



Energy Infrastructure Risks from Climate Change

Vulnerability Research in California

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California Energy Commission

Energy Research and Development Division

2014 Workshop on SF₆ Emission Reduction Strategies

Long Beach, CA, May 6, 2014

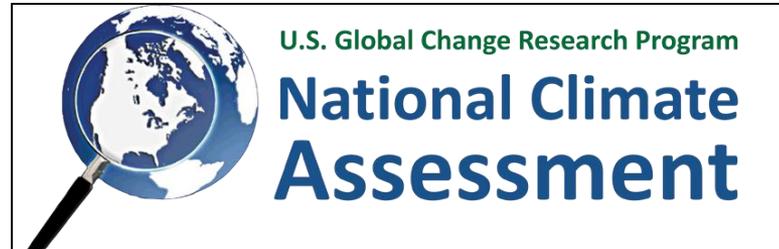


The California Energy Commission

- State's primary energy policy and planning agency.
- Six basic responsibilities:
 1. forecasting future energy needs
 2. licensing thermal power plants 50 megawatts or larger
 3. setting appliance and building energy efficiency standards
 4. developing renewable energy resources and technologies
 5. planning for and directing state response to energy emergencies.
 6. supporting public interest energy research that advances energy science and technology (including climate change)

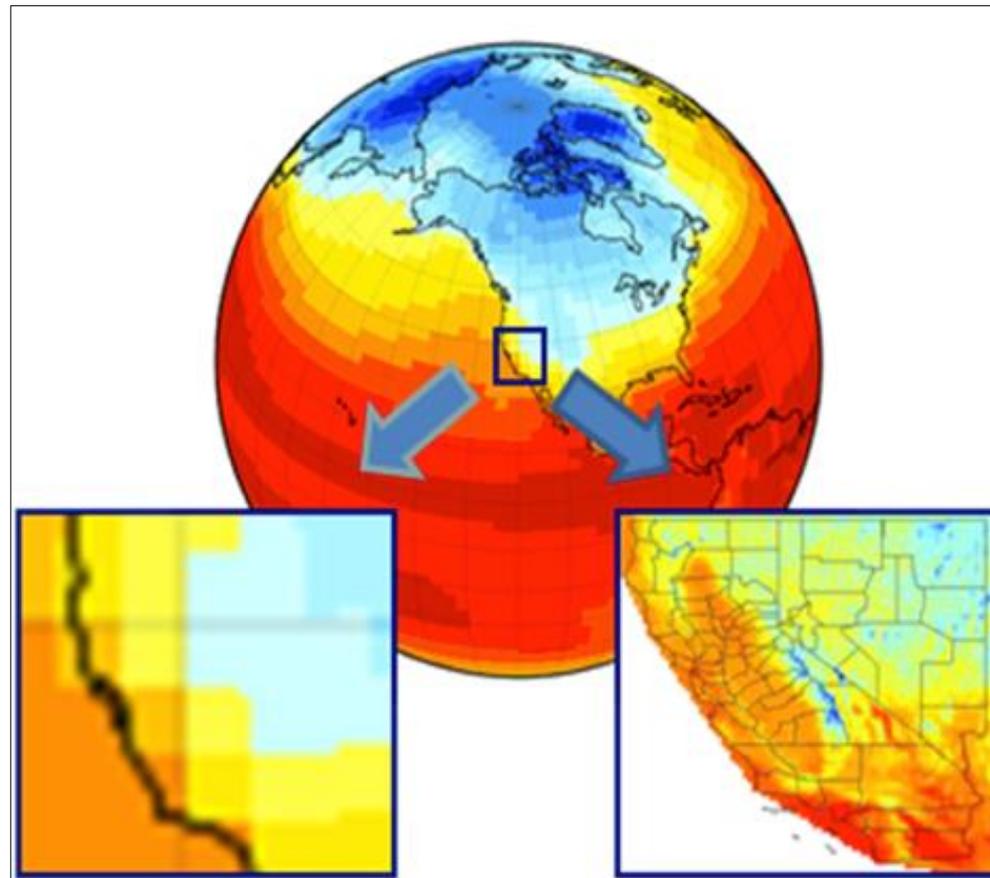


Global to local climate assessments





Climate modeling—global to regional

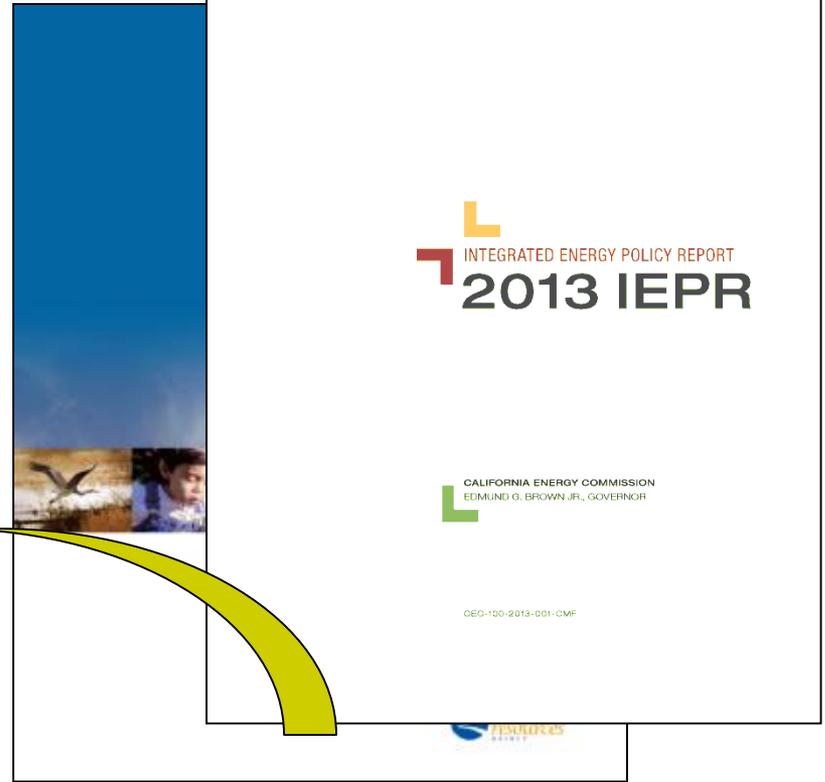
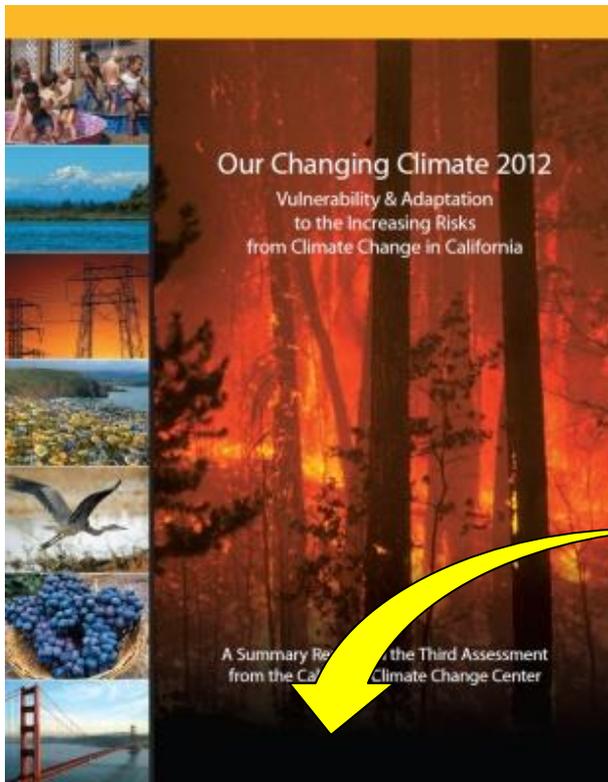


