



Personal Views of Peter Larsen



Electricity Supply and Distribution: Impacts of Abnormal Weather



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**South Bay Cities Council of Governments
15th Annual General Assembly**



Presentation outline



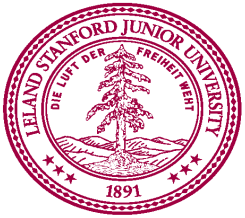
- 1. Background**
- 2. Two studies, two methods**
- 3. “Exploring reliability of U.S. power system”**
- 4. “Estimating risk to California energy infrastructure from projected climate change”**
- 5. Policy considerations**



Two Studies, Two Methods



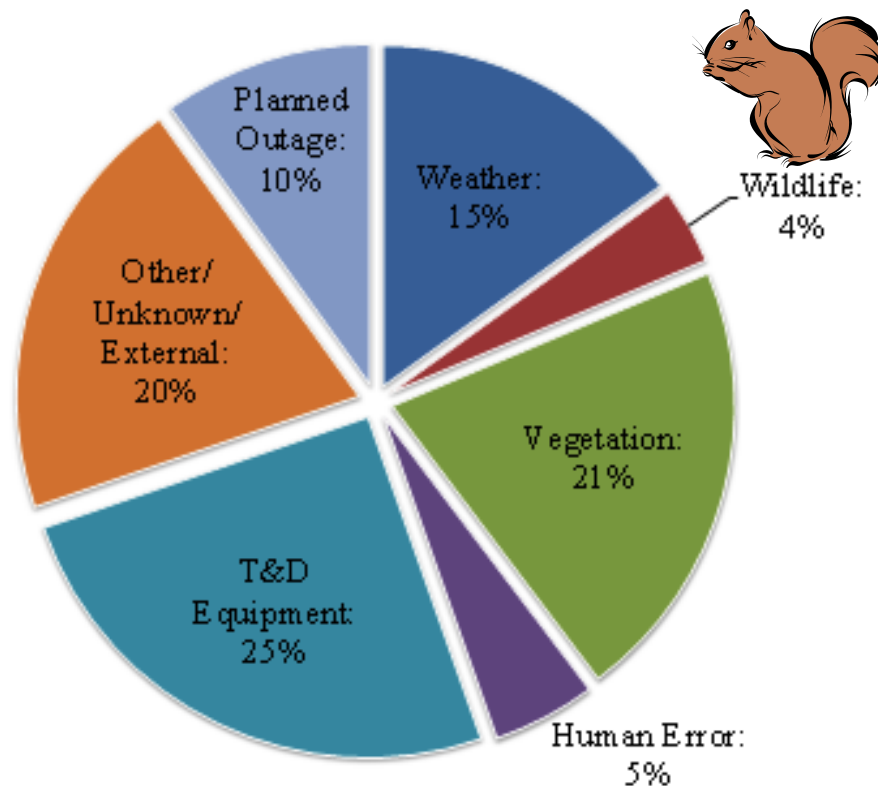
- More frequent “abnormal” weather conditions will likely increase the vulnerability of California’s electricity system.
- Two studies, which focused on supply and distribution of electricity, were recently conducted by LBNL:
 - (1) “Exploring reliability of U.S. power system” (*historical evaluation; preliminary findings*)
 - (2) “Estimating risk to California energy infrastructure from projected climate change” (*simulated future; peer-reviewed report*)



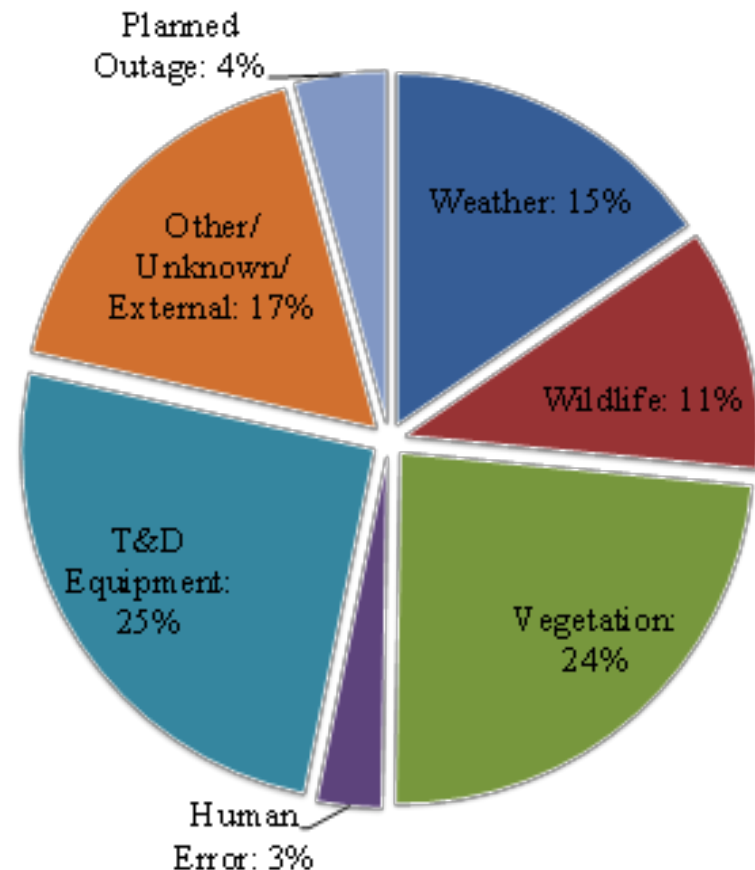
Study #1: What causes power outages?

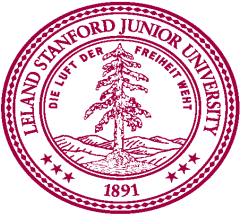


What causes increase the duration of reliability events?

