

On the Interdependence of Equity & Resilience

NASEM Workshop: Enhancing the Resilience of Healthcare and Public Health Critical Infrastructure



Bringing science
to energy policy



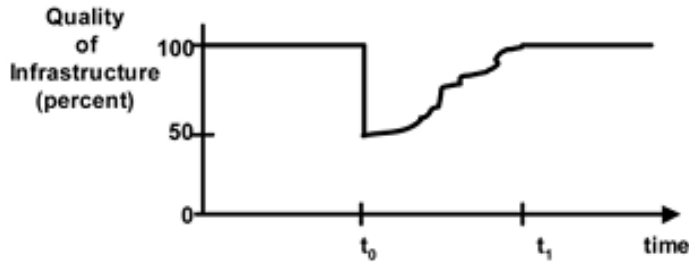
Agenda

- **Introduction**
- **Vulnerability, Resilience, Equity, and Affordability**
 - **Definitions, Metrics, and Indicators**
 - **Geography and Demography**
- **Critical Infrastructure**
 - **Interconnected**
 - **Capacity Shortfalls**
 - **Access, Affordability, and Equity**
 - **Potential Impacts on Healthcare Workforce**
- **Questions & Discussion**

Vulnerability, Resilience, Equity, and Affordability

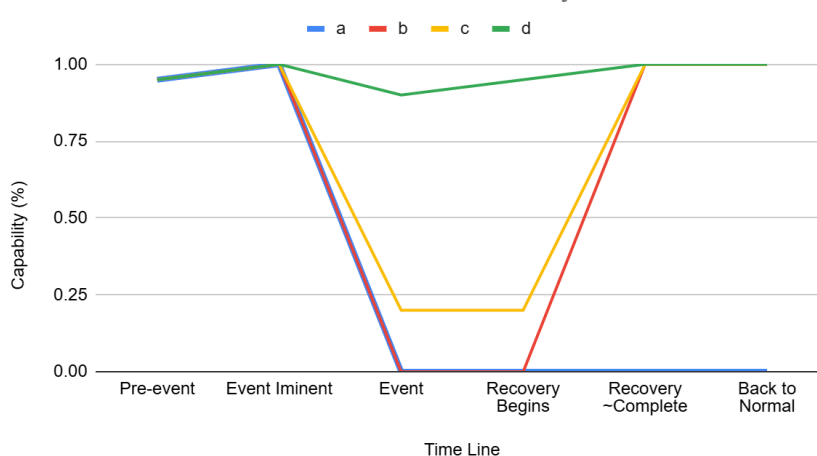
Definitions, metrics, and challenges

Resilience Trapezoid, Reframed

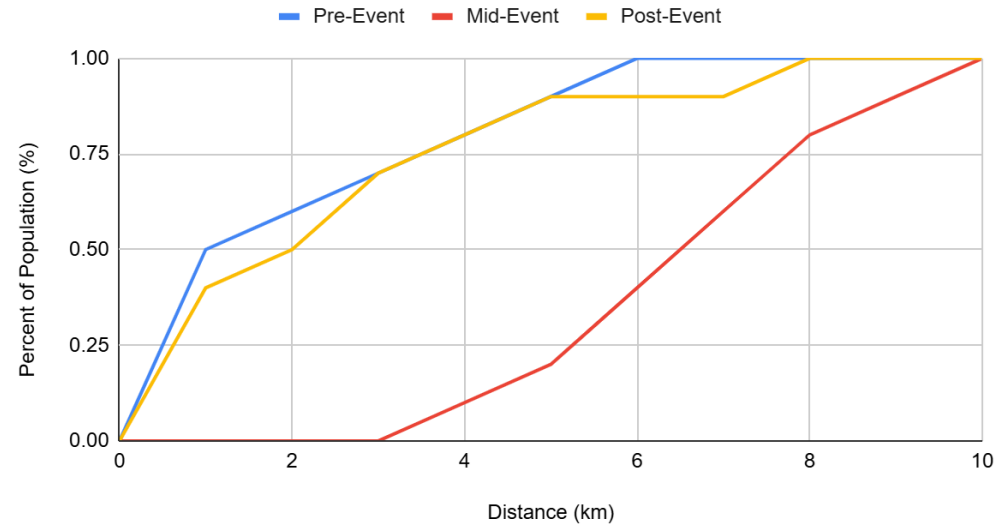


- a: fails ~ not resilient
- b: recovers ~ resilient
- c: critical backup ~ more resilient
- d: minimal impact ~ most resilient

