Teleconnections and Cascading Impacts

Policy Implications and Lessons Learned in the Los Angeles Region

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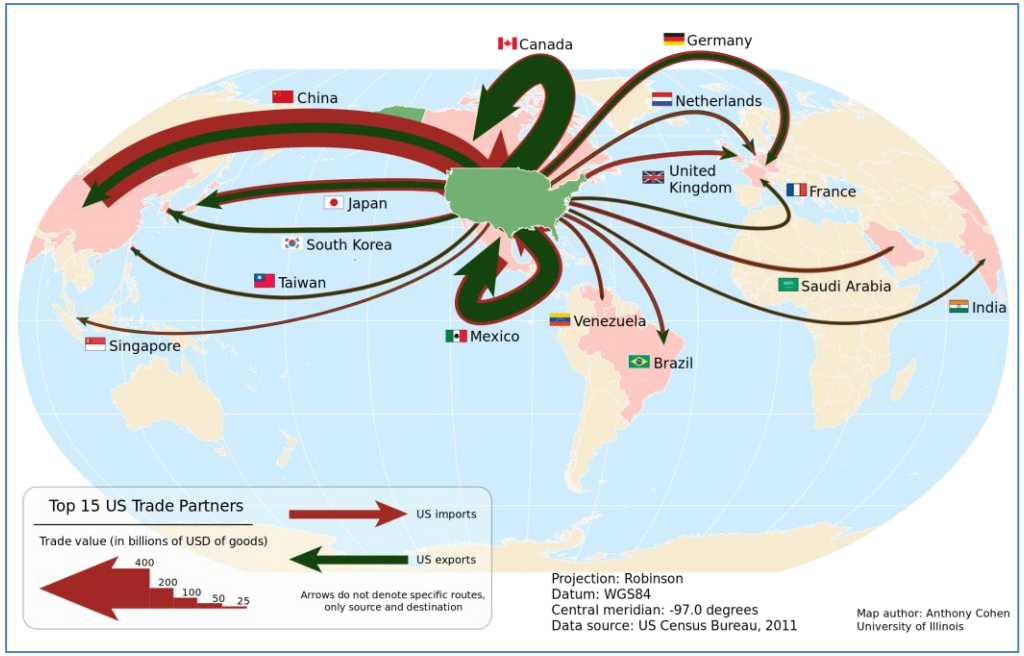
Core Concepts: Teleconnections and Cascading Impacts

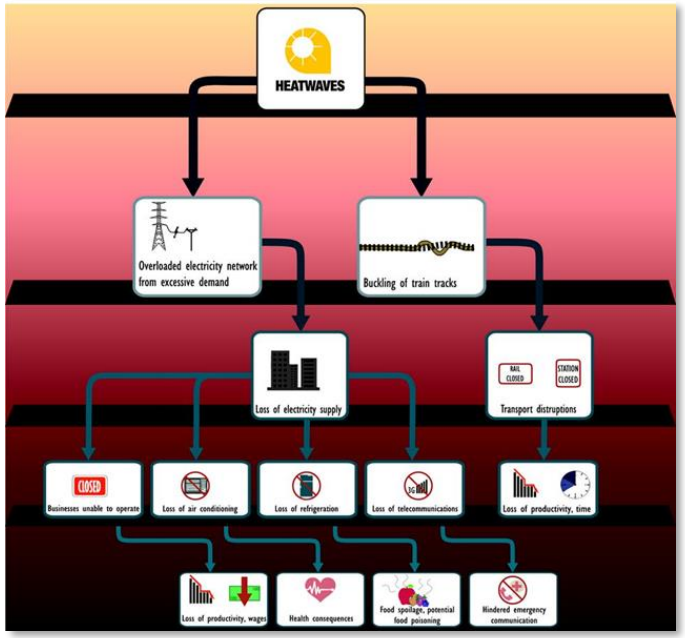


Societal teleconnections

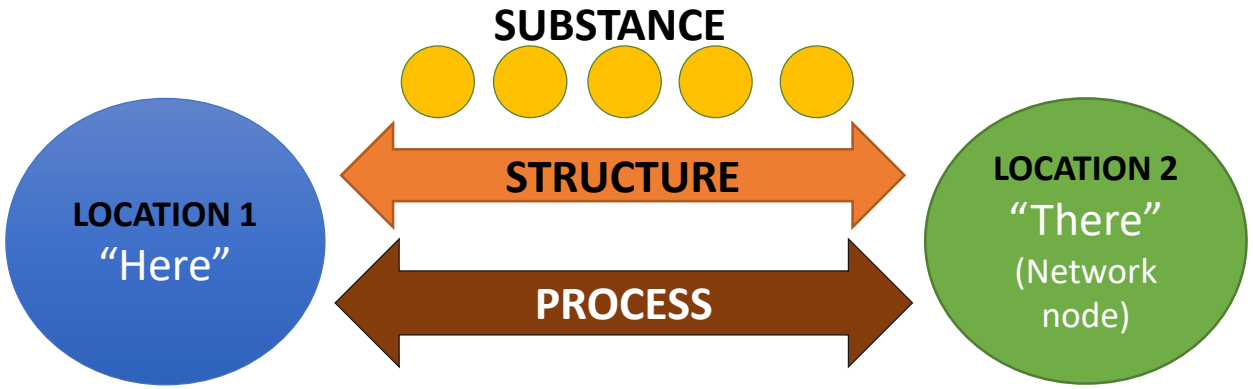
- **Human-created interconnectivity** among systems that transcend local/national/ international boundaries