**Global
scale**

**Downscaling
to regional
scale**



California Climate Assessments Inform State Policy



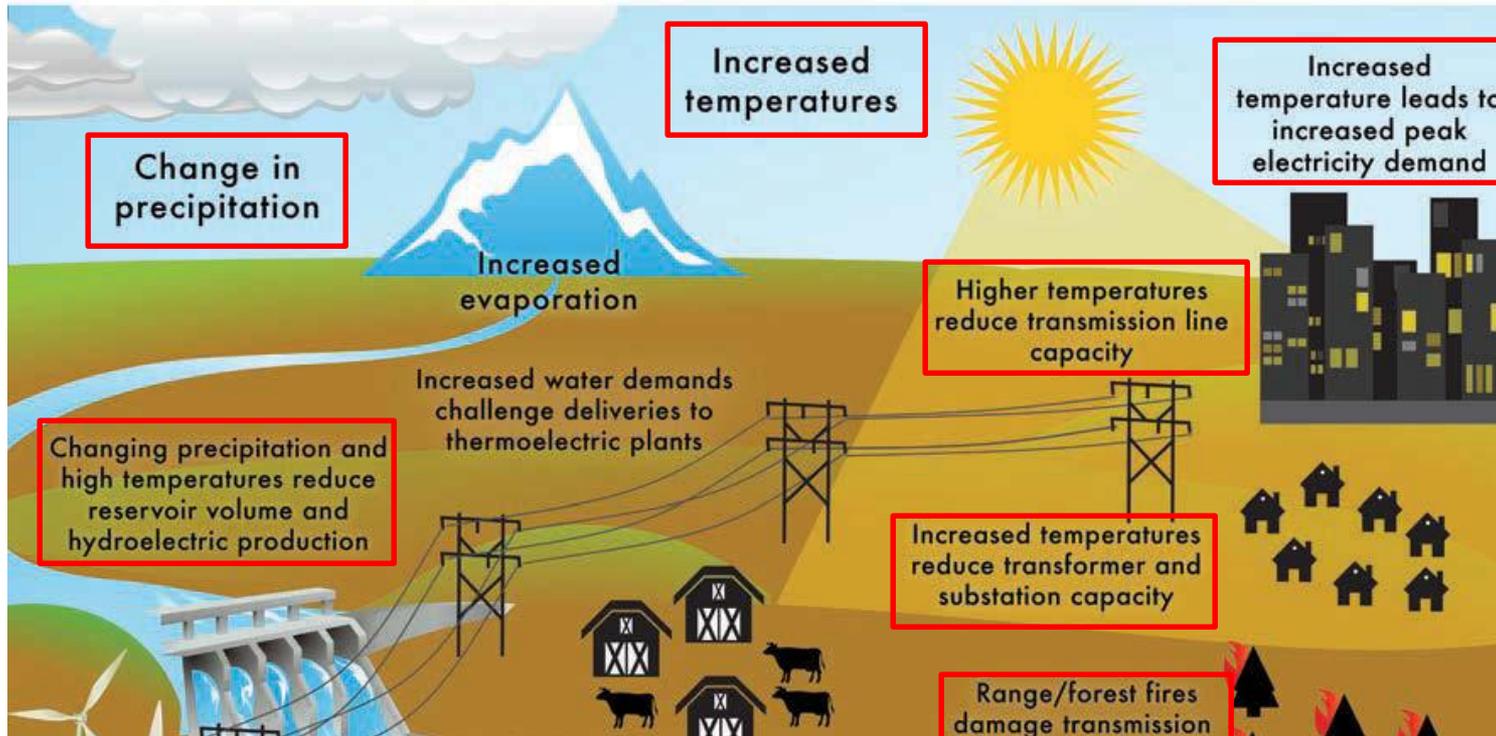
Science



Policy



Electricity sector vulnerability



Source:
Assessment of
Climate Change
in the Southwest
