Heat	1.68%	2
11	Habitats and Ecosystems	12.61%	15
12	Hydrological Changes (extreme rainfall, flood, drought, runoff, etc.)	3.36%	4
13	Sea Level Rise and Coastal Flooding	5.04%	6
14	Supply Chain Sustainability	2.52%	3
15	Transportation and Mobility	6.72%	8
16	Wildfire	5.04%	6
			119

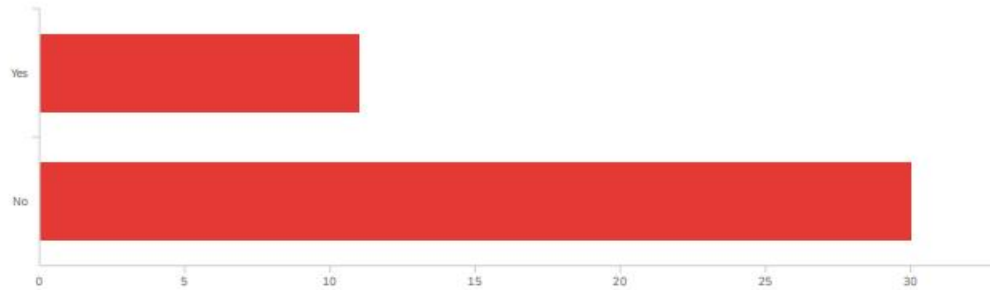
Q5 - How familiar are you with SDG&E's past sustainability and climate change initiatives? (i.e., Sustainability Strategy and climate adaptation outreach and initiatives)



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How familiar are you with SDG&E's past sustainability and climate change initiatives? (i.e., Sustainability Strategy and climate adaptation outreach and initiatives)	1.00	5.00	2.76	0.78	0.61	42

#	Field	Choice Count	
1	Not Familiar At All	4.76%	2
2	Slightly Familiar	28.57%	12
3	Moderately Familiar	54.76%	23
4	Very Familiar	9.52%	4
5	Extremely Familiar	2.38%	1
			42

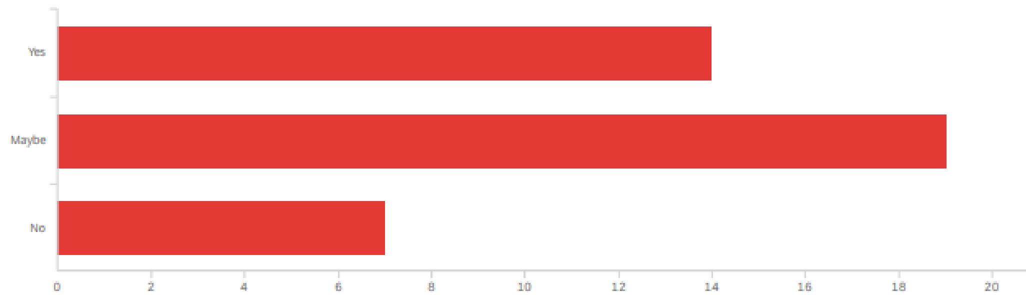
Q6 - Are you aware of the California Public Utilities Commission (CPUC)'s recent decision on how California investor-owned utilities' should approach Climate Adaptation, which includes guidance on how utilities like SDG&E should develop vulnerability assessments and community engagement plans? If not, please read the excerpt below.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you aware of the California Public Utilities Commission (CPUC)'s recent decision on how California investor-owned utilities' should approach Climate Adaptation, which includes guidance on how utilities like SDG&E should develop vulnerability assessments and community engagement plans? If not, please read the excerpt below.	1.00	2.00	1.73	0.44	0.20	41

#	Field	Choice Count	
1	Yes	26.83%	11
2	No	73.17%	30
			41

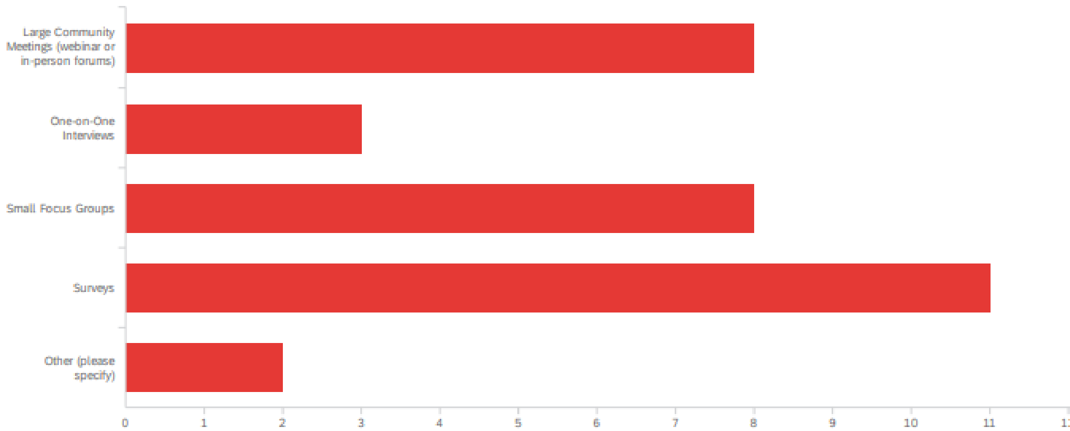
Q8 - Is your organization interested in directly engaging with and/or supporting SDG&E's development and implementation of a climate change Vulnerability Assessment?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Is your organization interested in directly engaging with and/or supporting SDG&E's development and implementation of a climate change Vulnerability Assessment?	1.00	3.00	1.82	0.70	0.49	40

#	Field	Choice Count	
1	Yes	35.00%	14
2	Maybe	47.50%	19
3	No	17.50%	7
			40

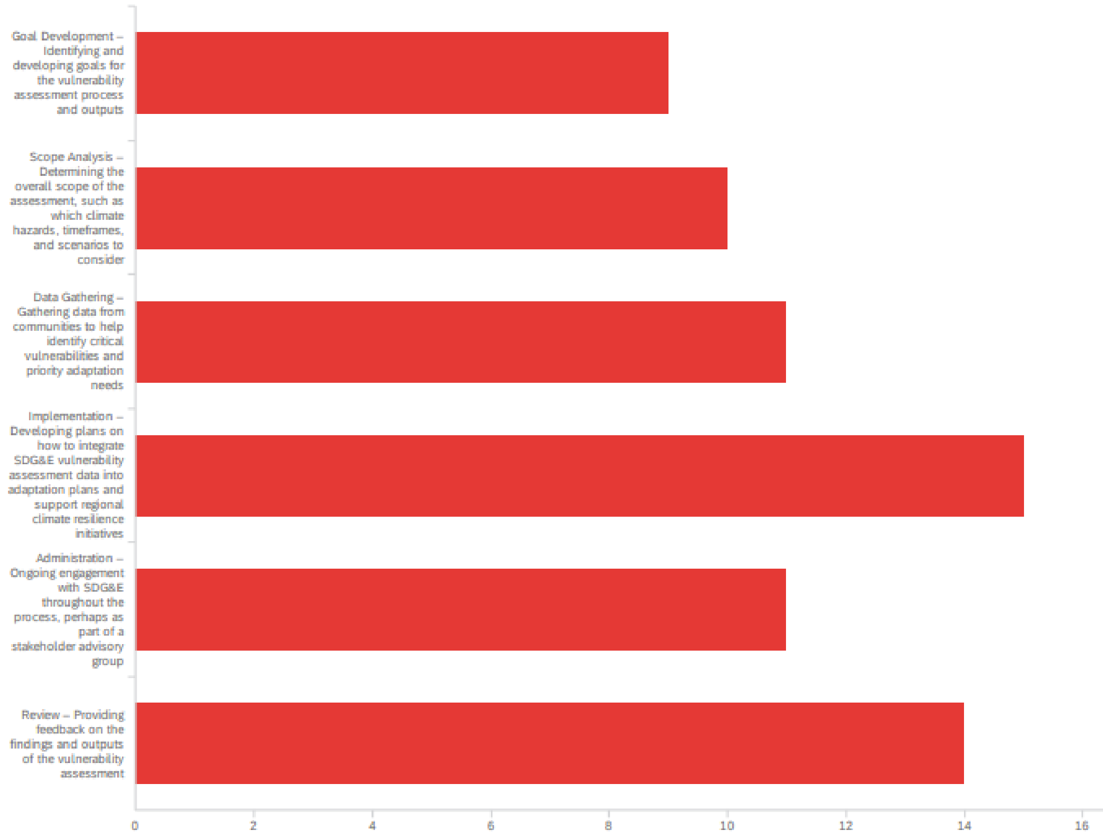
Q9 - How would you like to engage with SDG&E on their Vulnerability Assessments?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How would you like to engage with SDG&E on their Vulnerability Assessments? - Selected Choice	1.00	5.00	2.88	1.29	1.67	32

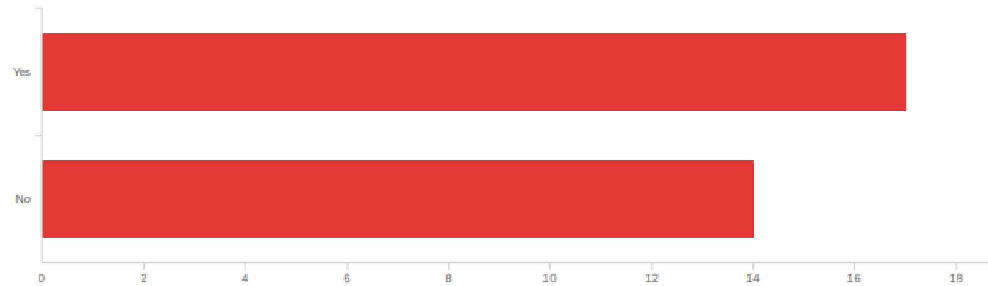
#	Field		Choice Count
1	Large Community Meetings (webinar or in-person forums)	25.00%	8
2	One-on-One Interviews	9.38%	3
3	Small Focus Groups	25.00%	8
4	Surveys	34.38%	11
5	Other (please specify)	6.25%	2
			32

Q10 - Please select which project phases of the vulnerability assessments you would like to be involved in? (Select all that apply)



#	Field		Choice Count
1	Goal Development – Identifying and developing goals for the vulnerability assessment process and outputs	12.86%	9
2	Scope Analysis – Determining the overall scope of the assessment, such as which climate hazards, timeframes, and scenarios to consider	14.29%	10
3	Data Gathering – Gathering data from communities to help identify critical vulnerabilities and priority adaptation needs	15.71%	11
4	Implementation – Developing plans on how to integrate SDG&E vulnerability assessment data into adaptation plans and support regional climate resilience initiatives	21.43%	15
5	Administration – Ongoing engagement with SDG&E throughout the process, perhaps as part of a stakeholder advisory group	15.71%	11
6	Review – Providing feedback on the findings and outputs of the vulnerability assessment	20.00%	14
			70