Resilience vs. Reliability



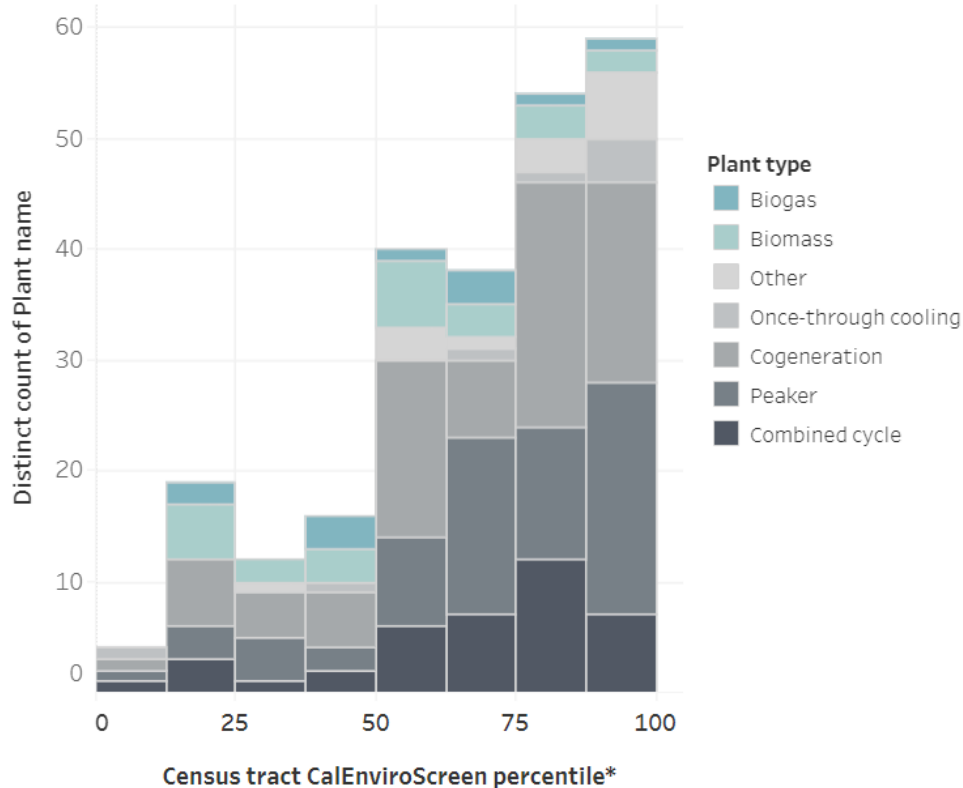
Distance to Essentials



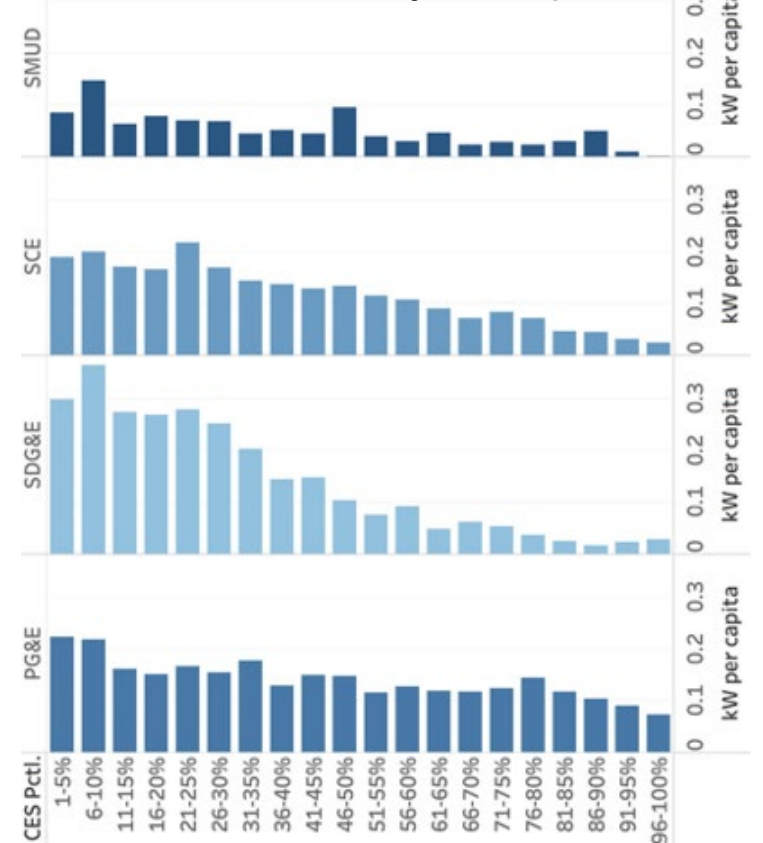
- Different trapezoids could be same event, different communities.
- Is distance correlated with or caused by inequity?
- Before and during disasters?
- **Resilience built before disasters.**

Equity: Impacts and Infrastructure

Distribution of plants by CalEnviroScreen percentile



Solar Penetration by CES percentile



Disadvantage correlates with :

- Proximity to fossil energy infrastructure
- A lack of resilient infrastructure

Policy Response:

- Equitable distribution of DER
- It's not just CO₂

Just and Equitable Energy Transition

Energy Justice and Equity: Applying a Critical Perspective to the Electrical Power Grid for a More Just Transition in the United States