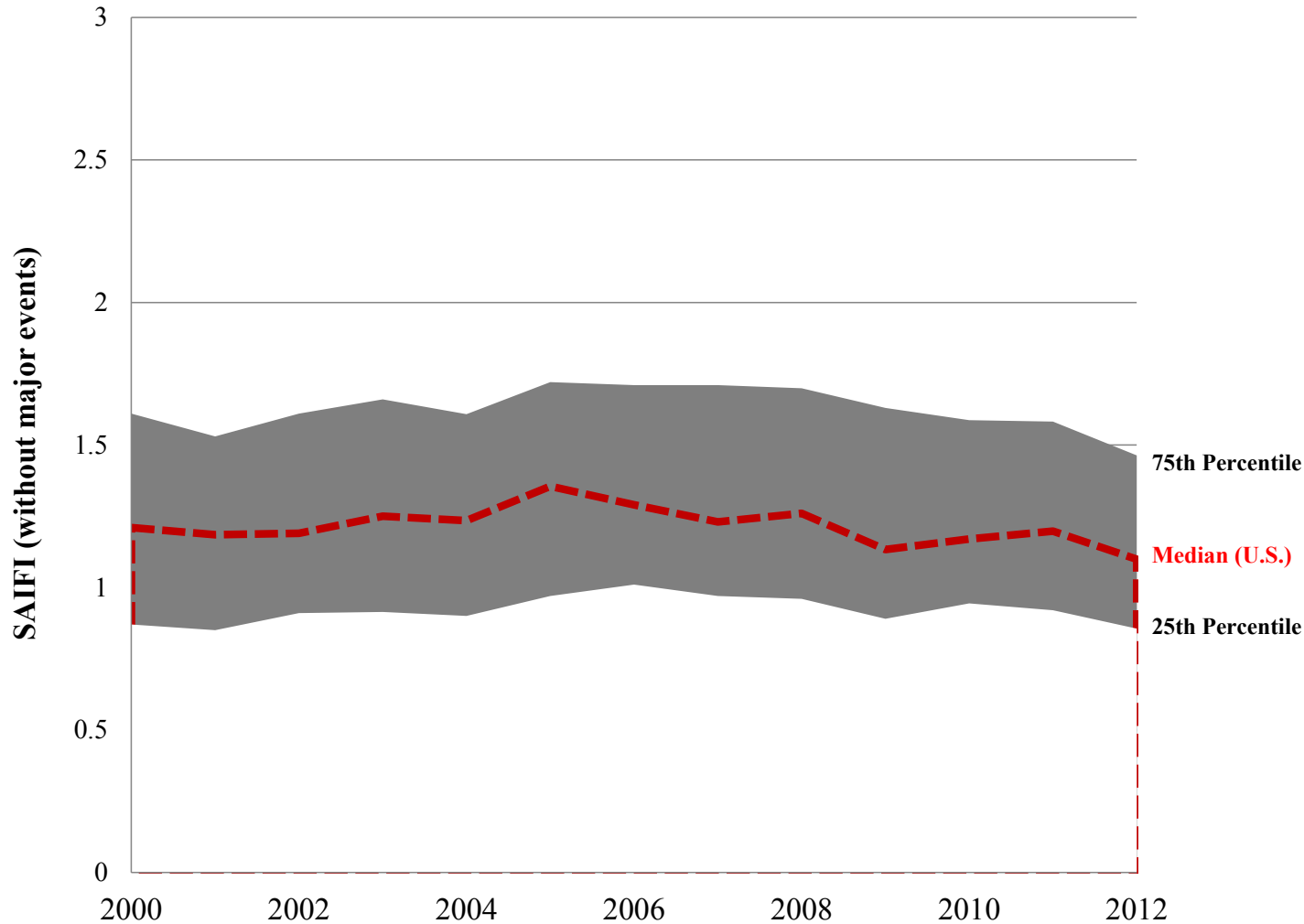


What causes increase the frequency of reliability events?





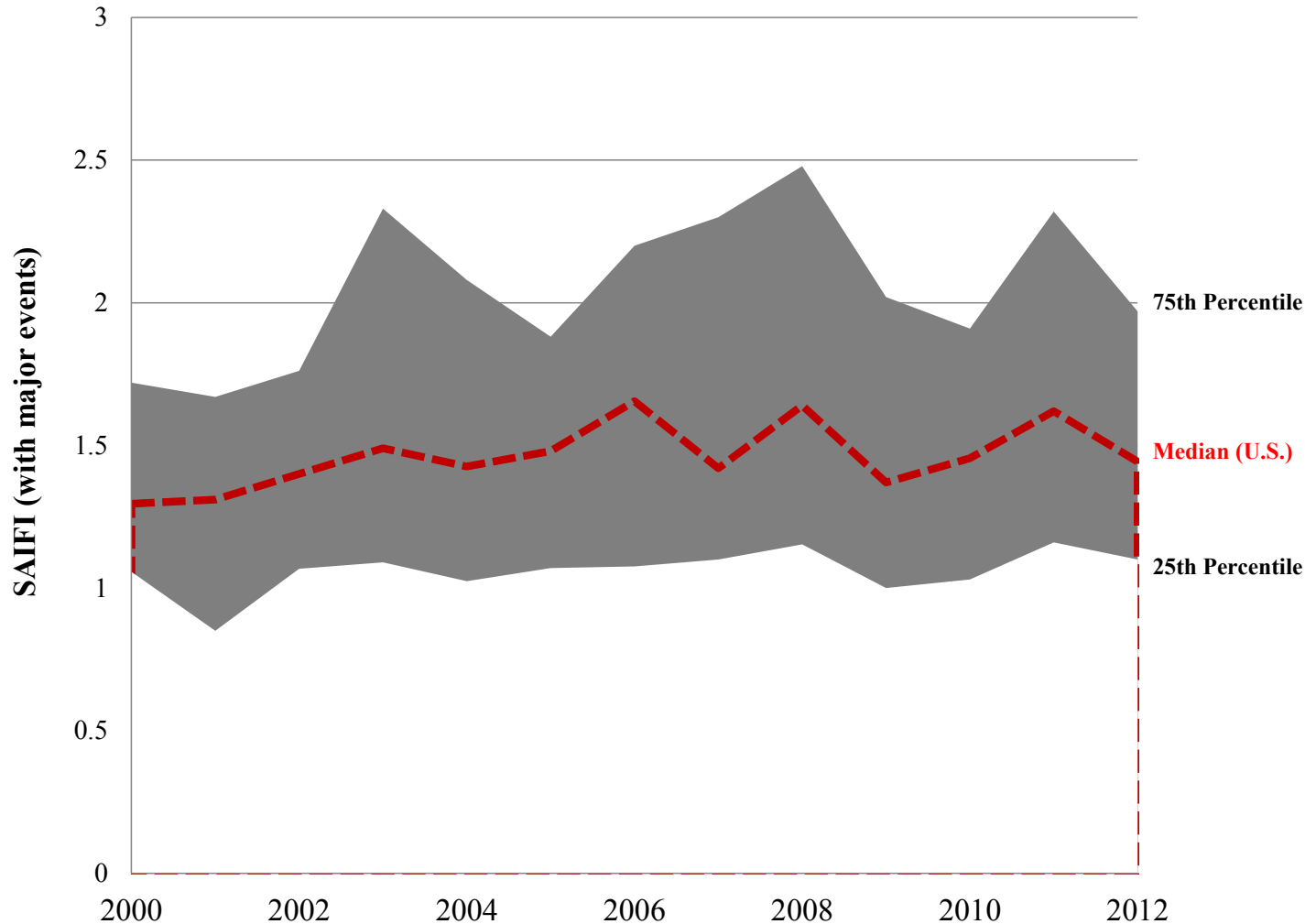
U.S. Power Outage Frequency: *Without Major Events*



