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ESTIMATING RISK TO CALIFORNIA ENERGY INFRASTRUCTURE FROM PROJECTED CLIMATE CHANGE

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Overview of Research Tasks

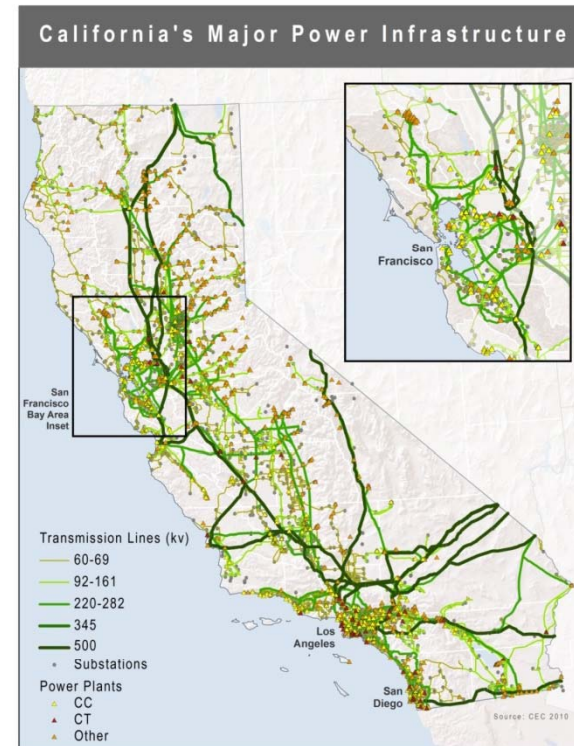
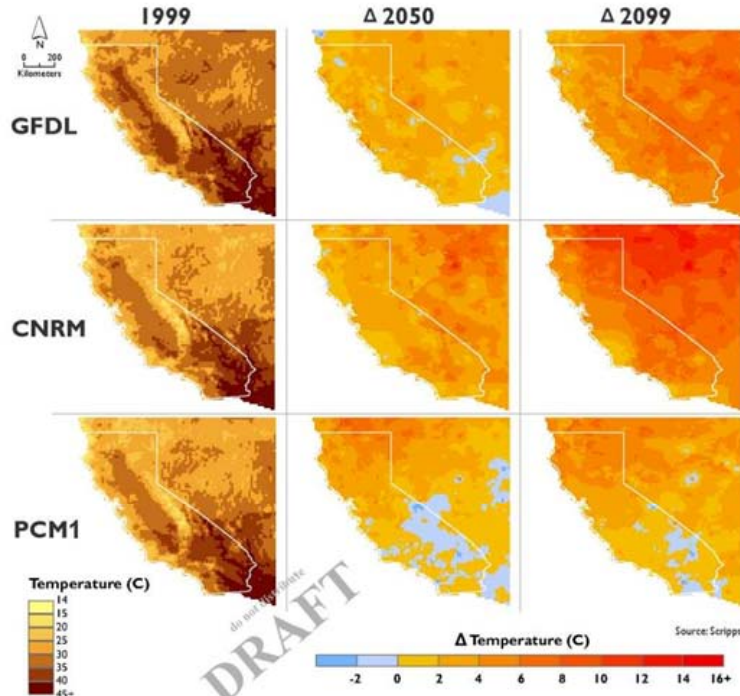
- Assess the vulnerability of ...
 - *electricity infrastructure* to **warming temperatures**.
 - *electricity infrastructure* to **wildfires**.
 - *electricity, natural gas, and other energy infrastructure* to **sea level rise**

Case Study: Risk to CA Energy Infrastructure

BACKGROUND:

- California Energy Commission funded study to estimate power demand and explore physical risk to CA energy supply system.
- Technical advisory committee, including power sector stakeholders, provide feedback on data sources and methods.
- Estimated risk for A2 and B1 scenarios for three time periods up to 2100

Change in August Mean Maximum Temperature from 1999: A2



BASIC METHOD:

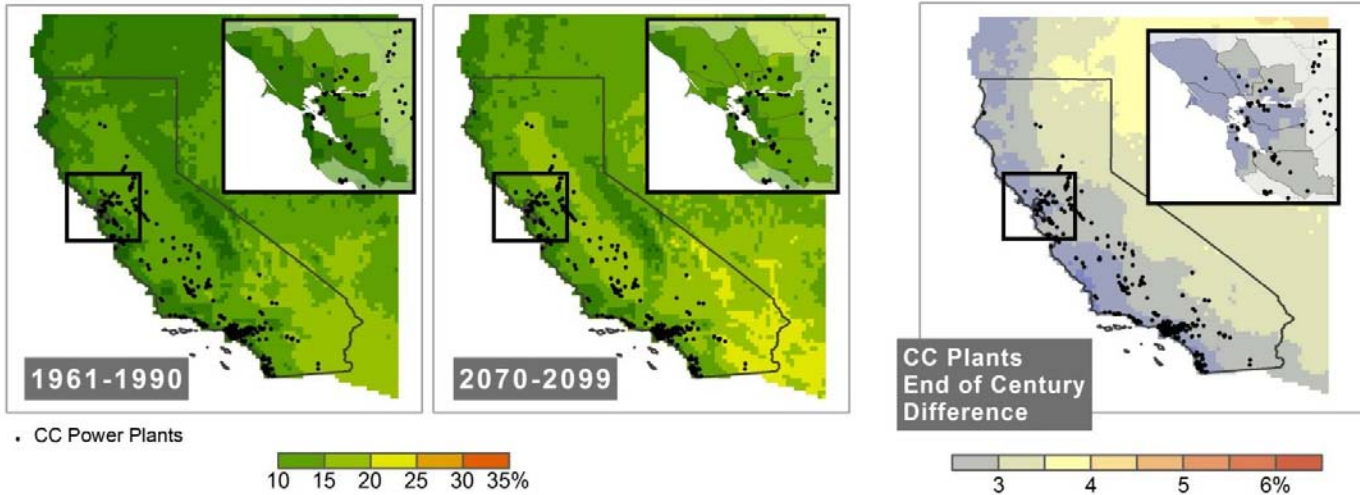
- Coupled downscaled AOGCM projections to electrical system thermal equations to estimate changes to system capacity and demand from increased ambient temperature.
- Overlaid sea-level rise estimates and wildfire projections with known location of CA energy infrastructure.

End-of-Century Impact Mapping

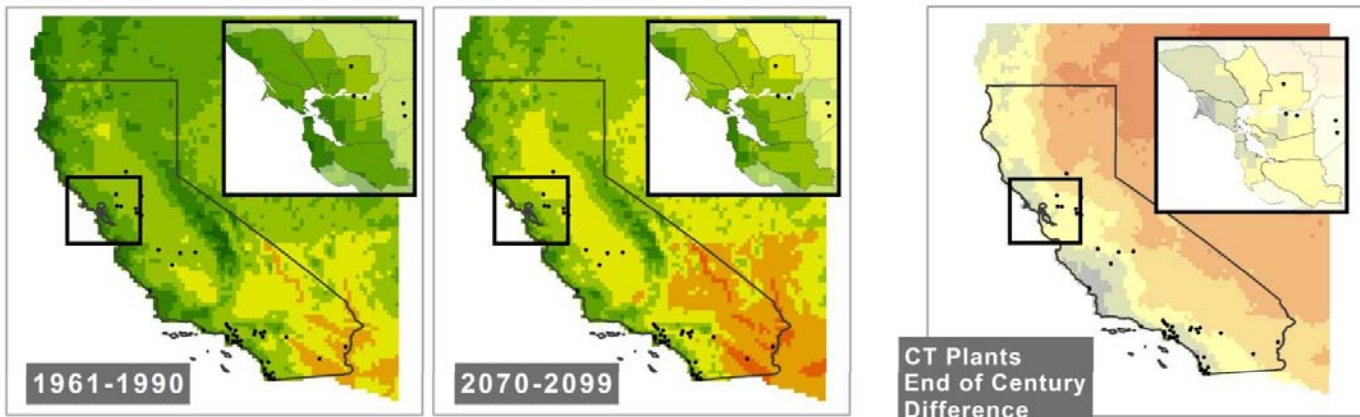
A2 Scenario, Three AOGCMs
Average Peak Capacity Loss in August

Source: Scripps; CEC; LBNL

CC Power Plants



CT Power Plants



● — Absolute Capacity Reductions — ● ● — Incremental Reduction — ●

Electricity Demand and Supply: Results Summary

- **Need for More Generation on Hottest Days**

- Decreased Gas Plant Generation Efficiency

- Current Nameplate 44.1 GW
 - Need 3.5 additional GW (8%)