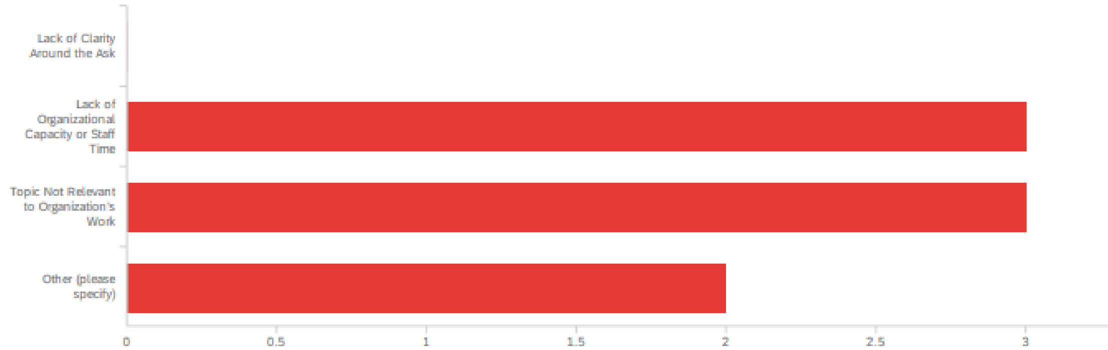
Q11 - Are you or your organization expecting to be compensated for your participation in these outreach and engagement activities?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you or your organization expecting to be compensated for your participation in these outreach and engagement activities?	1.00	2.00	1.45	0.50	0.25	31

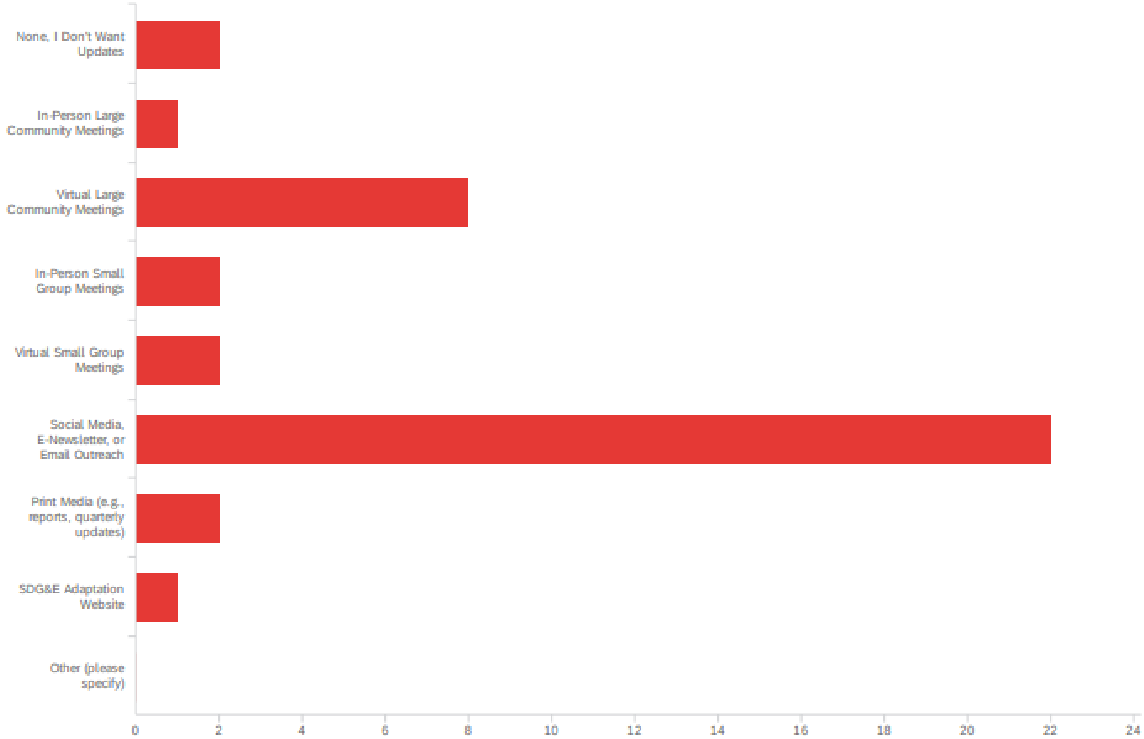
#	Field		Choice Count
1	Yes	54.84%	17
2	No	45.16%	14
			31

Q13 - Why are you not interested in supporting SDG&E's development and implementation of vulnerability assessments and climate adaptation planning? (Select all that apply)



#	Field		Choice Count
1	Lack of Clarity Around the Ask	0.00%	0
2	Lack of Organizational Capacity or Staff Time	37.50%	3
3	Topic Not Relevant to Organization's Work	37.50%	3
4	Other (please specify)	25.00%	2
			8

Q14 - How would you like to receive updates and reports on SDG&E's climate adaptation efforts, including Vulnerability Assessments?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How would you like to receive updates and reports on SDG&E's climate adaptation efforts, including Vulnerability Assessments? - Selected Choice	1.00	8.00	5.00	1.69	2.85	40

#	Field		Choice Count
1	None, I Don't Want Updates	5.00%	2
2	In-Person Large Community Meetings	2.50%	1
3	Virtual Large Community Meetings	20.00%	8
4	In-Person Small Group Meetings	5.00%	2

Appendix E. Community Engagement Event & Activities Tracking

Event	Date	Location	Organizer	SDG&E Role
Survey	5/2/2022	Online	SDG&E/SDRCC	Co-Lead
Focus Group	10/19/2022	Virtual	SDG&E/SDRCC	Participant
EC3 Meeting #1	5/11/2023	Century Park	SDG&E	Facilitator/Speaking
Viejas Tribal Earth Fair	5/20/2023	Viejas Reservation	Viejas Band of Kumeyaay Indians	Tabling
Inter-Tribal Long Term Resiliency Fund Breakfast	5/26/2023	Alpine, CA	ITLTRF	Presenter
Wildfire Safety Fair	6/10/2023	Ramona, CA	SDG&E	Tabling
Wildfire Safety Fair	7/29/2023	Julian, CA	SDG&E	Tabling
Wildfire Safety Fair	8/26/2023	Valley Center, CA	SDG&E	Tabling
Climate Readiness Information Session	9/12/2023	Escondido, CA	SDG&E	Speaking
San Diego Climate Summit	9/20/2023	San Diego, CA	Climate Science Alliance	Tabling
INSY Community Safety Fair	9/23/2023	Santa Ysabel Reservation	Iipay Nation of Santa Ysabel	Speaking, Tabling
Climate Readiness Information Session	10/2/2023	Logan Heights, CA	SDG&E	Speaking
Electric Vehicle Day	10/14/2023	Snapdragon Stadium, San Diego, CA	SDG&E	Tabling
Climate Readiness Information Session	11/29/2023	Chula Vista, CA	SDG&E	Speaking
EC3 Individuals - MAAC	12/1/2023	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - Climate Science Alliance	12/4/2023	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - San Diego Foundation	12/6/2023	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - Casa Familiar	12/11/2023	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - Bayside Community Center	1/16/2024	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - Jacobs Center for Neighborhood Innovation	1/16/2024	Virtual	SDG&E/SDRCC	Co-Lead

EC3 Individuals - San Ysidro Health	1/18/2024	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Individuals - San Diego Workforce Partnership	1/24/2024	Virtual	SDG&E/SDRCC	Co-Lead
EC3 Meeting #2	3/4/2024	Virtual	SDG&E/SDRCC	Facilitator/Speaking
Tribal Working Group	3/7/2024	Rincon Reservation	Climate Science Alliance	Presenter
CEP Webinar #1	3/14/2024	Virtual	SDG&E	Presenter
SCTCA	3/19/2024	NA	SCTCA	Presenter
LV Collaborative	3/19/2024	Linda Vista	Bayside Community Center	Presenter
CEP Webinar #2	3/20/2024	Virtual	SDG&E	Presenter
CEP Webinar #3	3/26/2024	Virtual	SDG&E	Presenter
Climate Readiness Information Session	4/11/2024	El Cajon, CA	SDG&E	Speaking
DACAG Meeting	4/19/24	Virtual	DACAG	Presenting

Appendix F. EC3 Guidelines

Equity-First Community Climate Coalition Charter & Guidelines

Background

At the recommendation of the San Diego Regional Climate Collaborative, San Diego Gas & Electric is founding the Equity-First Community Climate Coalition (EC3), which is a collective of local organizations collaborating to further SDG&E and the communities it serves' climate outreach and equity goals. The coalition will co-develop a variety of different outreach opportunities to best help community voices, needs, and feedback be incorporated into SDG&E's Climate Adaptation Vulnerability Assessment and Adaptation Planning processes. In certain cases, SDG&E will aim to develop ad-hoc partnerships with member CBOs for deeper outreach and engagement initiatives. The group will consist of between 10 and 18 members.

Mission & Vision

Mission:

The mission of the Equity-First Community Climate Coalition is to directly support SDG&E to incorporate community values, desires, and insight gained from lived experiences into SDG&E's climate vulnerability assessment and subsequent decision-making tools. This will be facilitated through a collaborative process with EC3 members that provides direct feedback from communities, supports two-way information sharing, and identifies new partnership pathways. EC3 will work to accomplish this by partnering on community outreach, and implementing new engagement pathways in order to create a more mutually beneficial relationship between SDG&E and community partners.

Vision: Our vision for the Equity-First Community Climate Coalition is to support SDG&E to create a truly equitable climate adaptation process for the communities in our service area and serve as an example of thought and action leadership locally and around the nation.

Guidelines

(1) Time Commitments and Compensation

SDG&E is committed to compensating CBO partners fairly for their time and expertise. As such, the Utility will ask for 10 hours per year from each EC3 member, at a compensation rate of $100/hour for time in Coalition meetings. This compensation will be for five 1.5 hour bi-monthly meetings through the rest of 2023 in addition to compensation for 30 minutes of prep time potentially needed for each meeting. In the event there are additional opportunities for collaboration stemming from goals and projects developed within the EC3, those compensation arrangements will be scoped and handled on a case-by-case basis to ensure robust and equitable partnership development.

(2) Geographic Diversity

The EC3 will have representation from around SDG&E's service area to ensure the Coalition effectively represents the diversity of communities and climate impacts across the region. At a minimum, SDG&E commits to trying to have the makeup of the group overall touch every Disadvantaged Vulnerable Community (DVC) in SDG&E's service area.

(3) DVC Representation

The Coalition, first and foremost, will prioritize representation from and initiatives aimed at the Disadvantaged Vulnerable Communities as outlined in the Climate Change Adaptation OIR. A map of DVC's in SDG&E's service area can be found on SDG&E's climate adaptation website (https://www.sdge.com/climate-adaptation-sdge).

(4) Intersectional Expertise

As climate change is a cross-cutting issue, so must the representation in the EC3, and SDG&E is committed to ensuring that there is a representation of many types of organizations such as youth groups, religious communities, and access and functional needs populations.

(5) Size & Meeting Frequency

Meetings will be held virtually and occur quarterly. Meetings will consist of one member from each organization and be facilitated by SDG&E's Climate Adaptation Team with support from the San Diego Regional Climate Collaborative. Should an organization wish to designate an alternate representative in the case the primary person cannot attend, there will be an opportunity to do so.