United States,
2013, Chap. 12.

The energy sector is changing rapidly, which represents an opportunity to design a system that is less vulnerable to climate impacts



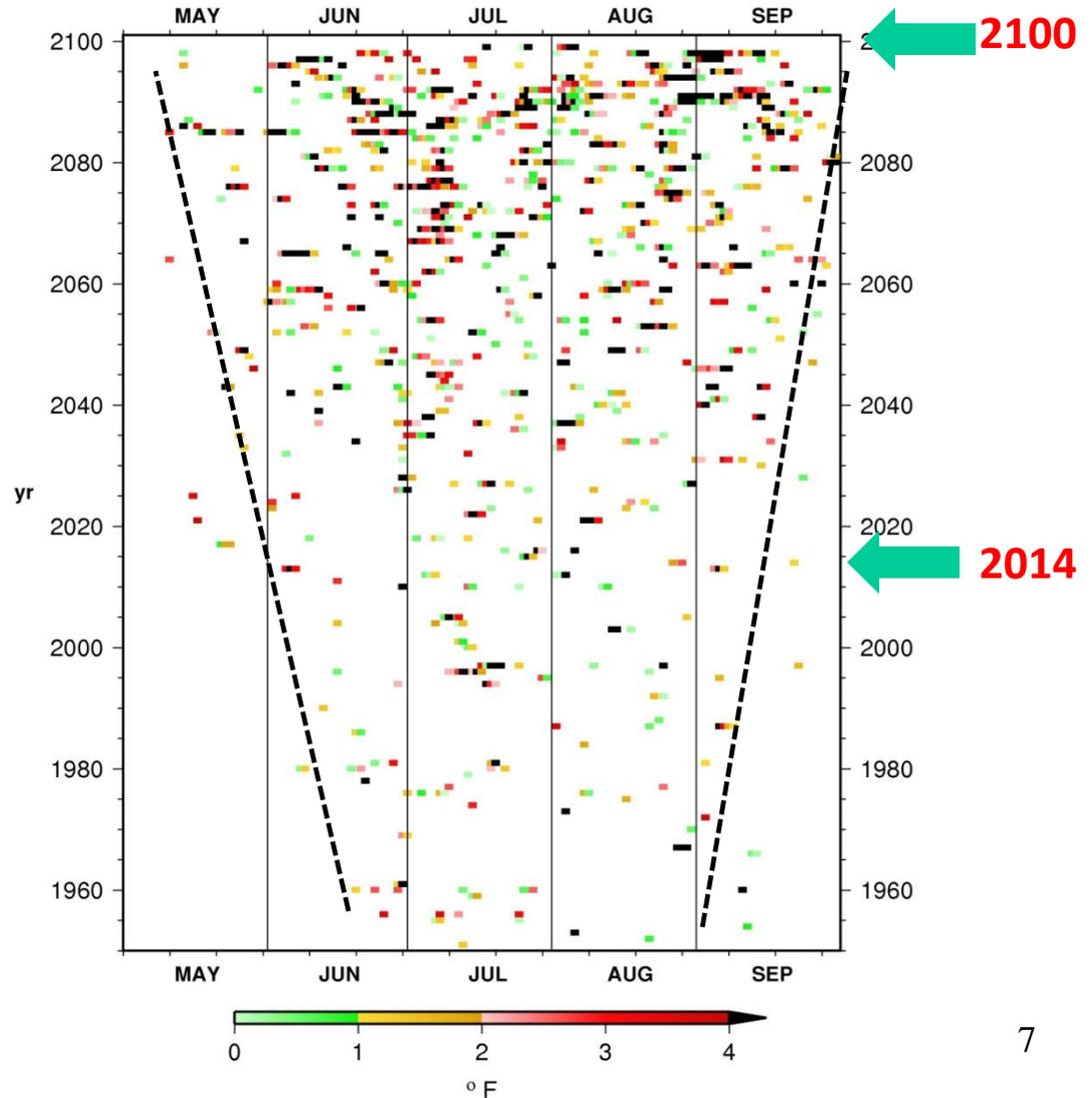
Projections of Heat Waves in Sacramento, California