Publisher: IEEE

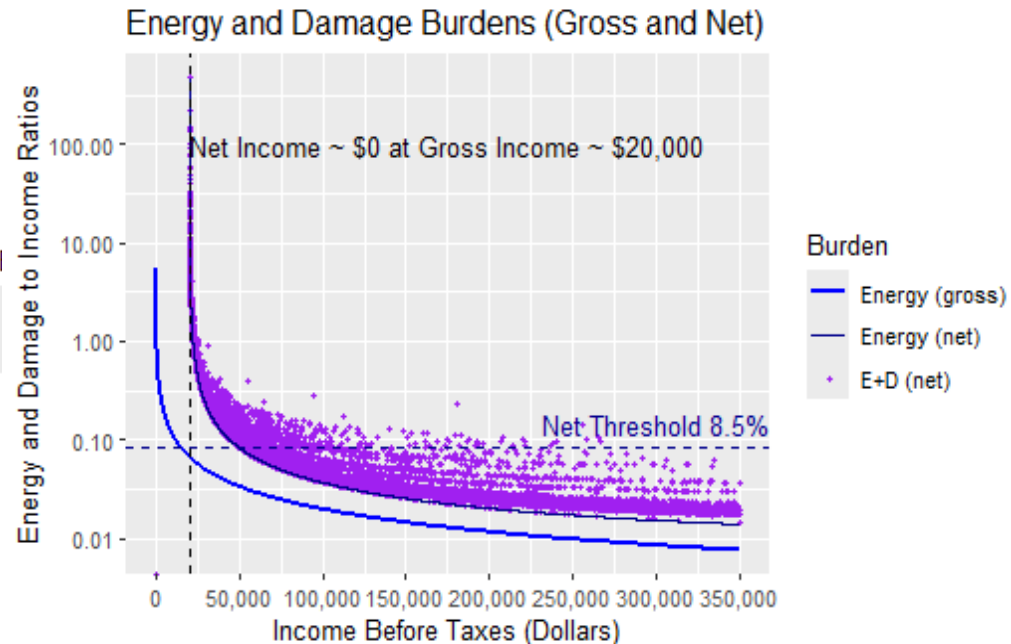
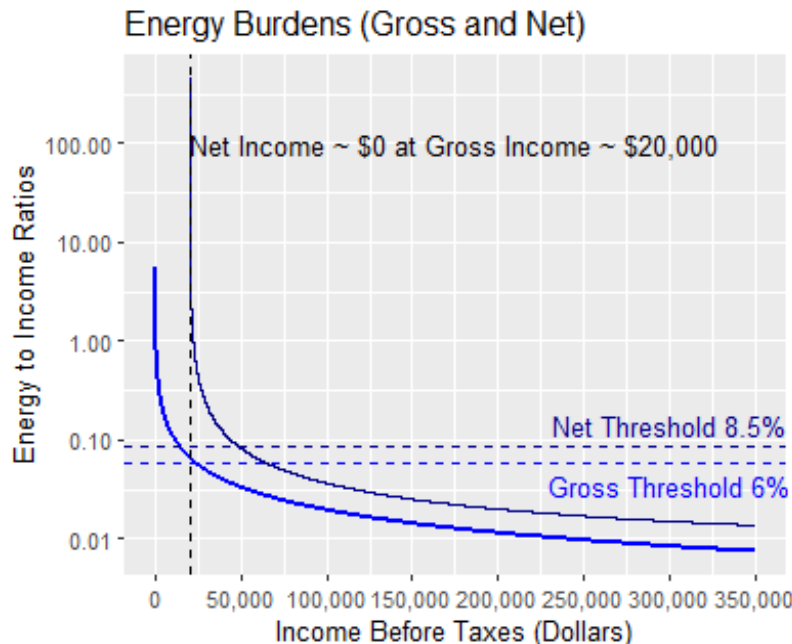
Cite This

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Policy Responses (from Sovacool's Pathways):

- Increase **affordability**
- Achieve **equitable reliability and resilience**
- Reduce environmental burdens
- Promote **participation in decision-making**



(In)Equitable Energy Resilience

Maps below adapt California Public Utility Commission's Energy Affordability Ratio to account for outage costs:

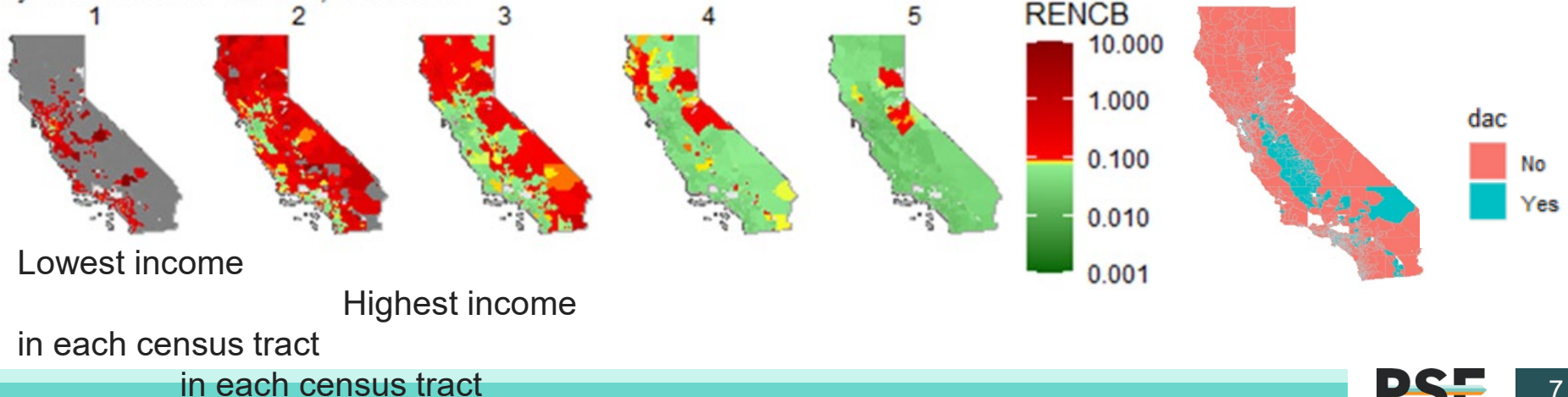
$$\frac{(\text{energy cost} + \text{outage costs})}{(\text{income} - \text{housing} - \text{utilities} - \text{other essentials})}$$