Cascading impacts

- **Downstream impacts** of an initial event, rippling through a system in hard-to-predict ways



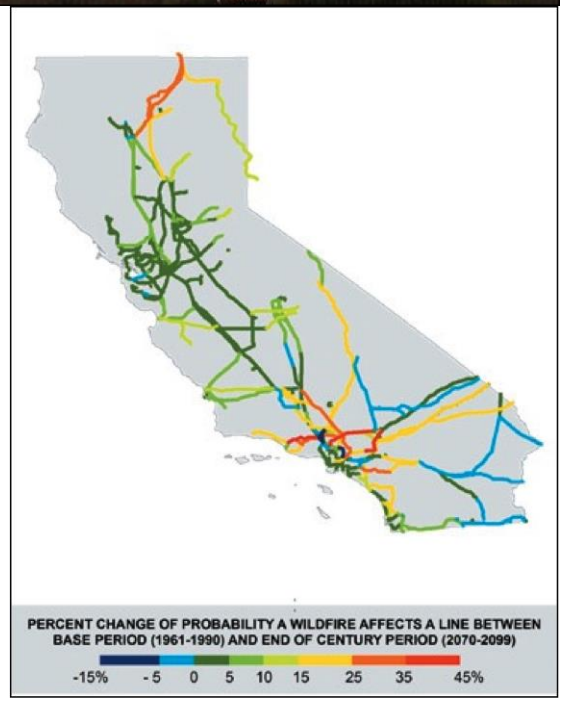
Source: Commissioner for Env. Sustainability, Victoria, Australia



Source: Moser & Finzi Hart (2015) *Climatic Change*

Example: Energy System

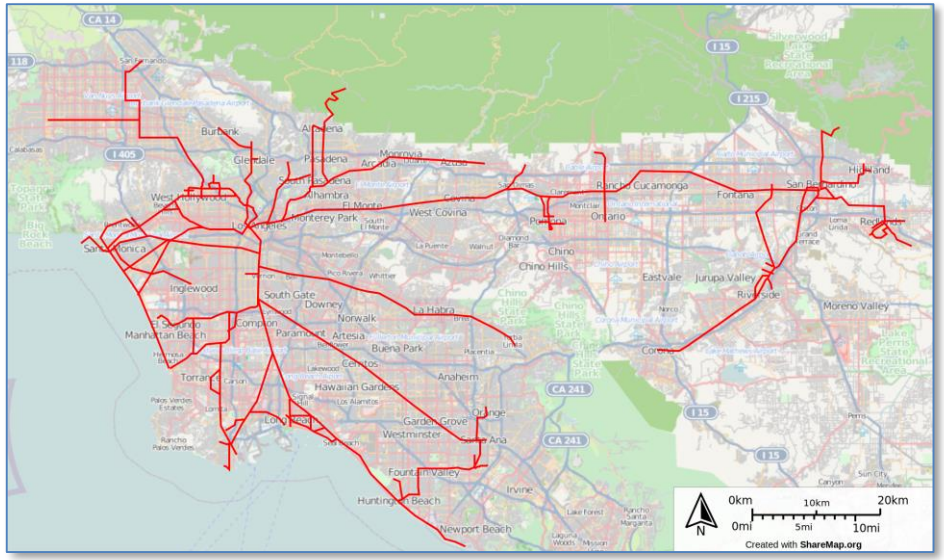
- *Structure*
  - Transmission lines connecting power generation and consumption
- *Process*
  - Supply & demand; energy markets, policies & regulations
- *Substance*
  - Electricity, oil, natural gas
- *Vulnerabilities > Considerations in Adaptation*
  - Energy production & transmission disruptions lead to economic, public health impacts
  - Increased energy use during extreme events can lead to shortages
  - Downstream impacts to critical lifelines



Source: KOMOnews.com; California 3rd Climate Assessment (2012)

Project Details

- Geographic Focus: L.A. Metropolitan Area
- Inter-sectoral Focus: Long-distance and downstream impacts on community lifelines
  - Electricity System
  - Communications, Water, Transportation, Emergency Response and Public Health



