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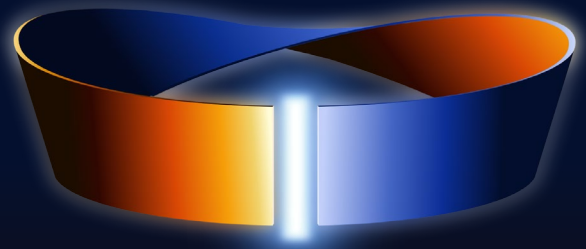

WARP to Resilience

Weather-Adapted Resource Planning

Projected climate trends and patterns of interest to California's energy system

Presented by MARIKO GERONIMO AYDIN

CEC IEPR Commissioner Workshop on Load Modifier Scenario Development

August 18, 2023

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Projected climate trends and patterns

What are climate projections telling us about future weather trends and patterns that are relevant to the performance of California's energy system?

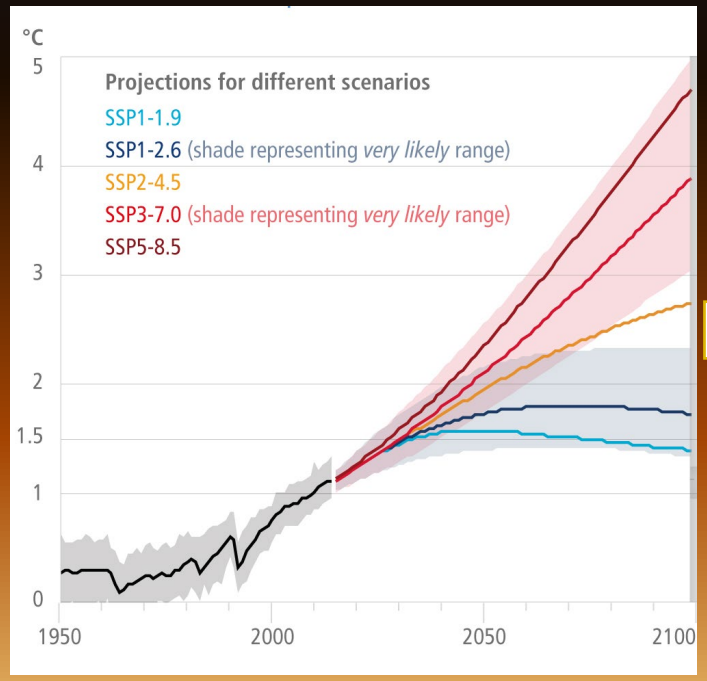
1. Overview of localized, downscaled, hourly climate projections
2. Annual average of summer daily max temperatures in California 1980–2100
3. Temperature trends at individual weather stations 1980–2100
4. Change from 2023 to 2050 in expected number of days reaching 90°F or above

   … and changes in what a more extreme heat year looks like
5. Changes in timing and patterns of days reaching 100°F or above at one weather station 1980–2100