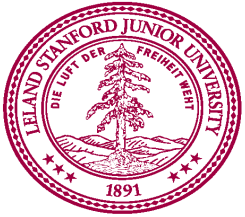
- **150+ Utilities**
- **2000-2012**
- **~1.4 outages per customer-year**



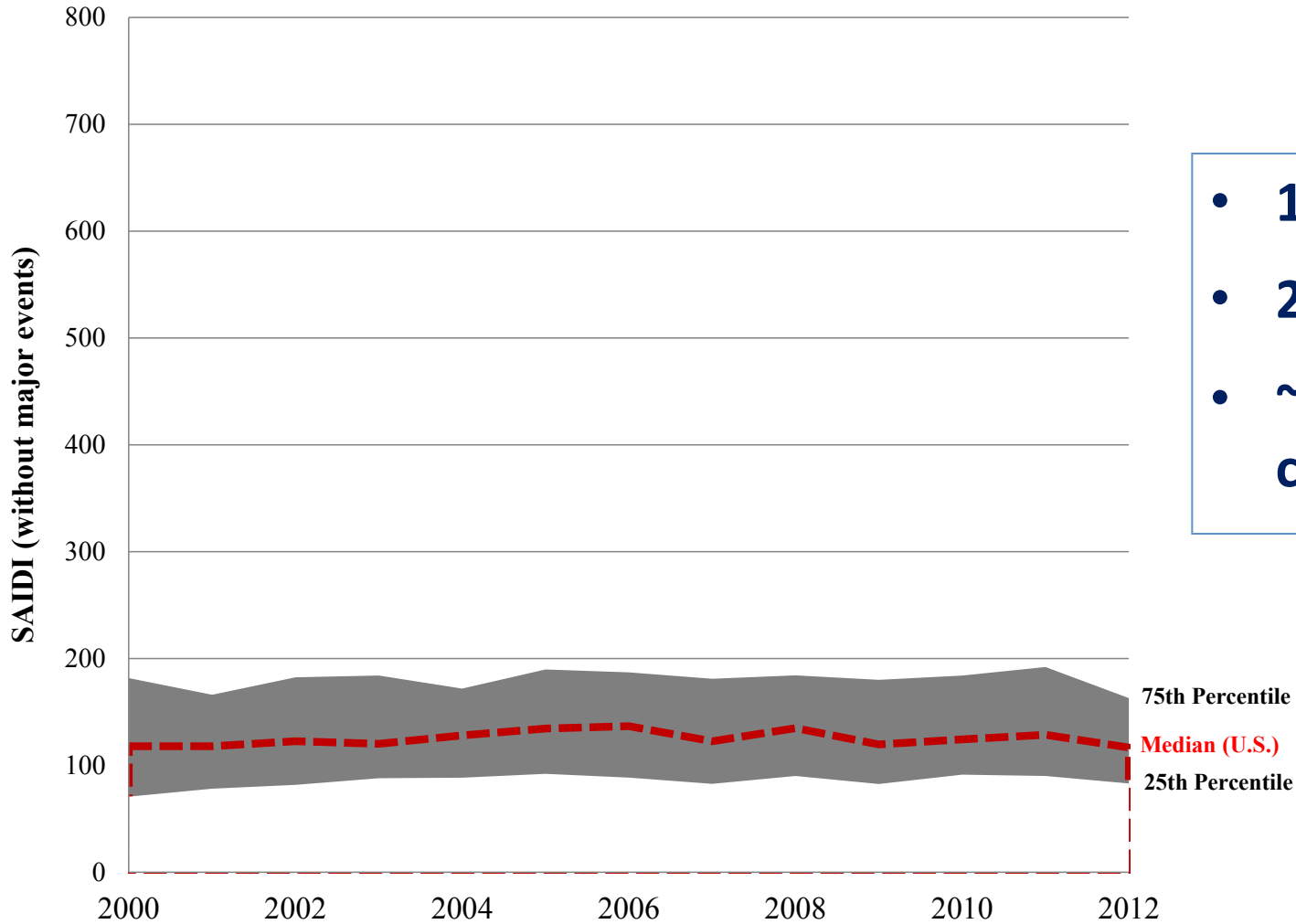
U.S. Power Outage Frequency: *With Major Events*



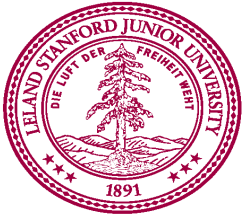
- **~1.8 outages per customer-year**
- **Increasing trend of ~2% per year**



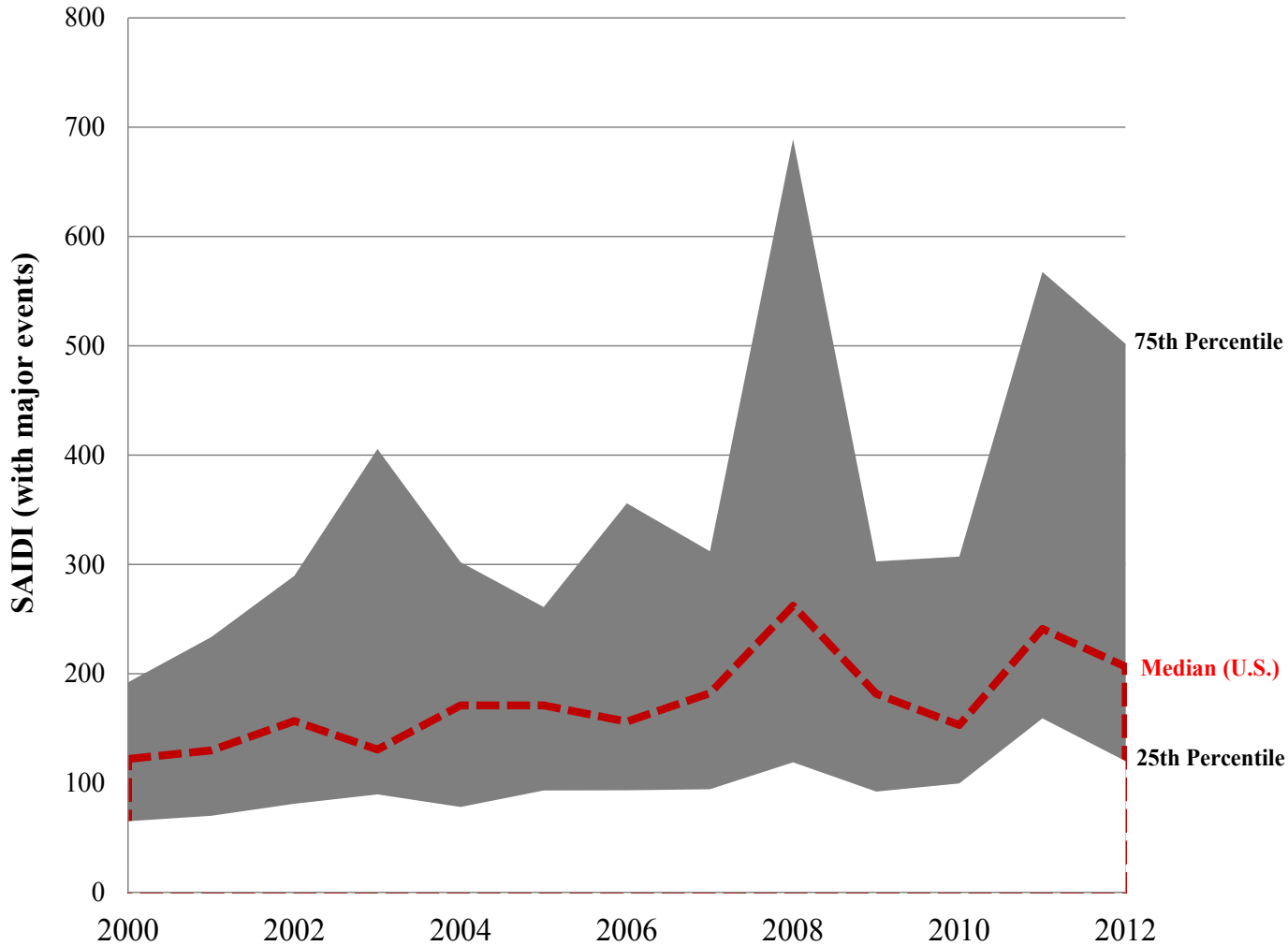
U.S. Power Outage Duration: *Without Major Events*



