

Justice, Equity, Resilience, and Vulnerability

CPUC Workshop



Bringing science
to energy policy



Agenda

- **Introduction**
- **Justice, Equity, Resilience and Vulnerability Metrics**
 - **Framework**
 - **Indices**
 - **Geographic and Demographic Scales**
- **Roles for R&D**
- **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.



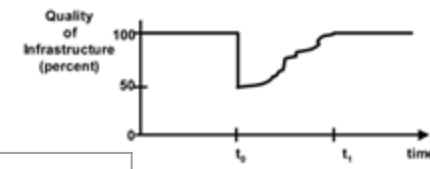
Justice, Equity, Resilience, and Vulnerability

Definitions and Metrics

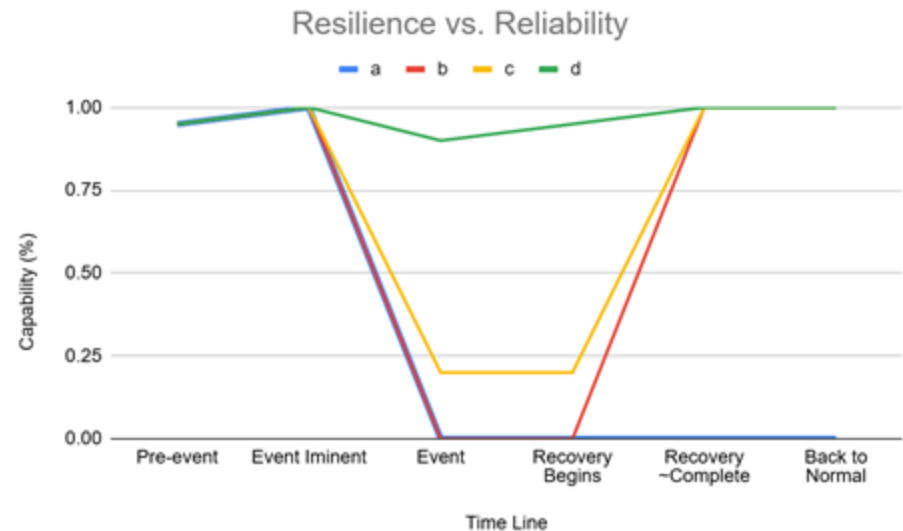
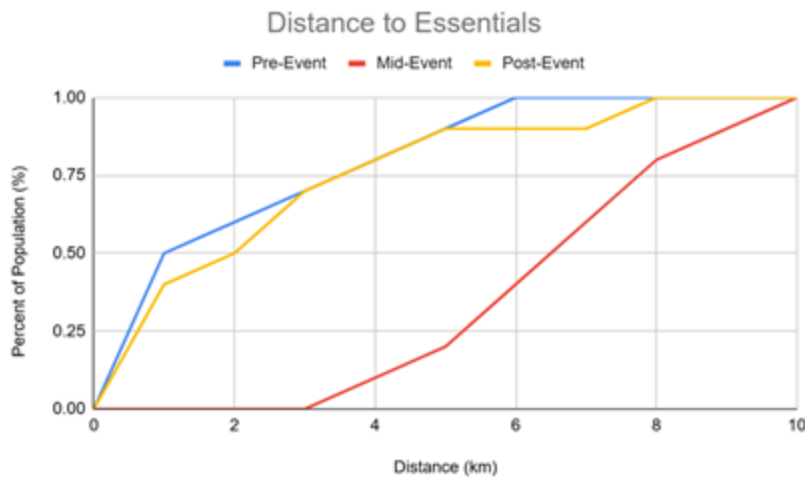
Elements of Energy & Enviro Justice

Justice Element	Goal	Actions
Procedural	Meaningful participation in decision making	• Solicit stakeholder input to inform project design • Create opportunities for stakeholder engagement
Distributive	Equitably distributing benefits and burdens	• Develop a community benefits plan in partnership with community stakeholders • Justice as fairness: “social and economic inequalities are to be arranged so that they are to the greatest benefit of the least advantaged members of society.” (Rawls, 1971)
Recognitional	Understanding history and context	• Baseline analysis of existing environmental burdens, hazards, and harms • Determine whether projects would create additional social or environmental impacts within the local community
Restorative	Facilitating healing and harmony	• Create opportunities to improve environmental and social conditions within communities • Include job and enterprise creation, as well as remediation of legacy pollution.

