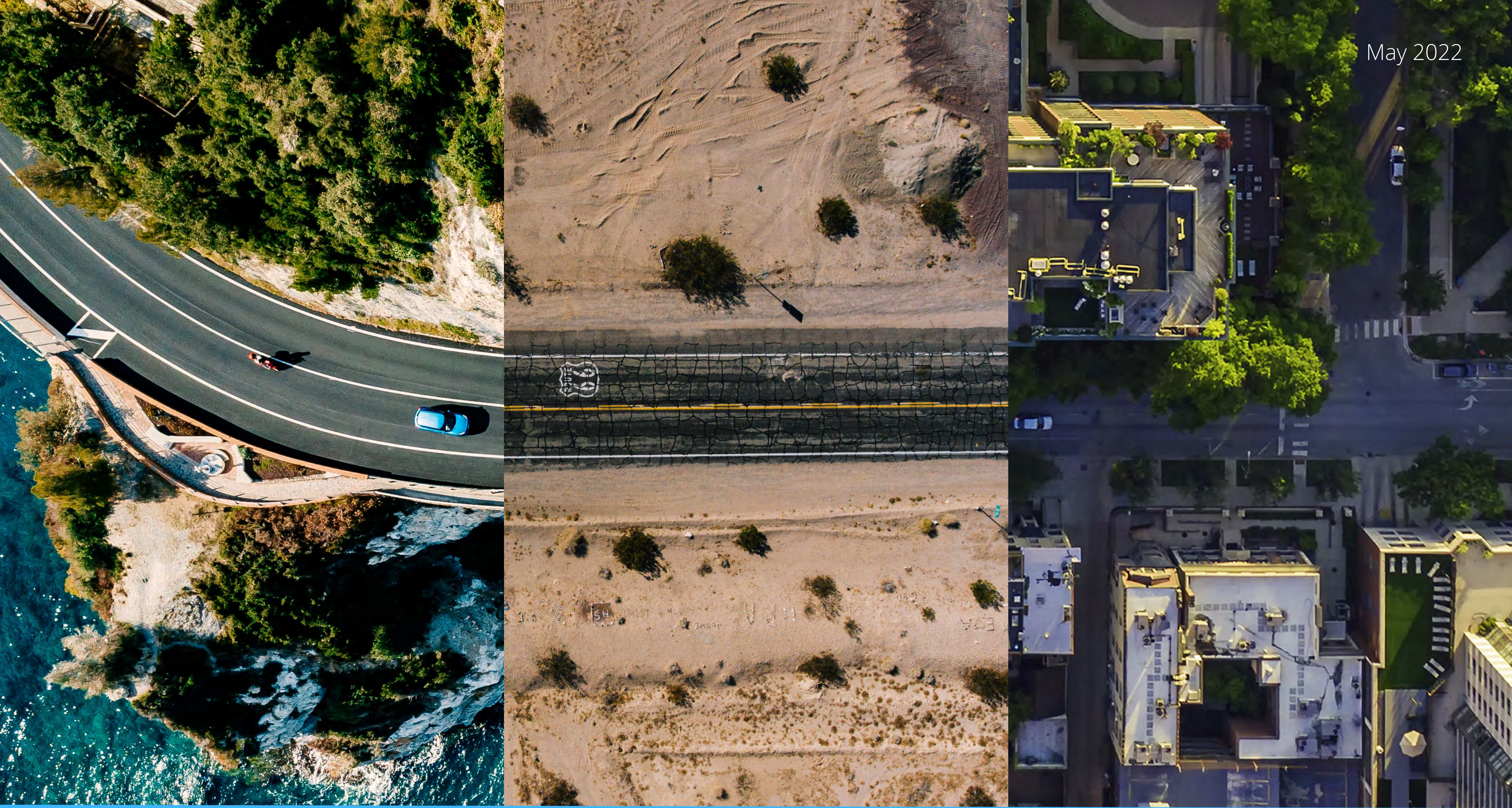
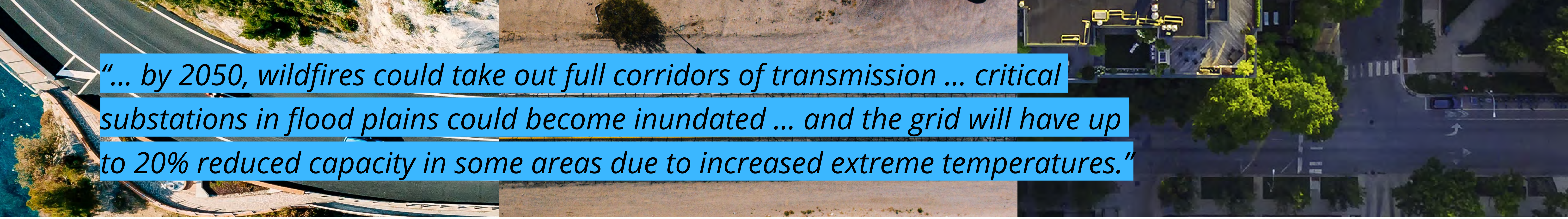
May 2022



EDISON INTERNATIONAL®

ADAPTING FOR TOMORROW

POWERING A RESILIENT FUTURE



"… by 2050, wildfires could take out full corridors of transmission … critical substations in flood plains could become inundated … and the grid will have up to 20% reduced capacity in some areas due to increased extreme temperatures."

EXECUTIVE SUMMARY

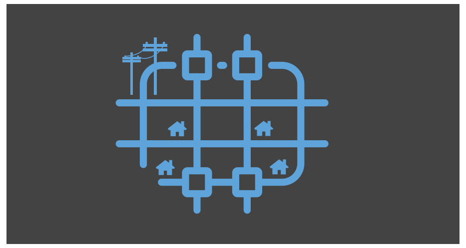
Climate change is a societal issue, and the failure to adapt poses severe consequences to public health, safety and finances.[1] The recently released Sixth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Impacts, Adaptation and Vulnerability*, found that increases in the frequency and intensity of climate and weather extremes around the world already have had widespread, pervasive impacts on ecosystems, people, settlements and infrastructure.[2] The cost of inaction is greater than the cost of action. If we do not rapidly decrease GHG emissions by midcentury, large parts of our planet will become uninhabitable and 10% of total economic value will be lost.[3,4]

The electrical grid is critical infrastructure that powers our communities. It is imperative in California and around the world to have a grid that adapts and responds to climate change, both to provide resiliency and reliability, and to achieve the carbon neutrality that will help slow the rate of climate change.

Southern California Edison recently completed a detailed climate adaptation vulnerability assessment (CAVA) on assets, operations and services throughout our 50,000-square-mile service area.[i] The chief conclusions are that, by 2050, wildfires could take out full corridors of transmission, leaving large swaths of customers without service for long periods; critical substations in flood plains could become inundated due to more extreme precipitation events; and the grid could have up to 20% reduced capacity in some areas due to increased extreme temperatures. To meet this new reality, infrastructure must be designed to withstand more intense storm surges and flooding, and new transmission lines must be constructed to bolster regional reliability under more severe wildfire conditions.

i. The SCE climate adaptation vulnerability assessment was filed with the California Public Utilities Commission on May 13, 2022 and is available at https://www.sce.com/about-us/environment/climate-adaptation.

KEY FINDINGS DEMAND URGENT ACTION:



PLANNING: Today, electric grid design standards and planning practices used at SCE and throughout the industry are based on historical climate data, underestimating future conditions and associated risks. Future climate states must be incorporated into planning processes to appropriately address chronic and acute climate risks, especially those related to long-lived assets and systems. Additionally, utility planning horizons should be extended from the typical timeframe of 10 years or less to at least 20 years, so investments in the near term can help address climate change risks in the long term.