Source: Cayan, 2013

from BCCA downscaled CNRM RCP8.5 simulation

Days above 106 ° F

Sacramento days exceeding 1961–1990 99th percentile Tmax MJJAS
CNRMCM5 RCP8.5 106.2°F





Electricity

LONG-TERM IMPACTS

Need for More Generation on Hottest Days

- Decreased Gas Plant Generation Efficiency
 - **Need additional GW (8%)**
- Peak Period Demand (90%tile)
 - 21% higher cooling demand
 - **Need additional GW (27%)**
- Substation Loss
 - 2.7% higher losses
 - **Need more GW (3.6%)**

Total Required Generation Capacity:

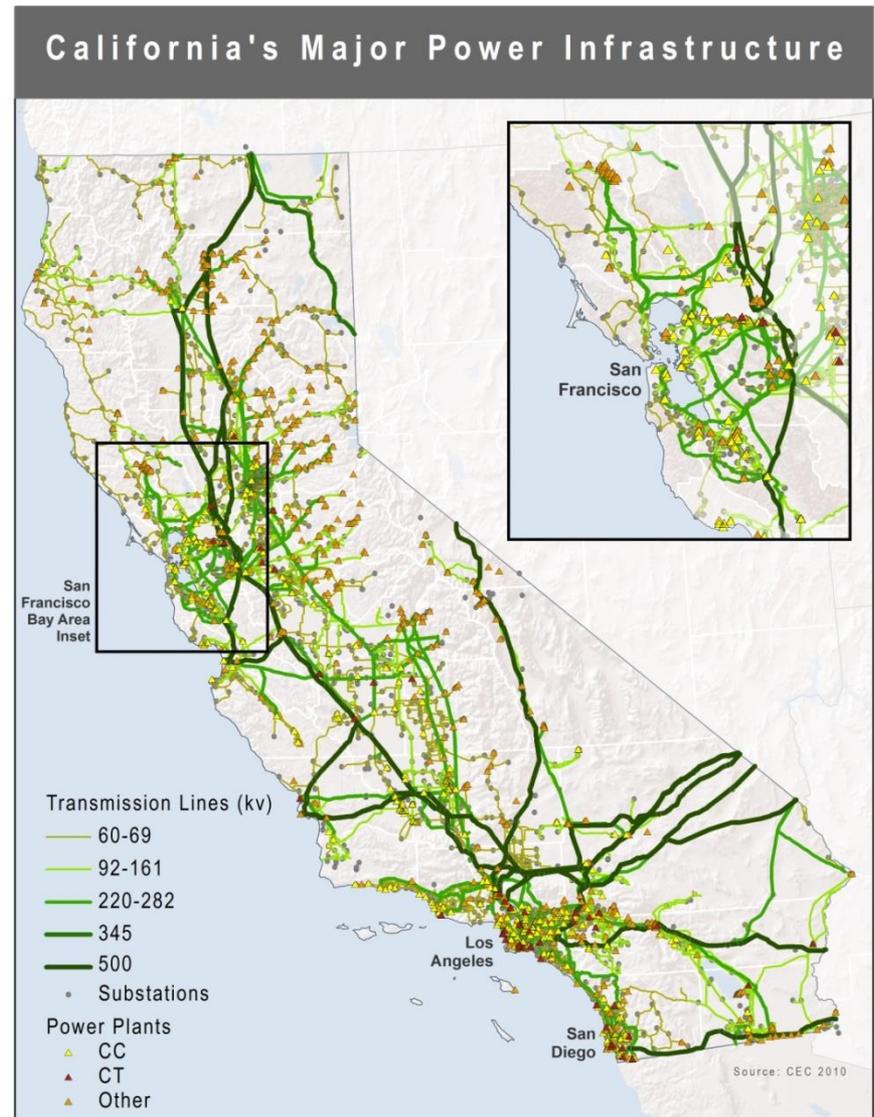
- **Need 39% more capacity GW**

Need for More Transmission Capacity

- Transmission lines
 - 7% - 8% loss of peak period capacity
 - **Need up to 31% additional transmission capacity**