Reliability vs. Resilience

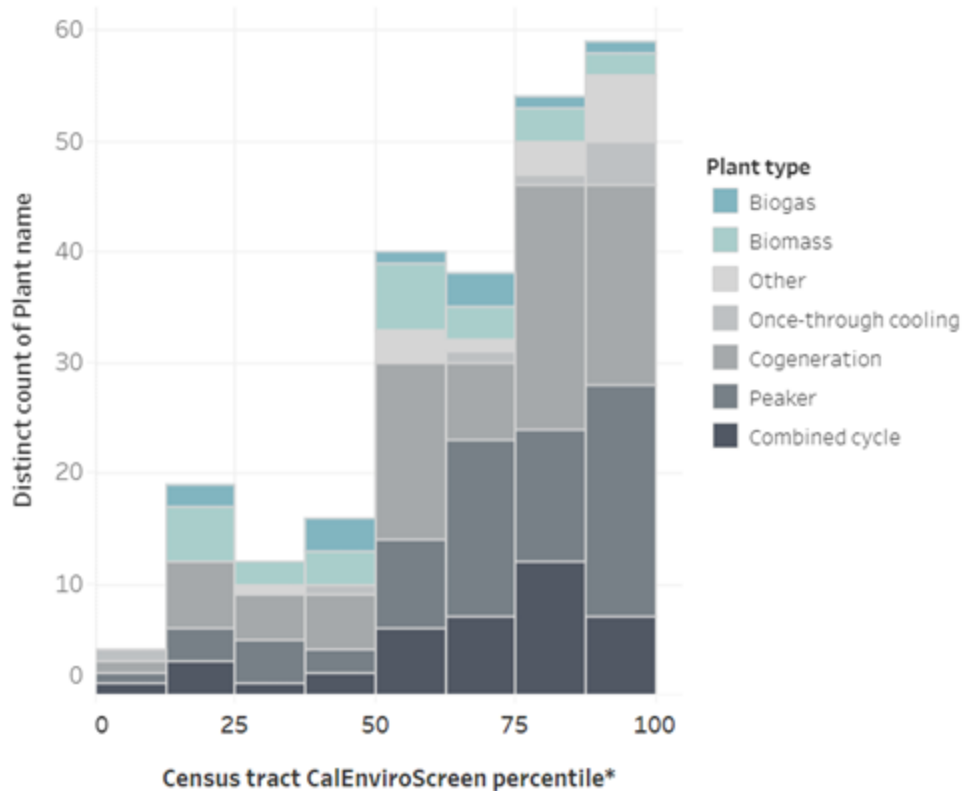


	Reliability	Resilience
Grid	- Dependably deliver power under normal circumstances. - Metrics: SAIDI/SAIFI/CAIDI/LOLE	- Prepare for, adapt to, withstand, and recover from disruptions. - Metrics: still emerging, especially for equity
User	- Average indices don't matter - Does my power stay on? - Metrics: aggregate to same?	- Maintaining some level of normalcy even if the grid goes down. - Metrics: Distance to essentials; Resilience affordability ratio