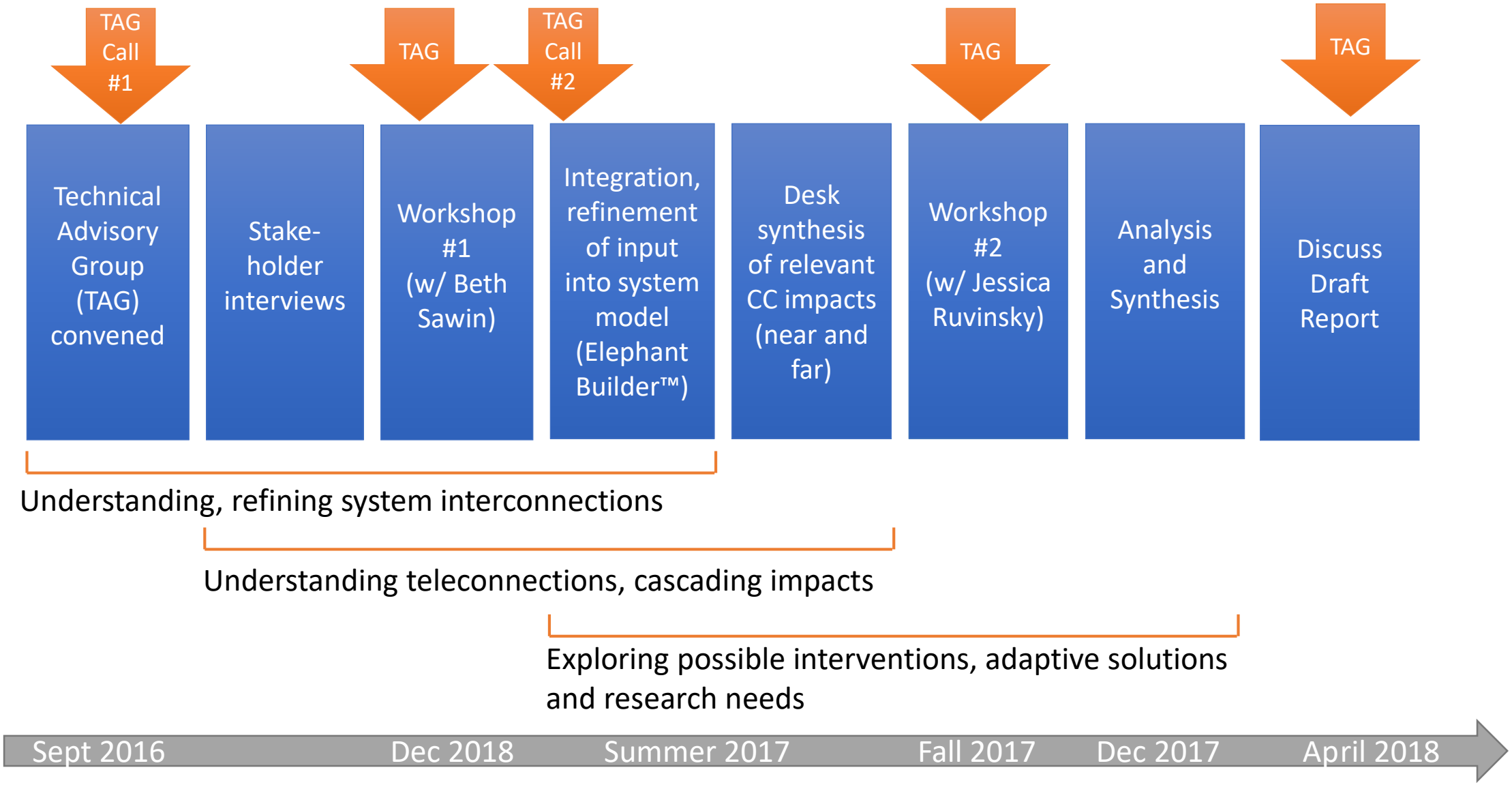
Source: Wikipedia; Rocky Mountain Institute

Project Goals

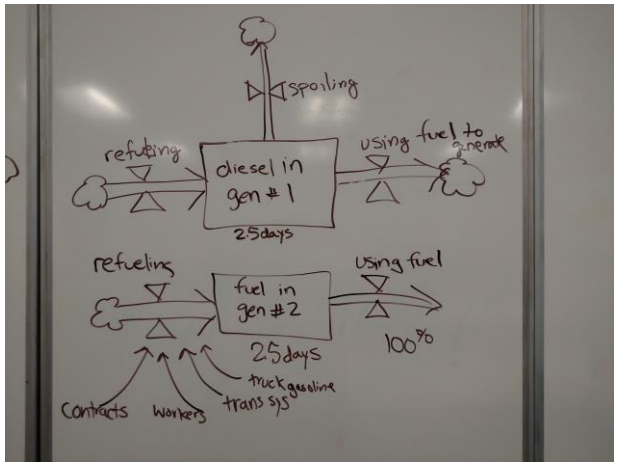
- Test the utility of a conceptual framework on societal teleconnections as a tool to assist electrical grid and downstream lifeline managers in preparing for climate change
- Identify research needs and action barriers
- Help other metropolitan areas and communities in California conduct similar analyses and improve their adaptation planning efforts