New climate projections data for California

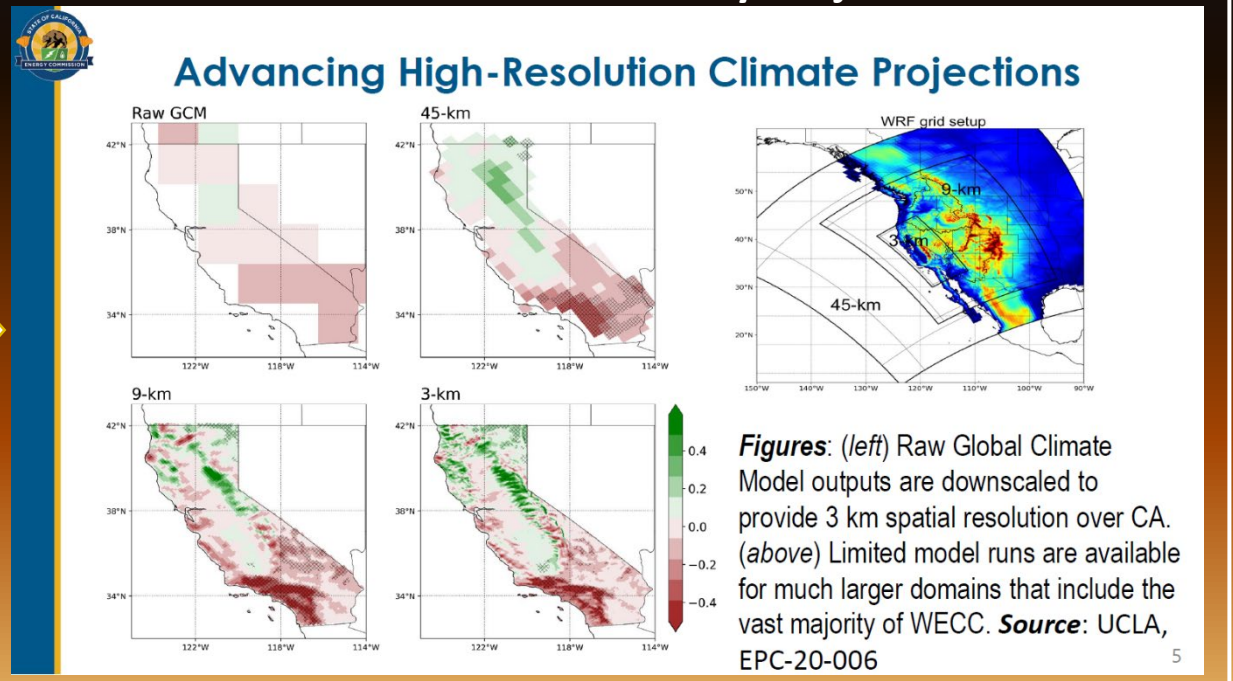
The CEC is working closely with the climate science community to produce detailed data on potential future weather outcomes and patterns to support a variety of mitigation and adaptation planning efforts in the state.

IPCC Sixth Assessment Report: Global Surface Temperature Change Increase Relative to the Period 1850–1900



Source: IPCC, 2022: Climate Change 2022: Mitigation of Climate Change

EPC-20-006: Scripps Institution of Oceanography (UCSD), with UCLA and UC Berkeley Development of Climate Projections for California and Identification of Priority Projections



Source: California Energy Commission, "Incorporating climate change in California's demand forecast," Presentation to Demand Analysis Working Group, June 1, 2023.

Key terms

"SSPs"
Shared socioeconomic pathways

"CMIP6 data"
Coupled Model Intercomparison Project Phase 6

"GCM run"
Global Climate Model

"Actual vs. reconstructed vs. modeled"

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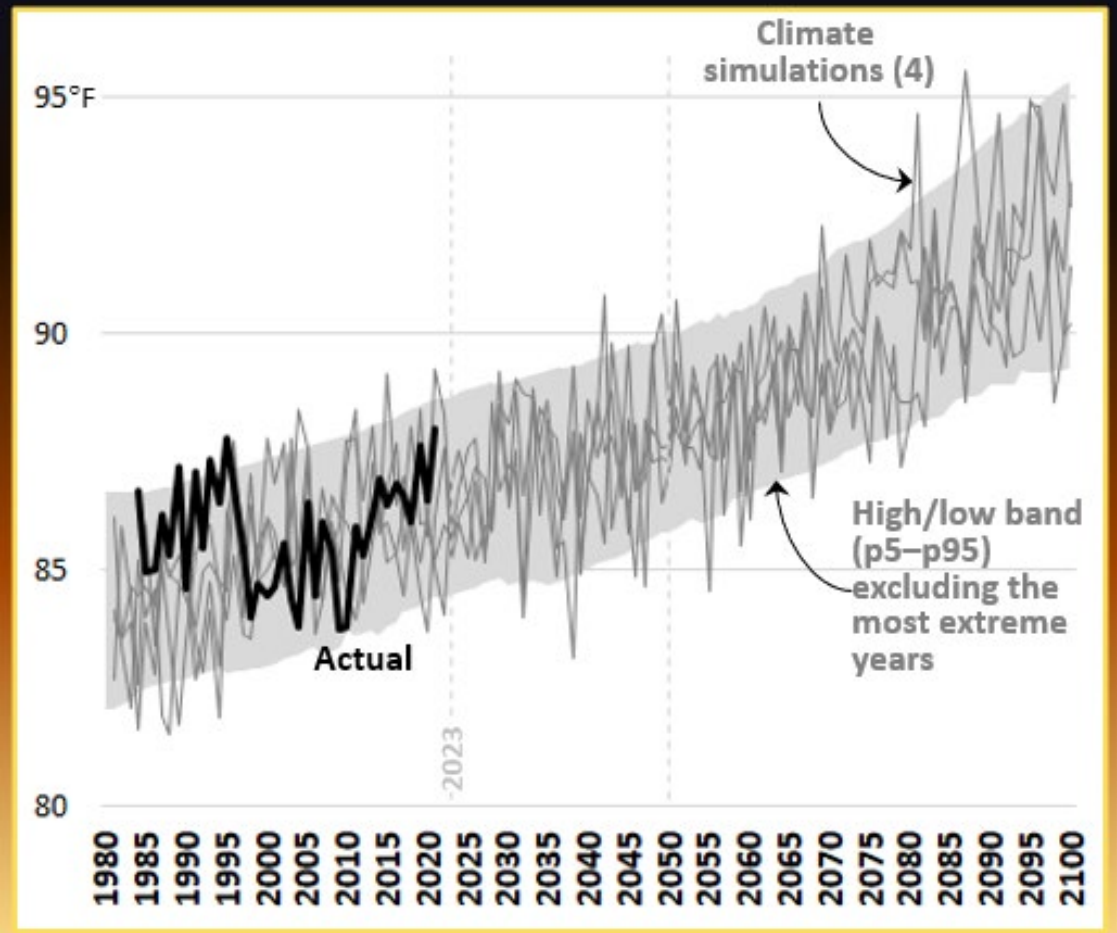
A few considerations as we explore climate projections data