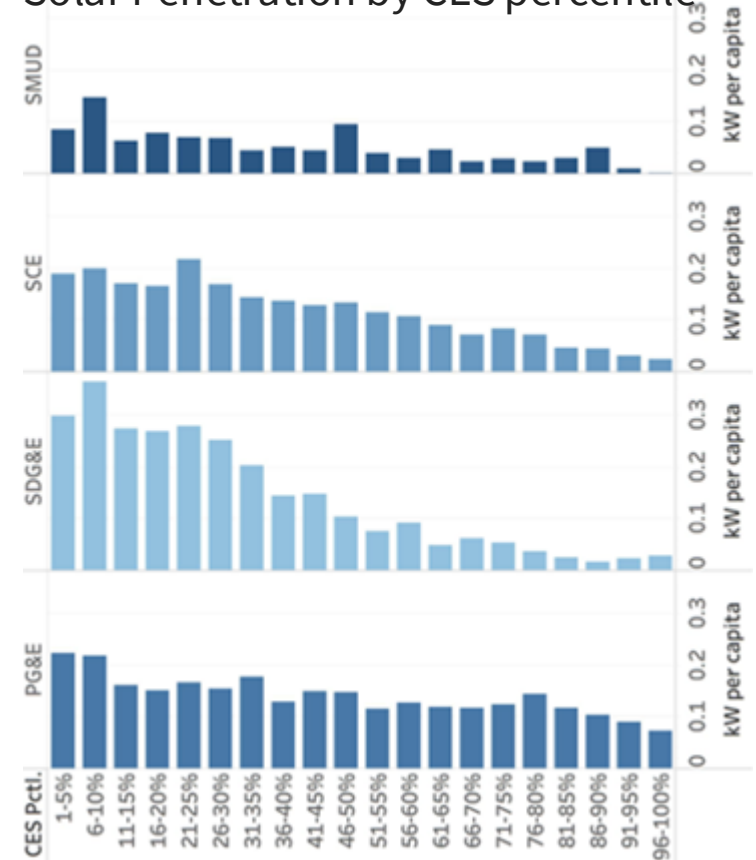


Equity: Impacts and Infrastructure

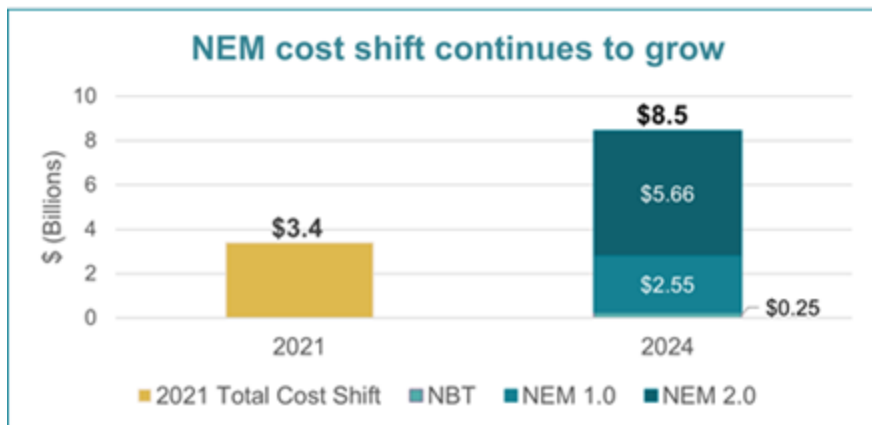
Distribution of plants by CalEnviroScreen percentile