INVESTMENT: Climate adaptation investments are needed now. No-regrets foundational measures need to be developed and funded in the near term with the understanding that more significant investments will be required in the next 10 to 20 years. The cost to invest now is far less than the cost of inaction and will help hedge against the uncertainty society faces in the future.

PARTNERSHIPS: Significant collaboration among communities, local and regional planning authorities, and governments is required to address the interdependencies of critical infrastructures; perform cross-sector resiliency planning to take care of disadvantaged, climate-vulnerable communities; and minimize societal adaptation costs.

At Edison International, we are committed to doing our part to safely meet the energy resiliency needs of customers and communities and, as we laid out in Pathway 2045, to lead the way to a cleaner and carbon-free California and U.S. We call on all our public, industry and community partners to join us now in the work of adapting to the changing climate.

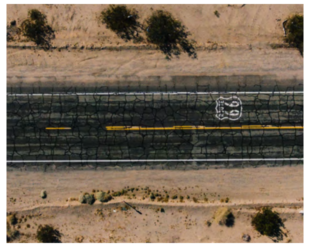
2050 CLIMATE EXPOSURE TRENDS AND POTENTIAL IMPACTS ON THE ELECTRICAL SYSTEM

AVERAGE TEMPERATURE

5°F projected increase relative to historical averages

AVERAGE TEMPERATURE IMPACTS

- Existing infrastructure will become less efficient, especially inland, resulting in reduced capacity on lines and higher losses in transformers
- Useful life of assets will decrease due to increased exposure and usage



EXTREME HEAT

7X more likely, on average, for SCE service area to experience temperatures as hot as or hotter than the historical 99th percentile temperature

EXTREME HEAT IMPACTS

- Worker safety standards will need to account for heat
- Peak load could increase significantly
- Equipment will not cool overnight during intense heat waves, reducing capacity and useful life of some equipment

PRECIPITATION

40% projected decline in snowpack and more variable year-to-year precipitation with more intense drought and fewer, more intense precipitation events

PRECIPITATION IMPACTS

- Infrastructure will need to be designed to withstand more intense storm surges and flooding
- Hydroelectric generation could become less reliable if the current drought continues or in the event of future prolonged droughts

WILDFIRE

23% more land projected to burn during summer fuel-driven wildfires and wildfire season is expected to become longer

WILDFIRE IMPACTS

- Conditions will be more conducive to wildfire ignition and spread
- Impacted service centers may not be able to operate or perform key functions during wildfires or droughts

SEA LEVEL

2.6 feet projected sea level rise relative to the year 2000

SEA LEVEL IMPACTS

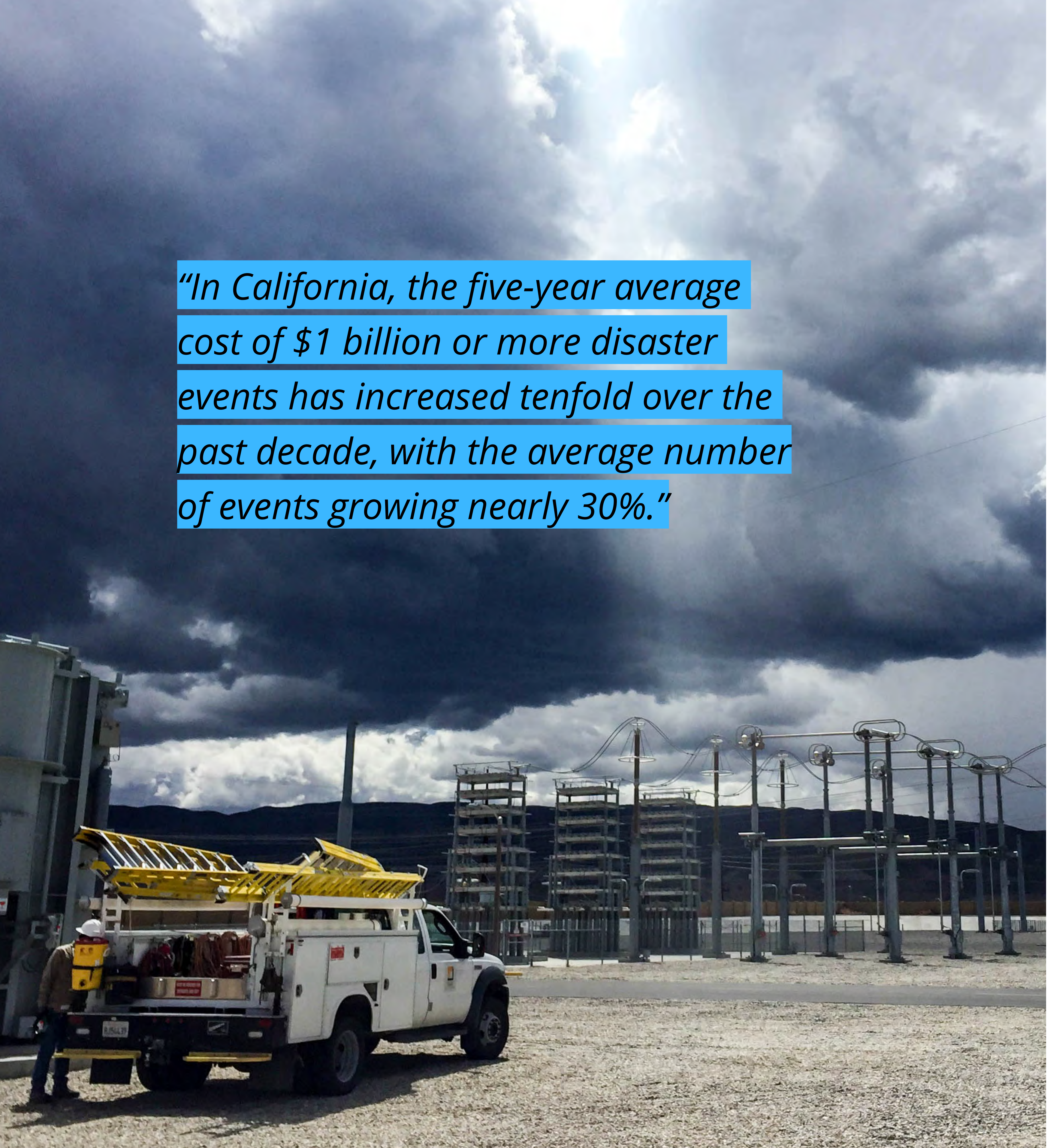
- Infrastructure and communities in some coastal areas will be at higher risk of flooding

CASCADING EVENTS

A range of high-impact, low-probability events can occur from the interaction between exposure variables such as post-fire mudslides (debris flow) and rain-on-snow events

CASCADING EVENTS IMPACTS

- Communities in or near high fire risk areas could be exposed to increased landslide risk
- Hydroelectric planners need to account for early snowmelt and extreme runoff



OVERVIEW

Identifying and mitigating climate vulnerabilities across communities is increasingly urgent. The impacts of climate-related events are alarming, and the costs are increasing. For example, more than one-third of costs related to billion-dollar-plus disaster events over the previous 42 years were incurred in the last five years[ii], and 2021 was the seventh consecutive year in which 10 or more billion-dollar weather and climate disaster events have affected the U.S.[5] Potentially even more alarming, in 2021 from a human and community perspective, more than 40% of Americans lived in counties impacted by a climate-related disaster.[6]