(6) Positive Environment

SDG&E is committed to fostering a two-way learning environment and maximizing the benefit of the Coalition to its members and the communities of San Diego in the context of climate change and its actual or expected adverse impacts on them.

(7) Evaluation

Evaluation of the effectiveness of coalition efforts and satisfaction of coalition members with group processes and outcomes will be completed at the end of each year. Additionally, tracking and monitoring of both Coalition processes and outcomes will be conducted regularly. These activities might include, meeting notes, attendance records, and event logs.

Appendix G. CETM Training Outline

1. Section 1: Introduction to Climate Equity and the Climate Adaptation OIR

1.1. Section 1: Introduction to Climate Equity and the Climate Adaptation OIR

1.3. Course Navigation

1.4. What is Climate Equity?

1.5. An Example of a Climate Equity Challenge

1.6. Tree Canopy and Urban Heat: An Example of Climate Equity Disparity

1.7. What are the ESJ Action Plan and Climate Adaptation OIR?

1.8. Internal Efforts to Promote Climate Equity

1.9. External Efforts to Promote Climate Equity

1.10. End of Section

2. Section 2: Identifying and Understanding Target Communities

2.1. Section 2: Identifying and Understanding Target Communities

2.2. Who are we engaging?

2.3. Climate Equity Challenges Faced by DVCs

2.4. How DVCs Can Be Disproportionately Affected By Climate Change

2.5. Importance of Tailored Engagement and Community Partnerships

2.6. An Example Of Collaboration In Action

2.7. End of Section

3. Section 3: Mindful Engagement - Principles and Best Practices

3.1. Section 3: Mindful Engagement - Principles and Best Practices

3.2. Outreach vs. Engagement

3.3. Spectrum of Engagement

3.4. Informed Outreach & Engagement

3.5. Impactful and Respectful Outreach & Engagement

3.6. Scenario: Building Trust and Authentic Partnerships

3.7. Scenario Question #1

3.8. Scenario Question #2

3.9. How did James do?

3.10. Cultural Competence and Inclusiveness

3.11. Recognizing and Respecting Diversity Within and Among DVCs

3.12. Ensuring Genuine Participation

3.13. End of Section

4. Section 4: Strategizing and Implementing Effective Outreach

4.1. Section 4: Strategizing and Implementing Effective Outreach

4.2. Conducting Needs Assessments

4.3. Collaboratively Defining Outreach Goals

4.4. Strategies for Collaborative Engagement

4.5. Event Organization

4.6. Continued Community Engagement

4.7. Course Resources

4.8. End of Section

Appendix H. Climate Adaptation Survey & Results

Climate Adaptation Survey

Extreme weather events in California and the western U.S. have emphasized the need for utilities to better adapt to climate change. SDG&E is researching how these changes – including extreme heat, drought, wildfire, sea level rise, and the frequency and intensity of storms – may impact communities and the energy grid.

We want to know what you and your community need in the face of climate change. Your input will be used to help determine SDG&E's future investments in climate adaptation.

1. In what capacity are you filling out this survey?
   - SDG&E or CCA Customer
   - Representative of Local Government
   - Representative of Community-Based Organization
   - Other…

2. What city, community and/or tribal nation best describes where you live or represent?

3. Are you aware of SDG&E's climate adaptation efforts, including a Climate Vulnerability Assessment and Community Outreach/Education?
   - Not at all familiar
   - Somewhat familiar
   - Familiar
   - Very familiar

4. Please rate the following climate hazards from not at all concerning to very concerning:

	Not at all Concerning	Somewhat Concerning	Neutral	Concerning	Very Concerning
Increased & Extreme Heat Days	○	○	○	○	○
Wildfire	○	○	○	○	○
Sea Level Rise/Coastal Flooding & Erosion	○	○	○	○	○
Extreme Precipitation & Stormwater Runoff	○	○	○	○	○
Extended Drought Conditions	○	○	○	○	○
Air Quality & Increased Pollution	○	○	○	○	○

5. What entity do you trust the most to conduct community outreach to gauge the gaps and opportunities for building climate resilience against the climate hazard you are most concerned about?
   - Utility Company (SDG&E)
   - CCA
   - Community-Based Organizations
   - Local Government
   - Other…

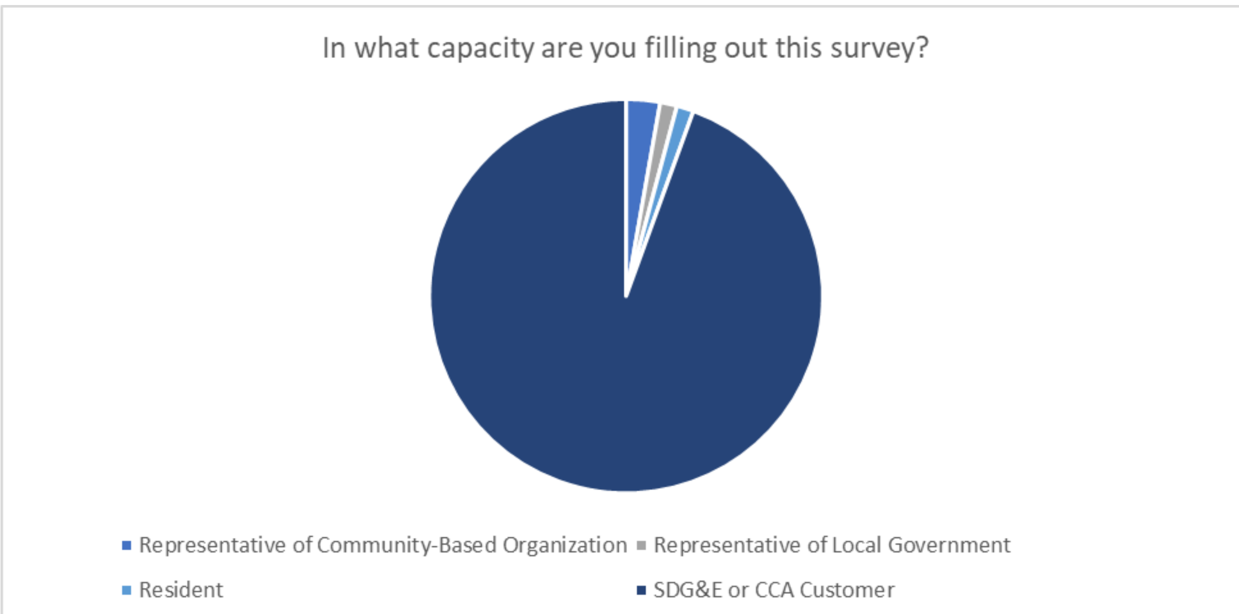
6. Would you like to be further engaged with SDG&E in their vulnerability assessment and climate adaptation processes?
   - Yes

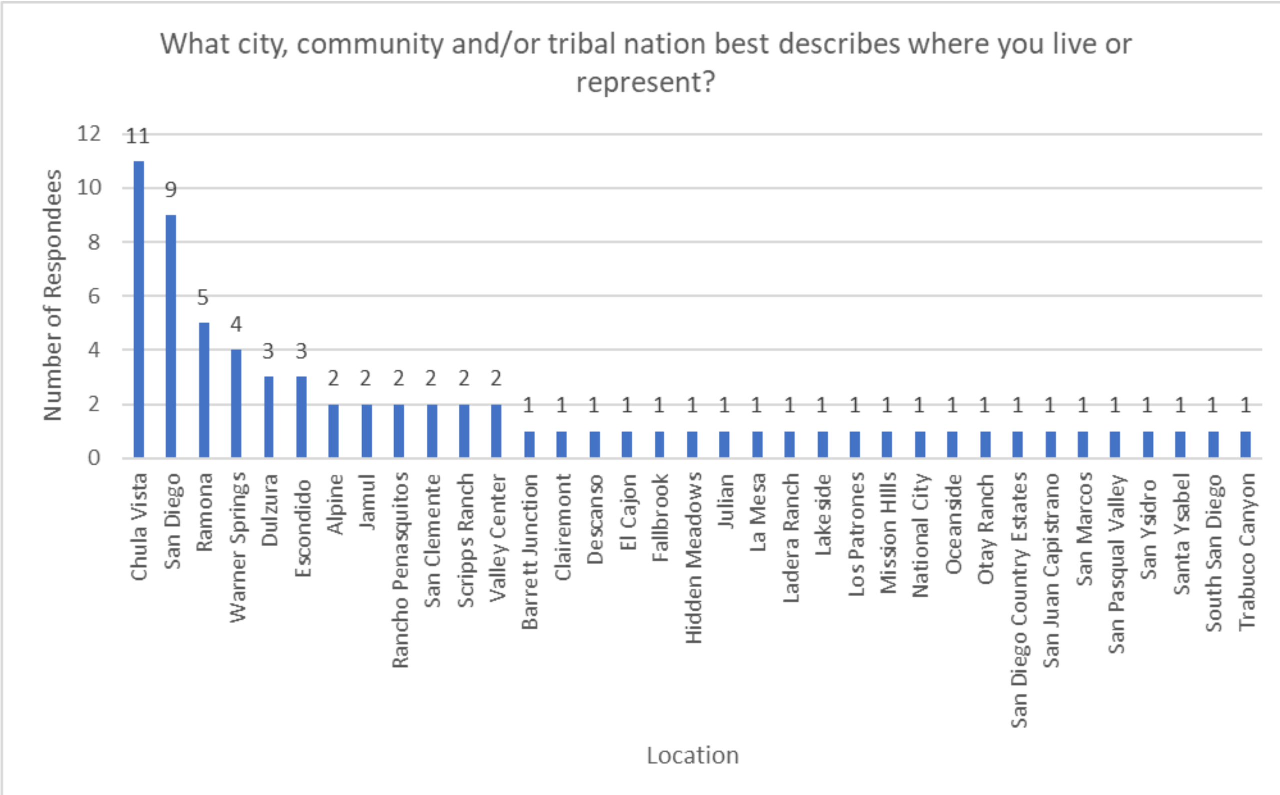
- No

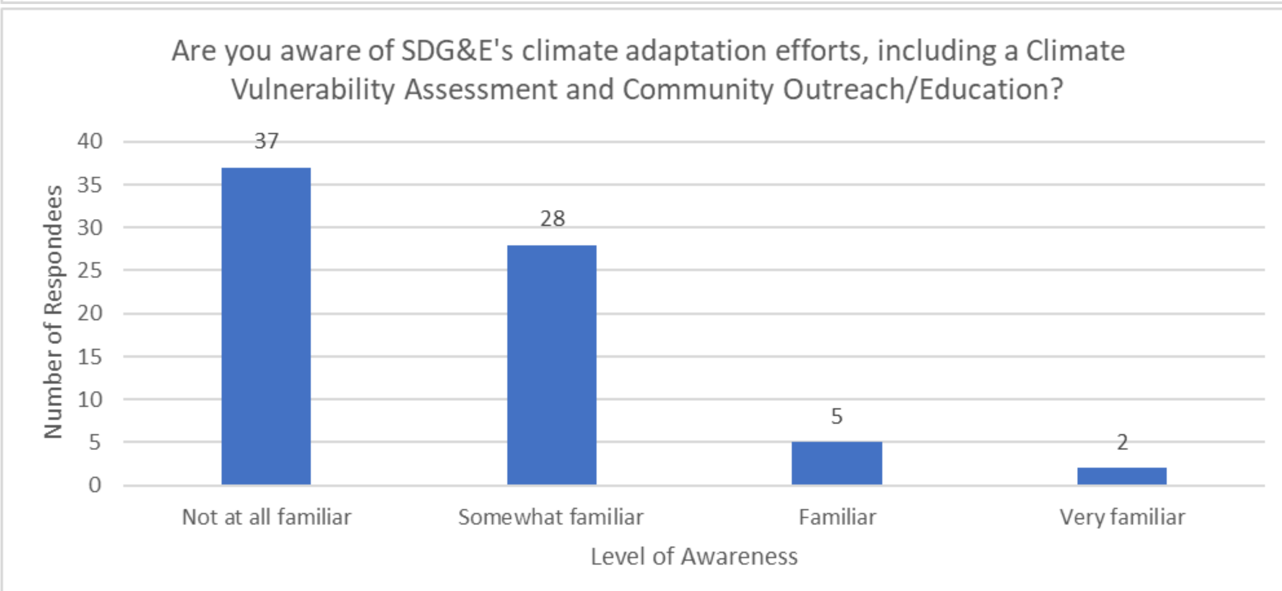
7. What outreach method(s) would be most effective for you and your community?
    - Newsletters
    - Town Halls
    - Webinars
    - Social Media
    - Climate Adaptation website
    - Other…
8. Do you have any questions or comments regarding SDG&E's climate adaptation efforts?