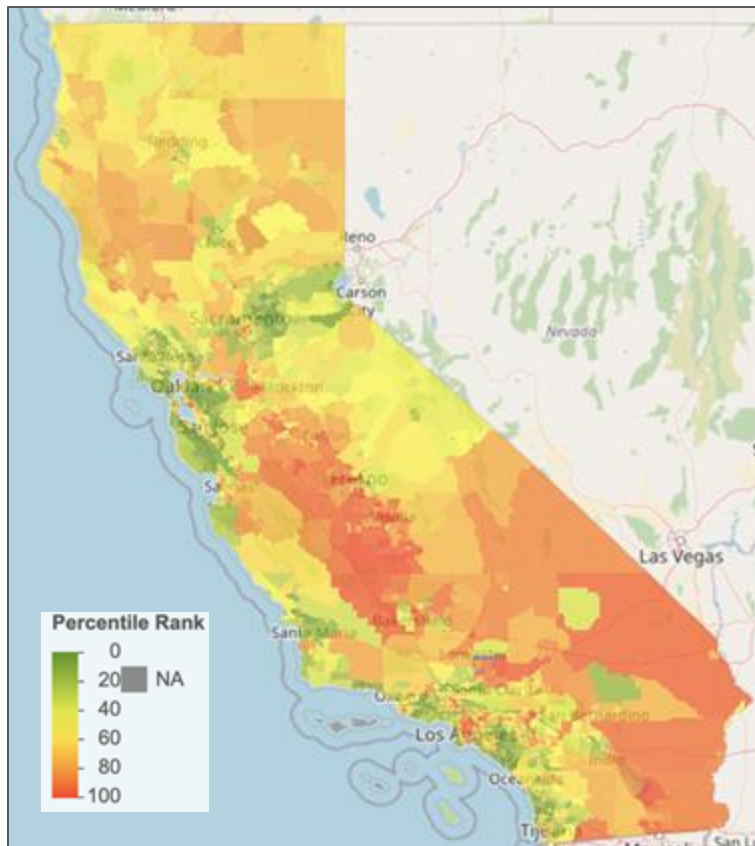
Solar Penetration by CES percentile



Cost Shifts and Equity

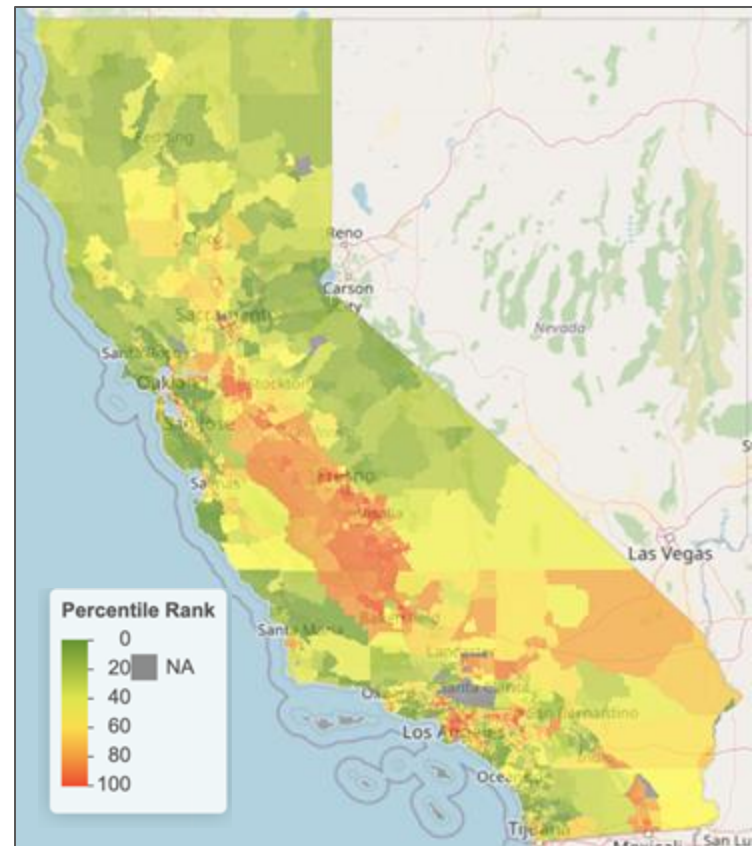


Climate Vulnerability Index



- Adaptive capacity
- Some vulnerabilities not captured in CES 4.0 (wildfire smoke)
- 365 additional census tracts as disadvantaged

CalEnviroScreen 4.0



- Not an either or, but understand the differences in various metrics or indices
- And what using those mean for policy outcomes

Other Vulnerabilities: At Risk Populations

At-Risk Populations



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

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

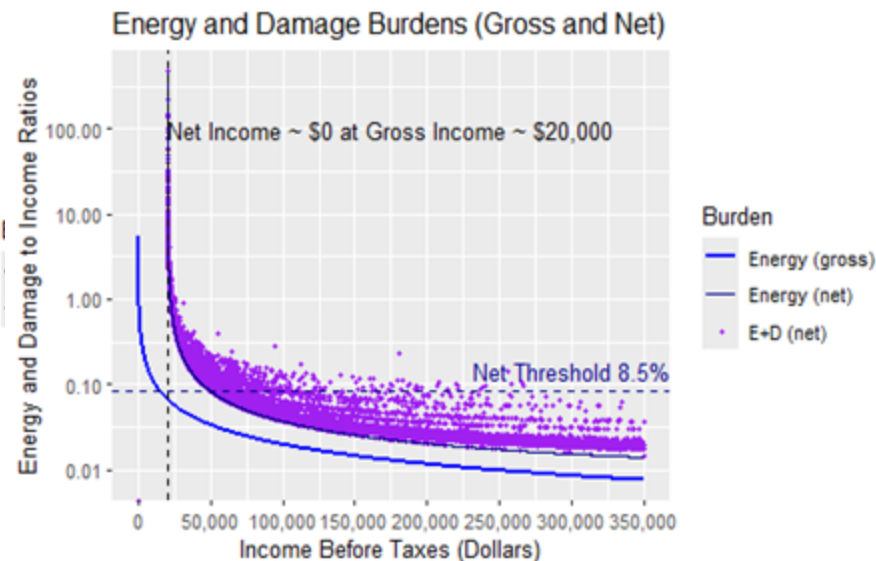
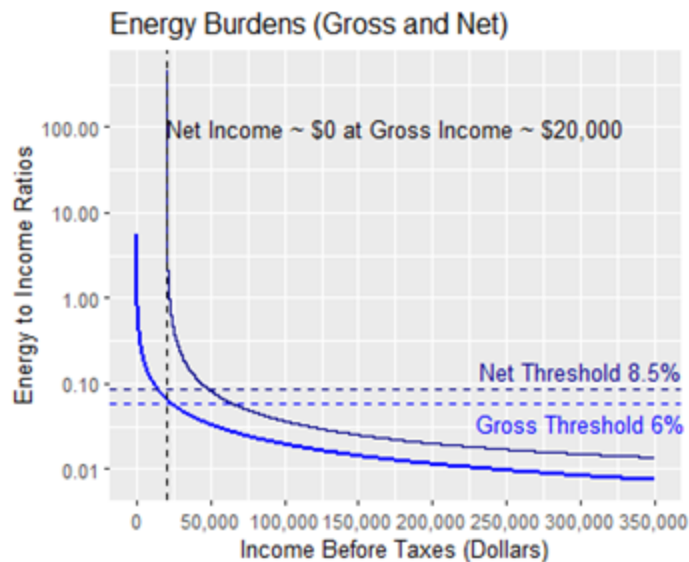
Cite This