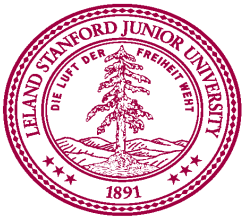
- **150+ Utilities**
- **2000-2012**
- **~140 minutes per customer-year**



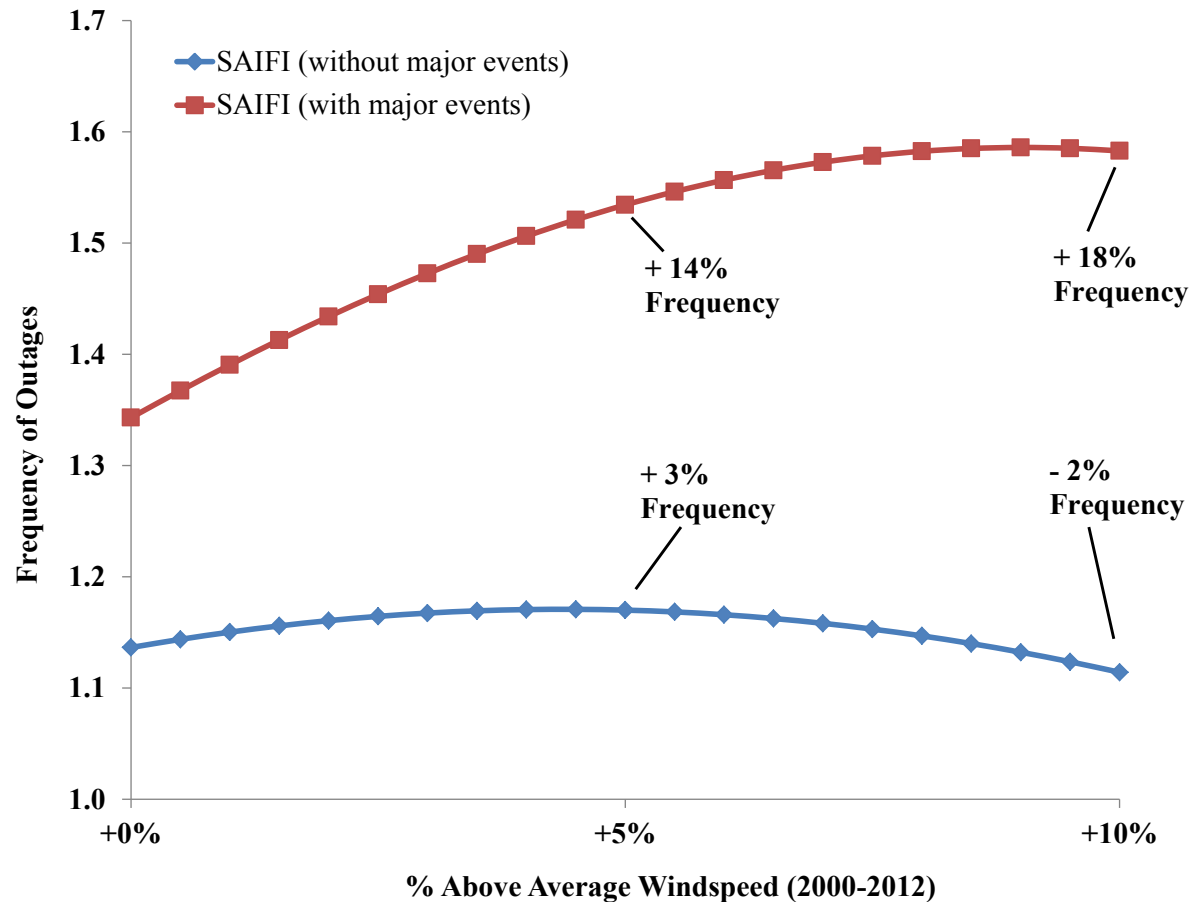
U.S. Power Outage Duration: *With Major Events*



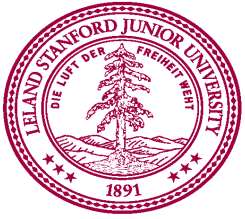
- **~370 minutes per customer-year**
- **Increasing trend of ~8% per year**