Observations:

- DAC, CES, and CVI are poor proxies for resilience impacts
- Policy analysis must include other vulnerabilities (low income, medical needs, climate)
- **Energy & housing insecurity are not resilient**

Resilient Energy Net Cost Burden (RENCB)

by Tract Income Quintile, California



Critical Infrastructure

What is critical depends on perspective

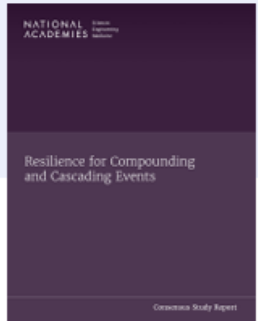
Interconnected Infrastructures

- Everything is connected
- Especially energy
- Failures cascade

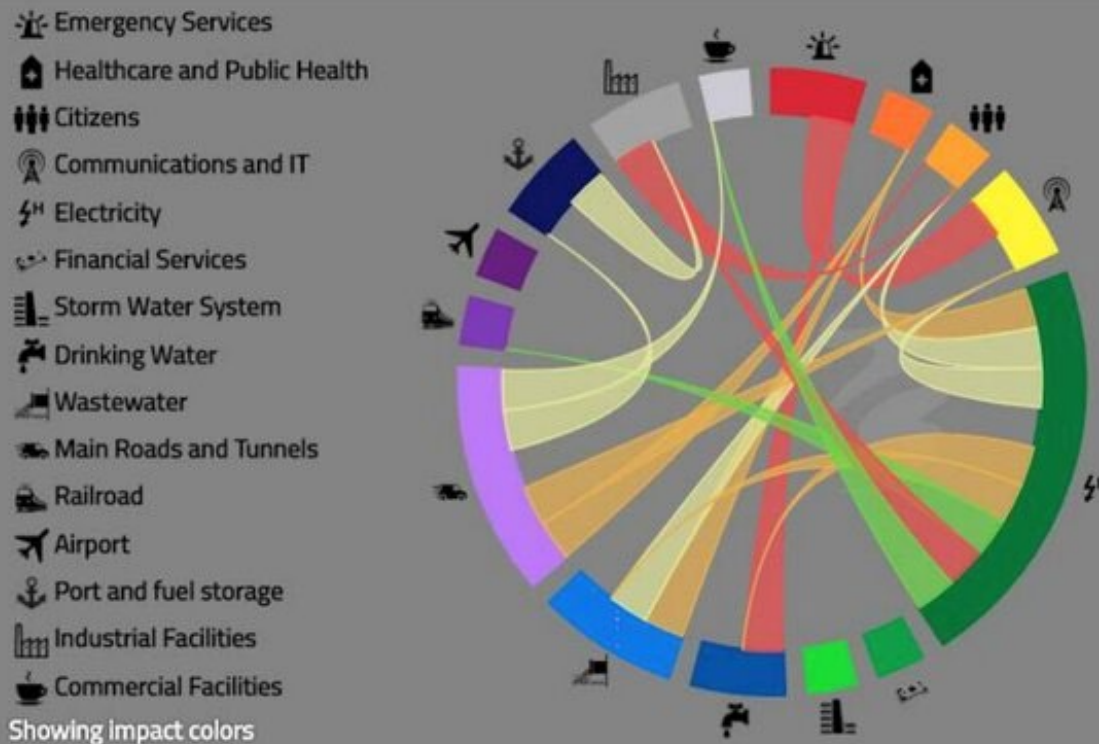
NATIONAL ACADEMIES
Sciences
Engineering
Medicine

Consensus Study Report
Highlights

Resilience for Compounding and Cascading Events



would strike one at
recover and rebuild.
ing disasters, one in
d instead seem to pile
tion on a community
prior disaster.
can compound
drought can lead to
ntense rain event



Critical Infrastructure: Key Components

The 16 Critical Infrastructure Sectors



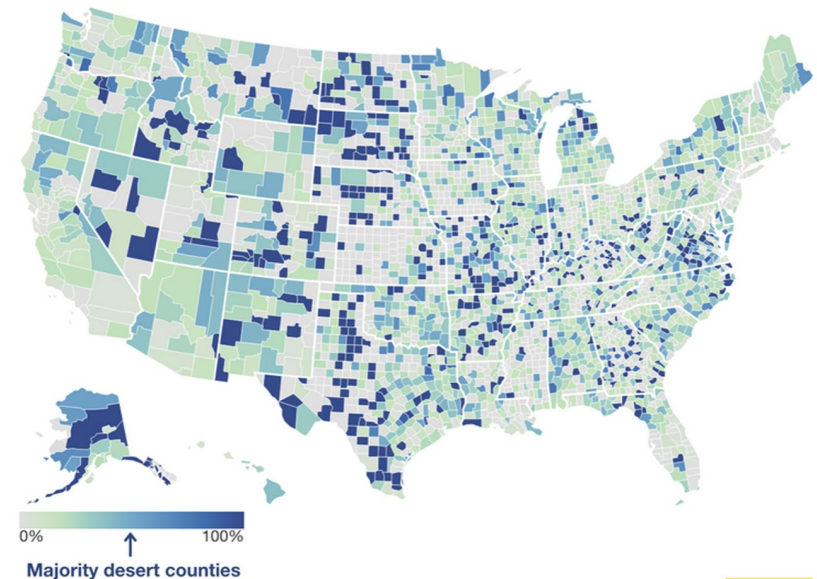
“Given the relatively large number of sector assets, particularly hospitals and clinics, protecting and preventing damage to any one asset is less vital than the ability to continue to deliver care.”