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Pathways:

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



(In)Equitable Resilience

Maps below adapt CPUC's Energy Affordability Ratio to account for outage costs:

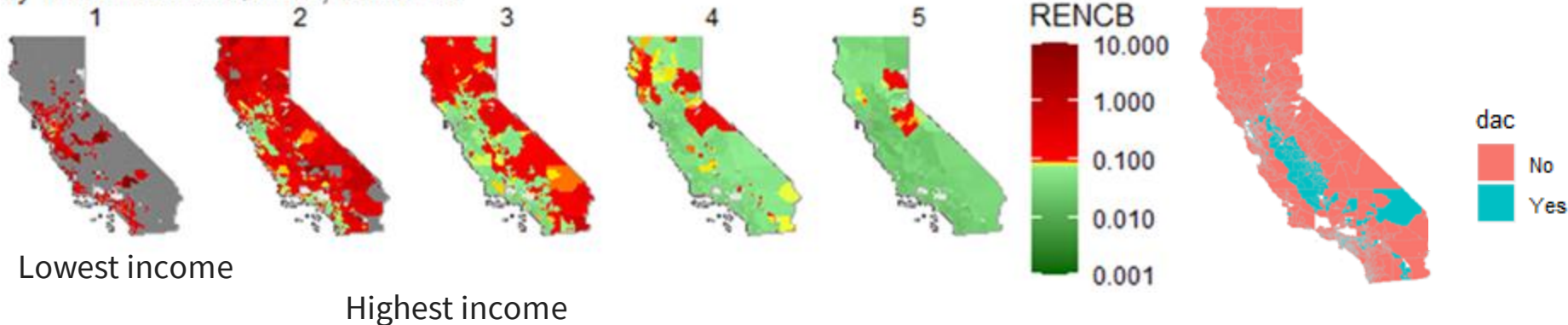
$$\frac{(\text{energy cost} + \text{outage costs})}{(\text{income} - \text{housing} - \text{utilities} - \text{other essentials})}$$

Observations:

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

Resilient Energy Net Cost Burden (RENCB)

by Tract Income Quintile, California



Lowest income

Highest income

in each census tract

in each census tract

Research Directions

Where to go next

Evaluate the Broader Impacts of Decarb



Energy Policy
Volume 96, September 2016, Pages 645-660



A retrospective analysis of benefits and impacts of U.S. renewable portfolio standards

Galen Barbose^a, Ryan Wiser^a, Jenny Heeter^b, Trieu Mai^b,
Lori Bird^b, Mark Bolinger^a, Alberta Carpenter^b, Garvin Heath^b,
David Keyser^b, Jordan Macknick^b, Andrew Mills^a, Dev Millstein^a

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<https://doi.org/10.1016/j.enpol.2016.06.035>