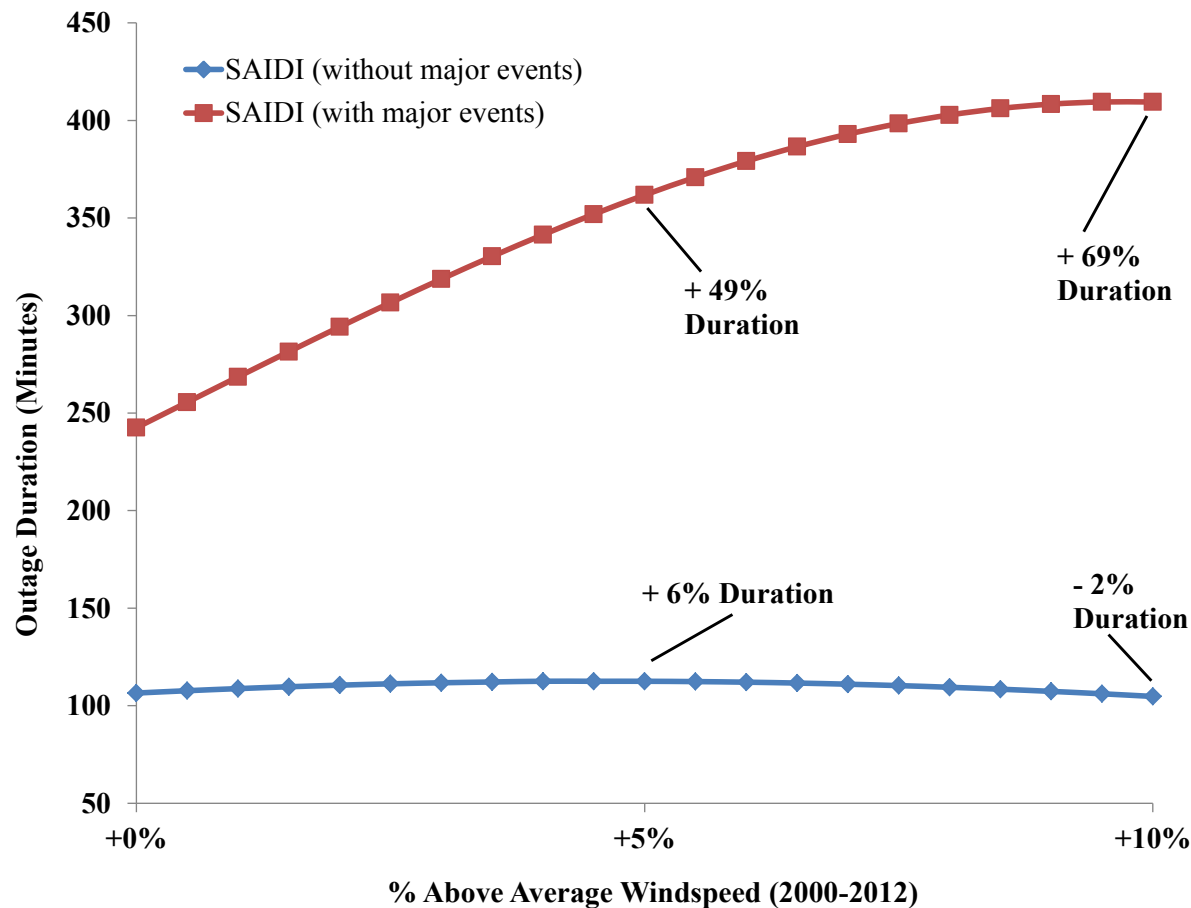
Outage Frequency and Abnormal Weather



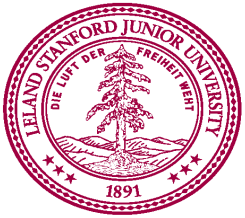
- +10% increase in lightning correlated with a +1% increase in the frequency outages
- +5% increase in annual average wind speed is correlated with a +14% increase in outages (+10% wind = +18% outages)



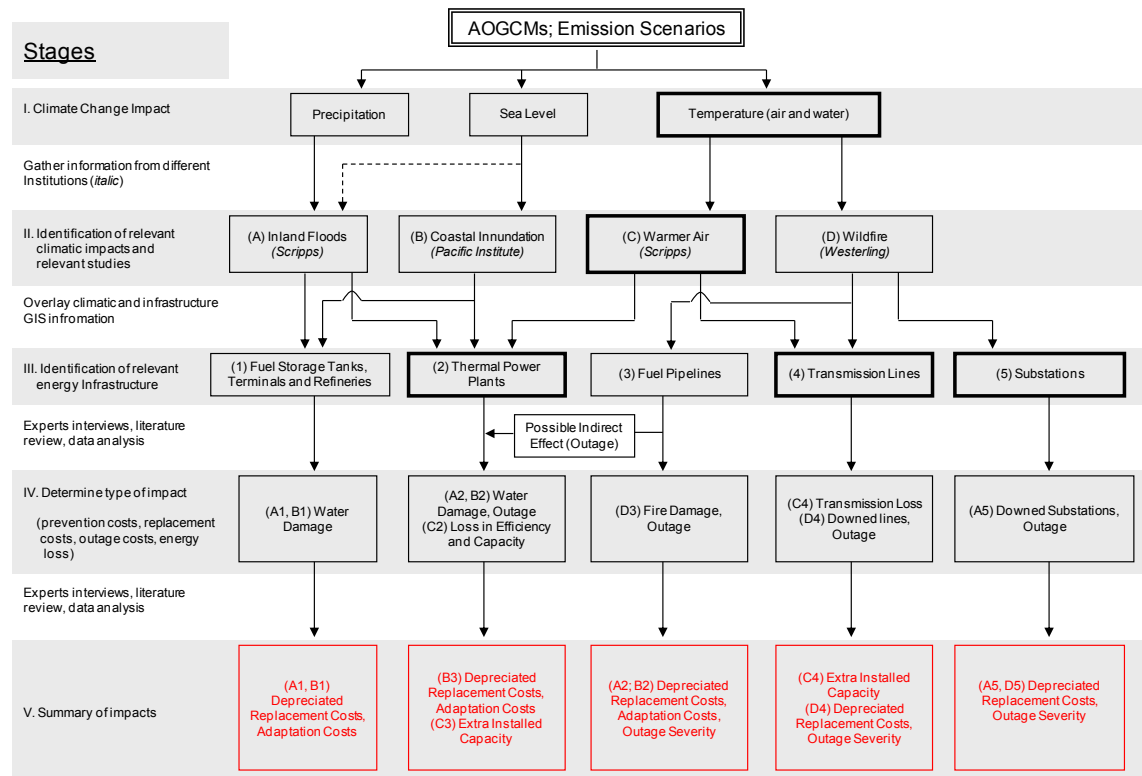
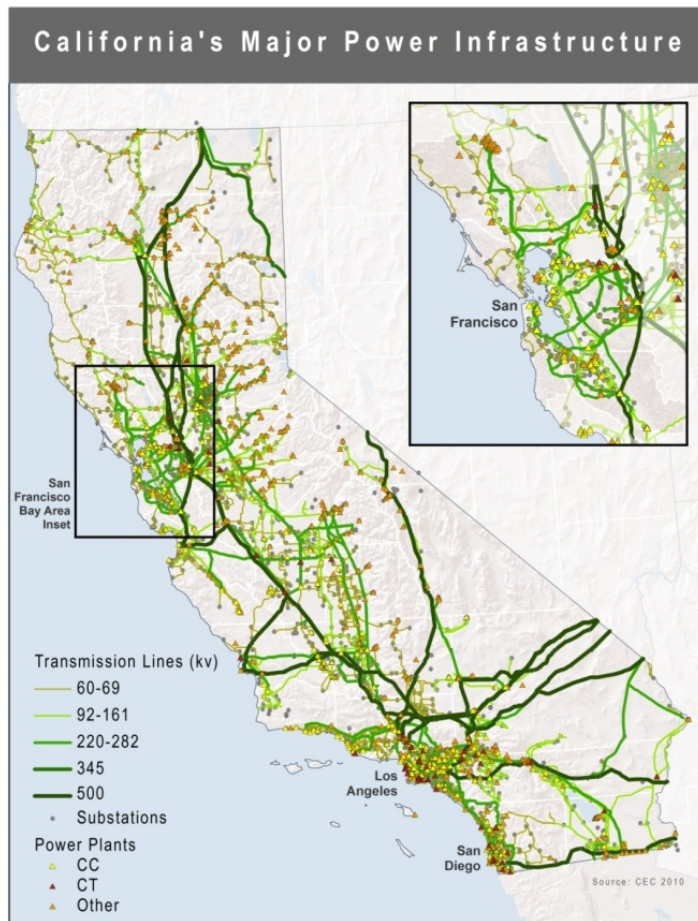
Outage Duration and Abnormal Weather