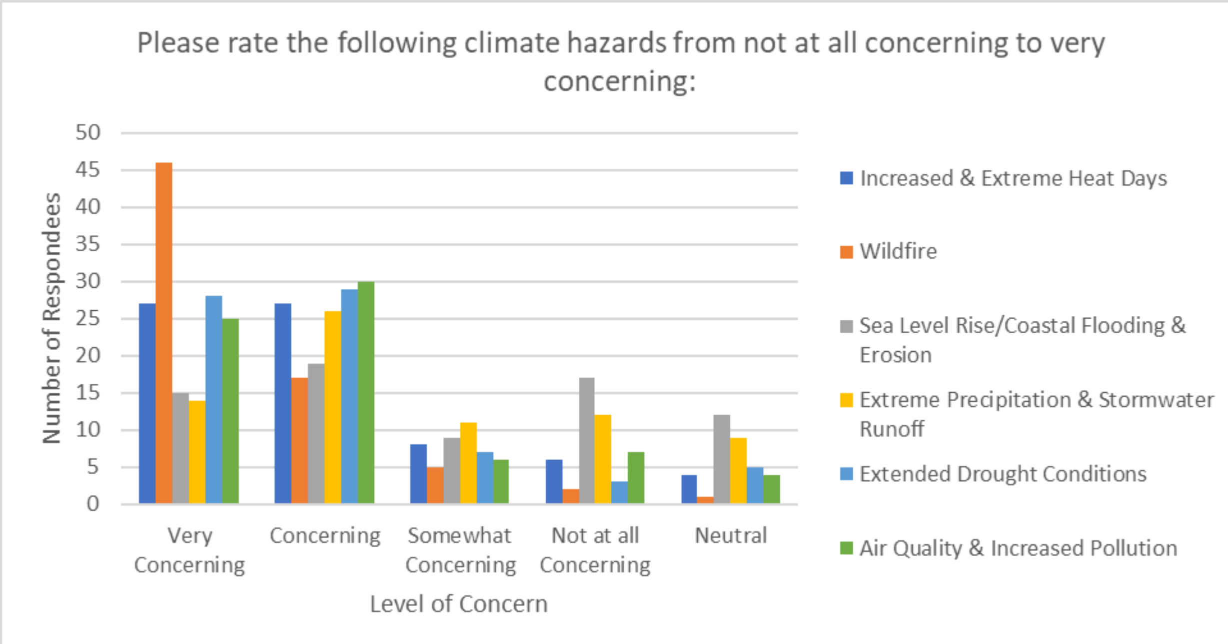
9. Would you like to learn more and sign up for our newsletter? If yes, please enter your email address in the box provided.