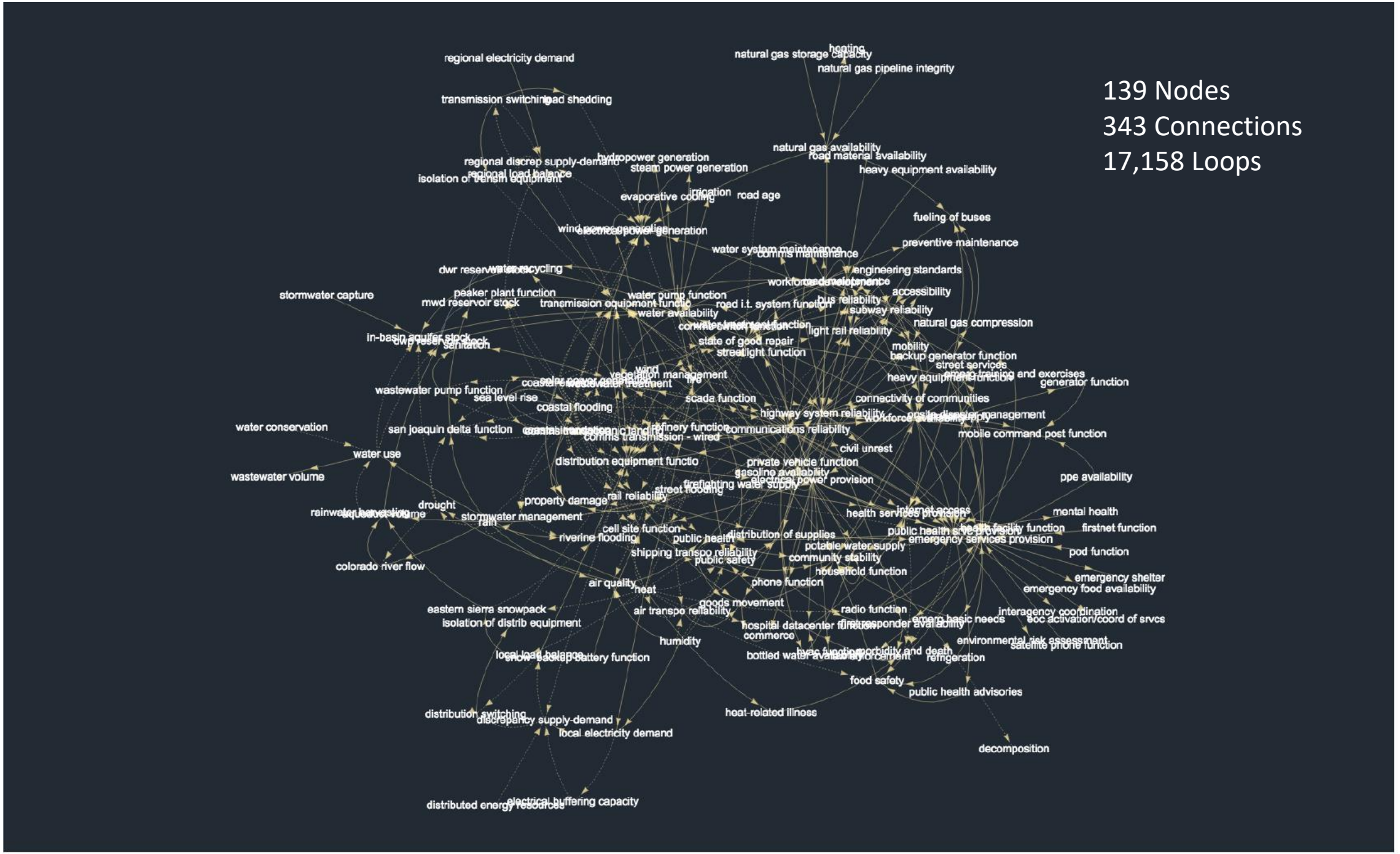
Pilot Study Approach:

Exploring a complex issue step by step…



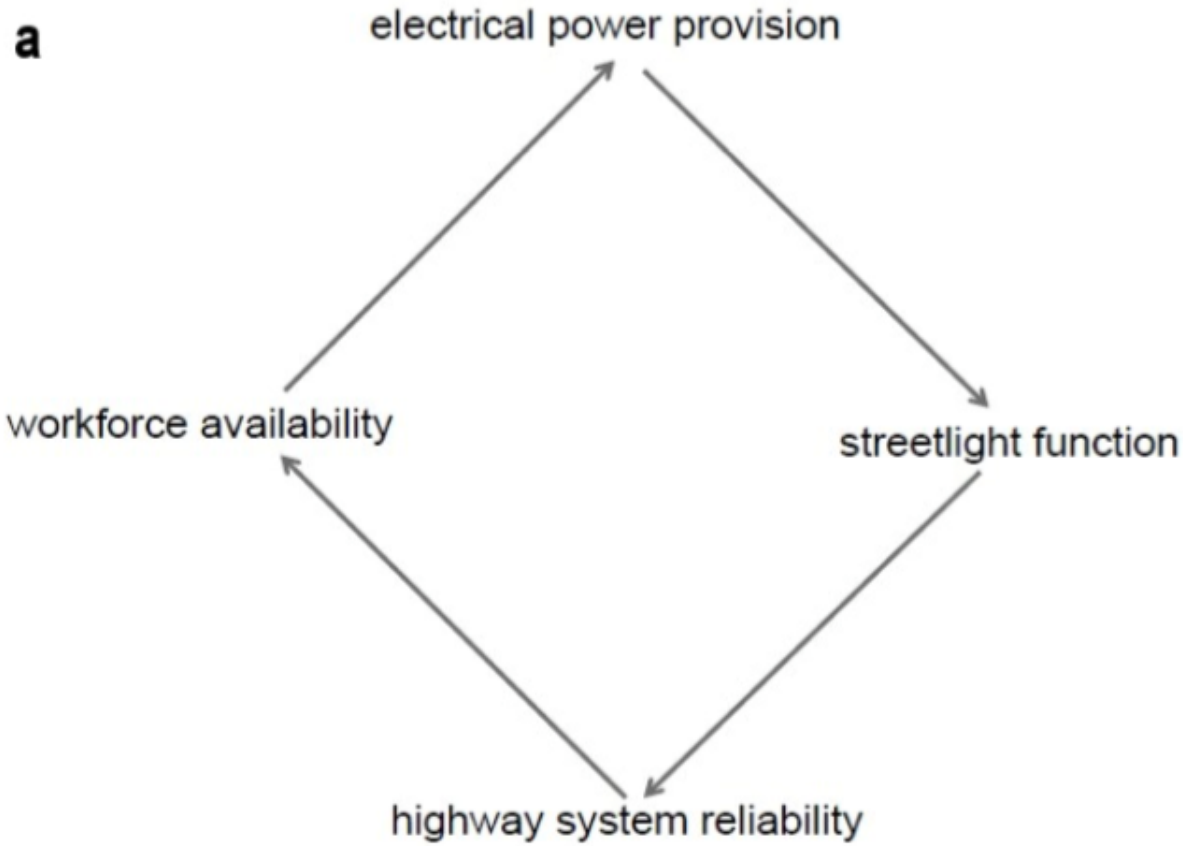
A Transdisciplinary Approach
From Beginning to End

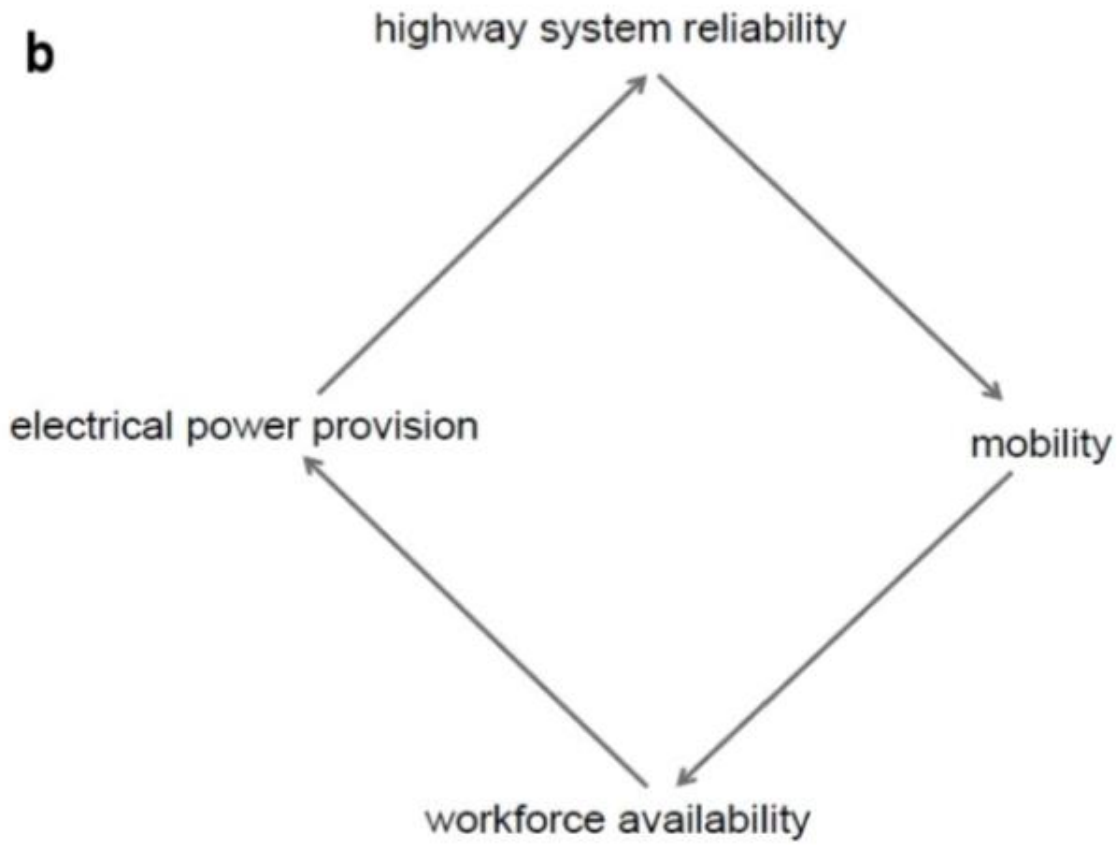




139 Nodes
343 Connections
17,158 Loops


hospital datacenter function
community stability
workforce availability
electrical power provision
potable water supply
onsite disaster management
health services provision
morbidity and death
communications reliability
backup generator function
firefighting water supply
health facility function


a
electrical power provision
workforce availability
streetlight function
highway system reliability


b
highway system reliability
electrical power provision
mobility
workforce availability