Critical Healthcare Components

- Facilities
 - ...
 - **Beds**
- Energy
 - UPS
 - **Hybrid long duration backup**
- Information systems
- **Healthcare workers**

Population Living in a Hospital Desert

Percent of county's population living over 30 minutes from the closest hospital.

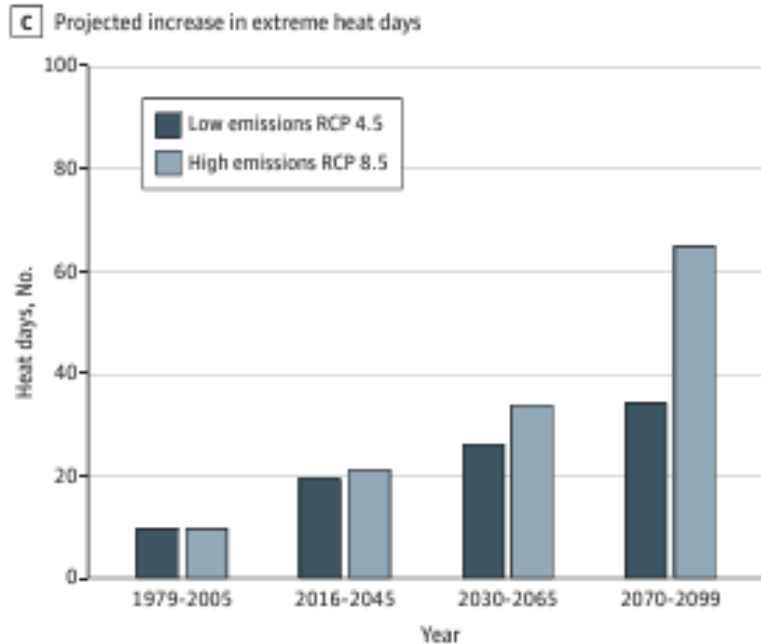


Source: Homeland Infrastructure Foundation-Level Data, Indian Health Service

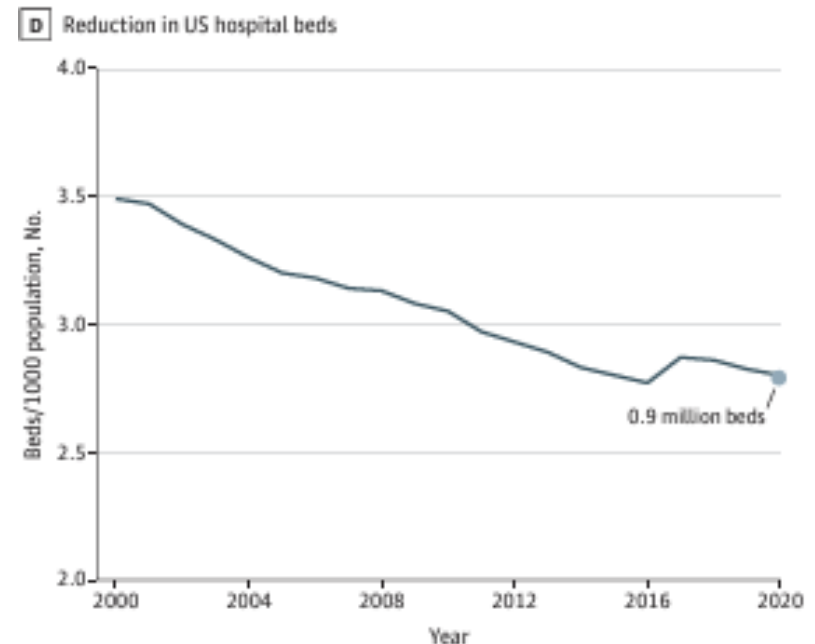
GoodRx

Increasing Exposure & Decreasing Capacity

From a NASEM New Voices collab:

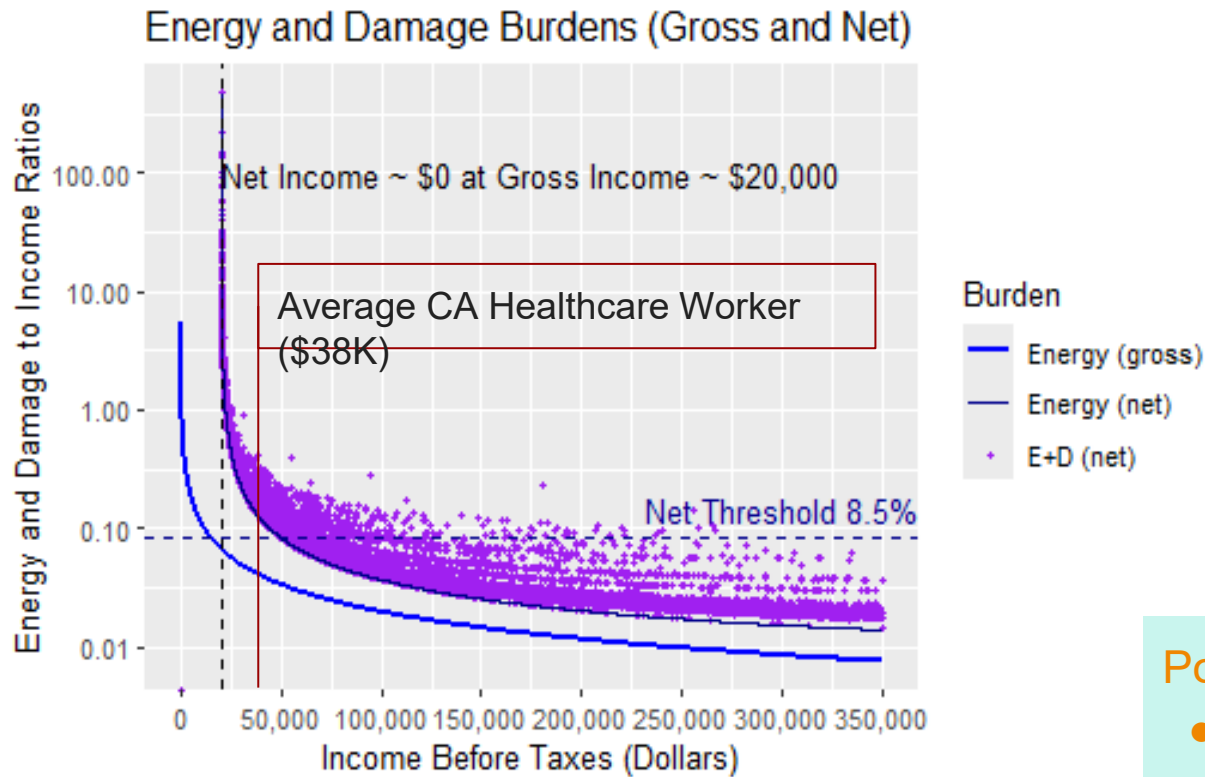


Increase in extreme heat days



Reduction in the total number of US hospital beds

Who Will Staff Healthcare Infrastructure?



- Resilient energy burdened households tend to lack backup systems.
- When schools and daycares close due to lack of power, do healthcare workers (a) go to work or (b) scramble to care for family members?

Policy Responses:

- Resilient energy for healthcare facilities
- Resilient energy for schools and daycares
- Resilient energy for critical workers
- Resilience hubs

Summary of Policy Responses

- Increase energy **affordability**
 - **Address housing cost crisis**
 - Consider optimal DER/grid mix vs. either/or
- Achieve **equitable reliability and resilience**
 - Equitable resilient energy for all
 - Resilient energy for healthcare facilities
 - Resilient energy for schools and daycares
 - Resilient energy for critical workers
 - Resilience hubs
- Reduce environmental burdens
 - Decarb pathways should also consider cleaner air, not just CO₂
 - Equitable, resilient healthcare
- Promote **participation in decision-making**
 - Avoid qualification cut-offs
 - Consider populations within geographies
- Environmental justice built on **procedural, distributive, recognitional, and restorative** justice

Questions & Discussion



About PSE

PSE Healthy Energy is a nonprofit energy science and policy research institute. Our mission is to generate science-based energy and climate solutions that protect public health and the environment.

Patrick Murphy, PhD, is a senior scientist at PSE Healthy Energy, where he researches clean energy transitions with a focus on resilience and energy equity.

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Thank you!



