

# Vulnerability and Adaptation to Extreme Events in California in the Context of Changing Climate: New Scientific Findings

This one day workshop at Scripps Institution of Oceanography on 13 December 2011 focused on extreme weather-related events in different sectors of the economy such as energy, public health, agriculture, coastal resources, and ecosystems. This workshop was a complementary event to Governor Brown's Conference on Extreme Climate Risks and California's Future, held in San Francisco on 15 December 2011.



# Potential Impacts of Extreme Events on Electrical Energy Demand and Infrastructure

Speaker: Maximilian Auffhammer (UC Berkeley)

Co-authors: Jayant Sathaye (LBNL), Larry Dale (LBNL),  
Joshua Viers (UC Davis), Sebastian Vicuna (U of Chile),  
Guido Franco (California Energy Commission).





# Potential Impacts of Extreme Events On Electricity Demand and Energy Infrastructure

**Maximilian Auffhammer**

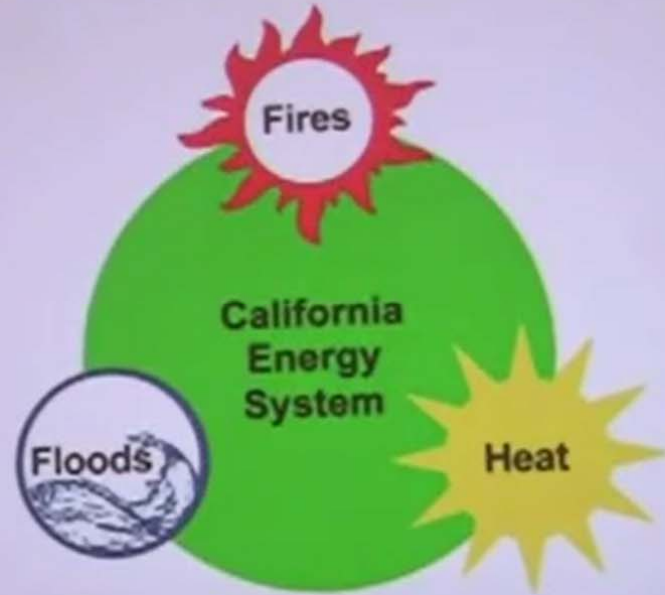
*Associate Professor, Agricultural and Resource Economics  
Energy Institute @ Haas  
National Bureau of Economic Research*

*Representing himself, Jayant Sathaye (LBNL), Larry Dale (LBNL), Joshua Viers  
(UC Davis), Sebastian Vicuna (U of Chile), Guido Franco (CEC)*

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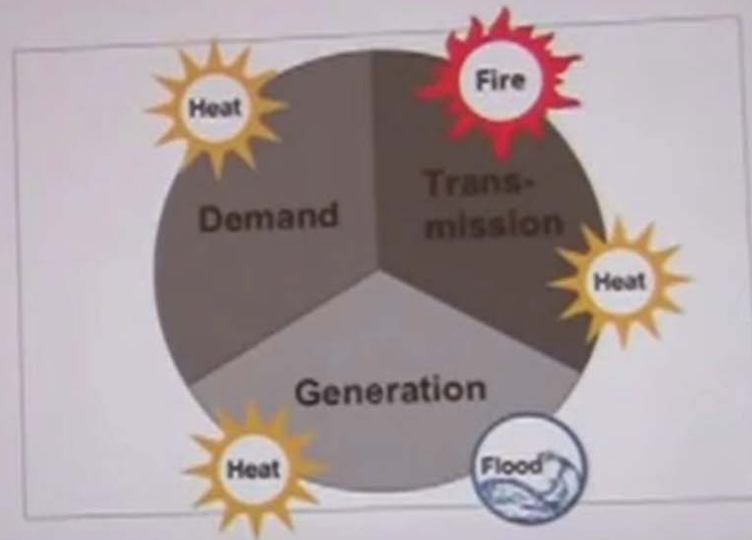


# Extreme events (will) add stress to California's energy system



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# Extreme events will affect different aspects of the energy system