- Peak Period Demand (90%tile)

- 21% higher cooling demand
 - Need 12.1 additional GW (27%)

- Substation Loss

- 2.7% higher losses
 - Need 1.6 GW (3.6%)

- Total Required Generation Capacity:

- Current capacity 44.1 GW
 - Need 17.2 additional GW (39%)

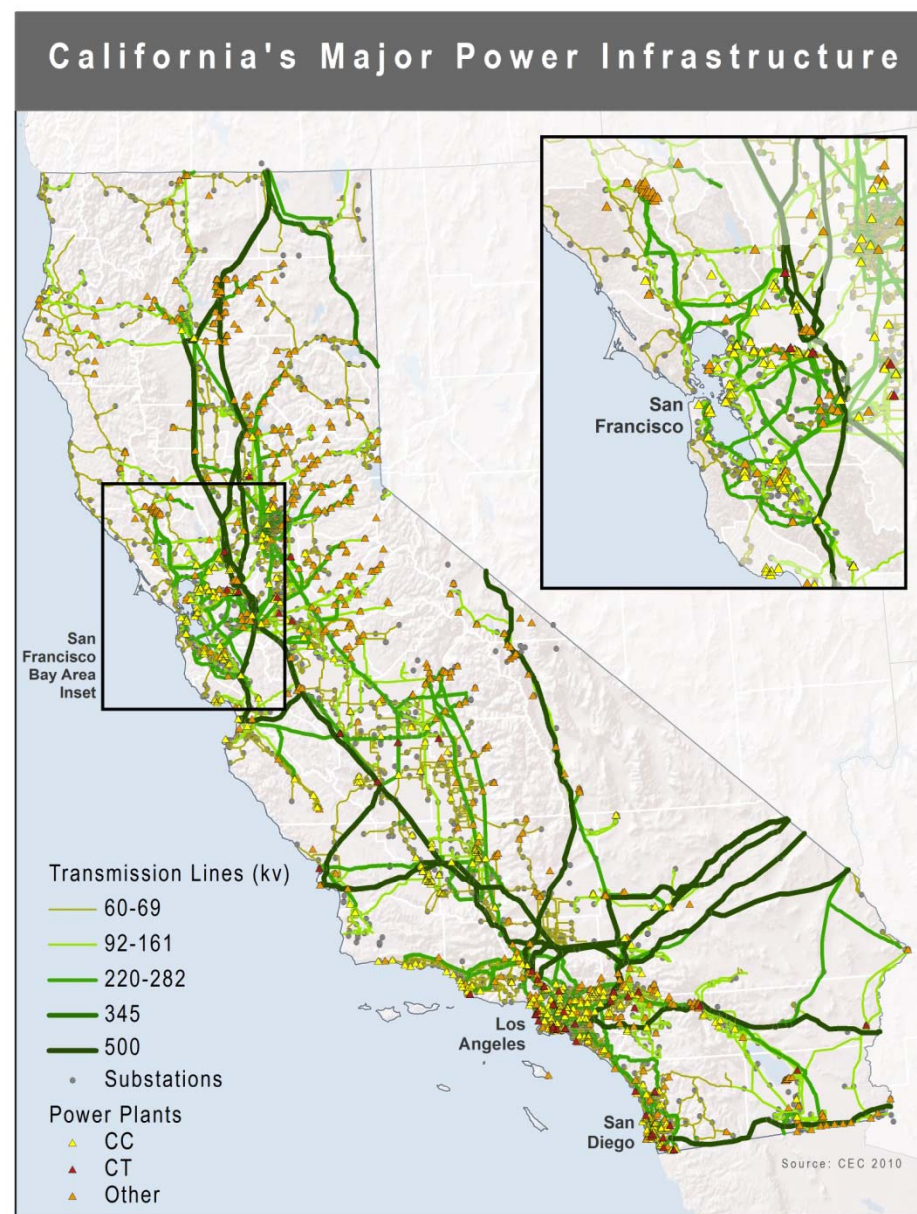
- **Need for More Transmission Capacity**