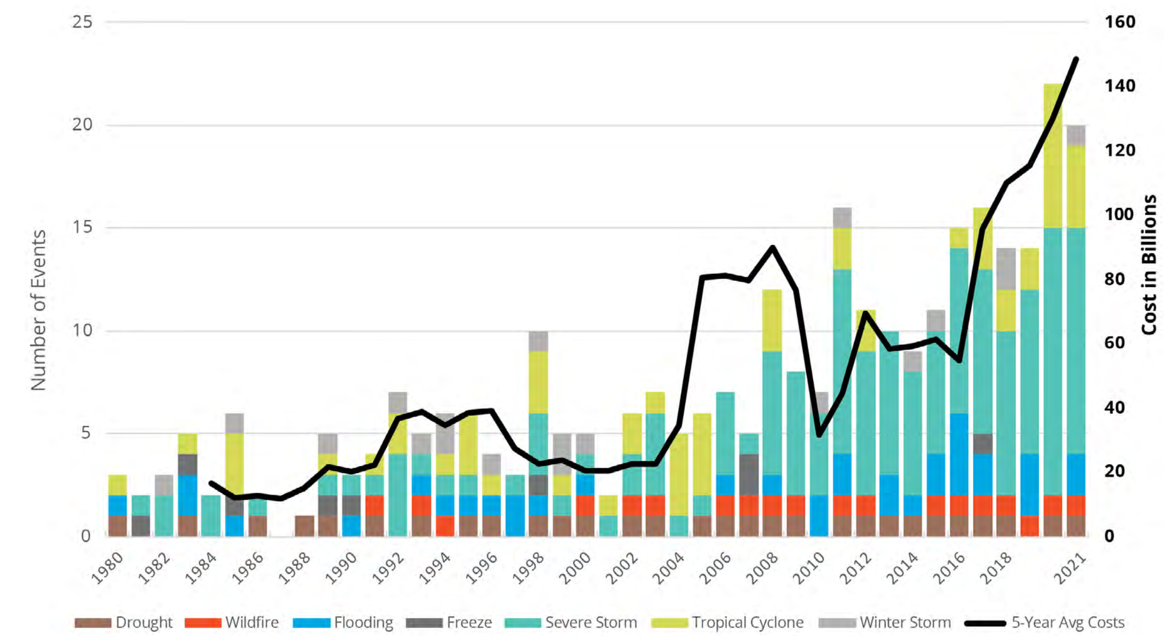


Figure 1: U.S. Billion-Dollar Disaster Events 1980-2021 (CPI Adjusted)

Studies have investigated the intensity of recent extreme weather events to determine the impact human-caused climate change has had on damages. For example, $8 billion of the $60 billion of damages from Superstorm Sandy from Florida to Maine was linked to climate-related sea level rise.[8] In addition, the Pacific Northwest 2021 heat wave was determined to be almost impossible without the influence of human-caused climate change.[9]

Looking into the future, a first-of-its-kind analysis released recently by the White House’s Office of Management and Budget estimated that, under current policy pathways, climate change could reduce U.S. GDP by 3% to 10% by the end of this century with an annual federal revenue loss of 7.1%[iii] at the upper end of the range.[10] Specific to the electric sector, a recent McKinsey study projects costs for 10 large power utilities in seven states where hurricanes are common. Their conservative analysis projects the cost of damages and lost revenues would rise by 23%, or $300 million, in economic damage for each utility by 2050 due to climate change.[11]

In California, the five-year average cost of $1 billion or more disaster events has increased tenfold over the past decade, with the average number of events growing nearly 30%.[12] In addition, California’s Fourth Climate Change Assessment shows statewide costs associated with direct climate impacts by 2050 in the order of tens of billions of dollars, with these direct costs likely multiplying as the rate of climate change accelerates.[13]

ii. NOAA’s U.S. Billion-Dollar Weather and Climate Disasters cost data shows total costs of $742 billion for years 2017-2021.
iii. In today’s dollars, this equals $2 trillion per year.

Over the past decade, climate adaptation has emerged as a critical topic at the federal level,[14, iv] in California's state government[15] and in some regional and local jurisdictions.[16] However, due primarily to knowledge gaps and lack of funding, many communities are lagging in identifying climate vulnerabilities and taking appropriate adaptive measures. Although mandated, 40% of counties (six out of 15) and only 25% of cities (52 out of 206) in SCE's service area have integrated climate adaptation plans into their general safety plans or developed a standalone resilience plan that includes climate adaptation.[17] Climate change is a societal issue, and the failure to adapt poses severe consequences to public health, safety and finances.[18]

The electric grid not only makes modern society function, but is a critical enabler for civilization to reach carbon neutrality by midcentury through decarbonization of the power supply and electrification of other sectors. With electricity becoming increasingly important, climate adaptation of the electric grid is required to provide reliability and resilience to better serve and power our communities in a changing climate. Moreover, if society does not move fast enough to decarbonize or the speed of onset of climate hazards is faster than expected, the need for more significant adaptations will increase. Making adaptation investment decisions now will help hedge against the uncertainty society faces in the future.

Coordinated adaptation among local and regional governments, communities and infrastructure providers is essential to minimize societal costs to reliably and resiliently meet society's decarbonization goals and adapt to the imminent impacts of climate change. Timeliness of action and alignment between public and private stakeholders on adaptation goals will help to minimize redundancy and prioritize areas of focus in promoting affordability and equity across communities.

iv. In 2015 and 2016, the U.S. Department of Energy (DOE) established the Partnership for Energy Sector Climate Resilience. Seventeen electric utilities, including SCE, serving approximately 25% of electricity customers in the U.S., conducted high-level climate vulnerability assessments to help advance resilience planning and adaptation across the industry.

EDISON INTERNATIONAL AND SCE: INVESTING TODAY IN A RESILIENT FUTURE

Since 2018, SCE has been adapting to climate change through system hardening to reduce wildfire risk. Today, SCE invests over $5 billion annually to maintain, upgrade and harden its system. By the end of 2021, SCE reduced present-day catastrophic wildfire risk by 65%-70% compared to pre-2018 estimates, and by the end of 2022, SCE will have hardened about 40% of its overhead distribution infrastructure in high fire risk areas.

Edison International is investing in climate resiliency through community engagement and partnerships. Our Corporate Philanthropy program has supported Climate Resolve's Ready for Tomorrow Program since 2018. In addition, SCE was a founding member of the California Resilience Challenge, which awards grants to local governments, tribes and community-based organizations in underserved communities for climate adaptation projects that address wildfire, high heat, drought and flooding.

"Making adaptation investment decisions now will help hedge against the uncertainty society faces in the future."

METHODOLOGY

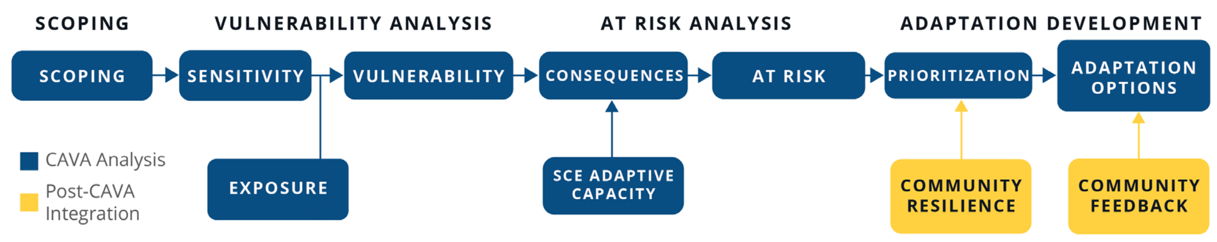


Figure 2: Climate Adaptation Vulnerability Assessment Flow Chart

In 2019, the CPUC issued a decision in the Climate Adaptation Order Instituting Rulemaking (OIR) requiring investor-owned utilities to identify expected climatic impacts through 2070 on assets, operations and services based on California's Fourth Climate Change Assessment. Pursuant to this, SCE filed its Climate Adaptation Vulnerability Assessment on May 13, 2022.