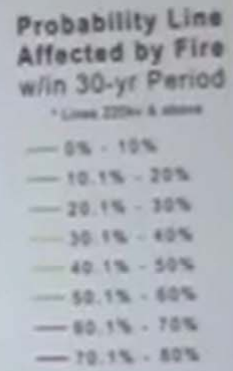
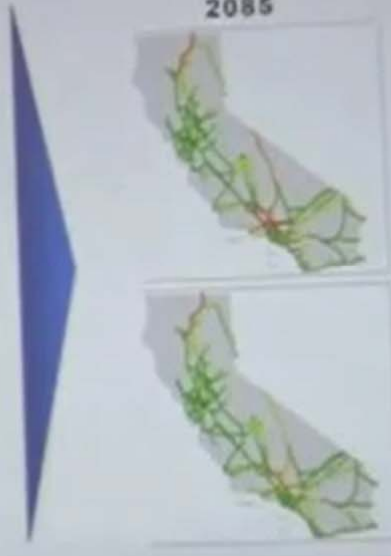
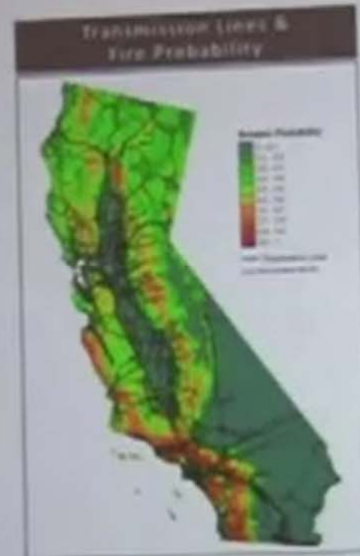


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# Existing Transmission Lines Under Increased Fire Risk

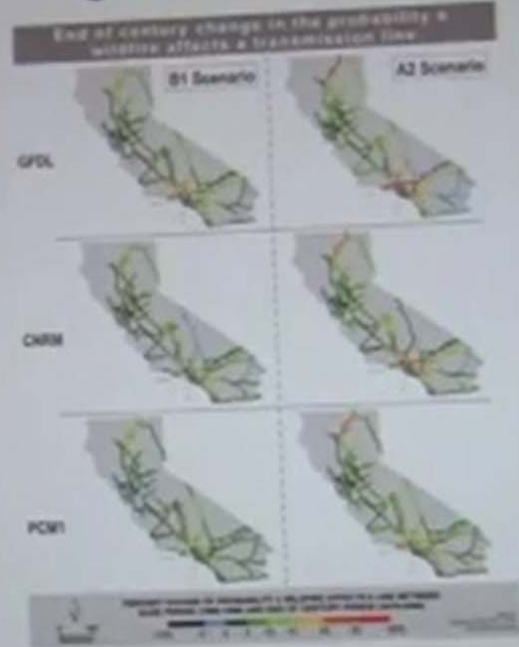


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# Change in fire risk by 2085



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# Change in fire risk by 2085

A2 Scenario



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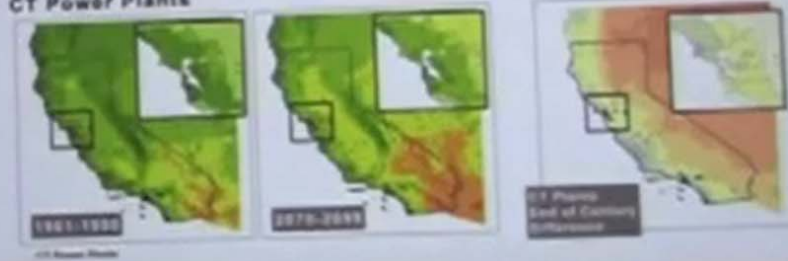


# Power Generation and Transmission Losses

## CC Power Plants



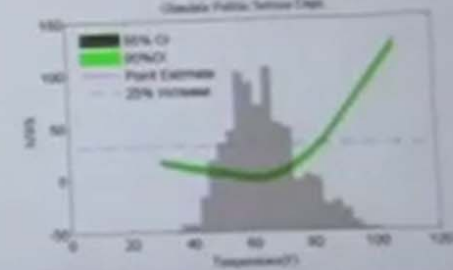
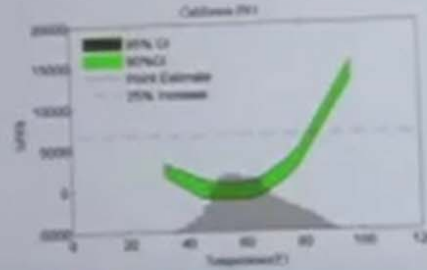
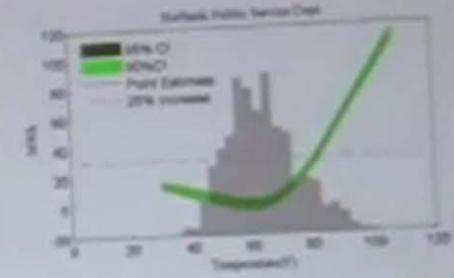
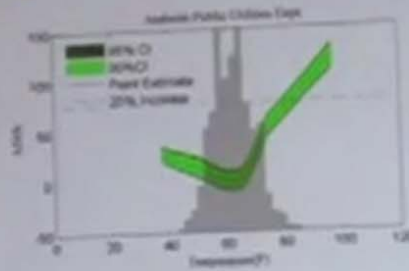
## CT Power Plants