- Transmission lines

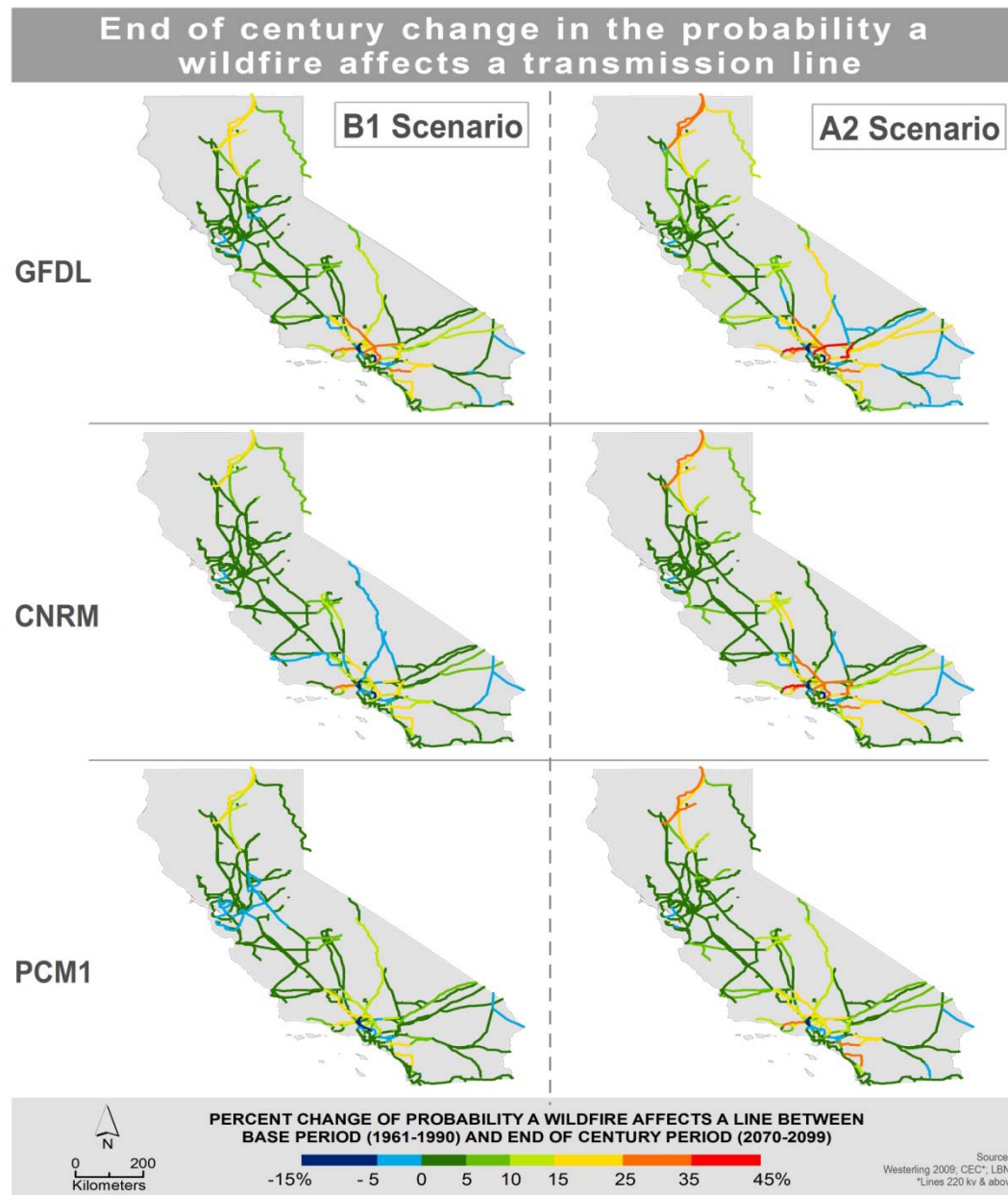
- 7% - 8% loss of peak period capacity
 - 21% higher peak load
 - Need up to 31% additional transmission capacity

- **End of Century and Mid Century Impacts**

- Focused on End of Century
 - Mid Century under 2100 impact
 - Growing Population