NEAR-TERM IMPACTS

- Additional capacity of 1.6 GW in the next 10 years

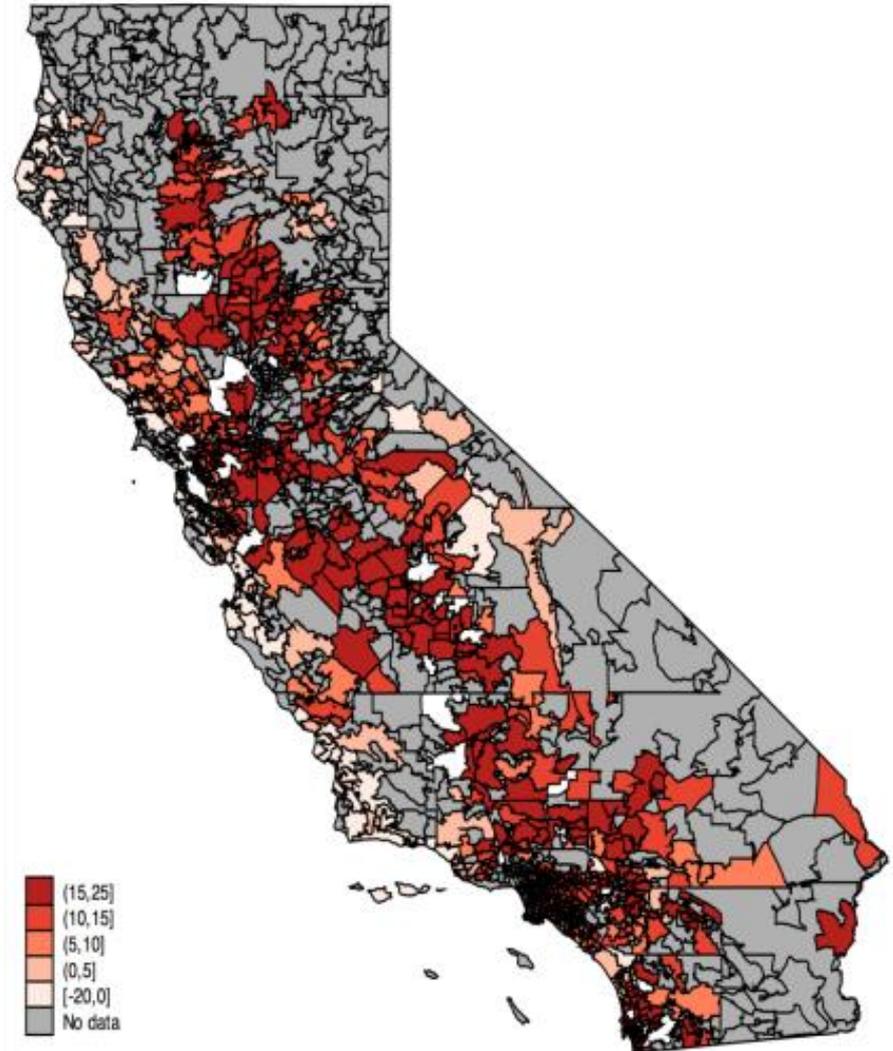




Higher temperatures increase electricity demand

Hotspots of Climate-Driven Increases in Residential
Electricity Demand

Publication Number: CEC-500-2012-021



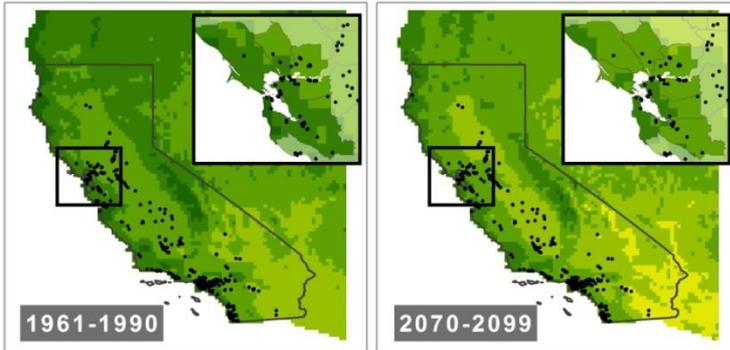


High temperatures reduce outputs from thermal power plants

A2 Scenario, Three AOGCMs
Average Peak Capacity Loss in August

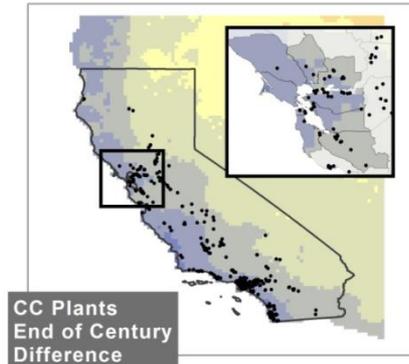
Source: Scripps; CEC; LBNL

CC Power Plants (Combined-cycle)



. CC Power Plants

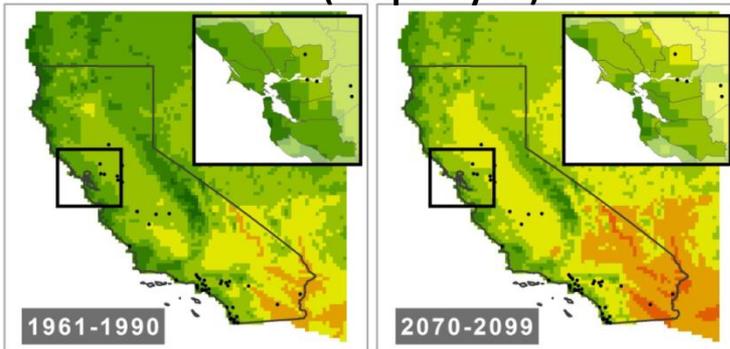
10 15 20 25 30 35%



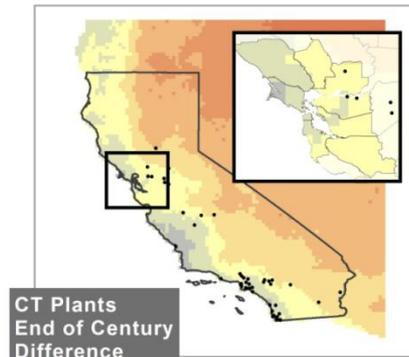
CC Plants
End of Century
Difference

3 4 5 6%

CT Power Plants (Simple-cycle)