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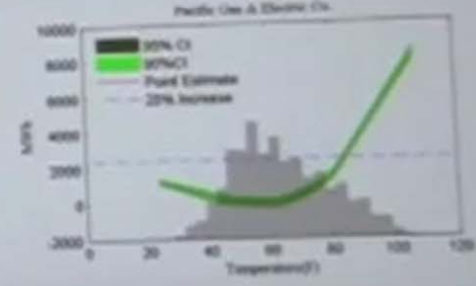
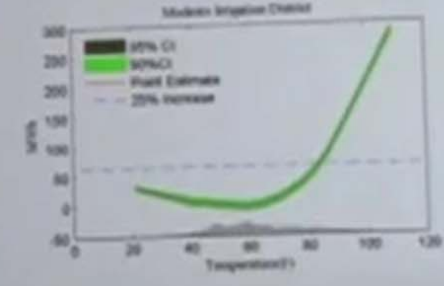
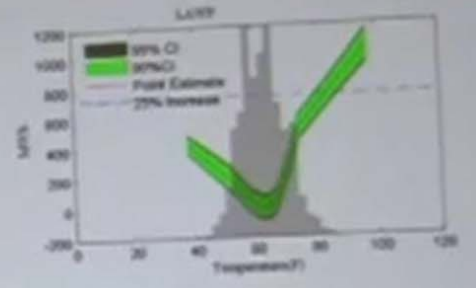
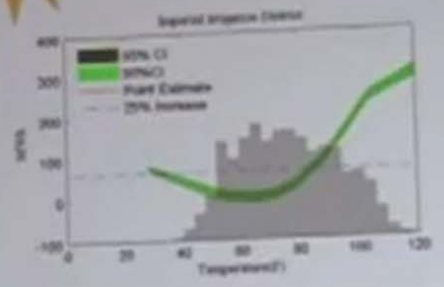
# Electricity Load varies across California



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# Electricity Load varies across California



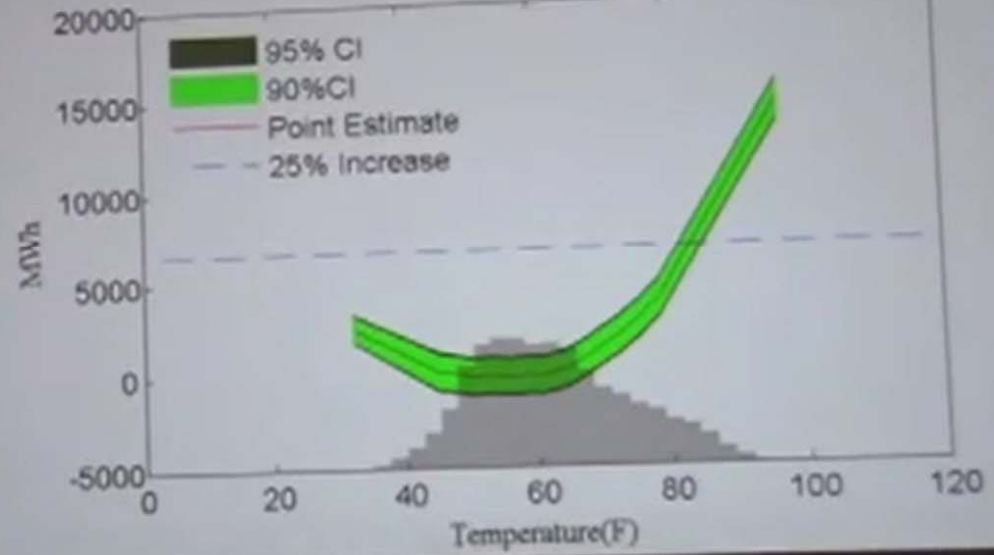
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# Electricity Load Increases on Hot Days