Figure 2 gives a high-level overview of the process used to identify vulnerabilities and possible adaptations for SCE's assets, operations and services for future climate conditions.

SCE used a phased approach to determine which projected climate events were most impactful. First, SCE considered future projections for temperature, wildfire, precipitation, sea level rise and cascading events such as debris flow, in 2030, 2050 and 2070 timeframes. All exposure projections reflect climate change under a "high emissions" scenario, or Representative Concentration Pathway (RCP), commonly referred to as RCP 8.5. The primary models used were the 10 Global Climate Models (GCMs) identified by California's Fourth Climate Change Assessment as best representing the state's climate. Figure 3 shows several key methodological components used to help develop SCE's CAVA.

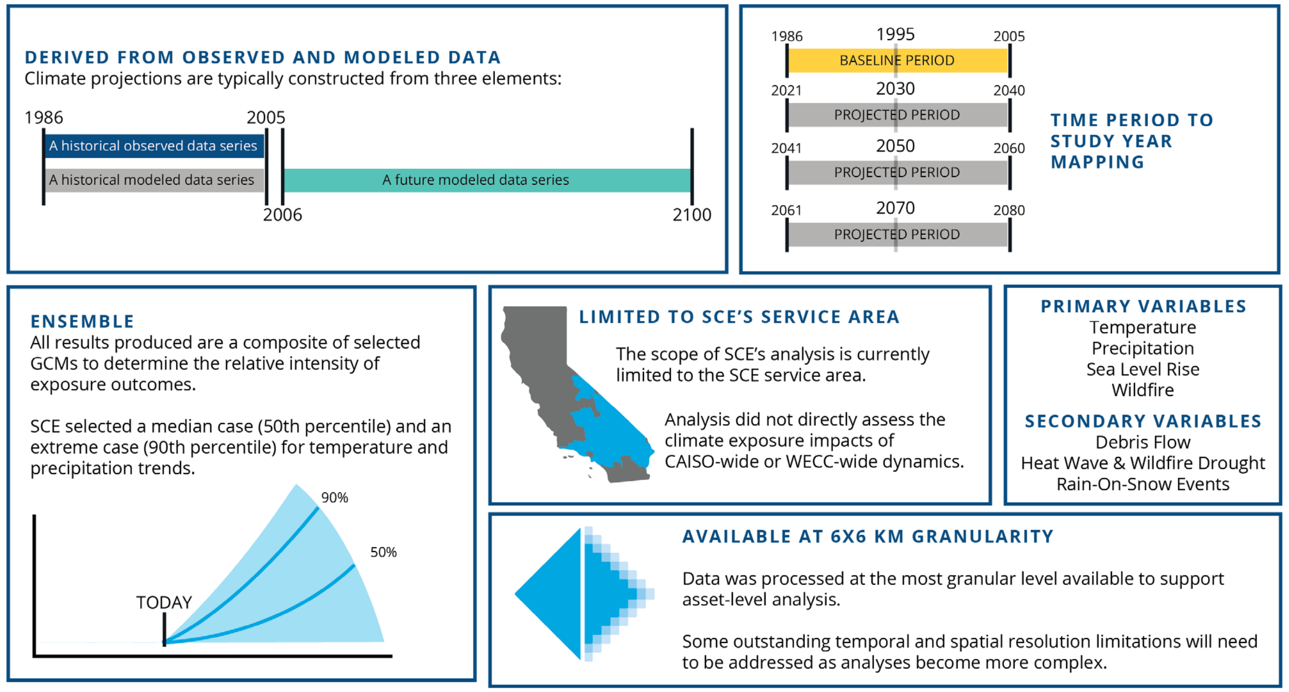


Figure 3: Key Methodological Components

Second, SCE considered vulnerabilities. Any asset, operation or service determined to be exposed to extreme conditions and sensitive to those conditions was deemed "vulnerable" and was considered for further analysis.

Third, SCE determined whether a given asset, operation or service was at risk based on potential consequence and adaptive capacity. Consequences were evaluated based on the safety, reliability and financial impacts of a given vulnerability. The adaptive capacity analysis considered whether existing or planned measures are sufficient to reduce the consequences to an acceptably low level or minimize the likelihood of the potential consequences occurring.

Finally, SCE considered potential adaptation strategies. The analysis identified investments that may be needed by 2030 and 2050 to address climate risks for at-risk assets, operations and services with low adaptive capacity.

CLIMATE HAZARDS EXPOSURE, VULNERABILITIES AND ADAPTATIONS

The CAVA focused primarily on the ways in which changes in exposure to temperature, precipitation, wildfire and sea level rise could impact SCE's assets, operations and services, consequently affecting power availability. Impacts to SCE's infrastructure were assessed by defining climate hazard exposure to assets, analyzing the degree to which assets can withstand climate impact, and identifying adaptations to the climate-induced impact, e.g., restoration activities, resiliency investments and design changes.

TEMPERATURE

Exposure

Climate projections show increases in average temperatures and heat waves. The average maximum temperature is projected to rise approximately 5 degrees F from 1995 temperatures by 2050, with slightly wider swings from summer to winter. Extreme temperature events such as heat waves are expected to become more frequent, more prolonged and more intense, particularly in inland regions of the SCE service area where the population is growing.

Without mitigations, extreme heat may put at risk our ability to meet electricity demand due to reduced generation, transmission and distribution capacity, and increased temperature-driven asset failures. Simultaneously, electricity demand will likely increase and concentrate due to cooling needs. SCE and other utilities will need to plan for more intense and more frequent heat waves over a broader geographical extent in the future. Additionally, the increase in exposure is expected to impact worker safety and the general public. On average, extreme exposure days, defined under OSHA standards, are projected to more than double from 29 days per year to 61 days per year across SCE's service area. Consequently, heat illness will become a much more significant concern, and more frequent extreme heat indices could alter SCE work schedules to protect worker safety.

Vulnerabilities

By 2050, SCE found that 24% of transmission circuits and subtransmission circuits will be exposed and sensitive to heightened levels of extreme temperature; the increased temperature is expected to decrease line capacity by 10% to 20%. In addition, 4% of SCE's distribution substation transformers are projected to be vulnerable to four-day heat waves by 2030. Key generators may be less available during critical periods due to exceeding design standard operating temperatures more often. The projected increase in the heat index in inland districts will impact field operations; for example, this could result in rescheduling nonessential work on extreme heat days.

Adaptations

Adaptation options for transmission and subtransmission vulnerabilities include reconductoring of lines or constructing new lines to compensate for the deratings and additional customer demand. Based on CAVA results, SCE is working to incorporate climate change-informed temperature projections and accompanying system reliability impacts into infrastructure replacement programs for distribution assets. For example, projected generation derates or outages should be incorporated into regulatory planning processes to ensure adequate resources are procured to meet reliability standards. In addition, deployment of lightweight personal protective equipment and portable air-conditioned breakrooms in districts projected to be exposed to extreme temperatures can ensure employee safety during these harsh working conditions.

PRECIPITATION

Exposure

Precipitation patterns in California are projected to become increasingly variable from year to year, which will likely contribute to increased flooding risks and longer droughts. Although average aggregate precipitation is projected to remain relatively constant, precipitation is expected to fall in fewer, high-intensity events. Increased frequency of whiplash between wet and dry periods may also trigger asset damage and landslides.