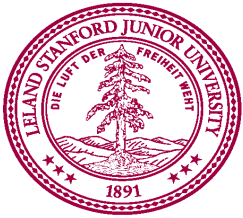


- +10% increase in annual precipitation is correlated with a +17% increase in the event duration
- +5% increase in average wind speed is correlated with a +49% increase in event duration (+10% wind = +69% event duration)

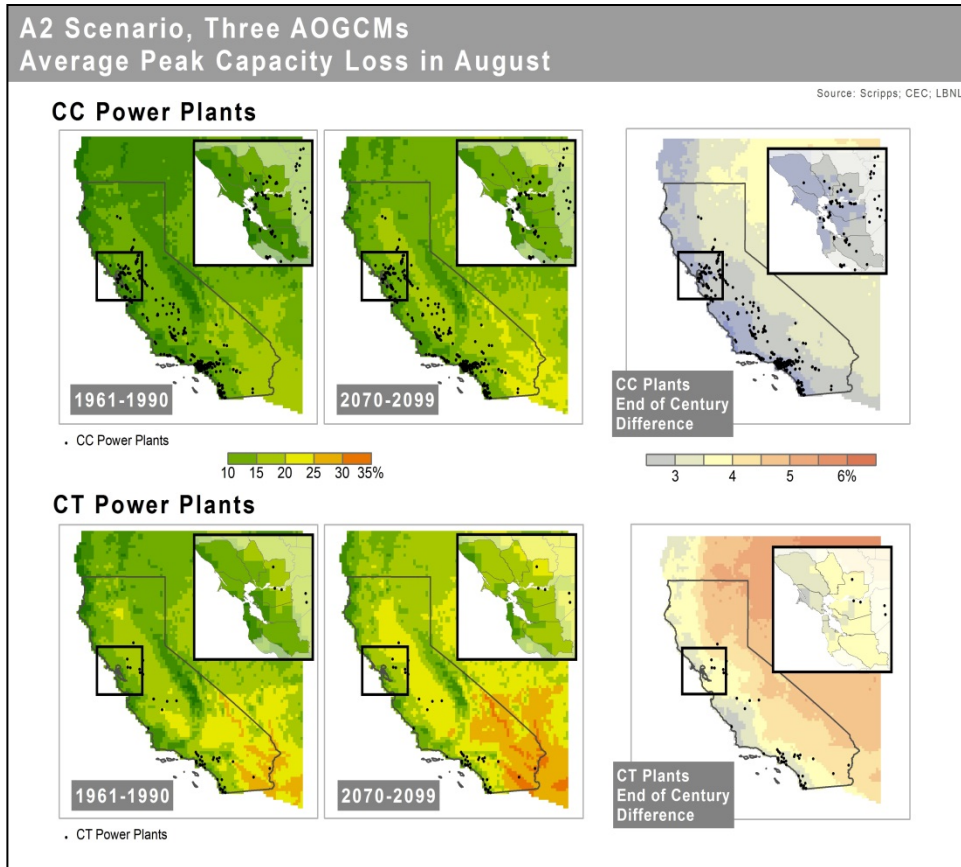


Study #2: How might climate change affect CA electricity infrastructure?