California ISO

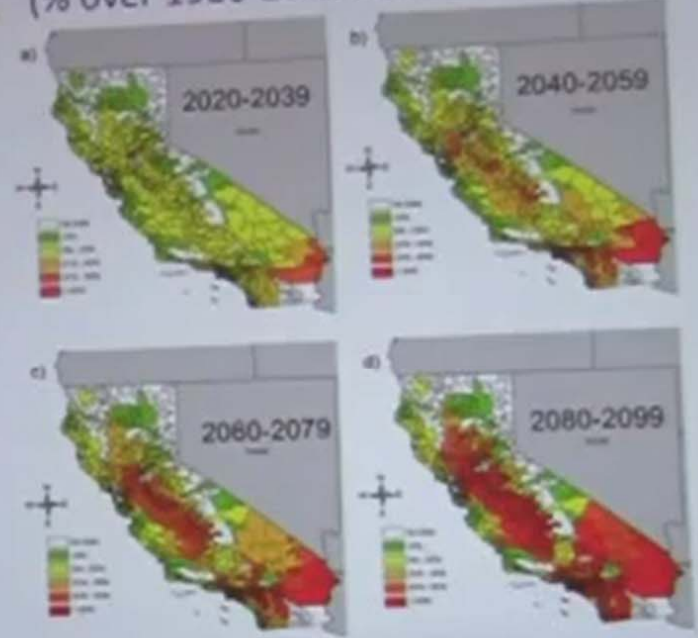


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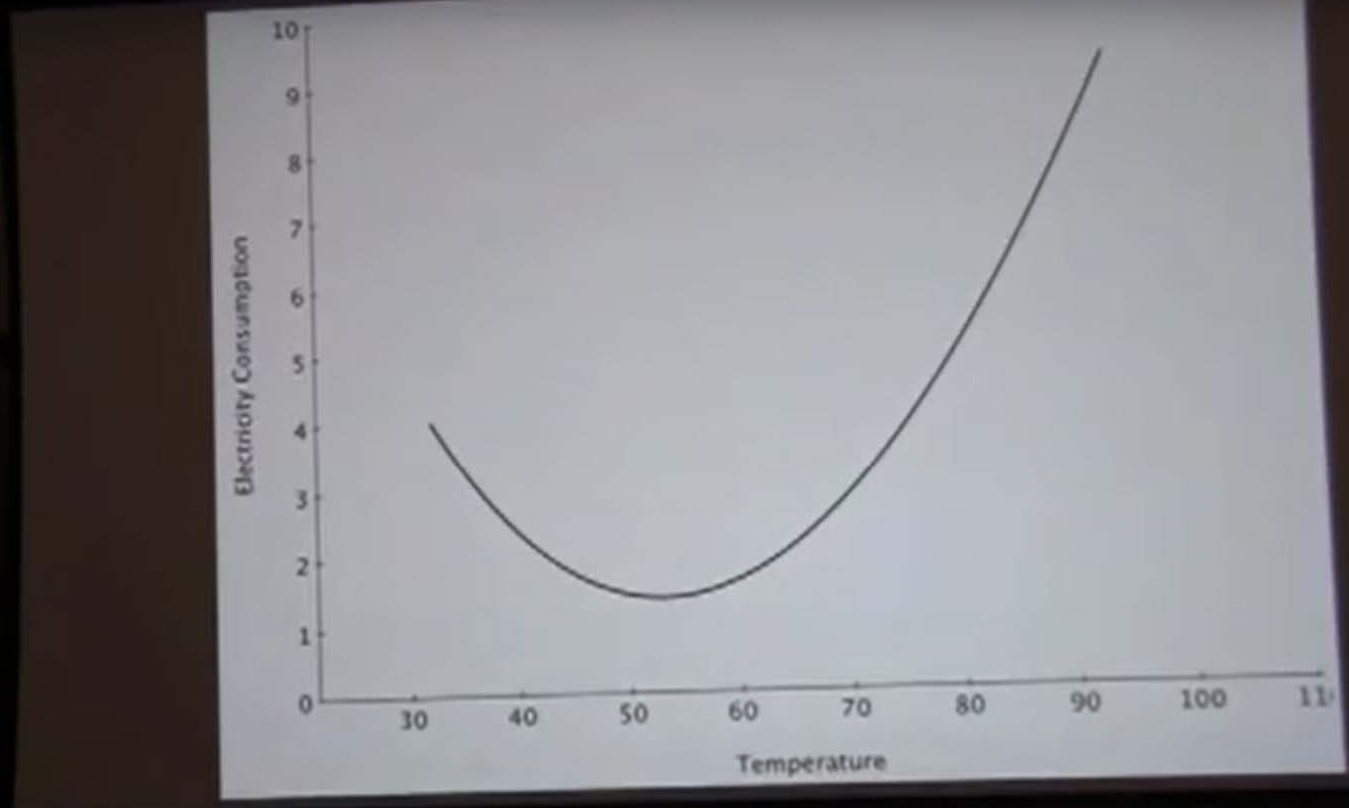
### Household Level Impacts (NCAR, A2) (% over 1980-2000 simulated consumption)



