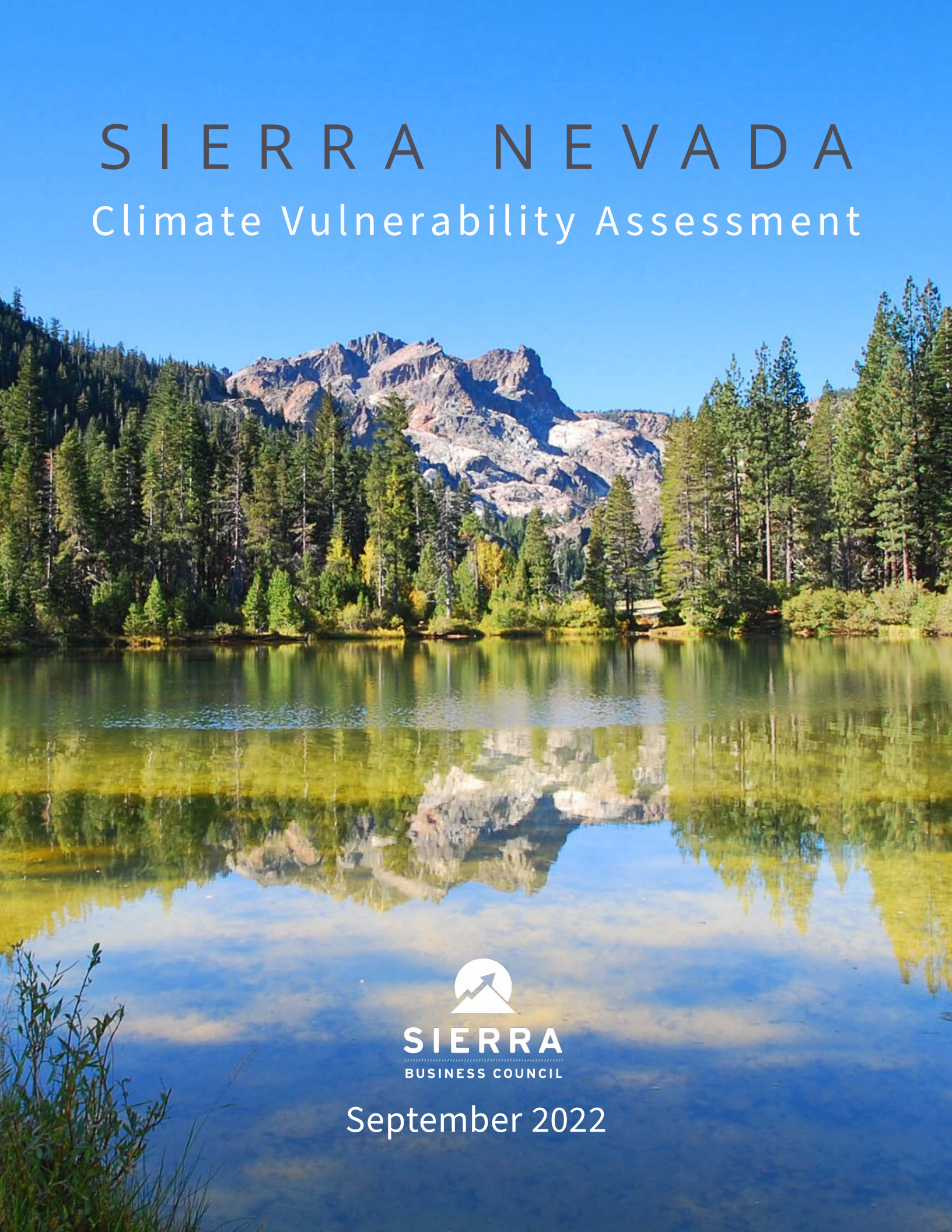
SIERRA NEVADA

Climate Vulnerability Assessment



SIERRA
BUSINESS COUNCIL

September 2022

ACKNOWLEDGEMENTS

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Climate Vulnerability Assessment