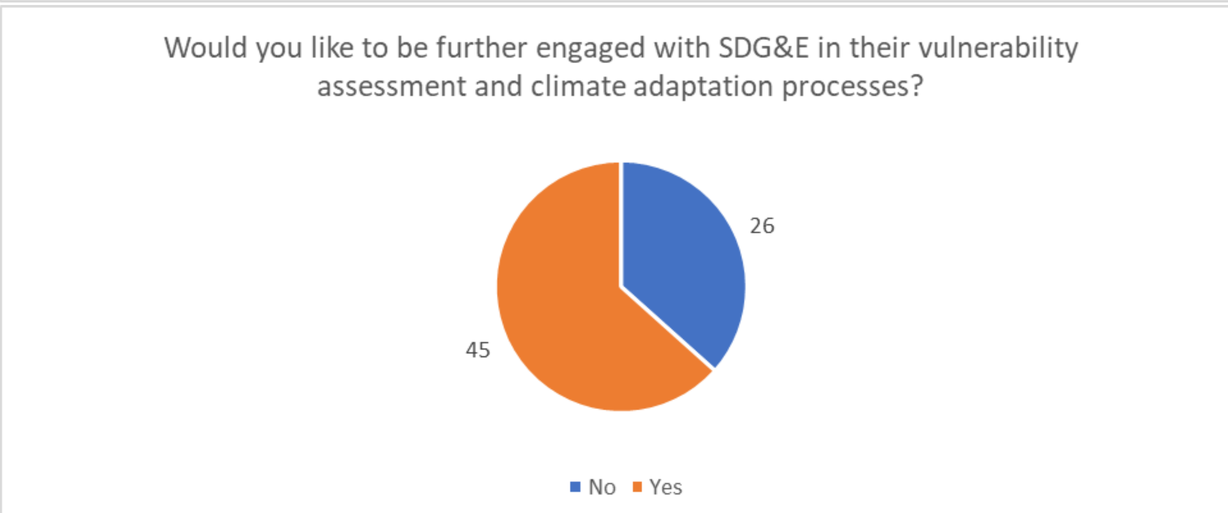
Survey Results

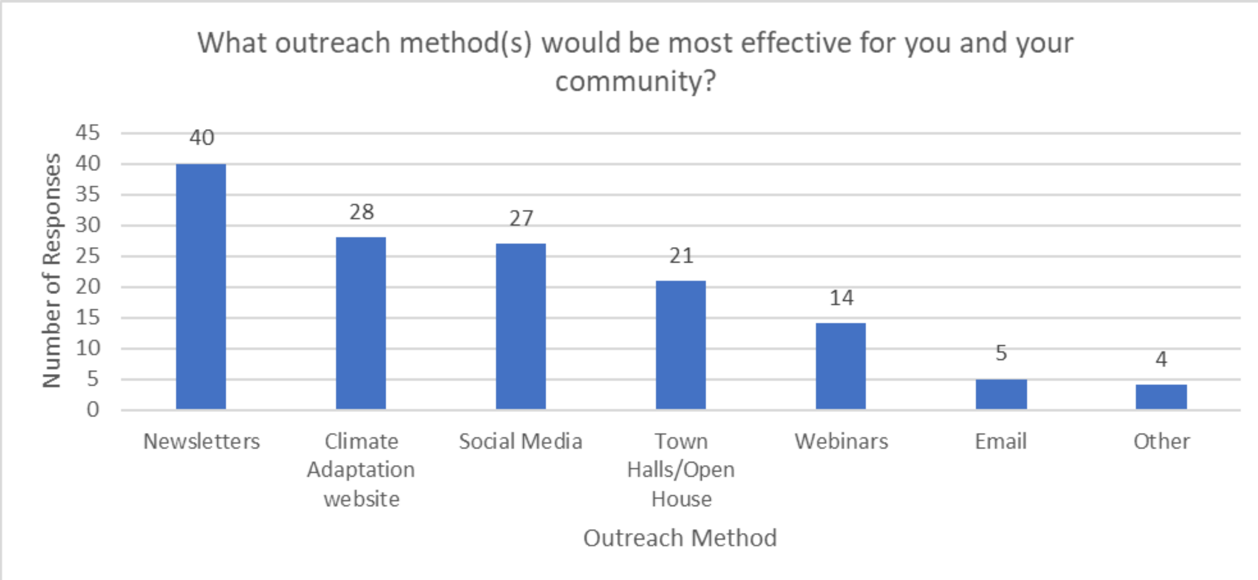


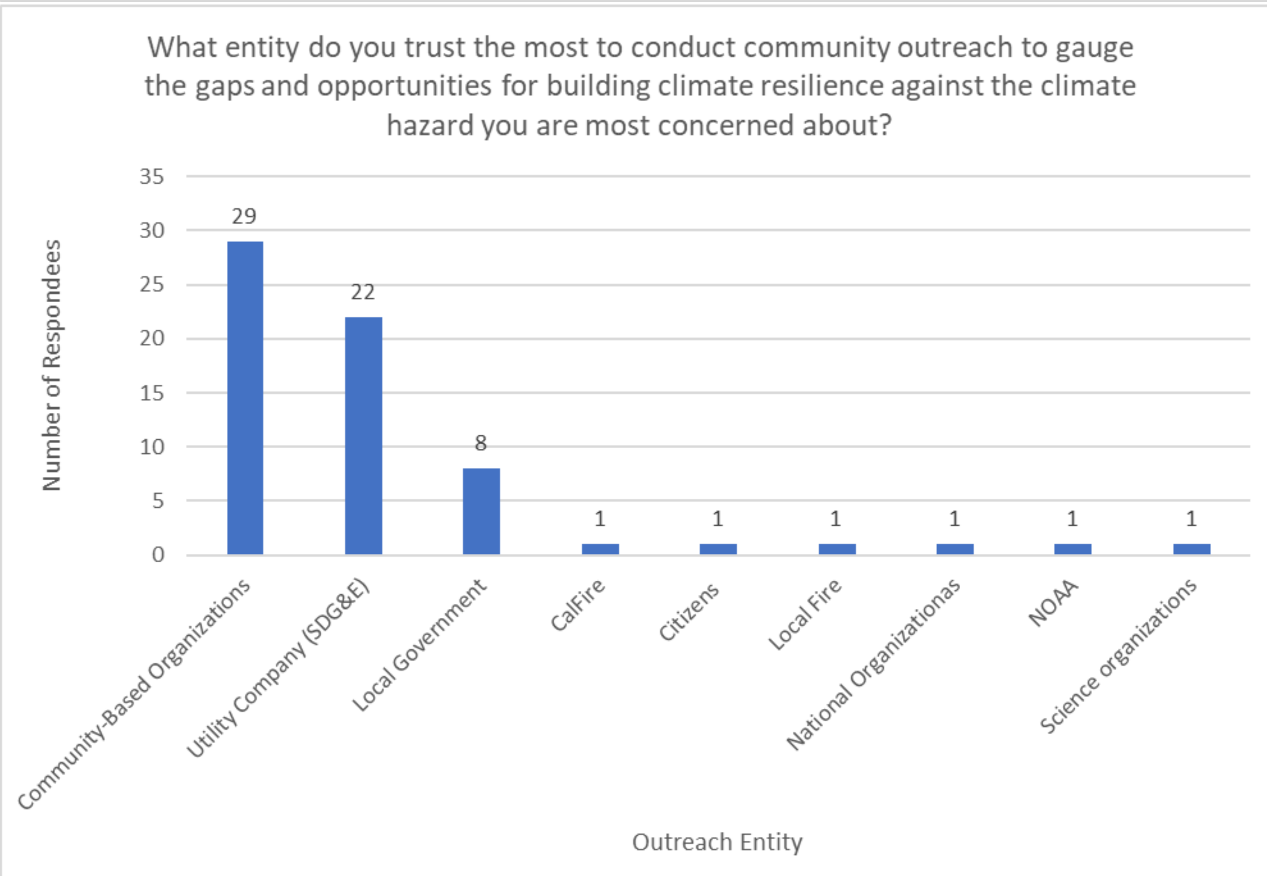

What city, community and/or tribal nation best describes where you live or represent?
Number of Respondees
Location
Chula Vista 11
San Diego 9
Ramona 5
Warner Springs 4
Dulzura 3
Escondido 3
Alpine 2
Jamul 2
Rancho Penasquitos 2
San Clemente 2
Scripps Ranch 2
Valley Center 2
Barrett Junction 1
Clairemont 1
Descanso 1
El Cajon 1
Fallbrook 1
Hidden Meadows 1
Julian 1
La Mesa 1
Ladera Ranch 1
Lakeside 1
Los Patrones 1
Mission Hills 1
National City 1
Oceanside 1
Otay Ranch 1
San Diego Country Estates 1
San Juan Capistrano 1
San Marcos 1
San Pasqual Valley 1
San Ysidro 1
Santa Ysabel 1
South San Diego 1
Trabuco Canyon 1


Are you aware of SDG&E's climate adaptation efforts, including a Climate Vulnerability Assessment and Community Outreach/Education?
Number of Respondees
Level of Awareness
Not at all familiar 37
Somewhat familiar 28
Familiar 5
Very familiar 2


Please rate the following climate hazards from not at all concerning to very concerning:
Number of Respondees
50
45
40
35
30
25
20
15
10
5
0
Very Concerning
Concerning
Somewhat Concerning
Not at all Concerning
Neutral
Level of Concern
Increased & Extreme Heat Days
Wildfire
Sea Level Rise/Coastal Flooding & Erosion
Extreme Precipitation & Stormwater Runoff
Extended Drought Conditions
Air Quality & Increased Pollution


Would you like to be further engaged with SDG&E in their vulnerability assessment and climate adaptation processes?
26
45
No
Yes


What outreach method(s) would be most effective for you and your community?
Number of Responses
45
40
35
30
25
20
15
10
5
0
40
28
27
21
14
5
4
Newsletters
Climate Adaptation website
Social Media
Town Halls/Open House
Webinars
Email
Other
Outreach Method


What entity do you trust the most to conduct community outreach to gauge the gaps and opportunities for building climate resilience against the climate hazard you are most concerned about?
Number of Respondees
35
30
25
20
15
10
5
0
29
22
8
1
1
1
1
1
1
Community-Based Organizations
Utility Company (SDG&E)
Local Government
CalFire
Citizens
Local Fire
National Organizationas
NOAA
Science organizations
Outreach Entity

7.6 Appendix VI – Community Engagement Events & Activities Tracking (Updated)

Event	Date	Location
Survey	5/2/2022	Online
Focus Group	10/19/2022	Virtual
EC3	5/11/2023	Century Park
Viejas Tribal Earth Fair	5/20/2023	Viejas Reservation
Inter-Tribal Long Term Resiliency Fund Breakfast	5/26/2023	Alpine, CA
Wildfire Safety Fair	6/10/2023	Ramona, CA
Wildfire Safety Fair	7/29/2023	Julian, CA
Wildfire Safety Fair	8/26/2023	Valley Center, CA
Climate Readiness Information Session	9/12/2023	Escondido, CA
San Diego Climate Summit	9/20/2023	San Diego, CA
INSY Community Safety Fair	9/23/2023	Santa Ysabel Reservation
Climate Readiness Information Session	10/2/2023	Logan Heights, CA
EV Day	10/14/2023	Snapdragon Stadium, San Diego, CA
Climate Readiness Information Session	11/29/2023	Chula Vista, CA
EC3 Individuals - MAAC	12/1/2023	Virtual
EC3 Individuals - Climate Science Alliance	12/4/2023	Virtual
EC3 Individuals - San Diego Foundation	12/6/2023	Virtual
EC3 Individuals - Casa Familiar	12/11/2023	Virtual
EC3 Individuals - Bayside Community Center	1/16/2024	Virtual
EC3 Individuals - Jacobs Center for Neighborhood Innovation	1/16/2024	Virtual
EC3 Individuals - San Ysidro Health	1/18/2024	Virtual
EC3 Individuals - San Diego Workforce Partnership	1/24/2024	Virtual
EC3	3/4/2024	Virtual

Tribal Working Group	3/7/2024	Rincon Reservation
CEP Webinar #1	3/14/2024	Virtual
SCTCA	3/19/2024	
LV Collaborative	3/19/2024	Linda Vista
CEP Webinar #2	3/20/2024	Virtual
CEP Webinar #3	3/26/2024	Virtual
Climate Readiness Information Session	4/11/2024	El Cajon, CA
DACAG Presentation	4/19/2024	Virtual
Intro w/ La Jolla	5/23/2024	Virtual
EC3	6/21/2024	Virtual
ITLRF Rise Breakfast	7/23/2024	Harrahs Casino
La Semilla Groundbreaking Ceremony	7/31/2024	San Ysidro, CA
EC3	8/22/2024	SDG&E WCRC
Chula Vista Fire Station Open House	10/12/2024	Chula Vista, CA
Mesa Grande 1x1	11/1/2024	Virtual
INSY 1x1	11/4/2024	Virtual
Pala 1x1	11/5/2024	Virtual
Los Coyotes 1x1	11/12/2024	Virtual
EC3	12/4/2024	Virtual
Balboa Park December Nights	12/6/24 & 12/7/24	Balboa Park
South San Diego Climate Adaptation Workshop	12/10/2024	San Ysidro Civic Center
SE San Diego Climate Adaptation Workshop	12/13/2024	Chula Vista, MAAC
Winter Wonderland	12/14/2024	336 Euclid Ave, San Diego, CA
La Jolla 1x1	1/23/2025	Virtual
SDUSC Climate Adaptation Workshop	1/28/2025	Malcolm X Branch Library
San Diego Children's Discovery Museum	1/31/2025	320 N Broadway, Escondido, CA 92025

Public Workshop/EC3	2/12/2025	SDG&E WCRC
Rincon 1x1	2/14/2025	Virtual
Campo 1x1	2/21/2025	Virtual

7.7 Appendix VII – WCRC Outreach and Engagement

The Wildfire & Climate Resilience Center (WCRC) has been leveraged to engage and educate community members on the work SDG&E is doing around extreme weather, climate hazards, emergency preparedness, sustainable energy, and more. The WCRC has provided a platform for subject matter experts in meteorology, climate science, and emergency management to educate community members about the science behind climate hazards and the situational awareness tools SDG&E makes publicly available to increase awareness and transparency. Community members have opportunities to ask questions, share concerns, and collaborate on conversations around mitigating the impacts of climate change. The WCRC is a resource both internally and externally for leaders to share best practices, local agencies to collaborate on preventing, preparing, and responding to emergencies. The WCRC was intentionally designed to promote sustainability, inclusion, and accessibility for a wide range of audiences.

Data from February 2024 - February 2025

WCRC Visitor Stats	
Students	**655**
CBOs	**69**
Emergency Services:	**7**
Government:	**60**
Higher education:	**29**
Industry partners:	**208**
School Groups:	**34**
Stakeholders:	**72**
Tribal Communities:	**10**
Orgs Total:	**489**
Number of Tours:	**206**
Total Visitor Count:	**3100**
External Visitors	**2044**

Figure 79. *School tour of the Resilience Zone*

Outcomes of WCRC Engagement

- Better understanding of what SDG&E does to meet our mission and keep communities safe
- Exposure to the diversity of career opportunities in STEM and at SDG&E
- Understanding of how to prepare for and respond to an emergency
- Increased engagement in conversations around climate change, sustainability, and the future of energy
- Deeper understanding of the effects of climate change
- Understanding of the concept and importance of resilience as it relates to climate, community, and an individual basis

What do student groups experience during an engagement?

- Relying on teamwork to accomplish a goal
- Using critical thinking to solve a problem
- Thinking creatively about large-scale issues
- Envisioning themselves as a scientist/grid operator/drone pilot, etc.
- Understanding how much they are needed for a sustainable future

7.8 Appendix VIII – 2025 Academic Partnerships

University of California San Diego Scripps Institution of Oceanography

SDG&E is working with researchers from Scripps Institution of Oceanography (SIO) at University of California San Diego (UCSD) to help further quantify vulnerability of SDG&E's infrastructure and operations to climate hazards. In particular, UCSD SIO researchers are examining the robustness of heat wave exposure calculations by performing sensitivity analysis of the results with different heatwave definitions (e.g., using heat index instead of air temperature) using the LOCA2-CA dataset. In addition, this project examines the CMIP6-based projected changes to low-level marine layer clouds near the coastline and synoptic-scale atmospheric patterns that are typically associated with high-impact extreme weather systems.

San Jose State University

SDG&E is working with researchers from Department of Meteorology and Climate Science at SJSU to help further quantify vulnerability of SDG&E's infrastructure and operations to climate hazards. In particular, SJSU researchers are examining the robustness of wildfire exposure by calculating the National Fire Danger Rating System (NFDRS) that is being widely used across the U.S. to support operational fire decision making process. In addition, SJSU researchers are developing new live fuel moisture content (LFMC) tools to better assess fire danger in the SDG&E service territory using various high-resolution satellite products.

Argonne National Laboratory

SDG&E is working with researchers at Argonne National Laboratory of the United States Department of Energy to help further quantify vulnerability of SDG&E's infrastructure and operations to climate hazards. In particular, Argonne researchers are examining the robustness of heatwave and wildfire exposure across the SDG&E service territory with their CMIP6-based Argonne Downscaled Data Archive version 2 (ADDAv2) that covers the entire North America continent and surrounding oceans with horizontal grid spacing of 4 km.

University of California San Diego Center for Western Weather and Water Extremes

The Center for Western Weather and Water Extremes (CW3E) at University of California San Diego Scripps Institution of Oceanography runs a version of the Weather Research and Forecast (WRF) model that has been optimized for extreme weather prediction in the Western U.S., called *West-WRF*. This West-WRF forecasting system currently includes a 200-member 7-day forecast ensemble that runs at 9 km horizontal grid spacing daily around the Pacific Coast wet season (October-March) and generates ensemble forecast products tailored for SDG&E operational decision support to identify potential hazards such as Santa Ana winds and heavy rainfall events. Due to the large number of members, the West-WRF ensemble can better represent the distribution of physically plausible weather forecast outcomes, capturing the probability of extreme events. The CW3E West-WRF system presents an opportunity to investigate potential improvements to fire weather forecasting by accounting for model uncertainty via a large ensemble. Output from the ensemble can be used to provide SDG&E with probabilistic forecast information about key meteorological variables associated with wildfire conditions.