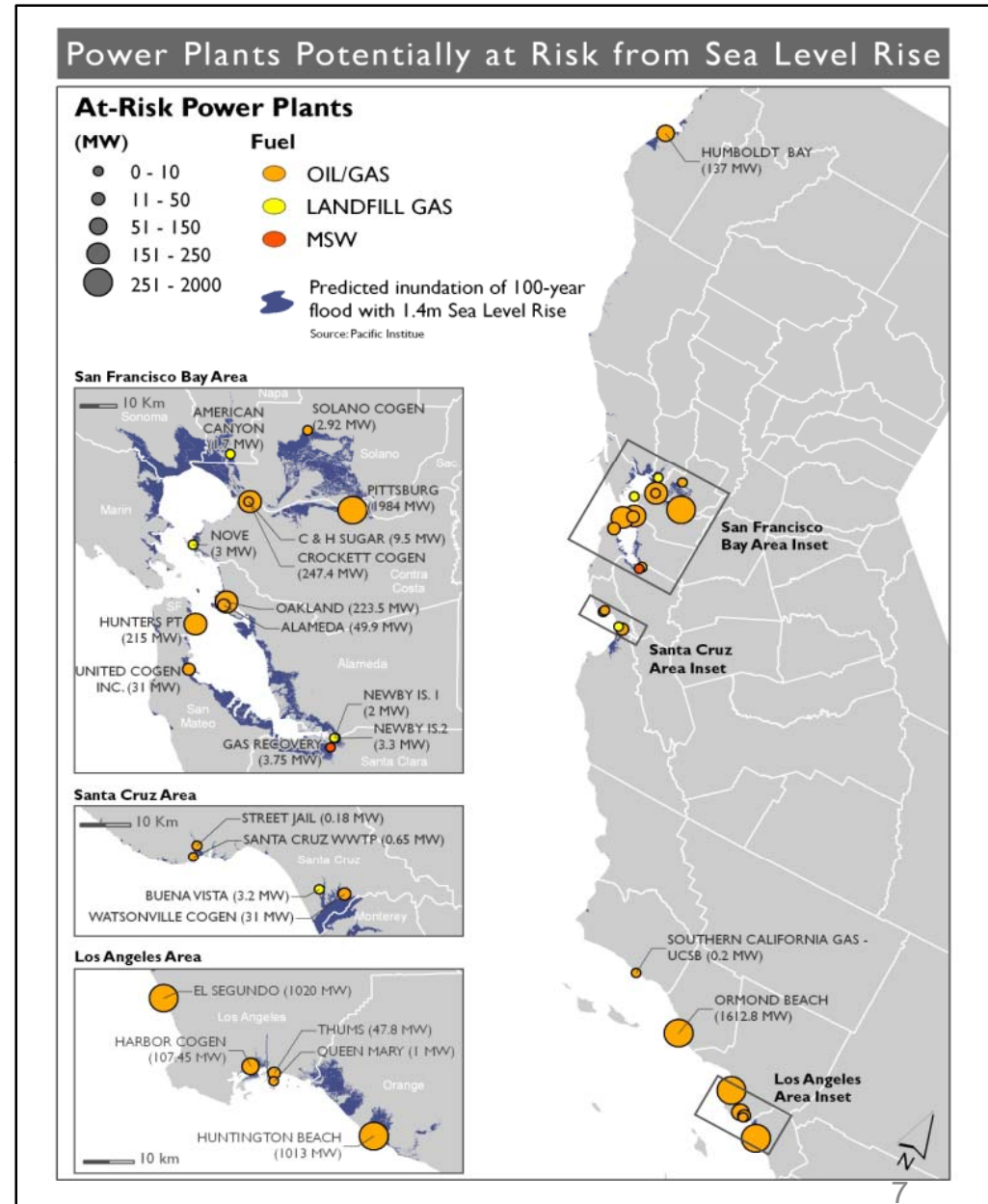


Projected fire risk to transmission lines for the A2 scenario



Sea Level Rise Impact Mapping & Comparisons

- Projected sea level rise – 1.4 meters
- 25 power plants and about 90 substations are vulnerable to sea level rise
- Humboldt Bay and Antioch Site visits indicated that coarse vertical resolution of CA topography may have over- or under-stated impacts in power plant locations.