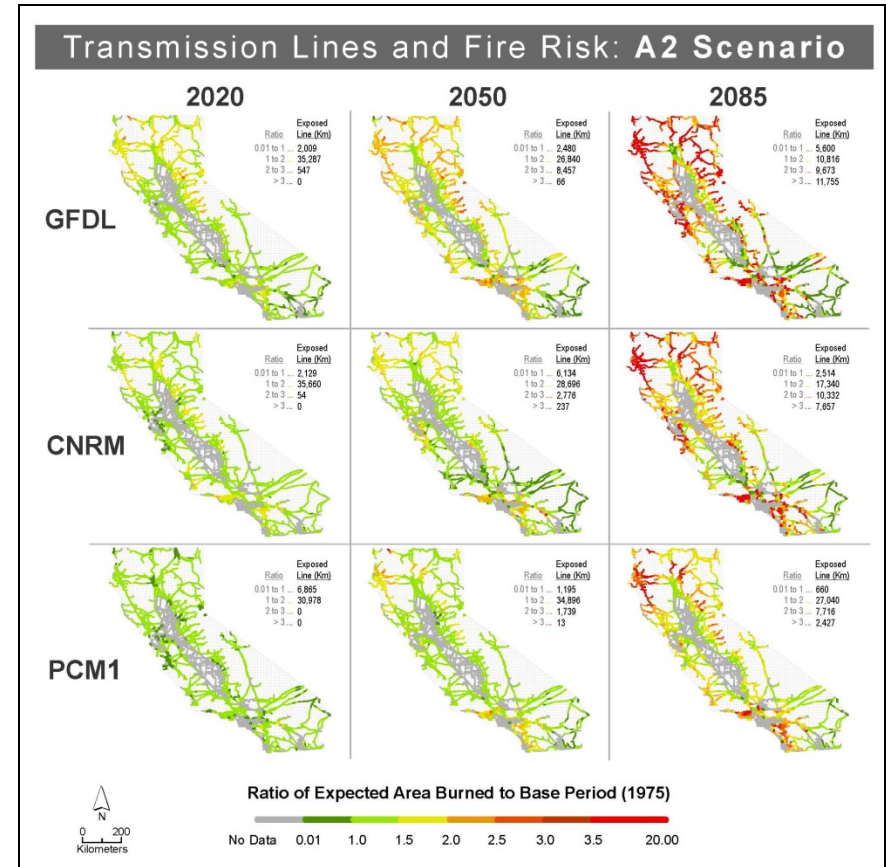




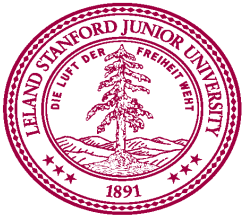
Projecting Long-term Impacts



Projected Change in Peak Capacity of CA Gas-Fired Power Plants



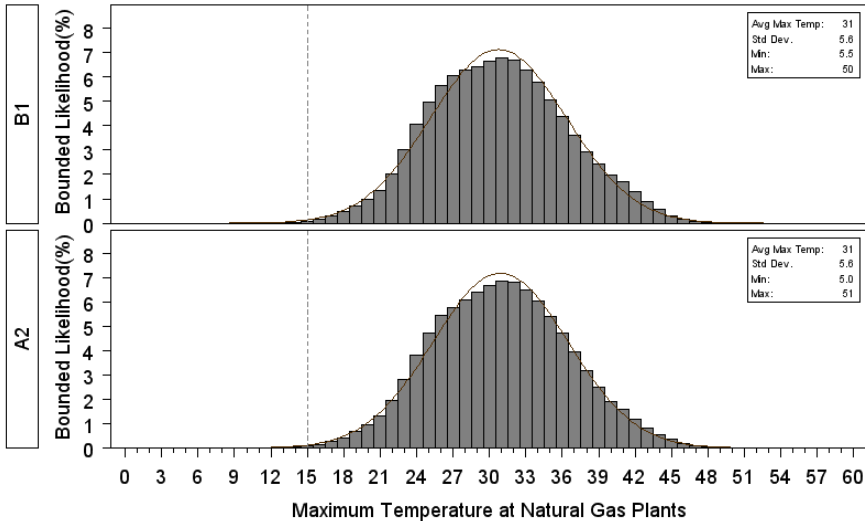
Projected Risk to CA Transmission Lines



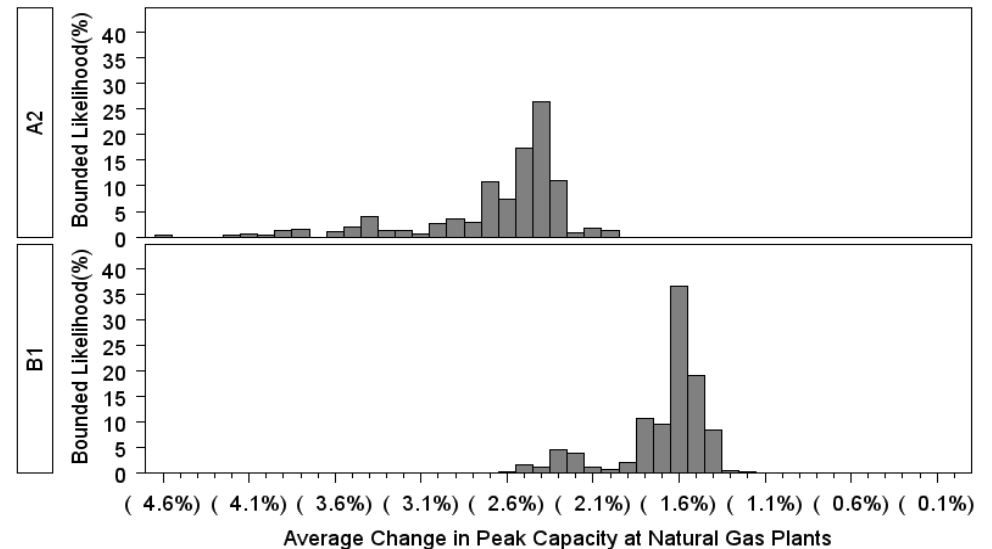
Uncertain Climate Change Impacts ≠ Climate Change Uncertainty



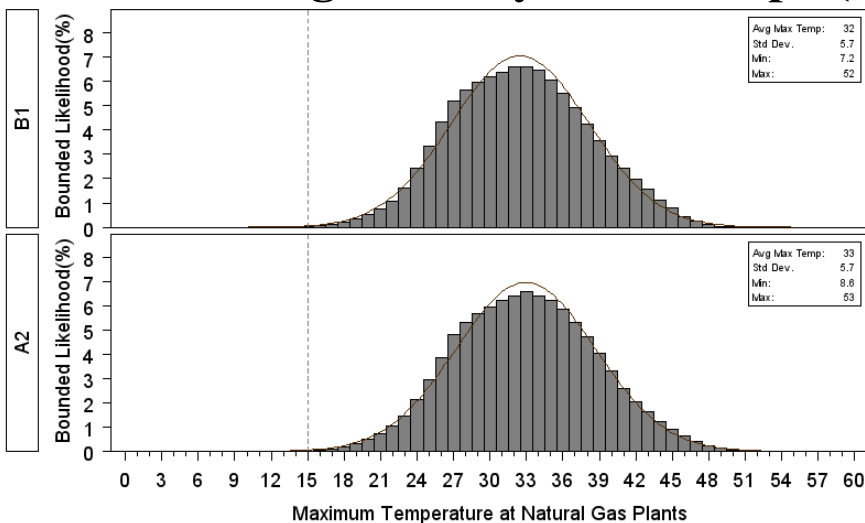
1961-1990 August Daily Max Temps (C)



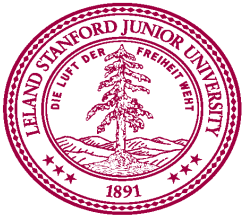
Projected Change in Peak Capacity of CA Gas-Fired Power Plants



2035-2064 August Daily Max Temps (C)