Atmospheric river events are responsible for most extreme precipitation events in California and are projected to increase in strength and intensity under climate change.[19] In Southern California, the frequency of these events is projected to double, and the intensity is projected to increase nearly 40% by the end of the century under RCP 8.5.[20] Concurrently, the peak season for atmospheric river events may also lengthen, extending California's flood-hazard season.[21]

Flood

SCE used FEMA maps of flood plains, which identify present-day risks and areas already considered to be exposed, to identify current and potential future at-risk areas for flooding due to changes in storm intensity and seasonal runoff. FEMA flood maps reflect present-day risks and indicate which areas are already considered to be exposed.

While the CAVA did not quantify potential flood plain changes, SCE evaluated regional precipitation projections to supplement the existing flood maps. Twenty-four-hour and 72-hour precipitation projections suggest FEMA flood plains may flood more often or with higher intensity due to climate change. SCE found that 100-year extreme precipitation events are projected to become on average 8% more intense by 2050. However, further analysis of storm sequencing and ground conditions prior to flood events needs to be conducted to determine how risks could compound.

Drought

California may continue to experience drought conditions with increasing severity due to climate change. A future 20-year drought (megadrought) or continuation of the current, worst regional drought in history could result in SCE's hydroelectric generation from Big Creek being nearly 24% lower than historical averages. Furthermore, future droughts may be even more severe than historical droughts, resulting in lower average hydroelectric production than historical drought years. This would reduce the predictability of generation capacity, increase power procurement needs and cause greater maintenance and operational requirements.

Drought may have cascading impacts beyond generation. Sustained droughts may weaken the flood resistance of soil and vegetation, resulting in worsened subsequent floods or landslides. During drought periods, wildfires may worsen because of decreased fuel moisture and increased dead fuel loading.

Vulnerabilities

Flood

Using FEMA flood maps, 23% of transmission substations are vulnerable to 100-year flood inundation exposure or sea level rise. In addition, SCE's assessment found that a subset of transmission substations that may be exposed to severe inland flooding put the transmission system at heightened risk of widespread cascading outages. SCE found that 22% of distribution substations are potentially exposed to 100-year inundation.

Drought

Although SCE's electric transmission and distribution assets do not face significant risks due to drought alone, drought presents potentially significant system-level vulnerabilities. For example, widespread protracted drought conditions can limit available hydroelectric resources and strain the water supply throughout the West. SCE currently relies on approximately 1,000 MW of hydroelectric generation from the Sierra Nevada. In addition, Southern California imports 60%-70% of its water from the Sierras and from the Colorado River Basin, which further underscores the importance of coordinated climate adaptation.[22] Droughts also have a secondary effect of potentially increasing wildfire exposure risks.

Adaptations

Substation hardening, which may include building floodwalls around substations within FEMA 100-year flood plains, is critical to managing increased flood risks. Longer-term redundancy investments such as developing new paths for power flow to lessen the impact of these critical substations' failure may also be needed. For vulnerable padmount asset types, waterproofing or raising the equipment above the flood levels would lessen the impact of flood events. Adaptation measures related to droughts include system-level planning, such as incorporating projected generation derates or outages into the integrated planning process to ensure adequate resources are procured to meet reliability standards. Additional adaptations related to the secondary impact of drought contributing to increased wildfire conditions are discussed in the Wildfire section below.

WILDFIRE

Exposure

Projected changes in fire weather suggest that peak fire seasons are likely to continue becoming longer and more intense. Increasing temperatures will lead to drier vegetation during summer and fall, contributing to increased wildfire volatility. More precipitation variability could also facilitate higher tree mortality and vegetation stress. Fire exposure is projected to increase in and around high fire risk areas (HFRAs), which already have an elevated risk of wildfires (Figure 4). Summer fuel-driven wildfires are projected to become more intense, particularly in mountain regions. However, most areas in the SCE service area outside of HFRAs are projected to experience similar area burned as in historical data.

It is also important to note that current wildfire projections do not include wind-driven fire weather, which typically occurs later in the year and presents the greatest risk to SCE assets and operations. Santa Ana winds are a particular concern. Historically, the strongest Santa Ana winds appear after the onset of winter precipitation when fuels are less flammable. Under a changing climate, precipitation may be reduced and delayed in fall and winter, causing drier vegetation and creating a longer window of time when Santa Ana winds can occur in the presence of dry fuels, which poses significant risks for fire growth and intensity. Wildfire projections, therefore, likely underestimate fire risk.

Vulnerabilities

Historically, transmission corridors impacted by wildfire have taken four days, on average, to resume operation from the initial time of de-energization. By 2050, wildfire seasons are expected to become longer and could affect regional reliability. Among SCE's transmission circuits, 23% are sensitive to projected potential wildfire exposure. SCE grouped the exposed assets into 33 common transmission corridors. If all lines in a corridor are impacted during a wildfire event, outages in five of the 33 corridors would result in system reliability concerns for these extreme simulations, potentially impacting upward of 2 million customers. Four of the five corridor outages require mitigations to ensure the system remains stable. On SCE's sub-transmission system, 28% of circuits are determined to be sensitive to potential wildfire exposure. Approximately 1,000 MW of generation in the SCE service area are vulnerable to wildfire.

Adaptations

In the near term, adaptation options for hydro generation facilities exposed to wildfire risk include deploying redundant communication and power equipment to key areas so critical water valves can be operated remotely during and after wildfires. In addition, no-regrets adaptations for the grid include increasing inspection and tower footing clearing frequency for transmission towers, prioritizing fire wrapping of sub-transmission poles, pole brushing and creating new circuit ties for high-risk areas for transmission and sub-transmission lines. Longer-term mitigation options for regional reliability, transmission and sub-transmission vulnerabilities include constructing new lines to add system redundancy, adding customer-sited generation and storage or shedding load to maintain system stability.[v]