. CT Power Plants

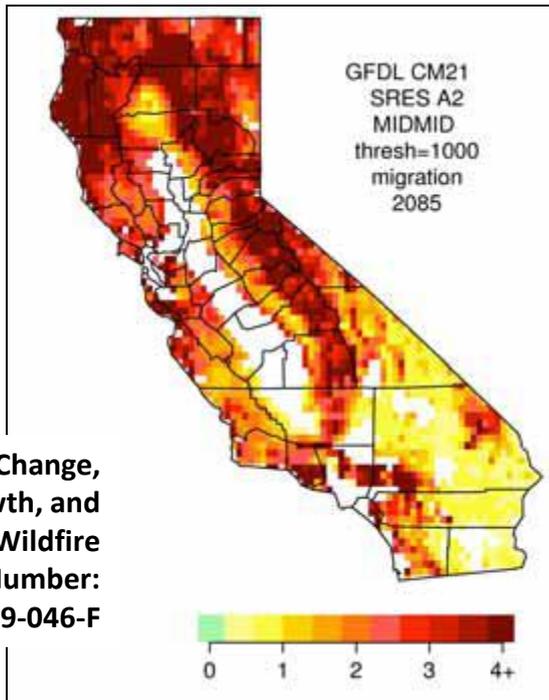


CT Plants
End of Century
Difference

Estimating Risk to California
Energy Infrastructure from
Projected Climate Change
Publication Number: CEC-500-
2012-057

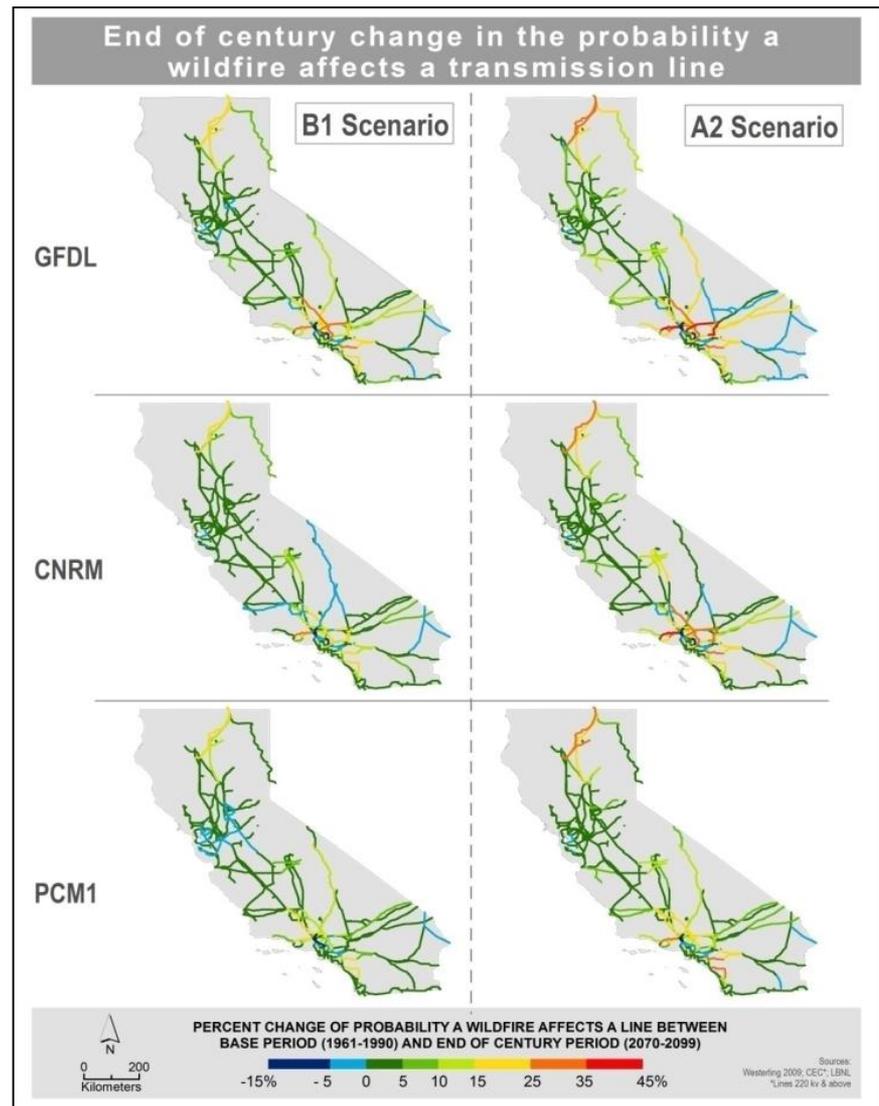


Wildfires would affect transmission lines



Climate Change,
Growth, and
California Wildfire
Publication Number:
CEC-500-2009-046-F