Climate projections help us to share knowledge across industries, understand the range of known possibilities and how they change over time, and ultimately to reduce our planning blind spots.

- No one can predict the future
- Many challenges to planning under uncertainty and interpretation of uncertainty in climate projections
- This presentation's focus is on high temperatures, but cold temperatures and other weather metrics are important and being explored
- For more climate projections data exploration, please see the Cal-Adapt resources:
  - (note CMIP6 data incorporation is currently in progress; some sites may show CMIP5 data)
  - Data repositories
  - Web-based visualization tools: https://cal-adapt.org/
  - Analytics Engine data processing tools: https://analytics.cal-adapt.org/

Annual average of summer daily maximum temperatures in California 1980–2100

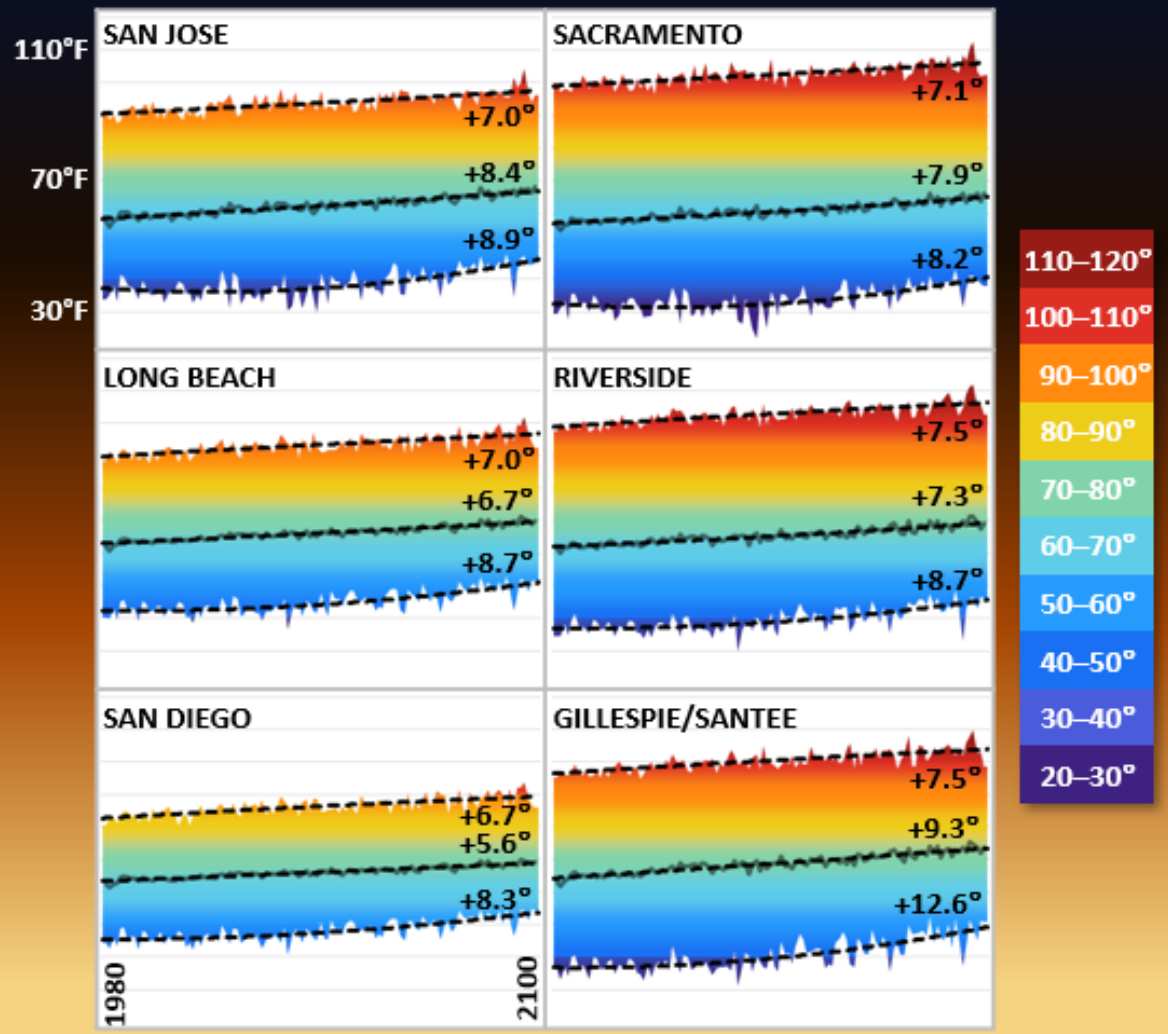
California's climate projections help us better understand both long-term trends and the range of year-to-year variability.