University of Wisconsin Madison Space Science and Engineering Center

The Space Science and Engineering Center (SSEC) at University of Wisconsin Madison is a world-class archive of satellite data, receiving, archiving, and redistributing most geostationary weather satellite data produced globally. SSEC and SDG&E have partnered to increase situational awareness of wildfire ignitions in the service territory. Utilizing the Geostationary Operational Environmental Satellites (GOES-18/19) with the Advanced Baseline Imager (ABI), has enabled fire detection and characterization at 2 km spatial resolution and temporal resolutions of five minutes and in some circumstances one minute or faster. Fire Detection and Characterization (FDC) is accomplished with the Wildfire Automated Biomass Burning Algorithm (WFABBA) adopted for ABI-class sensors. Hotspots are rated in six fire categories based on confidence in the Fire Radiative Power (FRP), size, and temperature estimates, and are subsequently archived at the San Diego Supercomputer Center (SDSC). Registered users receive an email with a link that leads to a map of the area with camera images auto triangulated on the fire.

San Diego Supercomputer Center

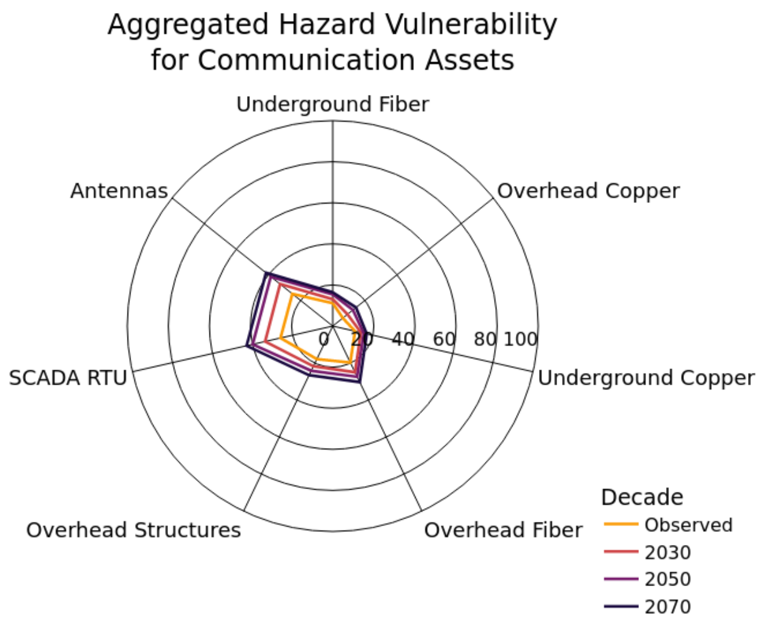
San Diego Supercomputer Center (SDSC) ingests and stores SDG&E datasets for weather forecasts, fire potential index and fuels to enable findability and accessibility of these datasets for various stakeholders through web services and visual maps. All output from the SDG&E's Weather Research and Forecasting model (WRF) is archived daily on a publicly available platform. Application Programming Interfaces enable time range or geolocation and tagged metadata-based querying as well as grouping and subsetting of datasets for context-driven use by authorized users. The map services have enabled layering of these datasets for use in fire modeling. The project maintains a server at SDSC for data access along with data storage capabilities stored at SDSC and back up storage on Amazon Cloud.

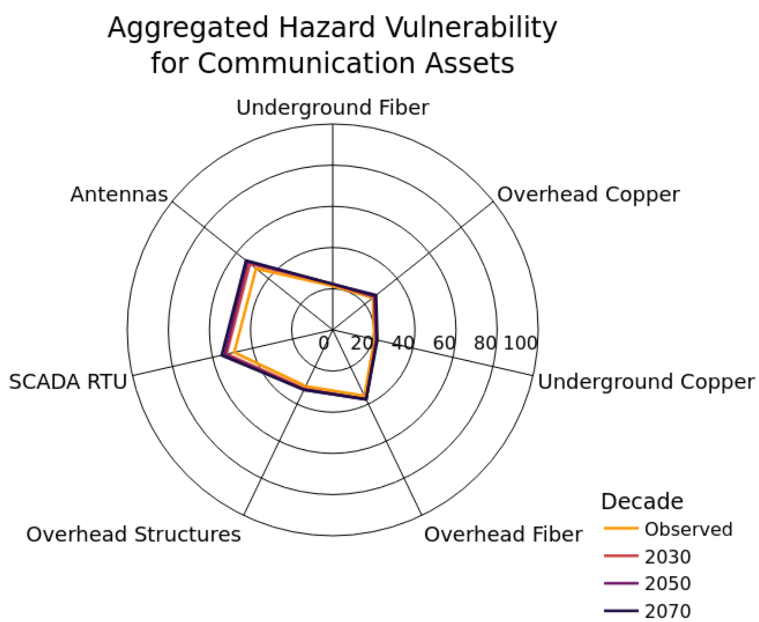
7.9 Appendix IX – Aggregated Vulnerability

Communication Assets:

SCADA RTU and Antenna assets result in the highest aggregate vulnerability and are projected to have the most significant rise in vulnerability for all time horizons when compared to the observed timeframe. While not the most vulnerable, overhead copper and fiber aggregate vulnerability scores are projected to increase in 2030, double by 2050, and remain relatively stable by 2070.

Figure 80. *Aggregate vulnerabilities for communication assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

<table>
<tr>
<td>Medium (time-P50)</td>
<td>


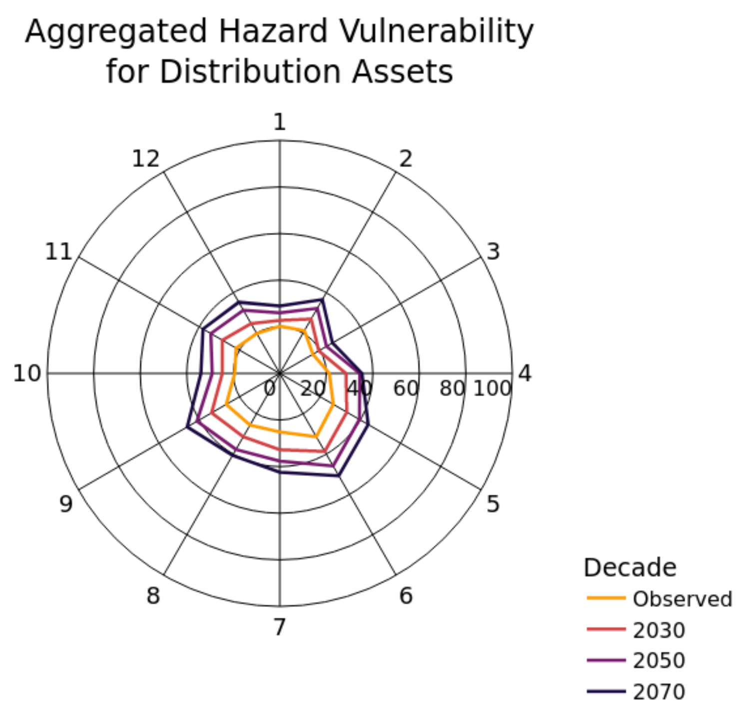
</td>
</tr>
<tr>
<td>Extreme (time-P95)</td>
<td>


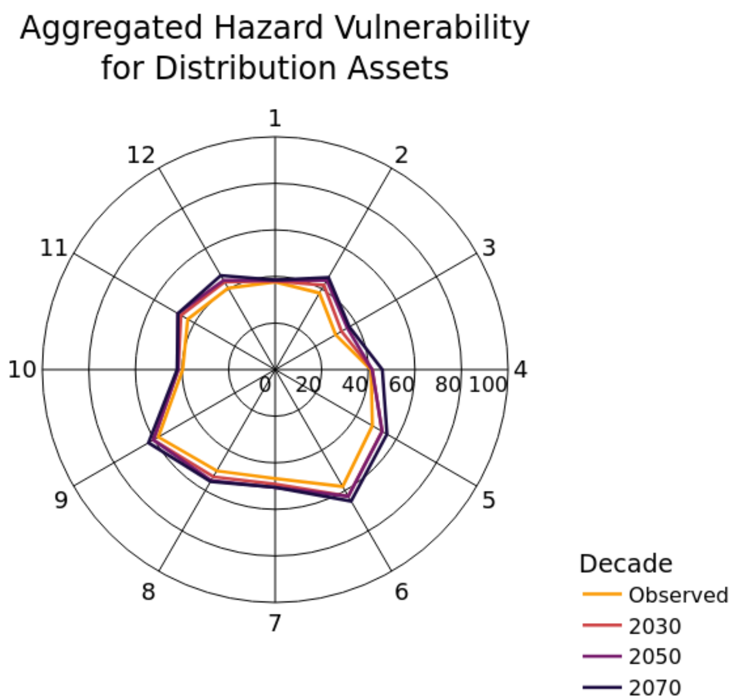
</td>
</tr>
</table>

Distribution Assets:

Pad-mounted transformers and switches have the highest aggregate vulnerability scores, followed closely by overhead transformers, voltage regulators and dynamic protection devices. All assets increase in aggregate vulnerability score by 2030, approximately double by 2050, and remain stable or increase slightly towards 2070.

Figure 81. *Aggregate vulnerabilities for distribution assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