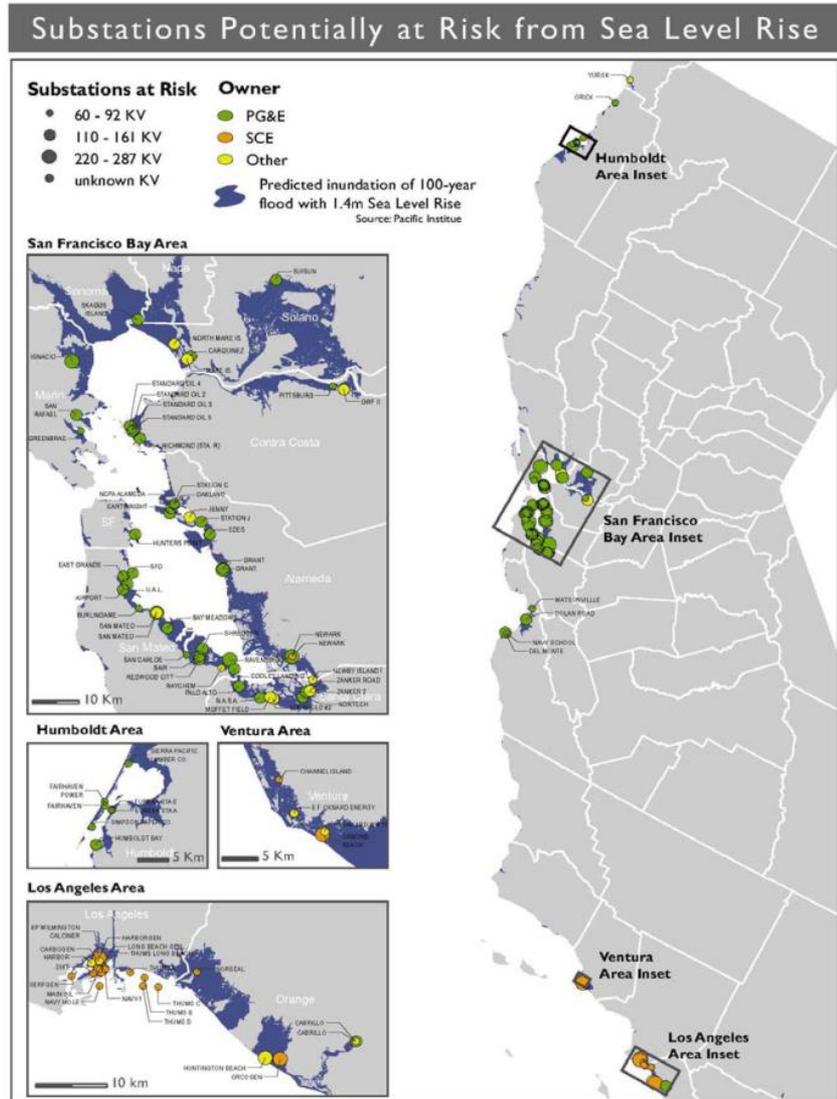
Estimating Risk to California Energy Infrastructure
from Projected Climate Change
Publication Number: CEC-500-2012-057





Coastal substations would be more vulnerable to flooding

Estimating Risk to California Energy Infrastructure from Projected Climate Change
 Publication Number: CEC-500-2012-057

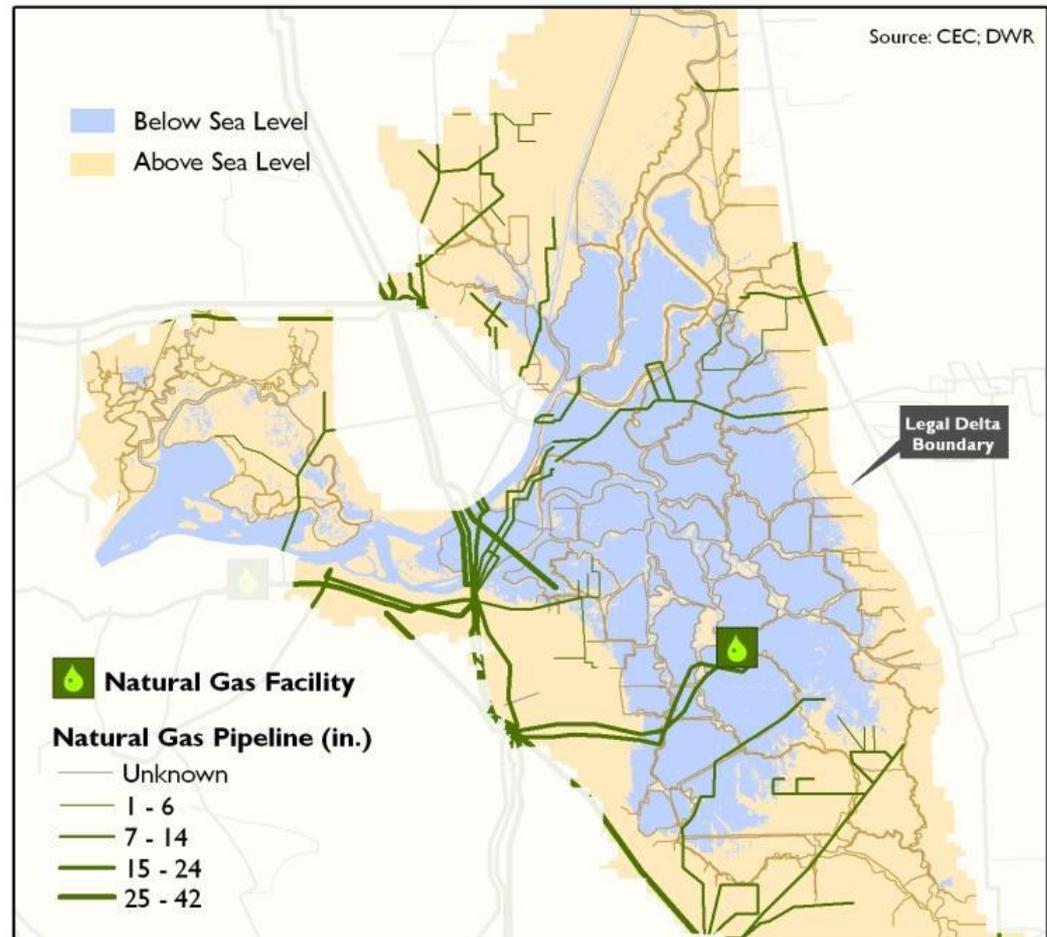




Natural gas facilities below sea level in the Sacramento–San Joaquin Delta

Estimating Risk to California Energy Infrastructure from Projected Climate Change
Publication Number: CEC-500-2012-057