Prepared for and funded by
Sierra Nevada Conservancy

Prepared by
Sierra Business Council

with assistance from
The Sierra Institute for Community and Environment

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FUNDING

In 2020, Sierra Business Council's Sierra Climate Adaptation and Mitigation Partnership (CAMP) was awarded $191,655 from the Sierra Nevada Conservancy as part of their Resilient Sierra Nevada Communities Program funded by Prop 68. Proceeds from the grant were used to complete a triple-bottom-line climate vulnerability assessment across all 22 counties of the Sierra Nevada.

The Sierra CAMP is a cross-sector partnership that promotes and facilitates regional climate adaptation and mitigation strategies; serves as a climate action capacity-building hub for Sierra/Cascade communities; and fosters urban-rural connections to build statewide investment in our region's communities and natural resources. Sierra CAMP is a collaborative effort managed by Sierra Business Council.

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California-Nevada Climate Applications Program at Scripps Institution of Oceanography

EXECUTIVE SUMMARY

Introduction

The Sierra Nevada Climate Vulnerability Assessment identifies climate vulnerabilities specific to the Sierra Nevada Conservancy (SNC) region. The assessment is designed to provide communities with localized climate risks and hazards, projection data, and technical support to undertake climate planning and priority-project identification. This climate assessment was guided by a triple bottom line approach that considers the economy, environment, and community simultaneously and holds that these sectors thrive when positioned in balance with each other.

The primary intent of this report is to provide an understanding of climate risks within the SNC region, and to technically assist with implementation of Senate Bill 379 (SB 379). Many SNC communities do not have a hazard mitigation plan or updated safety element as required by SB 379. This assessment is intended to provide more specific indicators and hazards at the jurisdictional level, and explain how Sierra ecosystems, economies, and communities will be impacted by those hazards. This assessment can be used to inform hazard mitigation plans and safety elements for counties within the SNC region.