www.psehealthyenergy.org



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Extras

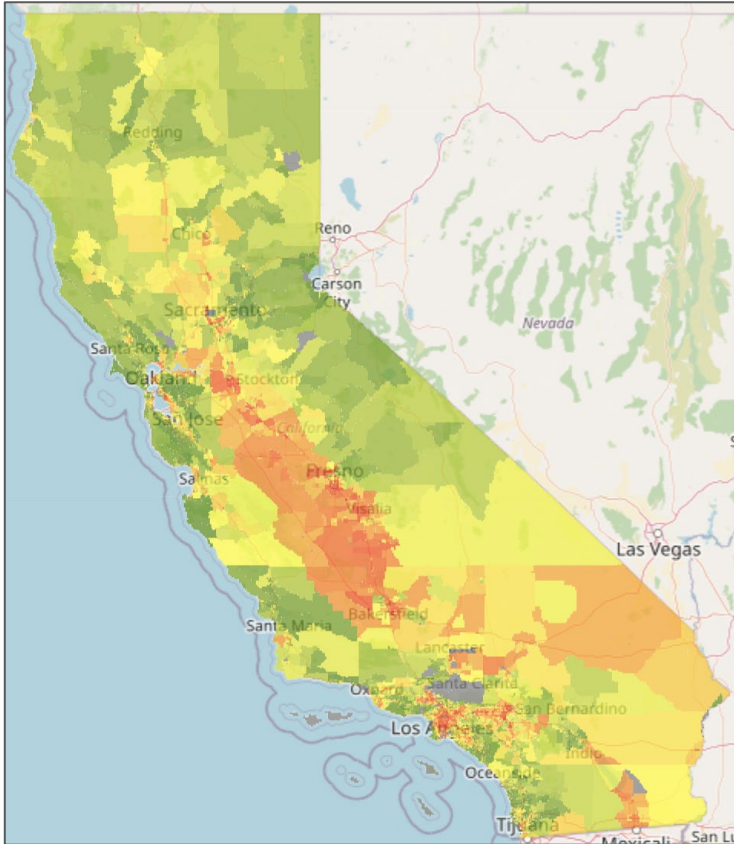


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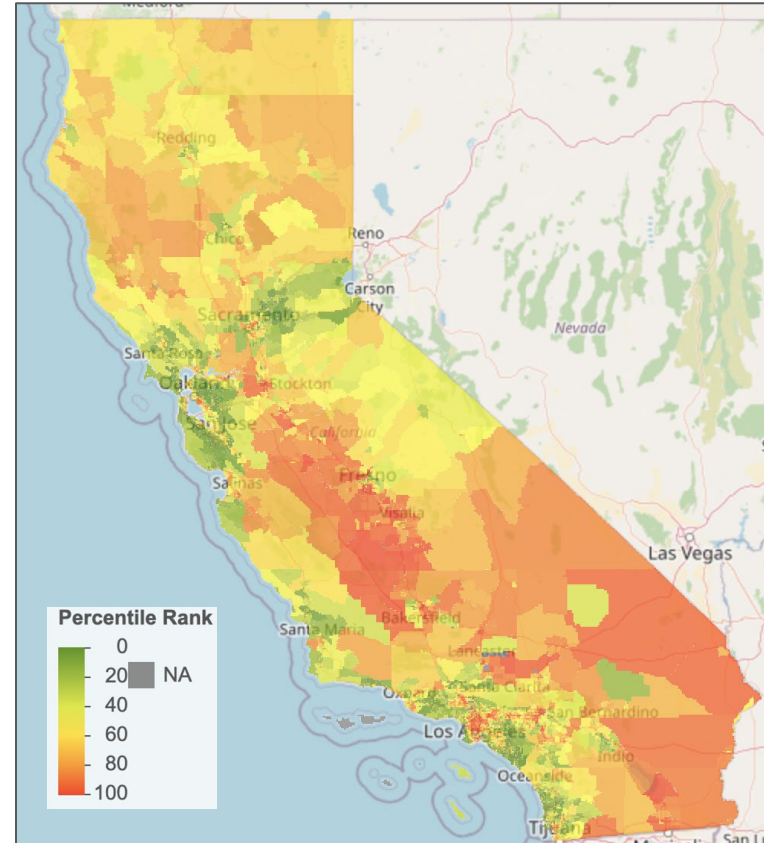
Who Will Need Healthcare Infrastructure?

CalEnviroScreen 4.0



- Demographic screens: not an either or, but understand the differences in various metrics or indices;
- and what using those mean for policy outcomes

Climate Vulnerability Index



- CVI captures some characteristics not in CES 4.0
 - wildfire smoke
 - healthcare worker shortages
- 365 additional disadvantaged census tracts

Other Vulnerabilities: At Risk Populations

At-Risk Populations



- Not typically visible in census tract scale analysis
- Populations can be difficult to reach with information and/or countermeasures

Policy Responses:

- Avoid qualification cut-offs
- Consider populations within geographies

Redlining: ↑ Exposure, ↓ Infrastructure

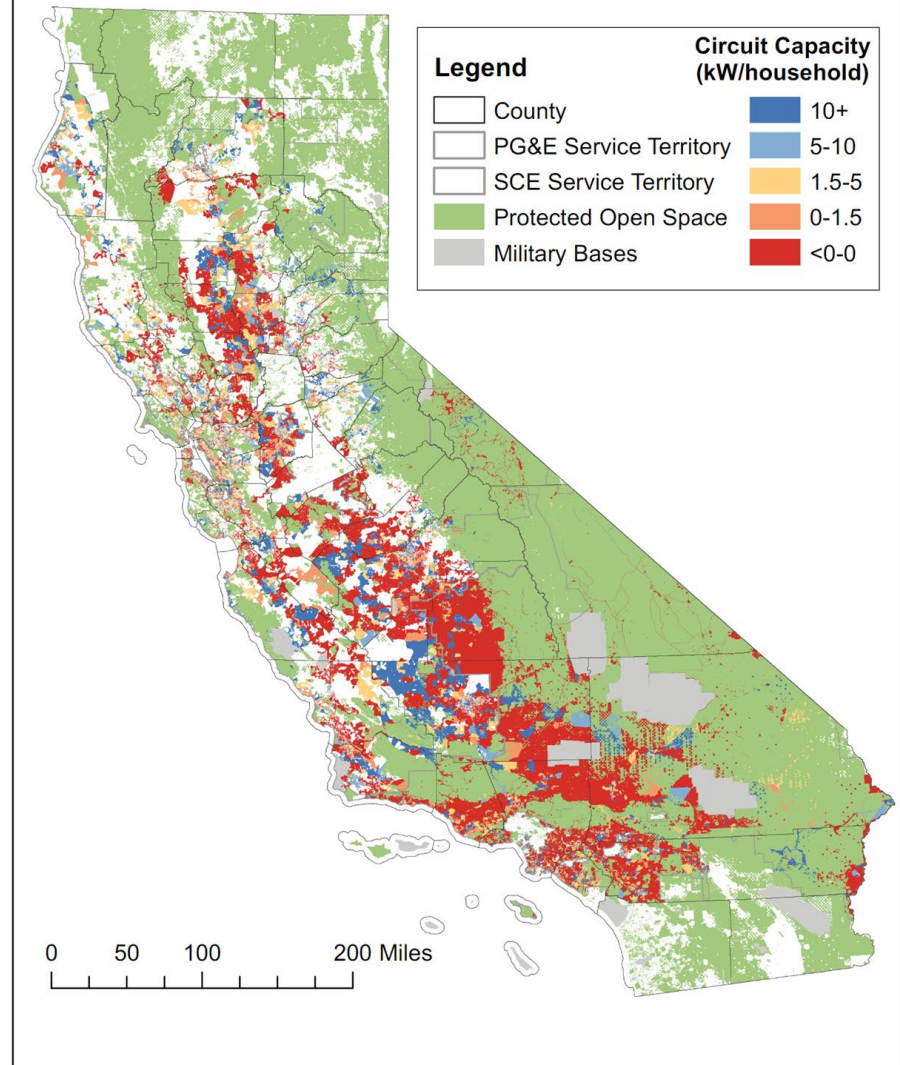
E.g. circuit hosting capacity in DACs may limit EJ communities' access to:

- Decarbonized heating, water heating and cooking
- Air Conditioning
- DER for affordability and resilience

Policy Responses:

- Improve infrastructure
- Consider optimal DER/grid vs. either/or

Grid Limits for Distributed Energy Resources: Load



Brockway et al. (2021)

Affordability & Capacity Lacking Nationwide

Resilient Energy Cost Burden-Net
(RECB-N)
by Tract Income Quintile

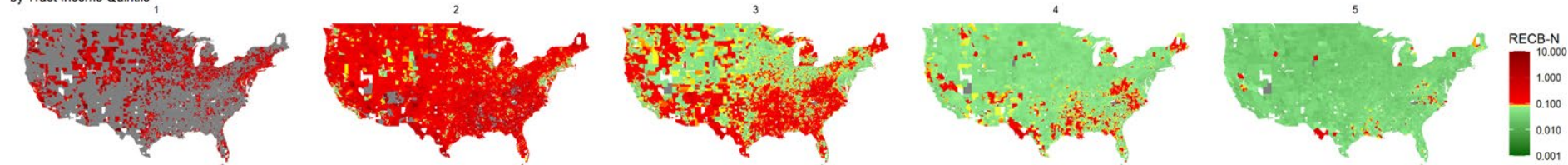
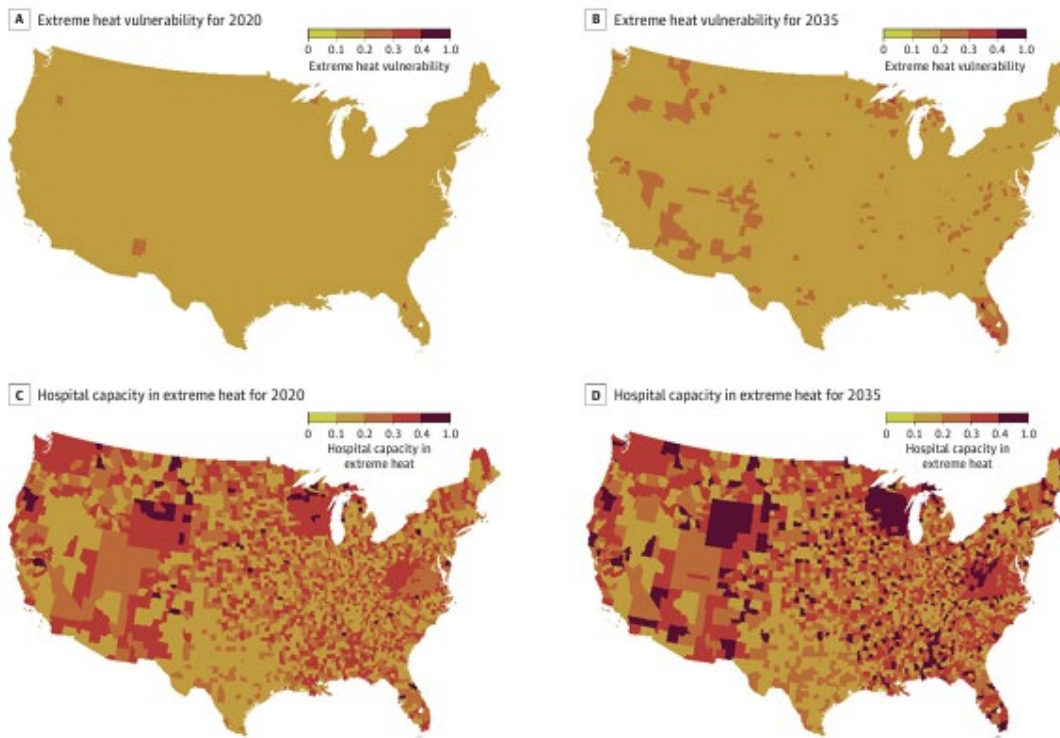


Figure 2. Extreme Heat Vulnerability and Hospital Capacity in Extreme Heat in the US



- Note, even in upper-middle income quintiles, especially:
 - ME
 - Appalachia
 - MI
 - AZ, NM
 - CA Sierras

Policy Responses:

- Equitable resilient energy
- Equitable resilient healthcare
- Address housing costs