Key Study Insights

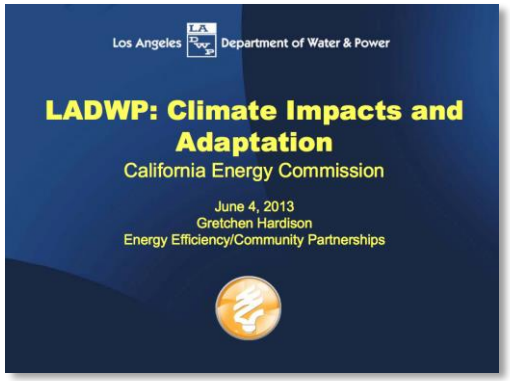
Interconnections and Cascades

- No unified map of the interconnected lifeline system until now
- Functioning of the overall system is an emergent property without overarching control
- There are critical mutual dependencies and notable gaps
- Overconfidence in controllability of individual (yet interconnected) lifeline systems

Gaps in the Interconnected Lifeline System

- Cross-sector relations informal and ad-hoc
- Deferred maintenance impacts physical structures
- Staff capacity
- Historical legacies
- Experience and attitudes
- Varying degrees of adaptation planning

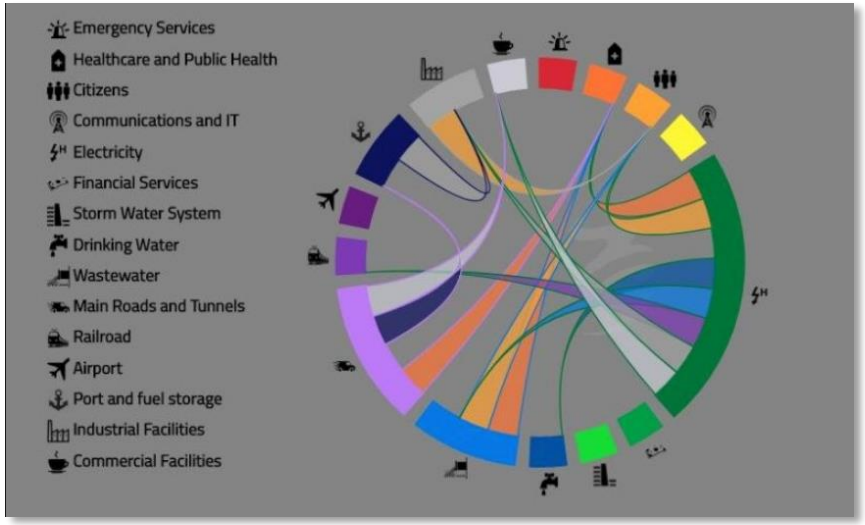

Discussing Water Rights, A Western Pastime



Key Study Insights:

Assessing Complex Risks in Practice

- Utilities have their own system models, but not connected to other lifelines
- Consulting firms/research institutes provide expensive networked risk models
- Various boutique approaches
  - Build a common understanding of mutual dependence
  - Learn about archetypal system behavior
  - Identify intervention points
  - Limited in direct link to operations