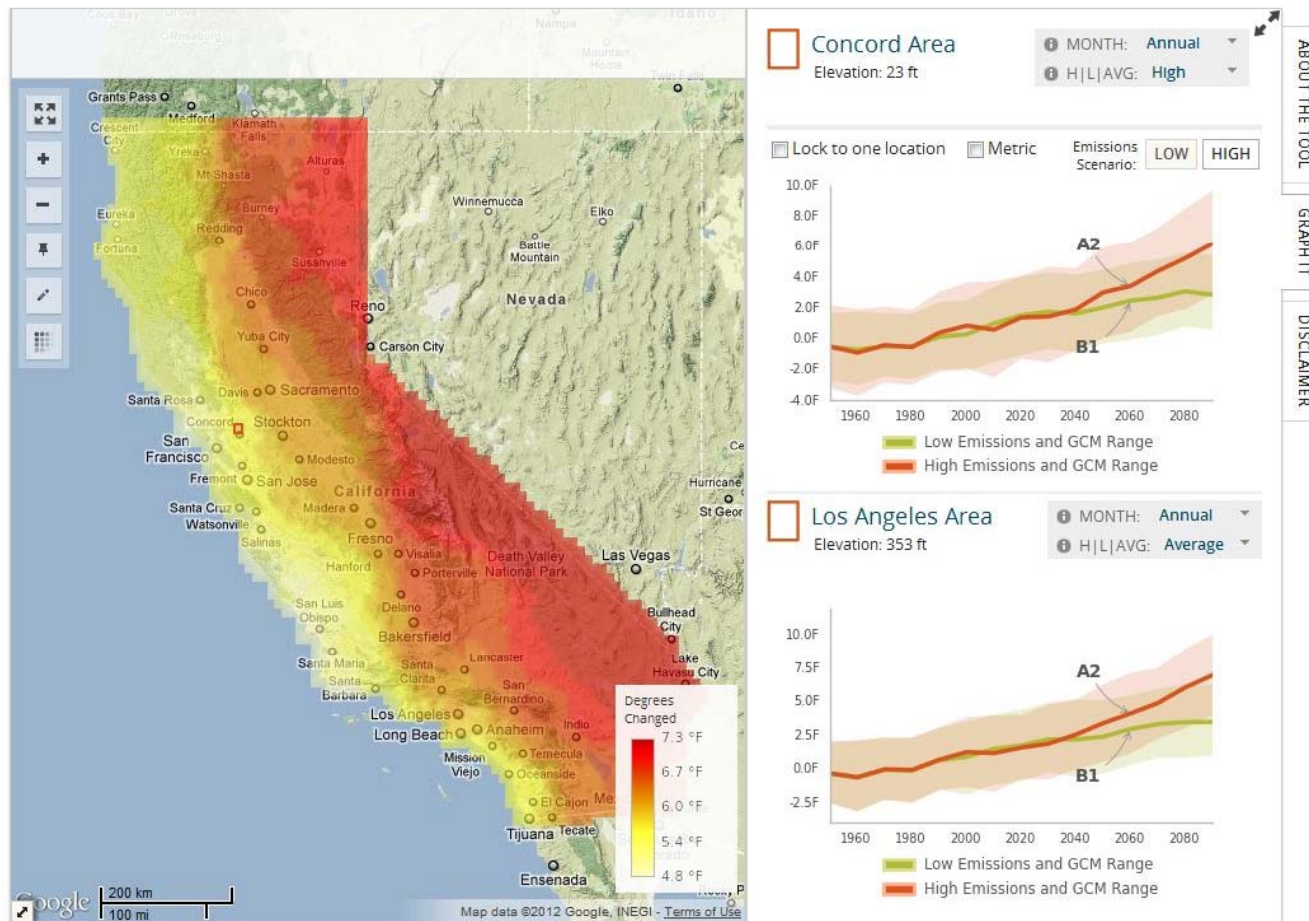


Lessons Learned

- Temperature impact on demand is higher than on supply infrastructure
 - Impacts work together combined impact is substantial—38% more generation needed
 - Impact on hydropower depends on water supply conditions
- Impact of wildfires potentially high.
 - Up to 40% increased fire risk along key transmission corridors.
- More data and research are needed to evaluate:
 - Wildfire and sea level rise.
 - Temperature impacts on electricity transmission and distribution
 - Changes to electricity infrastructure design
 - All time periods
- Electric Utility Planning Issues

New Data from Cal-Adapt Site

TEMPERATURE: DEGREES OF CHANGE MAP



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