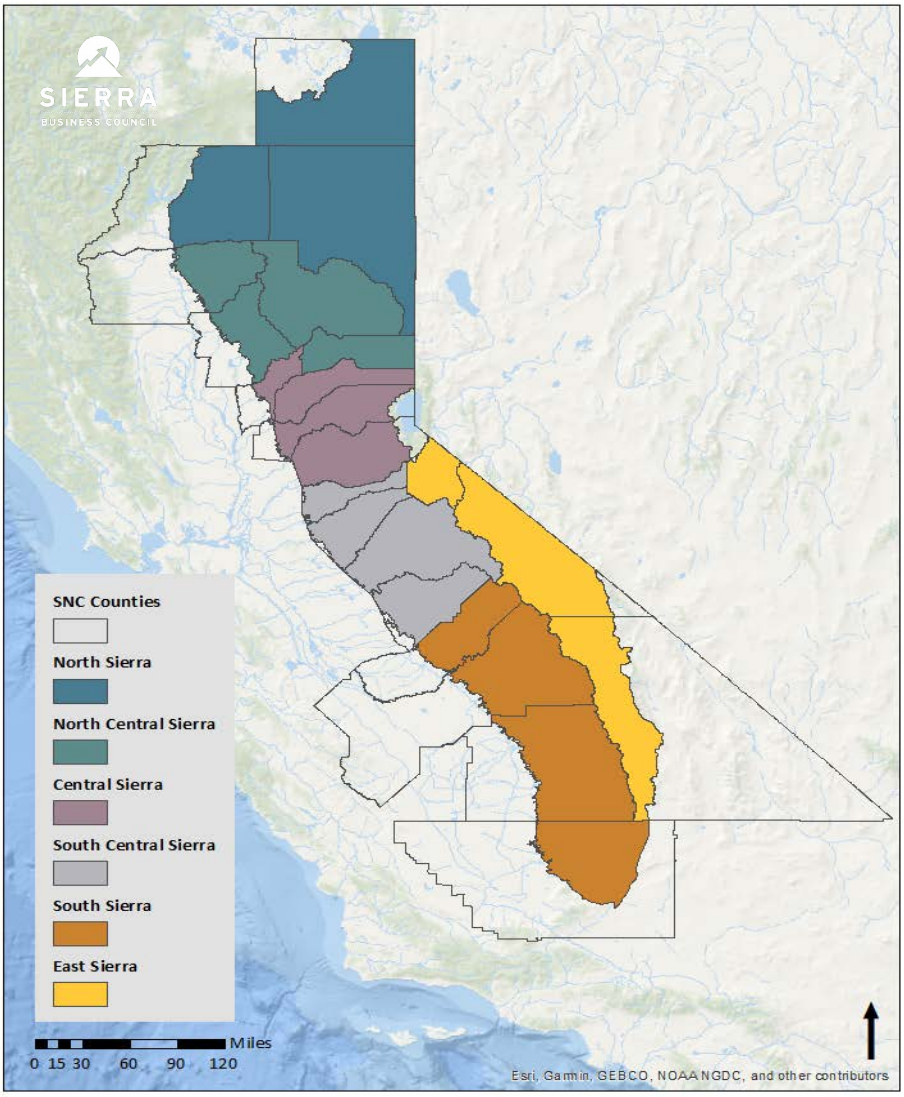
Assessment Boundary

The Sierra Nevada Climate Vulnerability Assessment is confined by the SNC boundary, which encompasses 22 counties and includes the Modoc Plateau, Southern Cascades, Basin and Range, and Sierra Nevada mountain range. This region is a quarter of California's landmass, covering nearly 25 million acres and ranging from 200 to 14,505 feet in elevation.

The SNC region is an ecologically diverse rural area characterized by mountainous peaks, rolling foothills, small towns, and pine forests. Due to the SNC region's extremely diverse topography and geography, SBC used the SNC-defined subregions to break up the larger region when discussing and analyzing the region's climate data projection.[1]

SNC-Defined Subregion Boundary

The landscape is one of the most important assets to the SNC region. The Sierra Nevada sources 60% of the state's developed water supply and embodies endless wilderness that provides natural resources and services critical to ecosystems and California economies.[2]



Land Cover Types:

Land Cover Types	Acreage	Percent of Total Land
Wilderness	20,359,813	87.89%
Agriculture	2,712,490	11.71%
Development	92,646	0.40%
Total Acreage	23,164,949	

Key Terms

Climate Change - the change in the state of the climate that can be measured by a change in the average, or variability of properties that exist for long periods of time (decades or longer)

Climate Effects

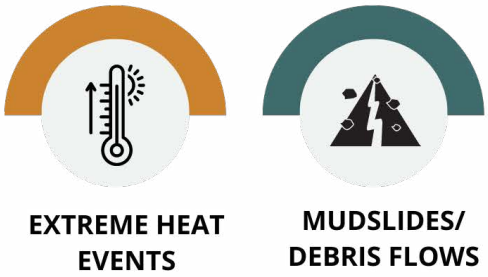
Climate effects (stressors) are changes in climate caused by GHG emissions

CHANGING PRECIPITATION PATTERNS

INCREASING TEMPERATURE

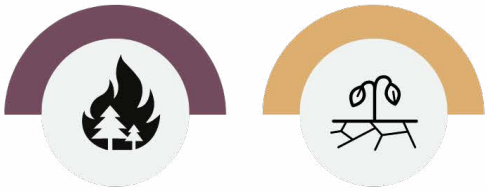
Climate Hazards

Climate hazards result from climate effects, like extreme weather or natural disasters