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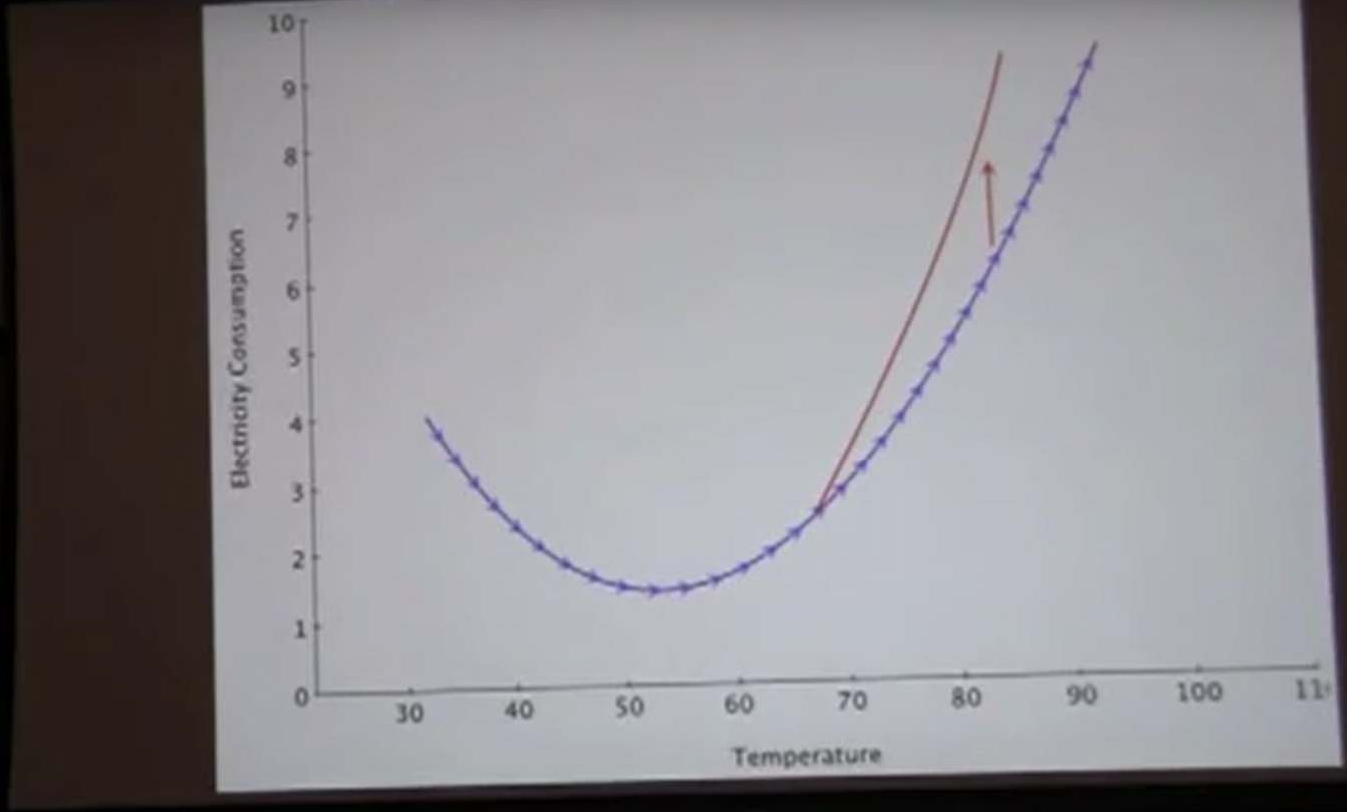