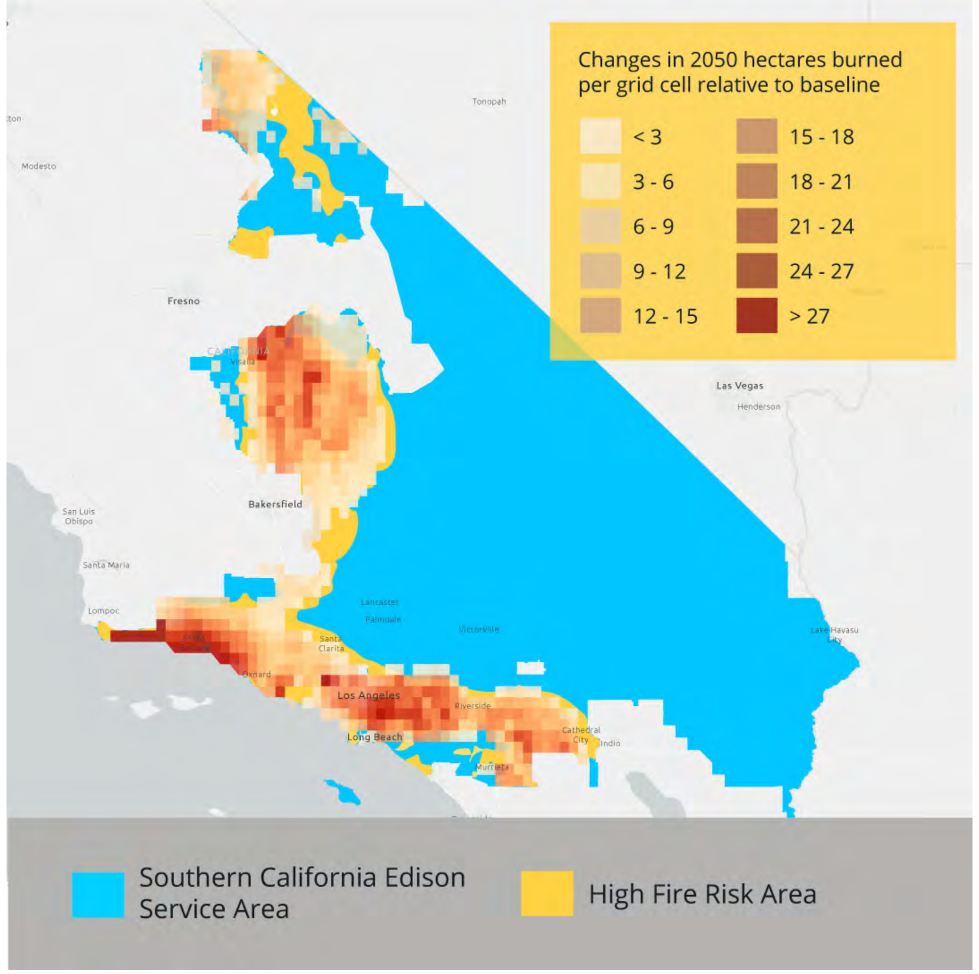


Figure 4: Overlay of Changes in Area Burned with HFRA Boundaries

BOOTLEG FIRE TRANSMISSION IMPACTS

As the Bootleg Fire in southwest Oregon grew to over 240,000 acres, the 500 kV lines that comprise the AC Intertie north of the Oregon-California border tripped in and out of service on July 9, 2021 due to smoke particles from the fire. The AC Intertie was reduced to less than 10% of its capacity, 428 MW. Additionally, the Oregon-California DC path that feeds Southern California was derated 50%, to 1,500 MW, for reliability issues. From July 9-13, 2021, California, at times, could not access about 5,500 MW from the northwest. Despite the combined heat wave and wildfire threat, the grid was able to avoid rolling blackouts due to an emergency proclamation issued by Gov. Newsom and electricity conservation by customers. These types of extreme events will occur more frequently in the future if climate adaptations are not implemented.

v. Some near term and long lead time adaptation strategies directly overlap with SCE's Wildfire Mitigation Plan. Though most of these programs have been implemented to decrease utility-caused ignition, they can also reduce the probability of a wildfire causing damage to equipment. In the future, as SCE continues to deploy wildfire mitigation, SCE will consider climate hazard data to determine overall scope in a given area.

SEA LEVEL RISE

Exposure

With sea level rise, more assets will be exposed to coastal flooding during storms. SCE evaluated sea level rise through average conditions, king tide[vi] conditions, 100-year storm conditions and 100-year storm conditions coinciding with king tide conditions. SCE followed California's sea level rise guidance recommendations for critical infrastructure to plan for approximately 1 foot of sea level rise by 2030 relative to 2000 and 2.6 feet by 2050.[23] Sea levels are projected to continue rising throughout the century and impact coastal communities across SCE's service area. This has the potential to drive permanent inundation of coastal assets in low-lying areas and require asset relocation.

Vulnerabilities

By 2050, 24 distribution substations (4%) are projected to be within the 100-year storm inundation area. From a distribution perspective, 530 distribution service transformers would be vulnerable to flooding. Catalina Island is particularly exposed to sea level rise and vulnerable during major storm surges. Catalina storm surges are associated with Southeast tropical swells and Northeast Santa Ana winds, which differ from the mainland king tide analysis.

Adaptations

Potential adaptation options to address sea level rise include installing distribution tie lines to increase operational flexibility and replacing padmounted transformers, switches and capacitors with waterproof padmount equivalents. In addition, installing additional tie lines would increase SCE's ability to support the load in neighboring circuits in the event of substation failure.

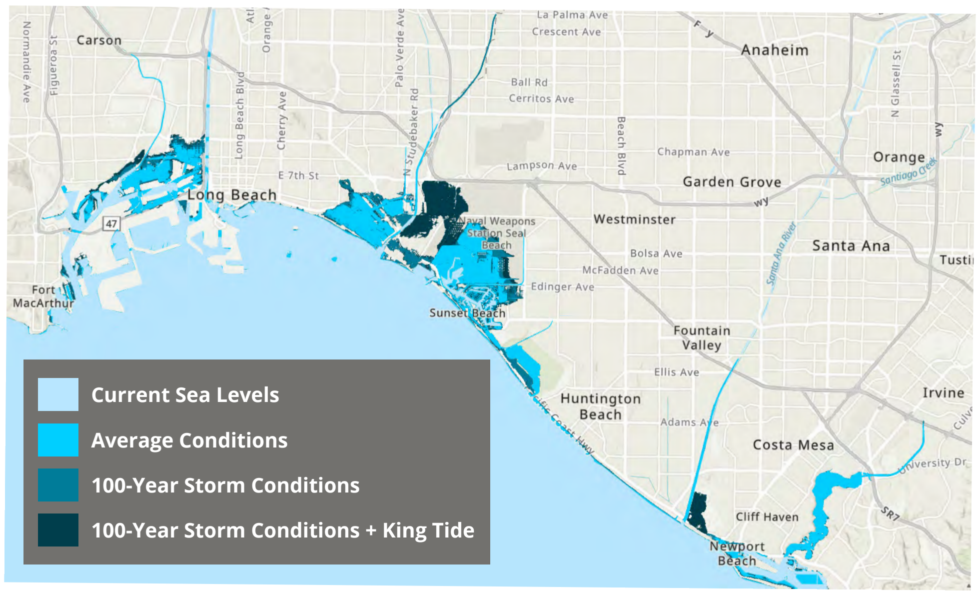
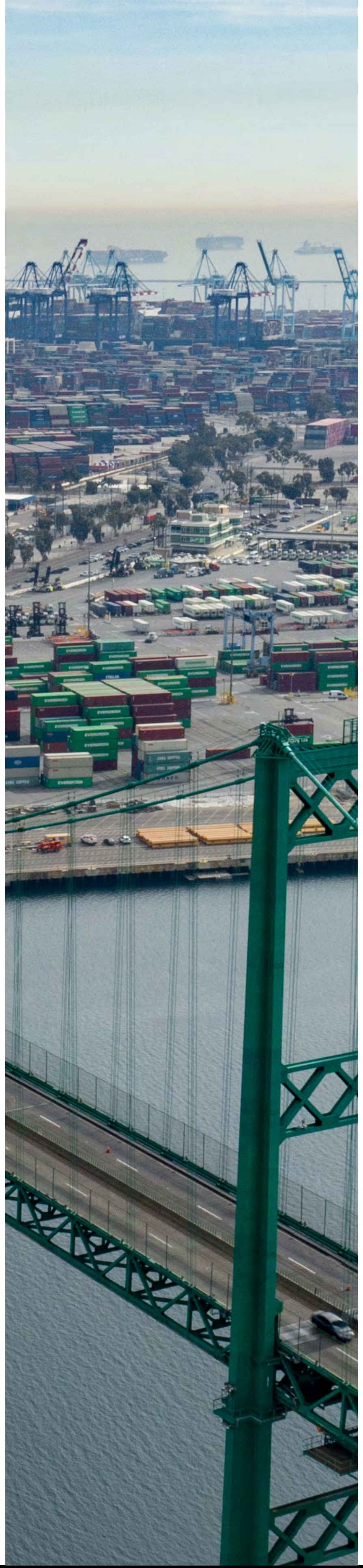


Figure 5: Coastal Inundation, 2050

vi. King tides are the highest and lowest tides of the year and typically occur seasonally during the summer and winter solstices.