EXTREME HEAT EVENTS

MUDSLIDES/ DEBRIS FLOWS



WILDFIRE

DROUGHT

Climate Impacts

Climate impacts are caused by climate hazards

WATER QUALITY

STRUCTURAL DAMAGE

PUBLIC HEALTH EFFECTS

SMOKE & ASH

ECOSYSTEM DEGRADATION

Vulnerability - the overall degree to which people, ecosystems, or infrastructure are susceptible to climate change; vulnerability is a function of climate impacts and the adaptive capacity of a system

Adaptation - the process of adjusting to projected or actual changes in climate and its impacts in order to reduce harm to humans, ecosystems, and infrastructure

Community Capacity - the ability of local residents to respond to climate effects, hazards, and impacts while meeting the needs of all residents

SB 379

As noted, this report is designed to technically assist with implementation of SB 379. SB 379 is a land use/ general plan/safety element act to amend Section 65302 of the Government Code approved by the governor in 2015. This assessment coupled with the Adaptation Planning Guide (APG) provides a starting point for counties and cities within the region to jumpstart their incorporation of SB 379. SB 379 requires that all cities and counties within California integrate climate adaptation into their general plans by 2022 (depending on whether or not jurisdictions already have a Local Hazard Mitigation Plan).

Report Preparation

In order to adequately present vulnerability and capacity in regards to climate change impacts within the SNC region, a comprehensive understanding of the historical climate data and projected climate data was necessary.

Observed data was collected from the state and federal sources described in the methods section of this report.

This report utilized climate projection data for mid-century and late-century time frames under RCP 8.5. Projection datasets for this assessment came from the California-Nevada Climate Applications Program at Scripps Institution of Oceanography.

A group of expert climate scientists in the Sierra Nevada region were consulted to better inform the climate science presented in this report.

Along with climate data, data on current socioeconomic well-being and demographic trends in the region was collected. Much of the data used in this report was pulled from the 2020 US Census.

This report defines the economic drivers of the region as tourism, recreation, natural resources, and agriculture. Analysis was conducted to determine the climate hazards and impacts that will most affect the economic development of the region.

In order to access community capacity, SBC partnered with the Sierra Institute for Community and Environment (SI) to conduct community workshops. These workshops asked participants to rate capacity in communities they are familiar with based on the five capitals that define capacity: physical, human, social, cultural, and financial. While these workshops did produce final capacity scores for all communities within the region, they were not highly attended and, in general, lacked diverse attendees that may have deeper insight into their communities' adaptive capacity.

Using climate and population data at the county level, risk profiles were developed for each of the 22 counties within the SNC region. These profiles use a scoring method to quantitatively present the likelihood of climate hazards occuring in each county, the risk faced by vulnerable populations in the county, and the combined impact of climate hazards on vulnerable populations. Local planners and policymakers may want to begin utilizing this report with the risk profile for their jurisdiction. These profiles will help planners and policymakers prioritize climate hazards and vulnerable groups in need of the most planning and resources to build adaptive capacity. We recommend planners and policymakers start utilizing this report by reading their jurisdiction's risk profile in chapter 6.

PIVOTAL FINDINGS

Climate Science

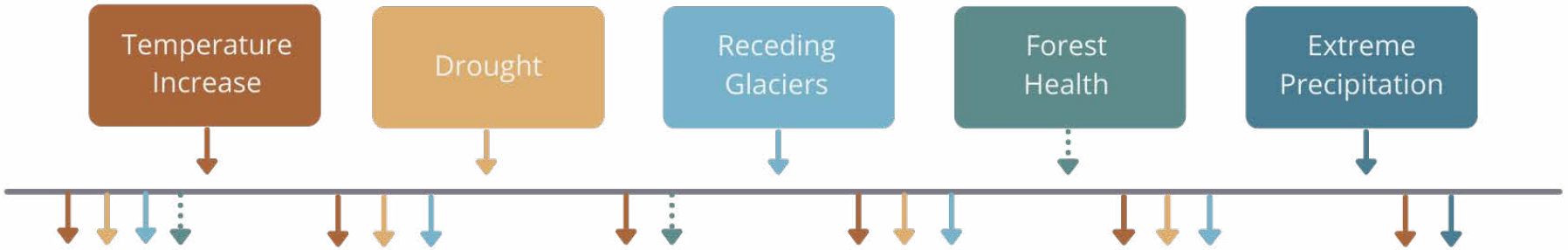
Increased Temperature
The mean temperature has increased 3°F in the last 60 years (from 46°F in 1960 to 49°F in 2020). In the next 20 years, the mean is anticipated to increase up to 1°F–2°F, and in the next 40 years is anticipated to increase an additional 2°F– 3°F.