- 4 climate simulations shown are for the SSP3-7.0 scenario; underlying data are hourly and localized to individual weather stations
- Graph shows **demand-weighted** temperatures for the 3 large IOU planning areas (using weather station weights)
- At a high-level, trends show increasing temperatures
- But what could happen in any particular year varies!

Temperature trends at individual weather stations 1980–2100

Because annual and state-level metrics are highly aggregated, they obscure differences in temperature levels and trends people experience in different parts of the state.



- Graphs show one climate simulation's (GCM=CESM2) results at 6 different weather stations
  - In each year: lowest 1% temperatures, highest 1% temperatures, and median temperatures
- Temperature changes are not uniform
  - Temperature levels and trends vary by location
  - Trends may be different at the extremes

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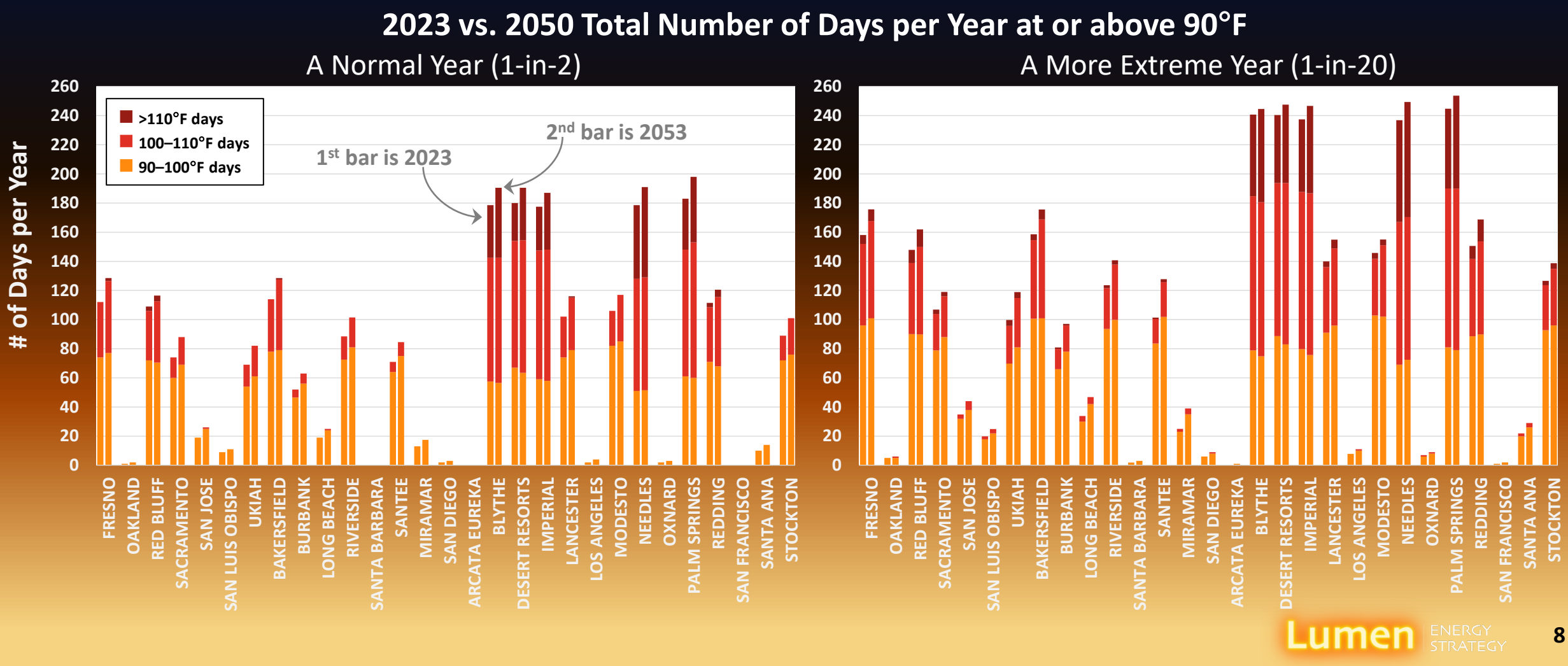
Change from 2023 to 2050 in expected number of days reaching 90°F or above...

Based on a subset of four climate simulations, future temperature trends and patterns translate to up to 17 additional 90°F+ days at selected weather stations across the state by 2050.

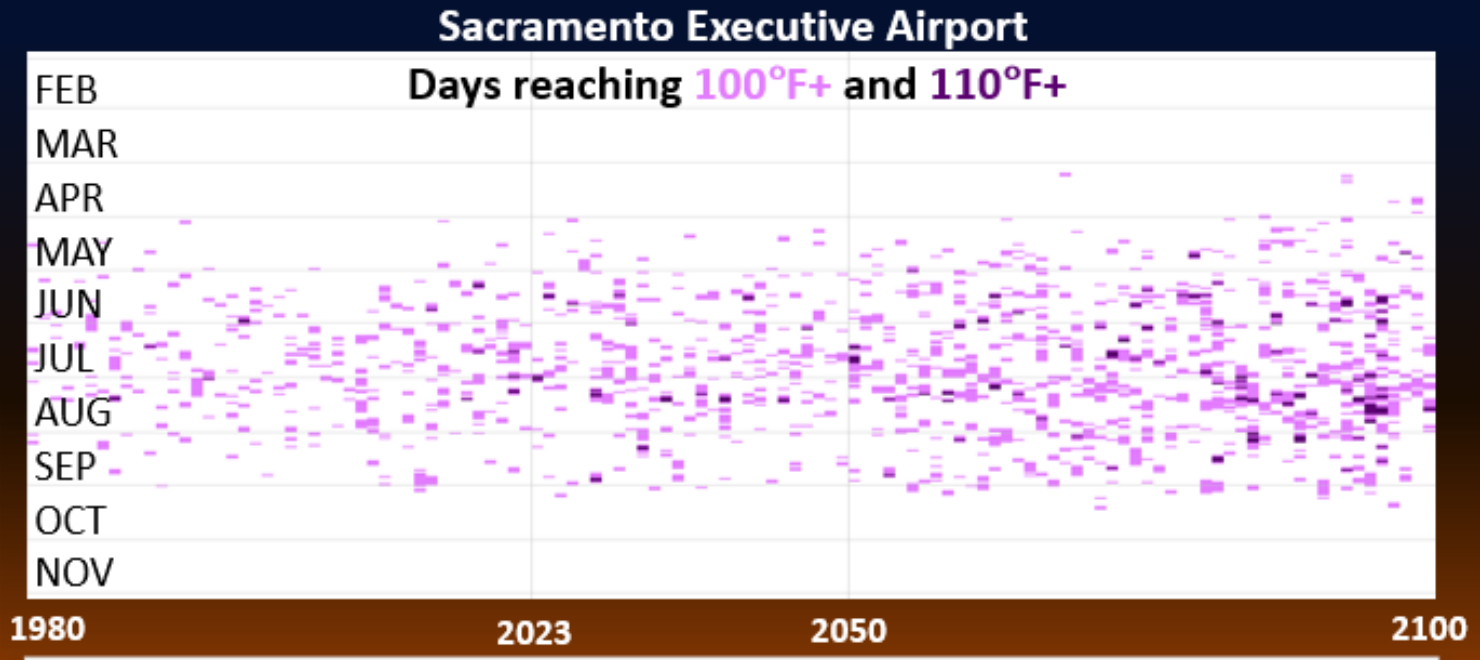
- Based on the four SSP3-7.0 climate simulations previously referenced
  - Considering "expected" (1-in-2, or p50) outcome out of 120 possible weather variants in each year 2023 and 2050
  - See next presentation for development of weather variants
- Depending on the location, additional high-temperature days may include 100°F+ days and 110°F+ days