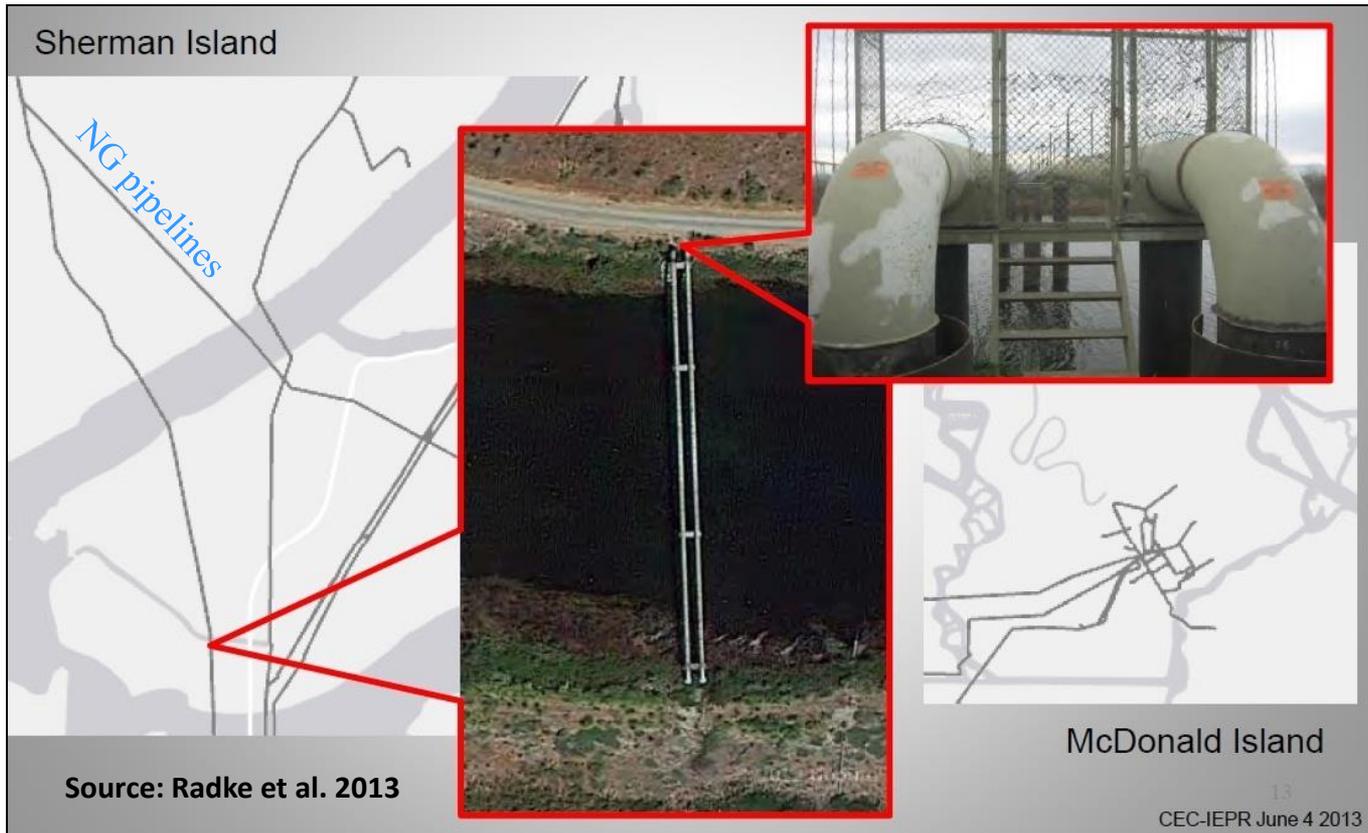
Natural Gas Infrastructure Below Sea Level





Energy Infrastructure in the Sac/SJ Delta

- **Catastrophic failure of the levees in the Delta to impact energy infrastructure**
 - Natural gas pipelines
 - Underground storage facilities
 - Electrical transmission lines





Strategies to prepare for risks

- Protect existing energy facilities from impacts of climate change.
- Diversify energy supply to reduce vulnerability to extreme weather-related events and climate change.
- Promote energy demand-side measures that facilitate climate adaptation.
- Continue energy-related climate change research.



Next steps

- California's 4th Climate Assessment is being planned, to be completed in 2017
- Research solicitations posted at <http://www.energy.ca.gov/contracts/> or subscribe to listserv for alerts



Thank you !

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<http://www.energy.ca.gov/2013publications/CEC-100-2013-002/CEC-100-2013-002.pdf>

STAFF PAPER

Climate Change and the California Energy Sector

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California Energy Commission

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DECEMBER 2013
CEC-100-2013-002

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