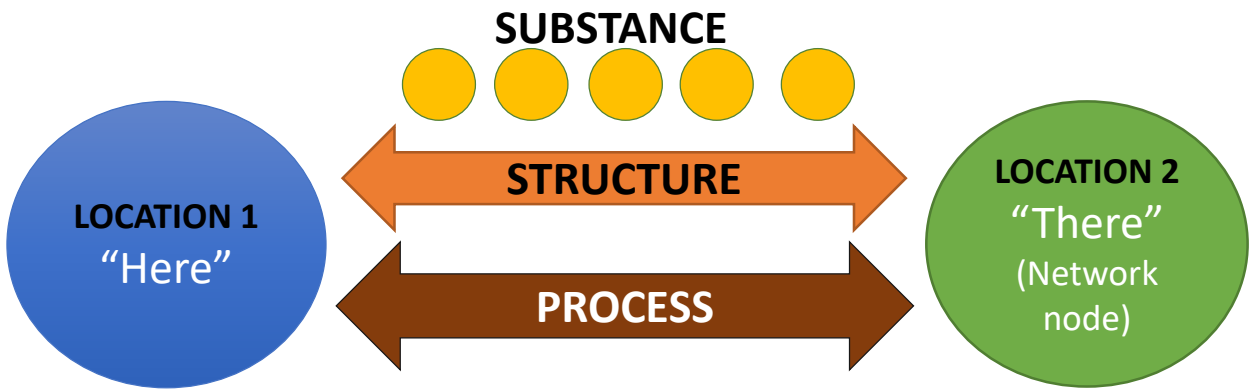


Key Study Insights:
Teleconnections

Teleconnections

- Teleconnections have variable and overlapping geographies
  - Service area/customer base
  - Supply chains
  - Management area
  - Governance across scales
- The teleconnections of one lifeline systems can be entirely different from those of another lifeline
  - Overlaps can increase risks
- In some instances, teleconnections are already actively used and managed
  - Procurement/supply chains
  - Water imports
- “Hardware” and “software” are weakest part of the teleconnection

Key Study Insights:
Teleconnections Framework



Utility of the Conceptual Framework

- Greatest benefit in bringing lifeline managers together in a room
- Opening up imagination to scope and complexity
- Useful to focus our research
  - Interview questions
  - Workshop design
  - Data analysis
- Greater utility at a later stage in the assessment of teleconnected (and even cascading) risks

Key Study Insights (cont.)

Climate Change Impacts, Adaptation and Preparedness for Extreme Events

- Significant advances in understanding extremes, yet aspects of greatest interest to lifeline managers are still active research frontiers
  - Esp. long-duration, concatenated or compound climate risks
- Well-established focus on and procedures for extreme events
- But, among some, lack of concern and active efforts in adaptation planning among those who are responsible for the basic functioning, safety, stability and well-being of communities

Moving Preparedness for Teleconnected & Cascading Impacts Forward

Advancing Understanding

- Climate Science and Extreme Events Relevant to Infrastructure
- Teleconnections and Complex Interdependent Lifeline Systems
- Understanding the Legal Context
- Technical/Material Science Needs and Data Gaps
- Building Tools at the Right Scale
- Pilot and Demonstration Projects

Action Opportunities

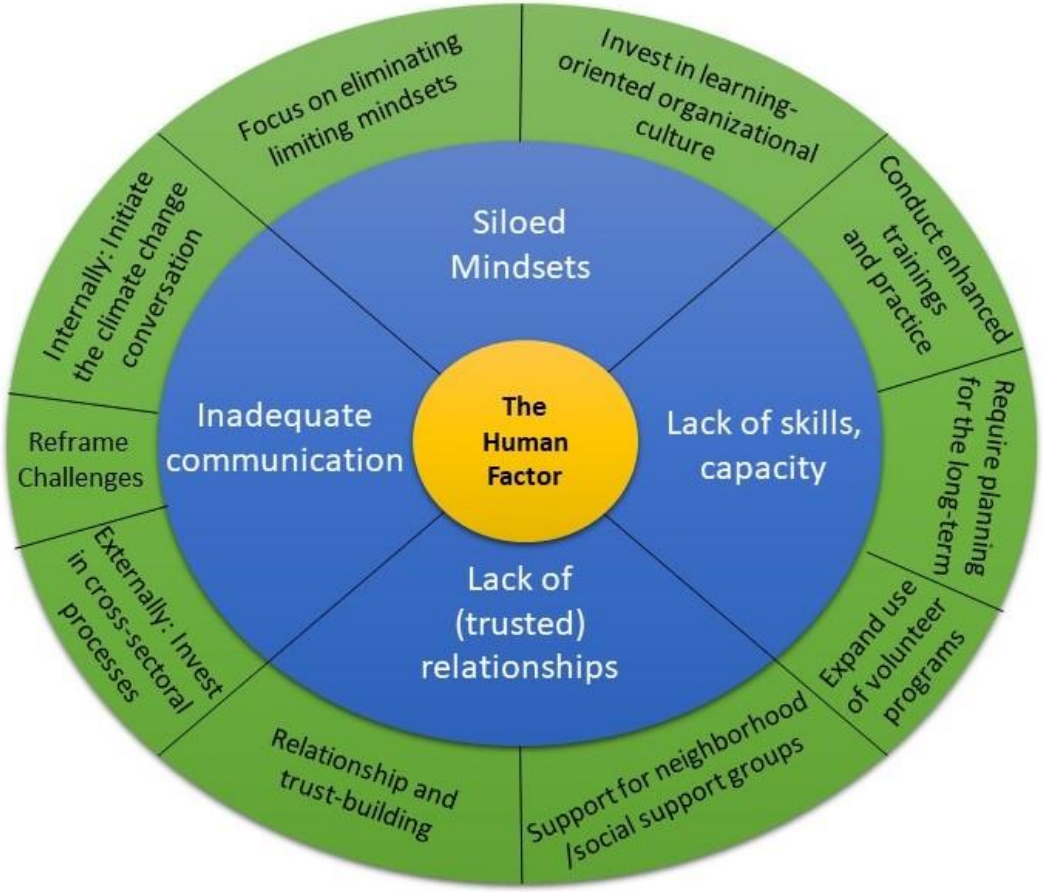
- Overarching: Closing Governance Gaps and Improving Policy Coherence
- Motivating Integrated Adaptation Planning through State-Level Policy
- Participating in Regional Lifeline Scenario Planning Exercises
- Addressing Institutional Barriers Within and Between Lifeline Sectors
- Taking Preparedness Measures at the Utility and Agency-Level