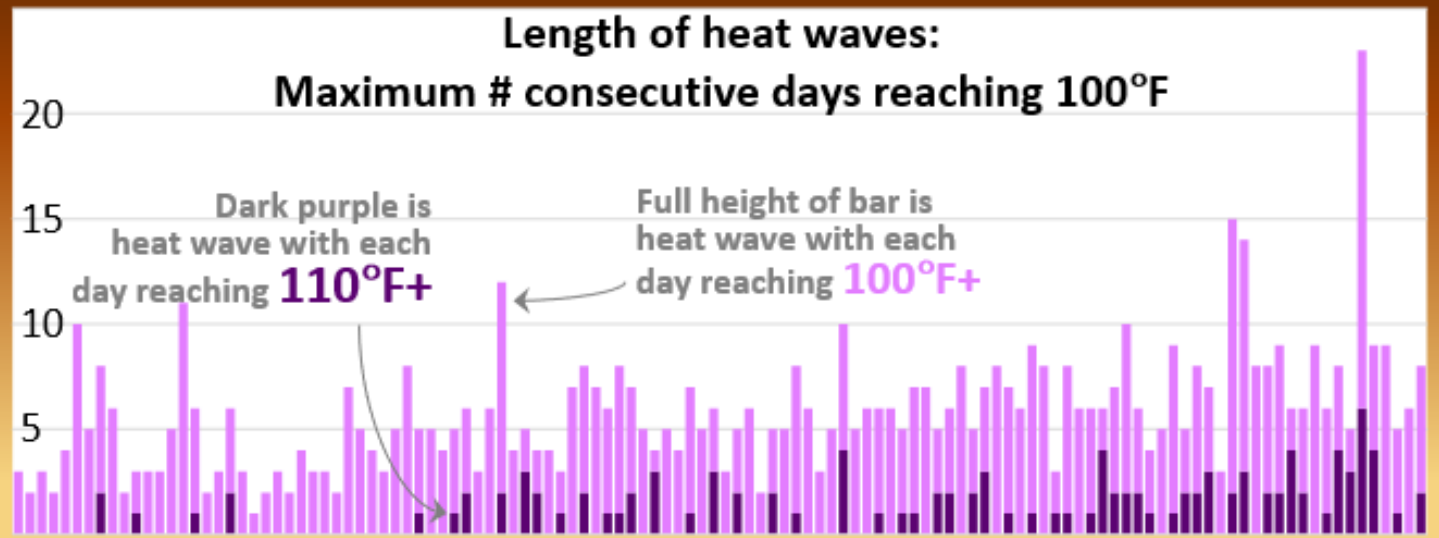
… and changes in what a more extreme heat year looks like

As the experience of a "normal" year changes, so will the experience of a more extreme year.



Changes in timing and patterns of days reaching 100°F or above at one weather station 1980–2100





Additional high temperature days may cluster in heat waves and present novel weather patterns that strain the grid.