Snow Water Equivalent (SWE)
Between 1950 and 1990, the Central Sierra subregion averaged ~4–11 inches (~7 inches average) of measured Snow Water Equivalent (SWE) on April 1. However, in the last 20 years, measured SWE has decreased to 2–4 inches on April 1. In the future, averages are projected to drop down to almost 0 inches of SWE by the 2090s.

Declining Snowpack
Snowpack is estimated to be minimal to nonexistent around the 6,000 ft elevation mark by 2099.
Glaciers in the Sierra have shrunk 70% on average since the beginning of the 20th century.[3]

Lengthening Wildfire Season
The California Department of Forestry and Fire Protection has estimated that the length of the fire season has increased by 75 days across the Sierra Nevada. Data from Cal-Adapt estimates this trend will continue to grow in the region by 48% on average during the mid-century (2035–2064) time frame.

Climate Data Summary



Wildfire

Decrease in soil moisture can lead to poor forest health.

Wildfire destroys forests and meadows in the Sierra, creating scars on the landscape that take hundreds of years to regenerate or never regenerate at all due to size and intensity of the fire.

Water Quality

Warmer temperatures and less precipitation can lead to evaporation of surface water and no replenishment.

Water quality can be degraded when certain minerals are condensed, bacteria grows, animals have restricted drinking water.

Pine Encroachment

Warmer temperatures in higher elevations can alter ecosystems.

High Sierra Pines will recede to cooler temperatures, and oaks will climb in elevation as temperatures change.

Meadow Degradation

Warmer temperatures evaporate water, drought conditions prevent replenishment.

Meadows that dry out are no longer a water storage source, have less ability for carbon capture, and dry grasses become fuel for potential fires.

Invasive Species

Warmer temperatures can lead to more invasive plants that can overtake native plants like riparian trees that produce more shade.

Invasive plants (e.g., cheatgrass) may increase the spread or intensity of fire.

Flooding

Warm intense precipitation events can lead to floods.

Floods lead to surface erosion and can destabilize hill slopes treefall and debris flows. This overwhelms streams, leading to channel degradation, and increased sedimentation in water.

PIVOTAL FINDINGS

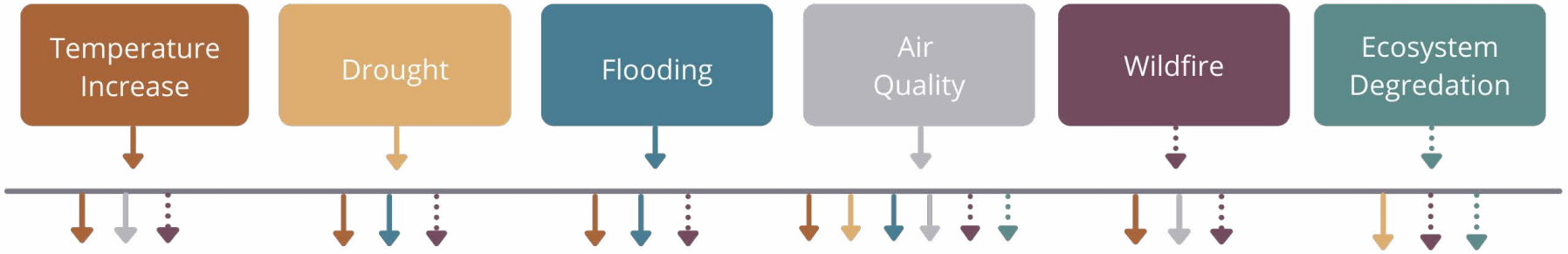
Underserved Populations

- Over half of the 880,000 people living in the SNC region belong to systemically underserved populations, including People of Color, the disabled community, Indigenous people, and people living in poverty.