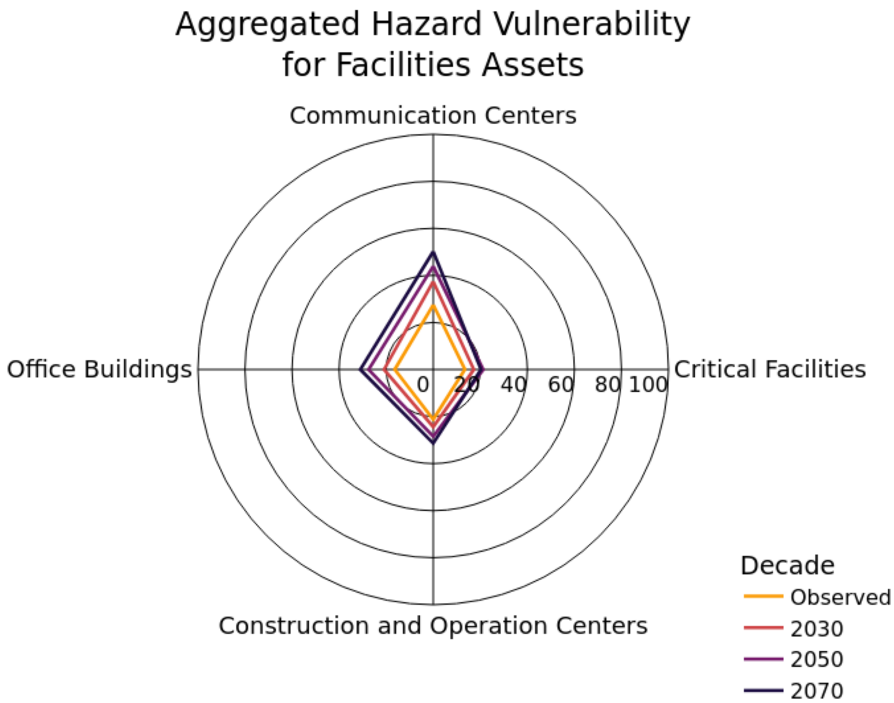
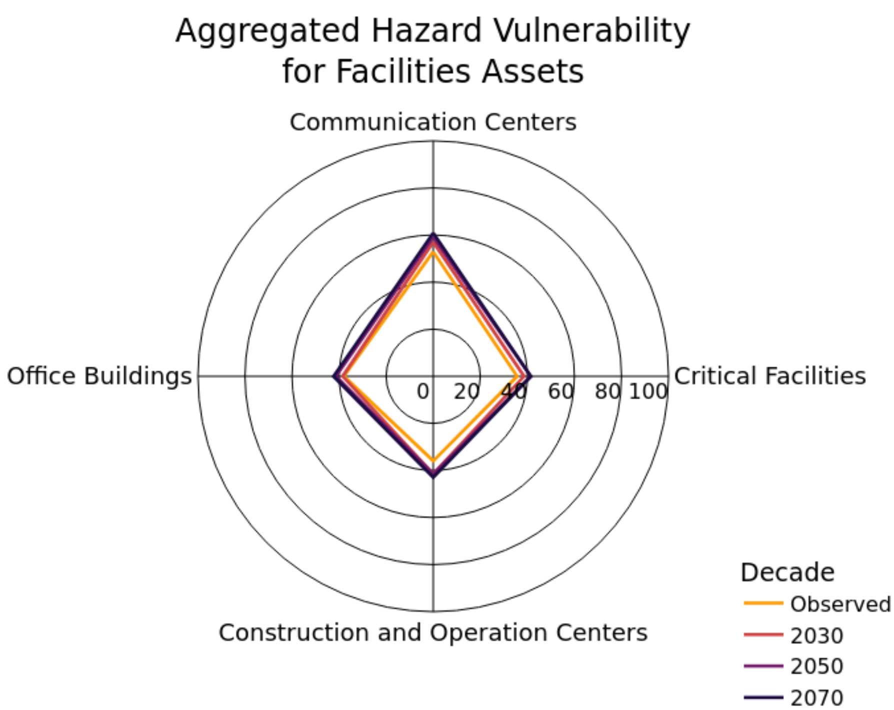
Medium (time-P50)	

Extreme (time-P95)	
Asset Legend: 1 – Overhead Structures 2 – Overhead Conductor 3 – Underground Conductor 4 – Underground Transformer 5 – Overhead Transformer 6 – Padmount Transformer 7 – Voltage Regulator 8 – Dynamic Protection Devices 9 – Padmount Switch 10 – Underground switch 11 – Overhead switch 12 – Distribution Capacitors	

Facilities Assets:

Communication Center assets result in the highest aggregate vulnerability and are projected to experience the most significant rise in vulnerability through all time horizons. Other facility assets are also projected to increase through all time frames. Under time-P50, there is a slight increase by 2030, nearly double in score by 2050 from the observed timeframe, and a slight increase between 2050 and 2070. Under time-P95, the vulnerability increases slightly through time horizons.

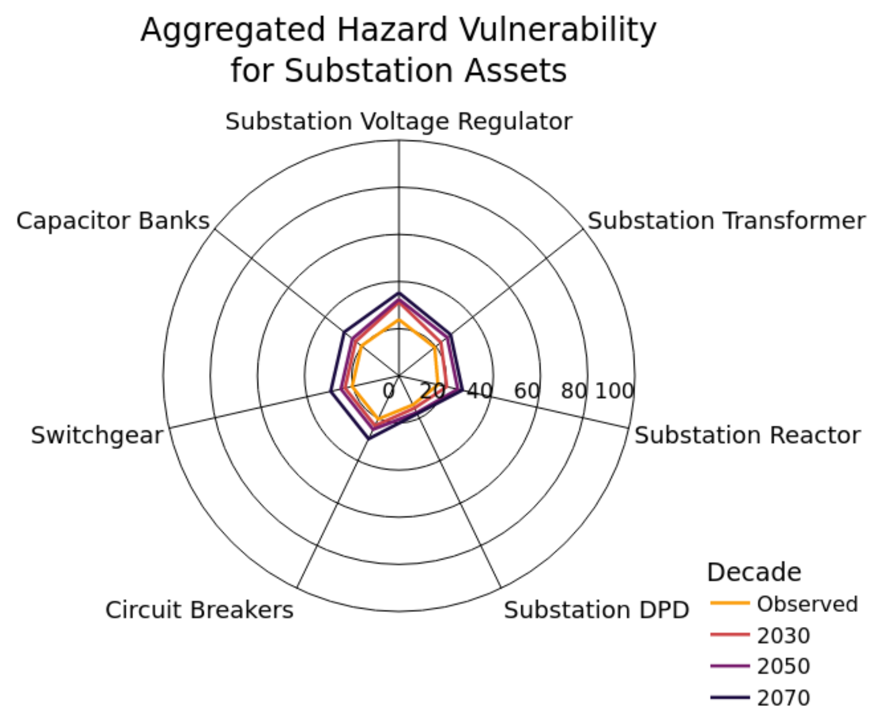
Figure 82. *Aggregate vulnerabilities for facility assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

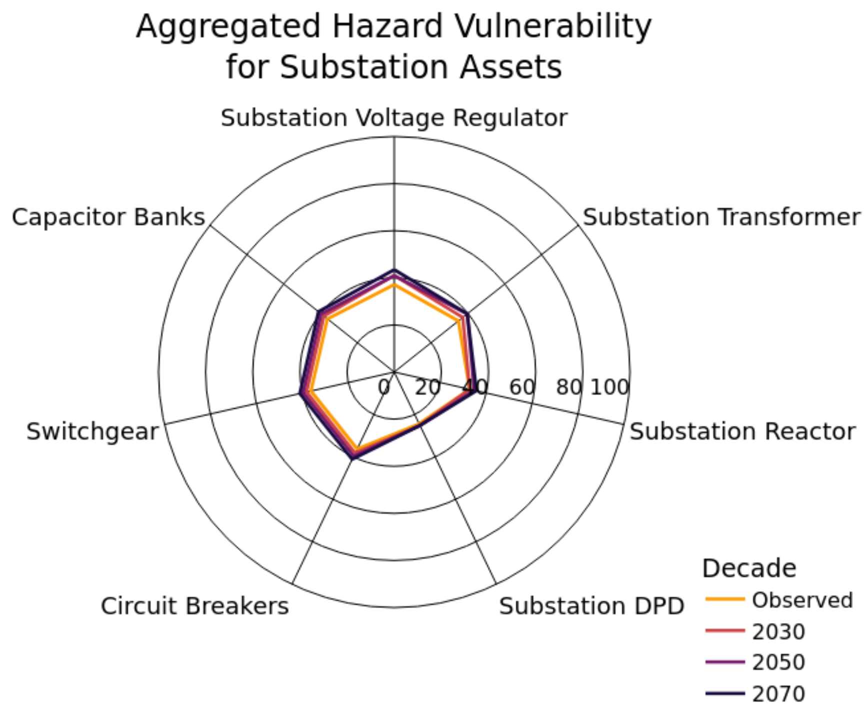
Medium (time-P50)	
Extreme (time-P95)	

Substation Assets:

Substation voltage reactors result in the highest aggregate vulnerability and have the highest increase in vulnerability by 2070. Substation Dynamic Protective Devices (DPD) experience the lowest rise in vulnerability across all time horizons, while the remaining substation asset types experience similar vulnerabilities and rises in vulnerability through 2030, 2050, and 2070.

Figure 83. *Aggregate vulnerabilities for substation assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

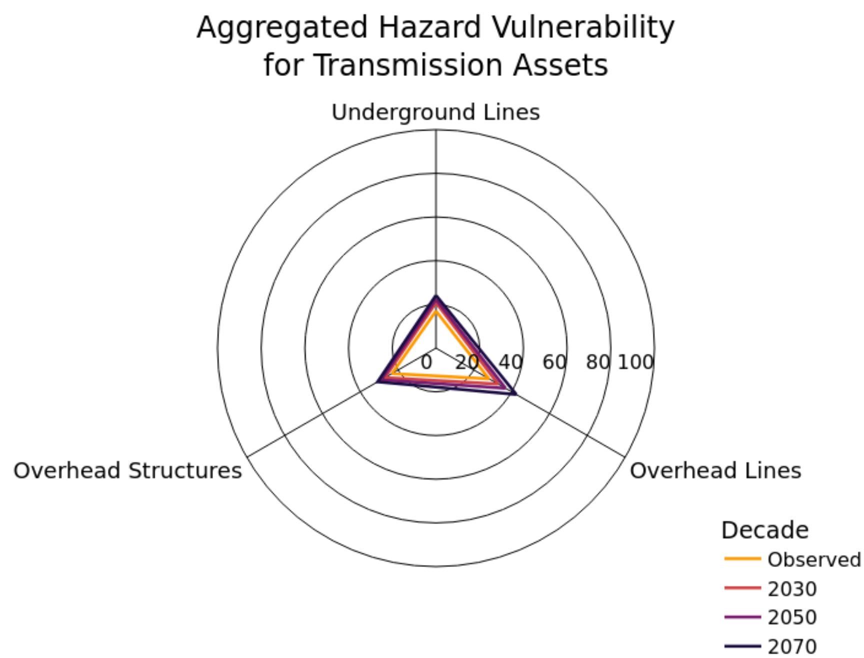
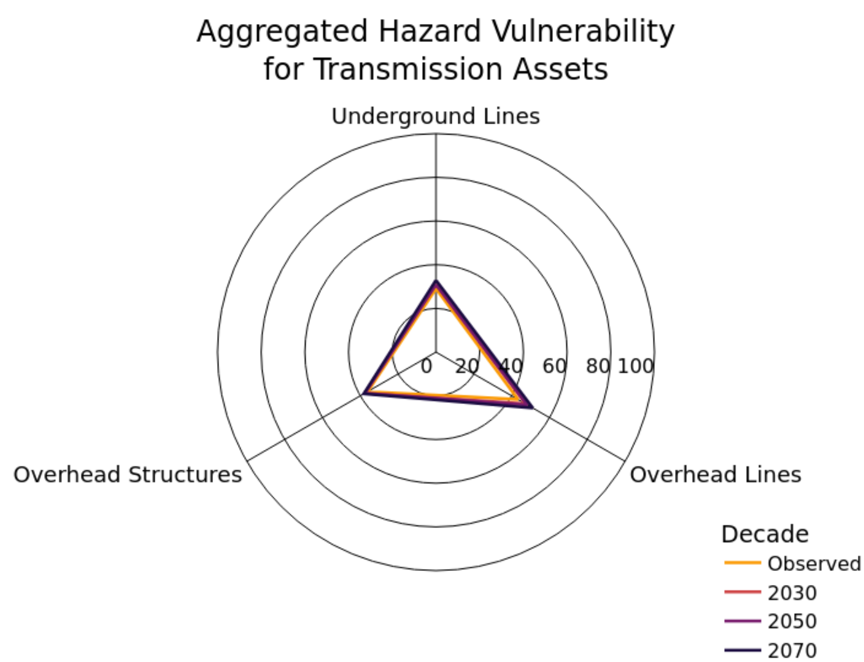
Medium (time-P50)	

Extreme (time-P95)	

Transmission Assets:

Transmission overhead line assets result in the highest aggregate vulnerability. Under time-P50, there is a gradual increase in vulnerability, increasing by five, ten, and fifteen points by 2030, 2050 and 2070, respectively. Under time-P95, there is a twenty point increase by 2030 and remains stable through 2050 and 2070. Underground lines are projected to have minimal increase in vulnerability throughout all time horizons when compared to the observed timeframe. Overhead structures have minimal increase in vulnerability throughout all time horizons under time-P50. Under time-P95, aggregate vulnerability is higher than time-P50, but remains stable through all time horizons.