Action Opportunities

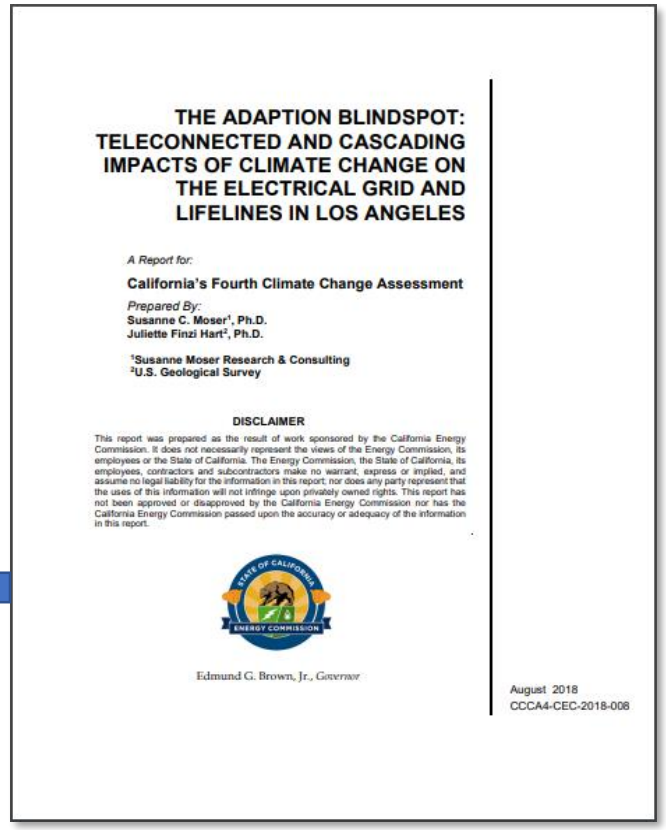
- Challenge #1: Building Back Better After Disaster
- Challenge #2: Detrimental Post-Disaster Waivers
- Challenge #3: Common Sequences of Extreme Events
- Challenge #4: Interconnections and Interdependencies
- Challenge #5: Lack of Communication

Action Opportunities (Cont.)

Taking Preparedness Measures at the Utility and Agency-Level



Further Reading



THE ADAPTION BLINDSPOT: TELECONNECTED AND CASCADING IMPACTS OF CLIMATE CHANGE ON THE ELECTRICAL GRID AND LIFELINES IN LOS ANGELES

A Report for:

California's Fourth Climate Change Assessment

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Edmund G. Brown, Jr., *Governor*

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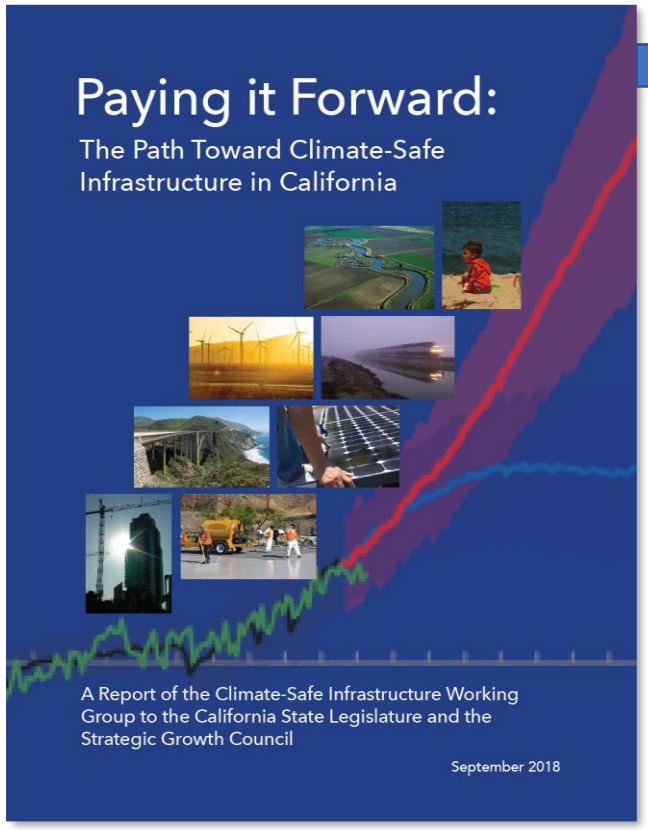
CCCA4-CEC-2018-008

http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-008.pdf



- 16-page Executive Summary
- 160-page Full Report
- 13 Appendices
- Additional materials (meeting materials and webinars) produced over the course of the project available at:

http://resources.ca.gov/climate/climate-safe-infrastructure-working-group/

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