- Over 40% of SNC regional households are housing burdened, and the majority of people in this group are renters.

- Populations with the highest risk to climate hazards are senior citizens, children, outdoor workers, and single-access road residents.

Population Data Summary



Respiratory Illness

Decrease in breath and lung function due to breathable ozone and PM2.5 from wildfires during outdoor work or recreation.

Increase in respiratory illness in children, seniors, and outdoor workers exposed to smoke.

Power Outages

Impacts to senior, disabled, or chronically ill residents on lifesaving equipment or refrigerated medications.

Loss of business or learning opportunities.

Loss of perishables due to lack of refrigeration.

Weather-Related Mortality

Prolonged heat exposure increases risk of heat-related illnesses in children, seniors, disabled/ill persons, and households without AC.

Extreme weather events increase risk of damage, injury, and death.

Mental Health & Stress

PTSD, grief, depression, and anxiety can increase in severity and occurrence during and after physical hazards.

People with less capacity may experience the most stress due to financial burdens of evacuations and missed work.

Increased Need for Medical Services

Outdoor workers, individuals in poverty, and groups unable to escape climate hazards may experience more illnesses requiring medical attention.

Sierra residents travel longer distances to receive care, increasing costs.

Reduced Cultural Practices

Indigenous people in the Sierra have spiritual ties to land, species, and waterways that may be destroyed by wildfire, drought, erosion, etc.

Less outdoor recreation opportunities may alter the demographics of the Sierra.

PIVOTAL FINDINGS

Economics

- Sectors that employ the majority of the population are Local Government and Social Services like health care, education, and utilities.

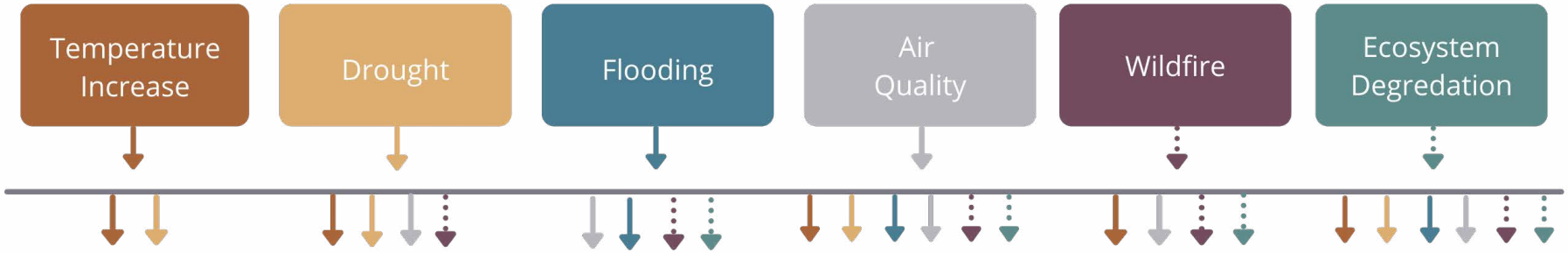
- While the average cost of living for a couple with one child is over $75,000. Low wages are common in rural areas of the state, but the cost of living in the Sierra typically exceeds income levels.

- The most vulnerable industry to climate hazards in the Sierra may be tourism and recreation.

- Workers in these industries will be heavily impacted by reduced visitation. These careers offer the lowest pay in the SNC region, indicating this group of workers will have less capacity to adapt to climate hazards, as well as reduced work opportunities. This may lead to a mass out-migration of the working class.