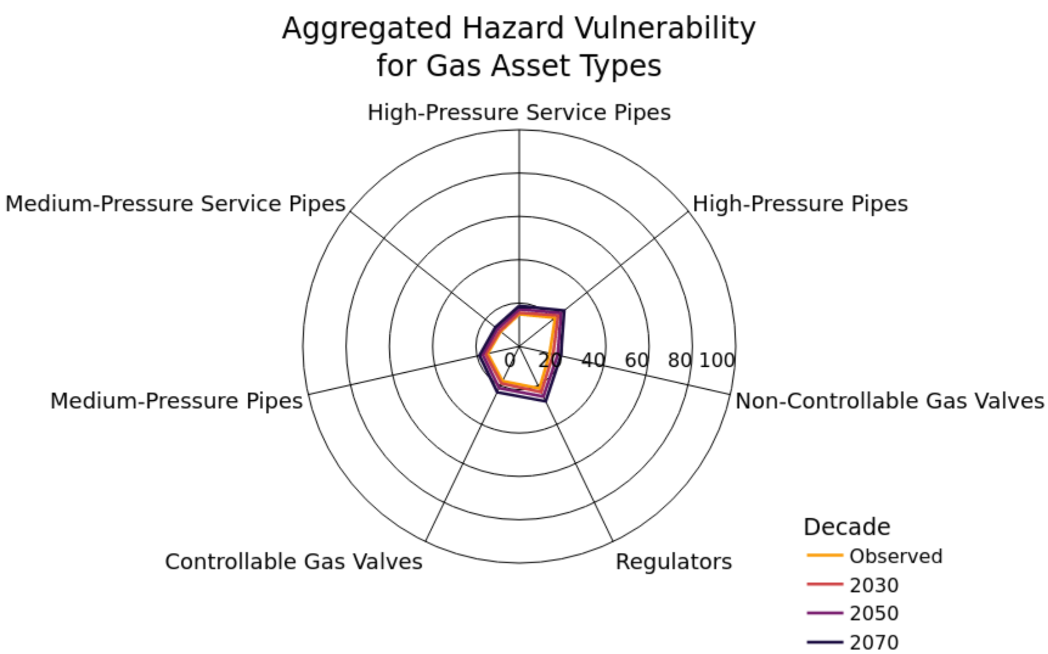
Figure 84. *Aggregate vulnerabilities for transmission assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

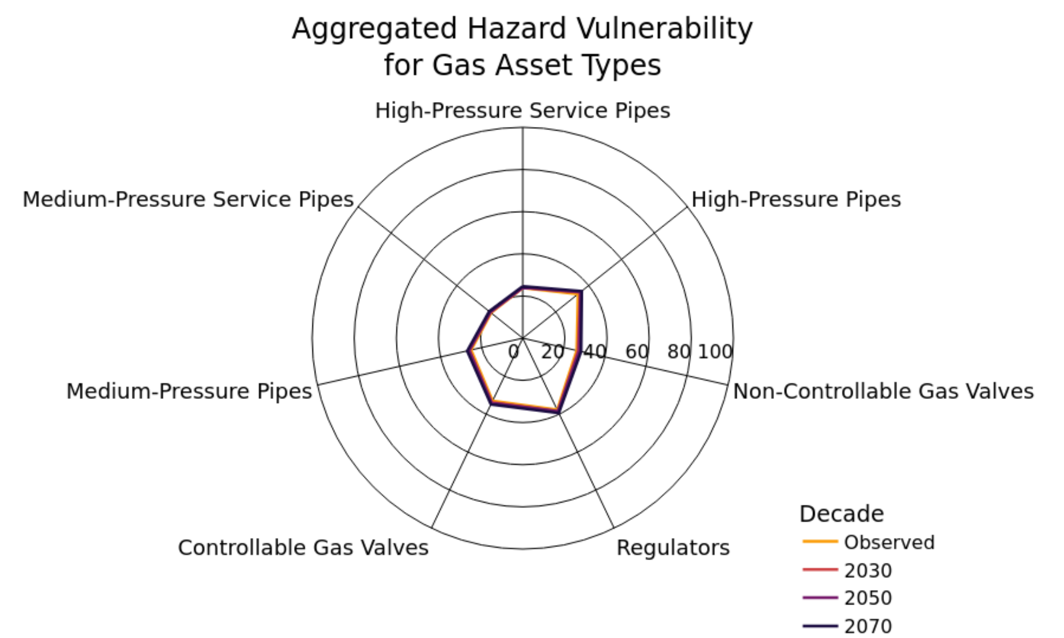
Medium (time-P50)	
Extreme (time-P95)	

Gas Asset Summary (All Types):

Regulator assets have the highest aggregated vulnerability, followed by high pressure pipes, and controllable gas valves. By 2030, regulators have the highest aggregated vulnerability, with controllable gas valves experiencing the most significant increase in aggregated vulnerability from observed conditions, with these trends remaining consistent through 2070. The increase in vulnerability is less apparent for all assets under time-P95. The highest vulnerability is for controllable gas valves and regulators, remaining relatively stable through all time horizons.

Figure 85. *Aggregate vulnerabilities for gas assets for 20-year time 50th and 95th percentile (time-P50 and time-P95) and the plots use SSP3-7.0 50th percentile (model-P50).*

Medium (time-P50)	

Extreme (time-P95)	

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starting with a 2015 center-year (2005-2024) and ending with a 2090 center-year (2080-2099) to reduce the effects of natural climate variability, such as the El-Niño Southern Oscillation.

[26] Coastal is made of CAZ043 (San Diego County Coastal Areas) and CAZ552 (Orange County Coastal), and Inland is made of CAZ050 (San Diego County Inland Valleys), CAZ554 (Orange County Inland), and CAZ057 (Santa Ana Mountains and Foothills). Mountain is made of CAZ058 (San Diego County Mountains), and Desert is made of CAZ062 (San Diego County Deserts).

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[34] Asset critical facilities not to be confused with Community critical facilities used in the creation of the Community Vulnerability Index (CVI).

[35] SDG&E Risk And Mitigation Phase, Cross Functional Factor, Asset Management, 5/2021

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[41] To improve quantifying vulnerabilities of the SDG&E's infrastructure and operations, incorporation of intensity-duration-frequency (IDF) curves into the extreme heat exposure methodology will be explored for the next SDG&E CAVA process, as IDF-based analysis could reveal important shifts from the baseline during the future years.

[42] For example, IEEE C57.91, C57.12 and C57.15 are used for transformers, reactors, and voltage regulators.

[43] As described **in 3.1.1.3 Adaptive Capacity, SDG&**E scored operational maturity from 0 to 5 by assessing five topics associated with resilience practices. Across each of these topics, the operations and services received a score of 0 to 1, with 1 representing a high compliance with the resilience practice. Operational maturity is used as a proxy for operational sensitivity to derive operational vulnerability.

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[48] As described in **3.1.1.3 Adaptive Capacity**, SDG&E scored operational maturity from 0 to 5 by assessing five topics associated with resilience practices. Across each of these topics, the operations and services received a score of 0 to 1, with 1 representing a high compliance with the resilience practice. Operational maturity is used as a proxy for operational sensitivity to derive operational vulnerability.

[49] To improve quantifying vulnerabilities of the SDG&E's infrastructure and operations, incorporation of intensity-duration-frequency (IDF) curves into the precipitation/inland flooding exposure methodology will be explored for the next SDG&E CAVA process, as IDF-based analysis could reveal important shifts from the baseline during the future years.

[50] As discussed by Sanders et al. (2024), the inland flooding exposure methodology adopted for the current SDG&E CAVA may be a bit oversimplified. The potential for using physics-based modeling approach, which has shown the higher accuracy of reproducing previous flooding events, will be explored for the next SDG&E CAVA analysis. Sanders, B. F., Wing, O. E.

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[51] As discussed by Sanders et al. (2024), the coastal flooding exposure methodology adopted for the current SDG&E CAVA may be a bit oversimplified. The potential for using physics-based modeling approach, which has shown the higher accuracy of reproducing previous flooding events, will be explored for the next SDG&E CAVA analysis. Sanders, B. F., Wing, O. E. J., & Bates, P. D. (2024). Flooding is not like filling a bath. Earth's Future, 12, e2024EF005164. https://doi.org/10.1029/2024EF005164

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[53] To help quantify uncertainty in the projections, two types of percentiles are typically calculated in the analysis – across time/year dimension within the 20-year bands and across different GCM model dimension. To help differentiate these different percentile types, the percentiles along the time/year dimension within the 20-year bands will be referred to as time-P (for example, time-P50 and time-P95 for the 50th and 95th percentiles). The percentiles along the GCM model dimension will be referred to as model-P (for example, model-P50 and model-P90 for the 50th and 90th percentiles). Please see Section 3.1.1.1

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[93] A total of 25 indicators are used in the CVI. 23 indicators come from the DVC (21 indicators from CalEnviroScreen 4.0 + 60% median household income + tribal land) and two additional SDG&E specific indicators are added to address AFN customers and availability and proximity of critical infrastructure. California Office of Environmental Health Hazard Assessment. *CalEnviroScreen 4.0 Report*. Sacramento, CA: California Environmental Protection Agency, October 2021, p. 21. Available at: https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf.

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[103] The National Weather Service (NWS) heat index, as discussed in https://www.weather.gov/media/ffc/ta_htindx.PDF, is used, which has been formulated mostly for temperatures of 80 °F or higher and relative humidity greater than 40%. Alternative formulations that work across wider temperature and humidity ranges will be explored.
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[109] Based on the CalEnviroScreen 4.0 methodology, when the original indictor was constructed using population-based metrics the downscaling also used population-based downscaling.
[110] It is important to note that the full number of hexbins with the SDG&E service area is 12,977. However, when looking at differences between ACS 2010 and 2020 census tracts, we lose 1 census tract, and as a result, also lose one of our hexbins.
[111] 'Tribal lands' encompasses all California tribal lands, including federally recognized tribes, tribes on the contact list maintained by the Native American Heritage Commission, and other California tribal entities. California Public Utilities Commission. *Decision Adopting The Societal Cost Test (R.22-11-013).* 15 July 2024, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M521/K660/521660266.PDF.