- Graphs demonstrate one climate simulation's (GCM=CESM2) results at one weather station (Sacramento)
  - Recall that historical period is modeled and not replicated
- Looking forward, high temperatures may occur more frequently and in additional months
- Heat waves may last longer and involve higher temperatures

Thank you

Learn more about WARP to Resilience and join our mailing list for study updates

www.lumenenergystrategy.com/resilience

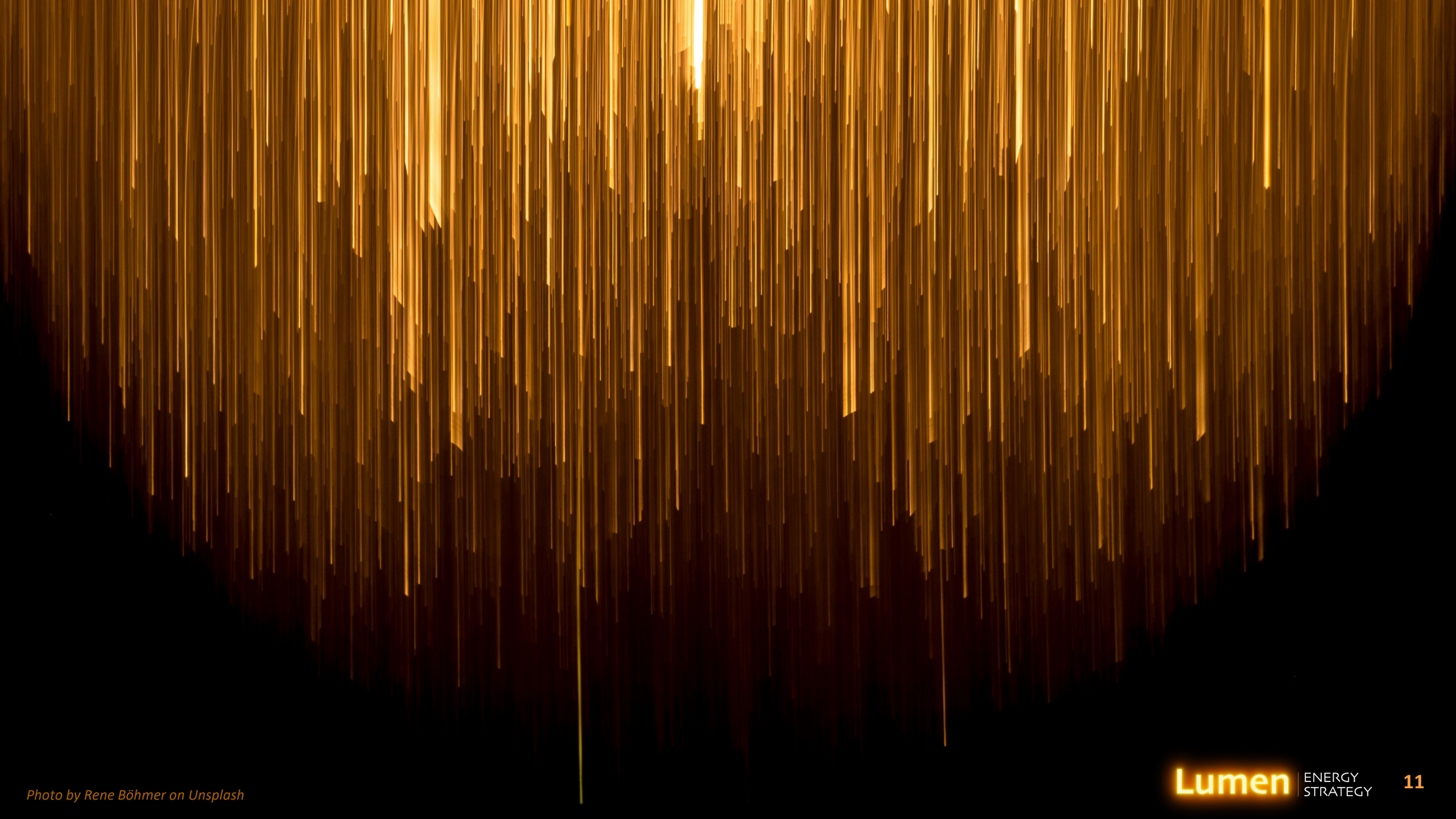


Photo by Rene Böhmer on Unsplash