- Visitation numbers may be reduced due to wildfire, either directly or indirectly by smoke. United States Forest Service data shows that when recreation opportunities are disrupted due to climate change, visitors choose a different destination entirely, rather than postponing their trip to the Sierra – this behavior may be heightened with snow drought and shorter ski seasons predicted to come by mid-century.

Economic Data Summary



Ski Resort Operating Days

Changing precipitation patterns and overall warming temperatures will impact the days with skiable snow cover.

Shorter ski seasons may impact hospitality, food and beverage, and retail sectors in winter recreation destinations.

Altered Food Production

Changing temperatures and water availability will impact the types of crops and amounts grown in the Sierra.

Agricultural workers may be at highest fiscal risk from water shortages, and health risks due to air quality.

Natural Resource Labor

A renewed interest in the timber industry and biomass production may increase demand for forestry laborers.

A growing need for conservation and prescribed burning will require a new workforce.

Business Revenue Losses

Businesses closed due to evacuations experience large revenue losses.

Reduced visitation due to climate hazards lowers revenue in tourism-based economies.

Small business may become less viable, resulting in relocation.

Demand on Infrastructure

Increasing need for cooling, warming, and evacuation centers.

High cost of living demands affordable housing and reliable broadband.

Sustainable tourism requires parking lots, bike paths, restrooms, trash pickup, etc.

Industry Pivots

The main economic drivers in the Sierra may see dramatic shifts in operations.

Public sectors will need to focus more resources on climate mitigation and adaptation.

Land use changes due to fire or degradation.

PIVOTAL FINDINGS

Community Capacity

- Community members ranked the average capacity score for the SNC region at 2.9 (out of 5). A community capacity score of 3 indicates medium capacity to deal with climate change hazards and community stressors, like passing local development measures, building cross-cultural relationships, and implementing adaptation and mitigation strategies at the local level.

- Communities in the SNC region that scored themselves as having lower levels of capacity to deal with climate hazards typically have lower physical and cultural capital compared to other SNC region communities.

- High-capacity communities tend to have higher populations of younger residents with higher education levels who frequently organize in order to further community projects.

NEXT STEPS

This report is a regional document that can be used as a starting point for future projects and project prioritization. Next steps have been identified at the regional or state level, and at the local level.

Next Steps at the Regional Level

This assessment identified knowledge gaps in the SNC region. Some gaps in regional knowledge worth highlighting for research prioritization are:

- Specific climate/environmental indicator data gaps (eg., air quality)
- Socioeconomic data at the community level
- Statistics for specific vulnerable populations with known presence in the region
- Impacts historically underserved communities in rural regions will face due to climate change (outside general knowledge)

These four essential data gaps must be addressed if decision-making at the regional and state level is to encompass all people living within the SNC region.

Next Steps at the Local Level

Using the risk profiles in chapter 6, local planners and community members can begin prioritizing adaptation measures and mitigation strategies to lessen the impact of climate hazards. Research for this report exposed large gaps in capacity within local governments and public organizations. These gaps were typically due to a shortage of government staff, limited or unusable resources for small businesses, and assorted priorities within government operations. Some of these issues will take systemic change to overcome. Actionable next steps to begin building local capacity and knowledge include:

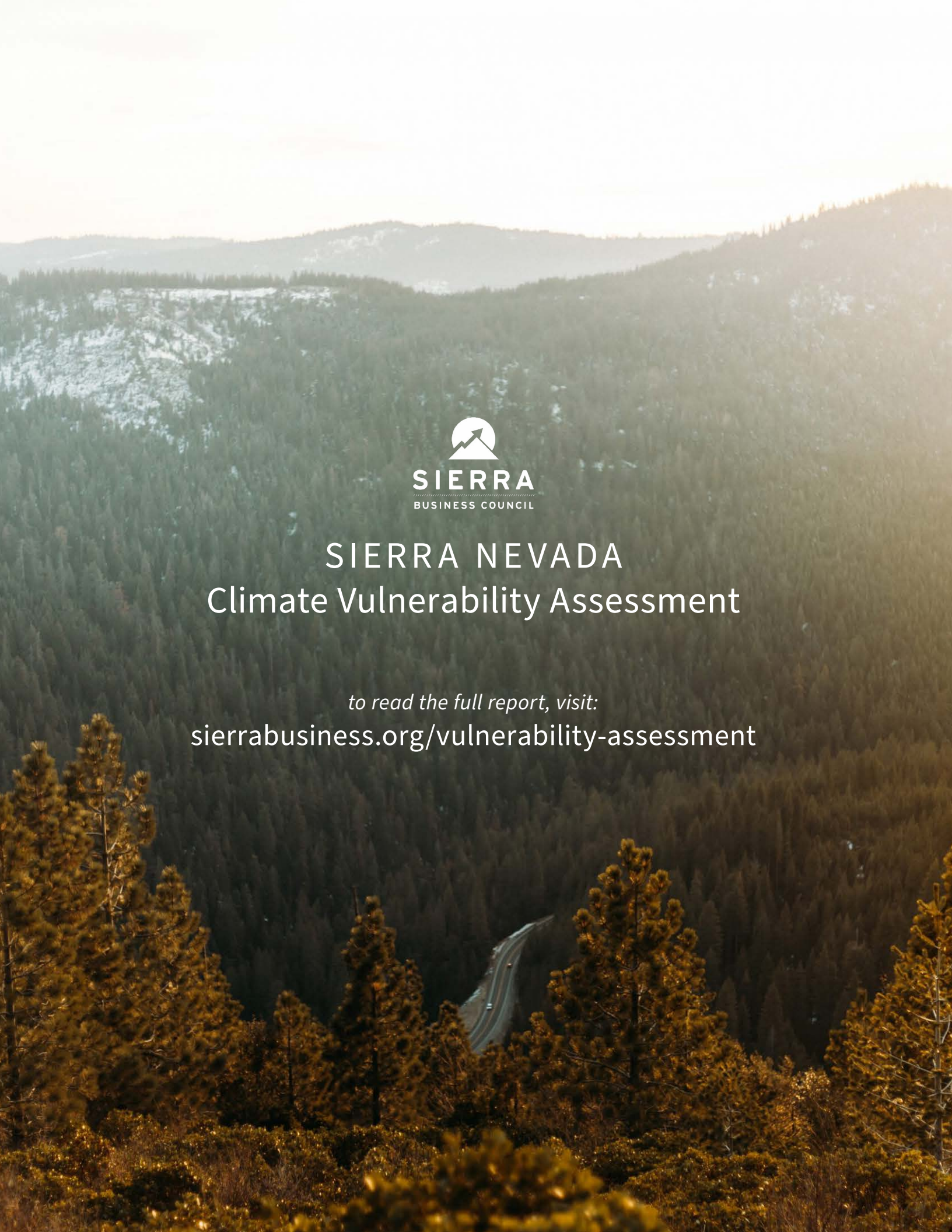
- Assessing local capacity by holding workshops with large groups of diverse community members representing each community
- Utilizing free technical assistance programs like the Sierra Nevada Energy Watch for energy efficiency projects
- Increasing starting wages for government employees to reduce turnover and attract new talent
- Developing hazard mitigation plans that consider how the most vulnerable populations will be affected by the most likely climate hazards

Ancestral Land Acknowledgement

SBC and the Sierra Nevada Climate Vulnerability Assessment recognizes that the region referenced in this report is the unceeded, ancestral lands of numerous tribes, the original stewards of the Sierra Nevada region.

Executive Summary References:

1 https://sierranevada.ca.gov/
2 https://sierranevada.ca.gov/wp-content/uploads/sites/326/2019/12/StateOfSierraForestsRpt_a11y.pdf
3 California 4th Assessment, Regional Report



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to read the full report, visit:

sierrabusiness.org/vulnerability-assessment