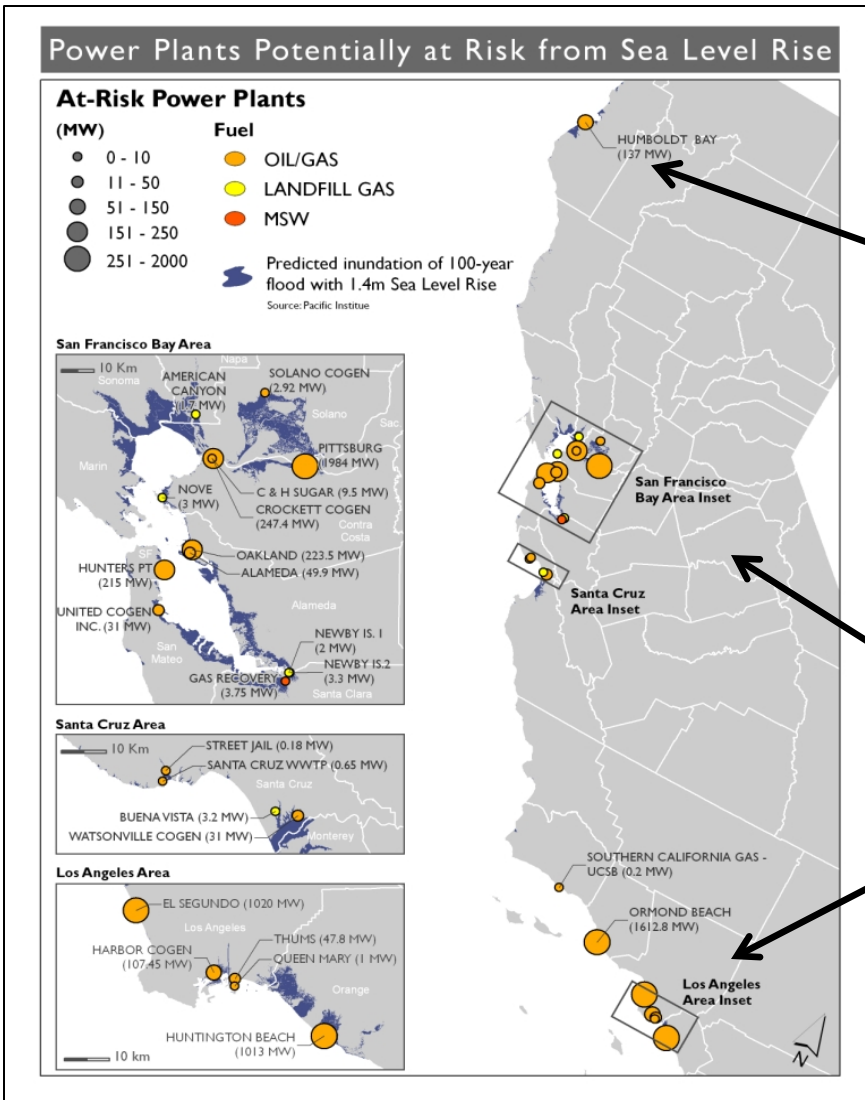


NOTES: Distribution based on results from three AOGCMs for 2070-2099 time period.



Importance of “Ground-truthing” Model Results

Model Results



Site visit to Humboldt Bay revealed that this power plant might not be impacted by SLR...

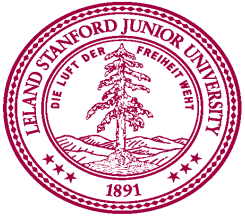
But other locations may be more at risk than originally believed...?



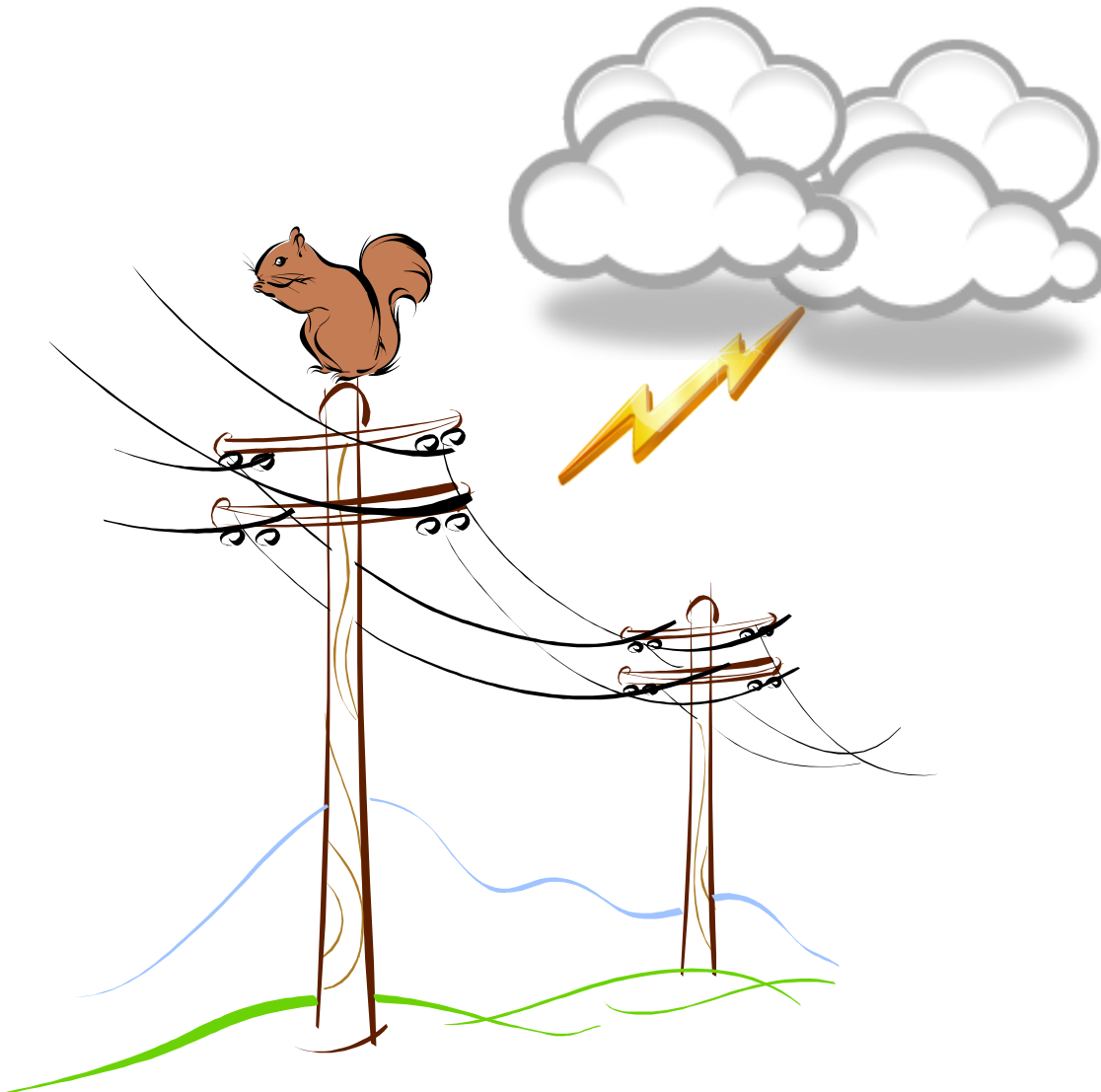
Policy Considerations



- ***Support* local climate/weather-related vulnerability studies**
- ***Encourage* ground-truthing of model results**
- ***Promote* policies that encourage local energy infrastructure adaptation**
 - Bury distribution lines?
 - Next-generation cooling systems at gas-fired power plants
 - Increase reservoir heights
 - Energy efficiency and demand response programs
 - Increase budgets for vegetation management



Thank You



For more information,
including reports and
citations, please feel
free to contact me.



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