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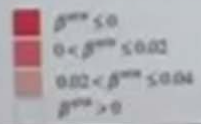




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# Maximum Temperature Response at ZIP Code Level



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## Decomposing Maximum Temperature response

	(1)	(2)	(3)	(4)	(5)	(6)
JJA Temp	0.357*** (0.039)	0.361*** (0.039)	0.386*** (0.042)	0.385*** (0.041)	0.380*** (0.041)	0.321*** (0.036)
Elevation		-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000*** (0.000)
Household Income			0.239*** (0.066)	0.235*** (0.066)	0.245*** (0.070)	0.279*** (0.087)
Population				0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Share White					0.686 (1.152)	1.394 (0.856)
Share Latino					0.658 (0.899)	1.902** (0.772)
Share Afr. Am.					0.474 (1.567)	2.287 (1.574)
Constant	-5.800*** (0.856)	-5.758*** (0.859)	-7.514*** (1.111)	-7.554*** (1.124)	-8.154*** (1.533)	-7.704*** (1.373)
Observations	1,337	1,337	1,337	1,337	1,337	661
R-squared	0.075	0.076	0.087	0.088	0.088	0.138

Notes: Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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# Temperature Response with Climate Change



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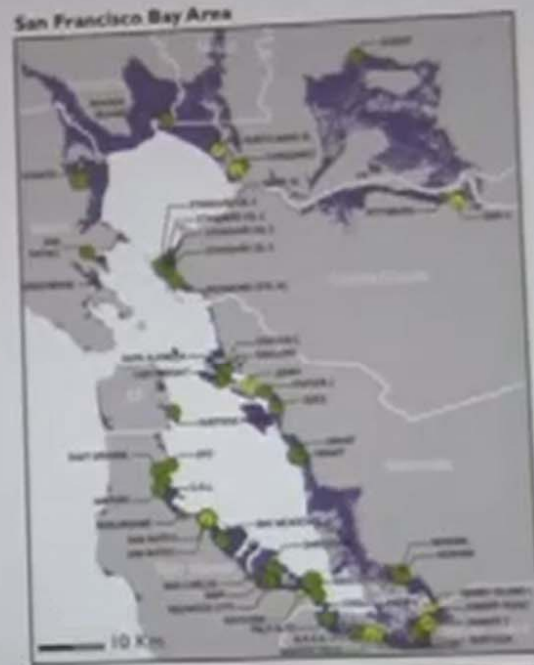
# Power Plants Potentially at Risk



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## Substations Potentially at Risk

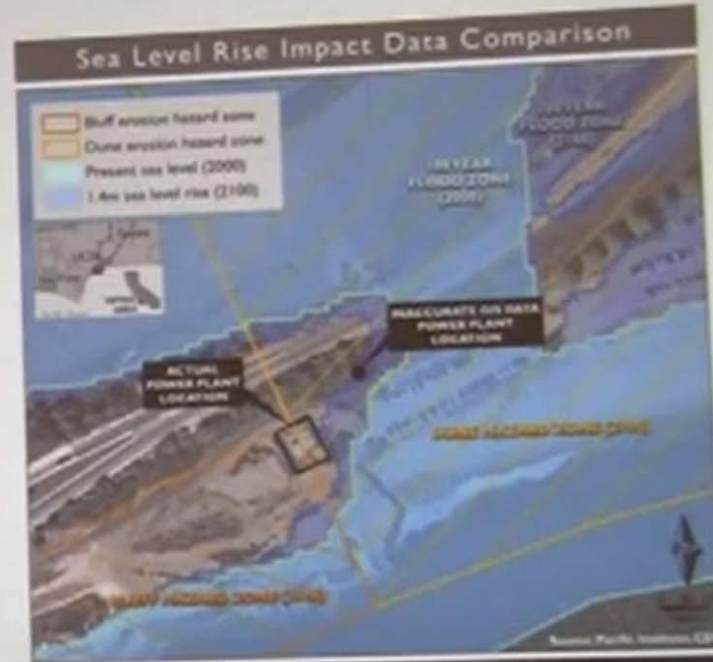


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## Verification of Locations.



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## Summary

- Climate Change will put additional pressures on California's energy infrastructure and demand
- Extreme events will be more frequent and in some case more intense.
- Market and Non-Market Damages
- Capacity planning needs to take into account mean changes and extreme events.

<http://sio.ucsd.edu/extreme>



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