KEY LEARNINGS

Climate adaptation investments are needed now and will grow over the next 20 to 30 years. Therefore, no-regrets foundational measures need to be developed and funded in the near term with the understanding that more significant investments will be required in the next 10 to 20 years. While these actions may require substantial funding, the cost of inaction would be even greater, not only in financial terms but also in terms of safety and health impacts on our population.

Utilities must incorporate future climatic conditions into planning and design processes, including load forecasts, resource planning, distribution and transmission planning, and asset and technology selection. Though there are inherent uncertainties in any climate change vulnerability assessment, utilities and their regulators must work together to proactively plan necessary remediations. Regulatory processes will need to review and approve investments in the near term to avoid costlier, just-in-time responses and more severe societal impacts if solutions cannot be implemented in time.

Significant collaboration among communities, local and regional planning authorities, and state agencies and governments is needed. While many asset-specific risks will require engineering solutions, a broader resource planning mandate remains unaddressed and requires significant coordination among stakeholders. The climate risks SCE assessed carry interrelated challenges outside a single electric utility's locus of control. Due to the grid's interconnectedness, major heat waves and wildfires require multilateral and regional adaptation plans to adapt to climate change effectively. For example, significant Western Interconnection interagency collaboration is needed to integrate climate change impacts into resource and infrastructure planning proceedings.

Additionally, adapting to climate vulnerabilities may be more cost-effective across jurisdictions than singular industry action. For example, urban flooding may require community action to cost-effectively mitigate the vulnerability instead of deployment of adaptations to singular assets like substations. A flood wall could be built to protect an entire community. Closer collaboration between governments and infrastructure providers across sectors is needed, guided by a common blueprint, targets and objectives set at the state level. Moreover, funding needs to be available to cities and counties for climate adaptation plan development. Less than half of counties and only one quarter of cities in SCE's service area have climate adaptation and resilience plans.[24]

Further advances in climate projections are needed to better understand the expected frequency and spatial extent of more extreme outlying events. The success of specific adaptation measures is dependent on preparing appropriately for these more extreme events. SCE's vulnerability assessment using climate projection data identified climate vulnerabilities and associated adaptations. The process also identified climate data gaps, including the need for wind speed and direction projections; forward-looking flood extent and depth maps under extreme precipitation events; and landslide maps that account for the probability of landslides due to heavy precipitation events.

CLIMATE RESILIENCE LEADERSHIP GROUP

SCE established the Climate Resilience Leadership Group (CRLG) in September 2021 and convened the group over a dozen times through March 2022 to improve engagement with Disadvantaged Vulnerable Communities (DVCs) on utility climate adaptation efforts. SCE proactively formed the CLRG as a critical step to better learn from SCE's communities. From this work, SCE learned that increased resources and collaboration with community-based organizations are necessary to collect DVC feedback; deeper education and awareness is critical on all related climate adaptation topics; and, customized strategies are essential to identify and meet specific groups' needs.

CALL TO ACTION

In October 2021, the Biden administration released more than 20 federal agency climate adaptation and resilience plans outlining the steps each agency will take to ensure its facilities and operations adapt to, and are increasingly resilient to, climate change.[25] In the same month, California released its Draft 2021 Climate Adaptation Strategy (Draft 2021 Strategy), defining the state's key climate resilience priorities and serving as a framework for action across sectors and regions in California.[26,vii] While progress is being made nationally and at the state level, there is a lack of common language among stakeholders and clear frameworks to apply climate projections locally across regions, sectors and hazards. Given the enormity of future costs associated with climate change, progress is not occurring at the required scale when assessed against future risk levels.

One of the Draft 2021 Strategy's key priorities is to collaborate to leverage resources, with supporting goals of building climate resilience across sectors and scales and developing public awareness of climate adaptation issues.[27] These goals should be a priority for the state of California and all levels of government, businesses and industry, including the electric sector, and communities.

Government/Regulatory planning: Many of the California Draft 2021 Strategy's priorities and goals resonate with SCE's climate adaptation work findings. For example, a key priority is to bolster public health and safety in light of increasing climate risks, with goals to consider future climate impacts in planning and investment decisions and build infrastructure resilience to protect public health and safety.[28]

These goals are consistent with SCE's finding that relevant climate projections should be consistently incorporated across all key long-term energy planning processes:

- The federal and state governments should fund local and regional adaptation planning and solutions that holistically address specific climate change risks in optimized ways.
- The California Energy Commission's Integrated Energy Policy Report (CEC IEPR) Load Forecast should reflect chosen RCP temperature projections through 2045, including the impact these future temperatures will have on cooling loads across different climate zones. These loads need to be integrated with the climate mitigation load of electrification through 2045. Given the use of the CEC IEPR load forecasts across agencies in planning proceedings, this incorporation is foundational.
- The CPUC's Integrated Resource Plan (IRP) should incorporate projected hourly capacity derates and lost energy production from increased temperature impacts. In addition, any associated reliability analysis should include climate change futures stochastically to produce a climate change-informed reliable resource buildout.

Industry/Electric sector planning: The electric sector has a history of mutual assistance, benchmarking and collaboration among utilities. Planning for climate change is no exception. Since Superstorm Sandy in 2012, Consolidated Edison Company of New York (ConEd) has been a leader in framing how to adapt to climate vulnerabilities.[29] In addition, the Electric Power Research Institute (EPRI) recently created the Climate READi Initiative, which focuses on developing a framework to enhance the planning, design and operation of a resilient power system in the context of climate change.[30]

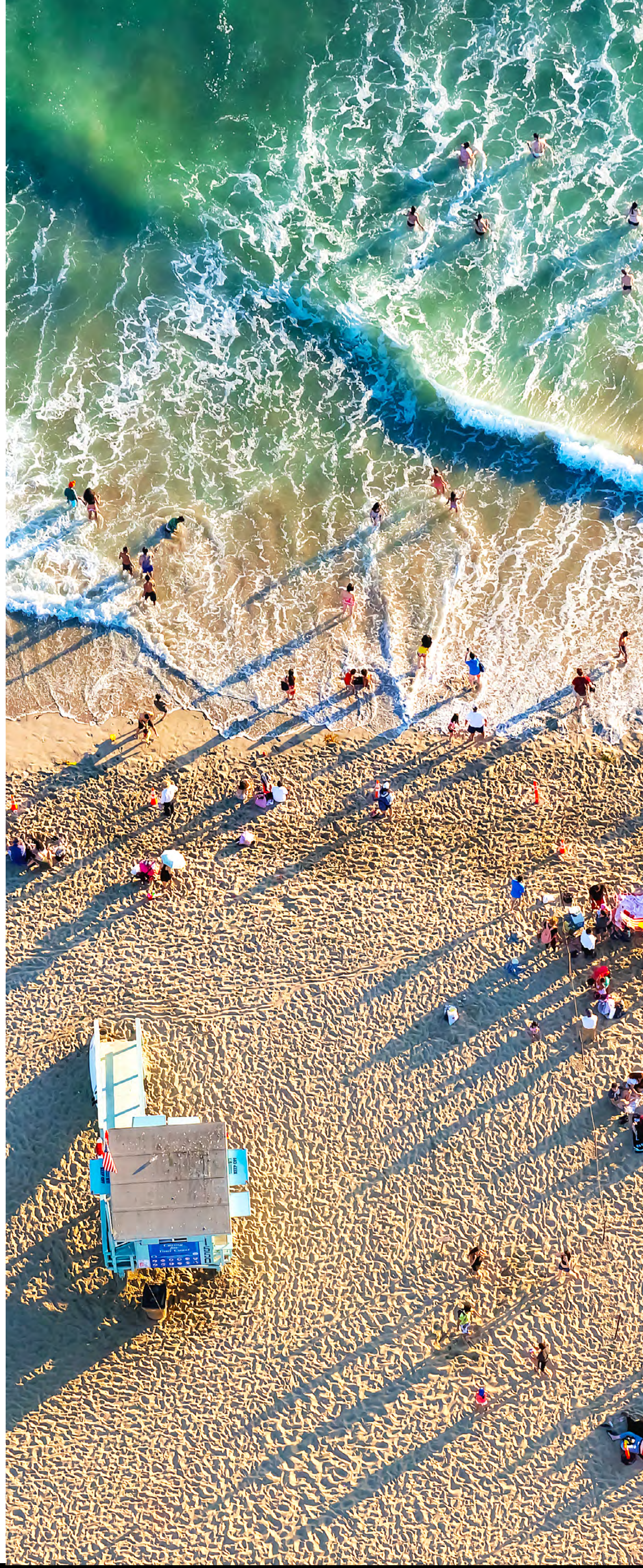
SCE identified the following insights that apply across the electric industry during discussions with industry partners and in developing the CAVA:

- Severe climate change impacts emerge over longer planning horizons than 10 years, while many utility planning process timeframes are 10 years or less. Therefore, extending planning horizons to 20+ years will help guide shorter-term infrastructure investments that also address longer-term climate change risks.
- The more the industry can incorporate scenario-based planning to allow for an ensemble of climate change futures, the better utilities will be able to arrive at least-regrets solutions that address many plausible outcomes. Appropriate resiliency design criteria need to be developed across the electric industry. Depending on the level of resiliency desired, more adaptations may be required. The industry has not yet defined these design criteria beyond the regular N-1-type contingency or loss-of-load expectation (LOLE) analysis. These current approaches may be insufficient to justify investment at the levels that may be needed to meet future desired resiliency levels.

Community Collaboration: A key insight from SCE's community engagement related to the CAVA is that a common understanding of climate change risks is needed among communities, local jurisdictions, state agencies and the federal government. This understanding will facilitate meaningful, collaborative discussions on climate adaptation measures to optimize the public good and perform cross-sector resiliency planning to address the interplay and dependencies of critical infrastructures such as water, wastewater, fuel supplies, transportation corridors, etc.

- Local jurisdictions and communities must be appropriately resourced to conduct their own climate change vulnerability assessments and identify specific risks before moving into productive adaptation development collaboration. Identifying common climate change risks is the starting point for any successful public/private partnership.
- State agencies need to provide local jurisdictions with climate adaptation vulnerability assessment guidelines and technical support services. This support will enable local jurisdictions to produce robust climate adaptation vulnerability assessments.
- DVCs need extra support to ensure a just transition. Federal, state and local governments should provide focused funding and technical assistance to DVCs to help with climate vulnerability assessments, climate mitigation and climate adaptation.

Society no longer has the luxury to wait and see what climate change will bring; the potential costs are too great. The time for action is now. While climate adaptation can help hedge against impacts from climate mitigation delays and vice versa, we cannot do one over the other. Instead, we must simultaneously decarbonize our energy systems and adapt to a changing climate. Efficient and effective adaptation requires assessing vulnerabilities across infrastructure, ecosystems and communities; investing in adaptations today with an eye toward solving tomorrow's issues; planning for tomorrow's needs; and partnering among communities, governments and industry to achieve the best outcomes for society.



vii.The Draft 2021 Climate Adaptation Strategy priorities have subsequently been included in California's updated Climate Adaptation Strategy interactive website released on April 4, 2022. https://www.climateresilience.ca.gov/

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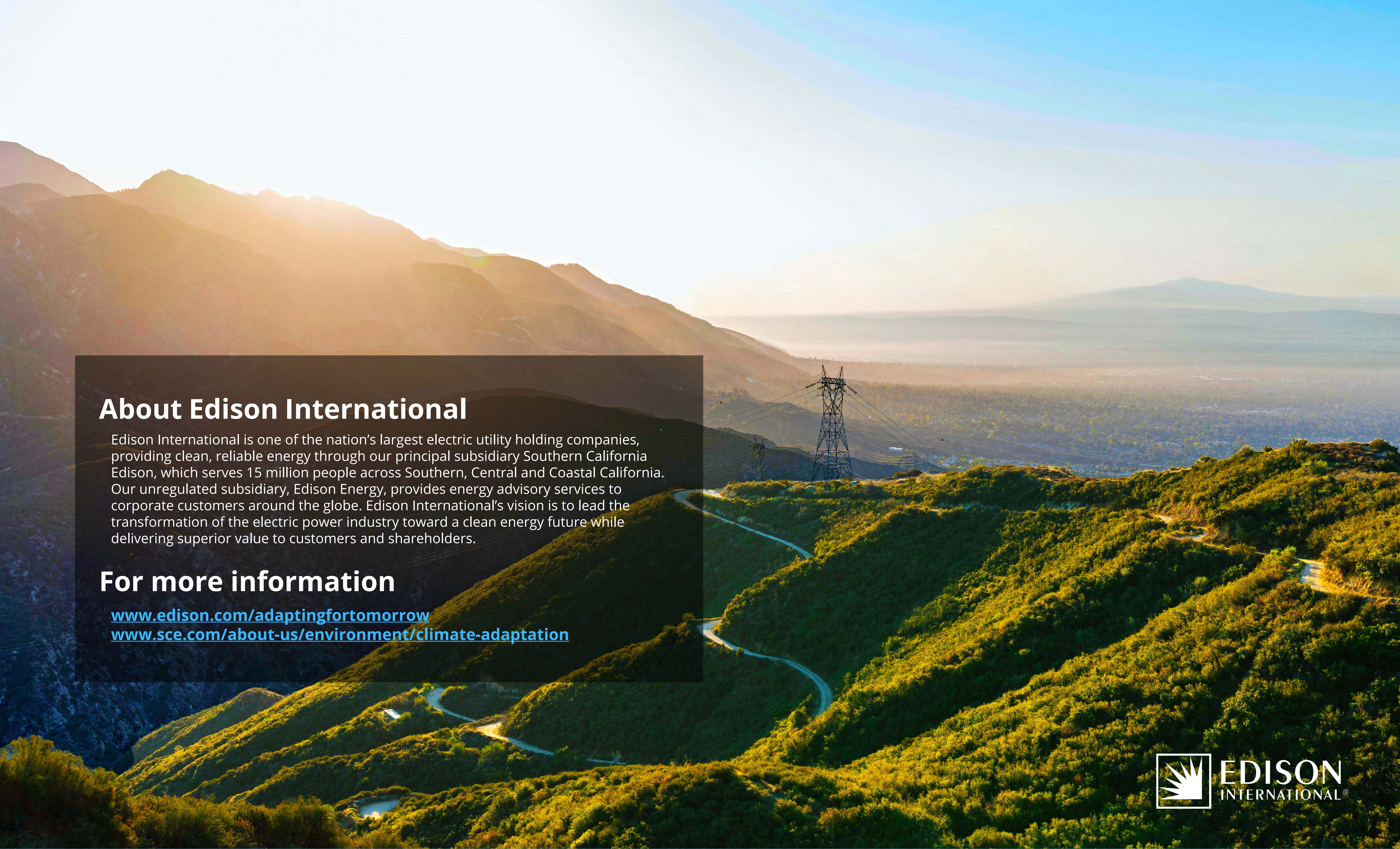

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