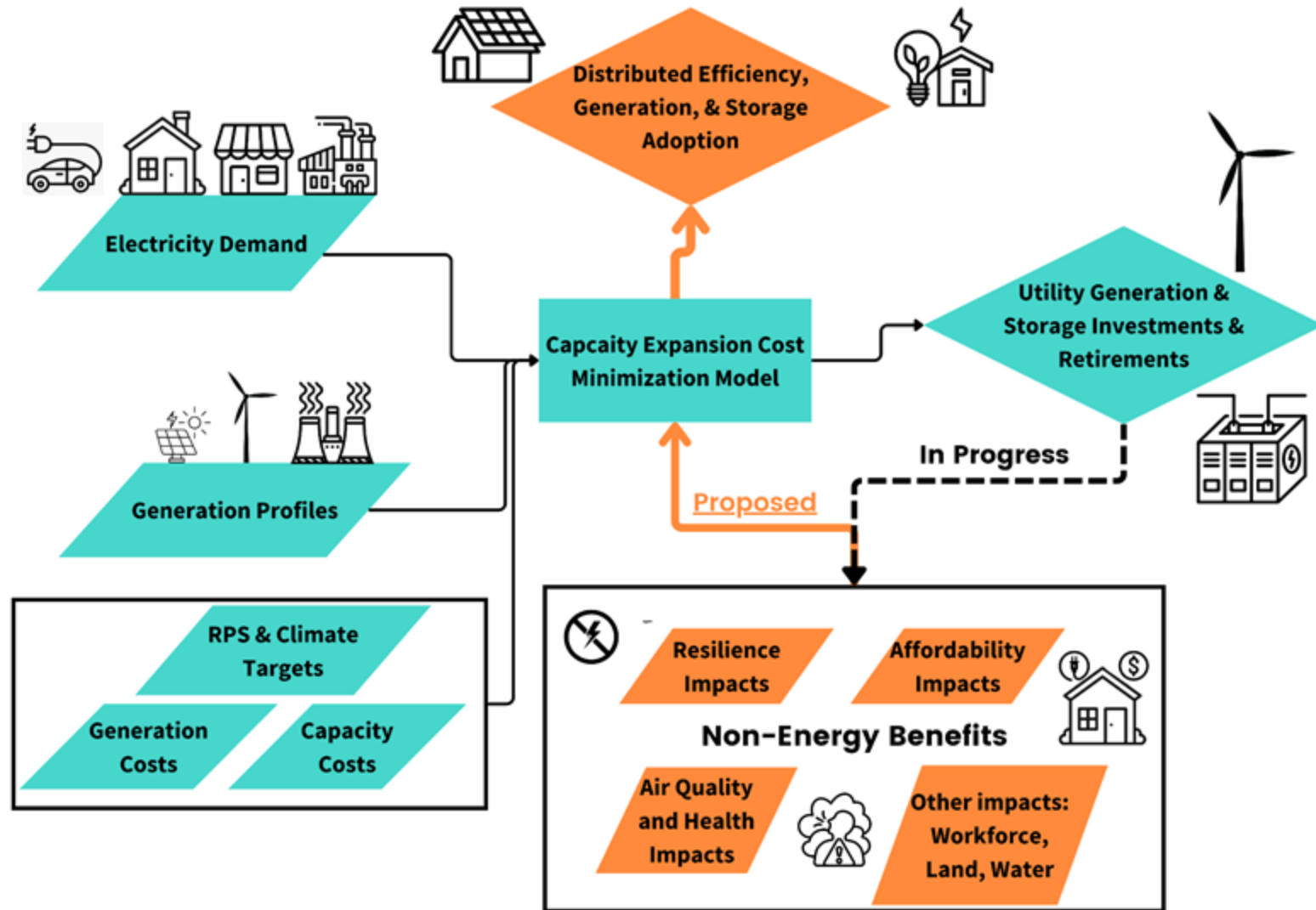
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Impacts of RPS in 2013:

- CO₂-equivalent emissions cut by 59 million metric tons (global benefits ~ \$2.2 Billion)
- Reduced air pollution (health and environmental benefits ~ \$5.2 Billion)
- Reduced water withdrawals (830 Billion gal) and consumption (27 Billion gal)

Are more savings possible with more inclusive optimization?

By Bringing Them into the decision space



Some Metrics that Should be Included

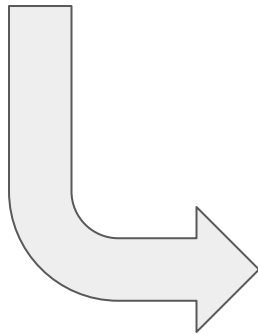
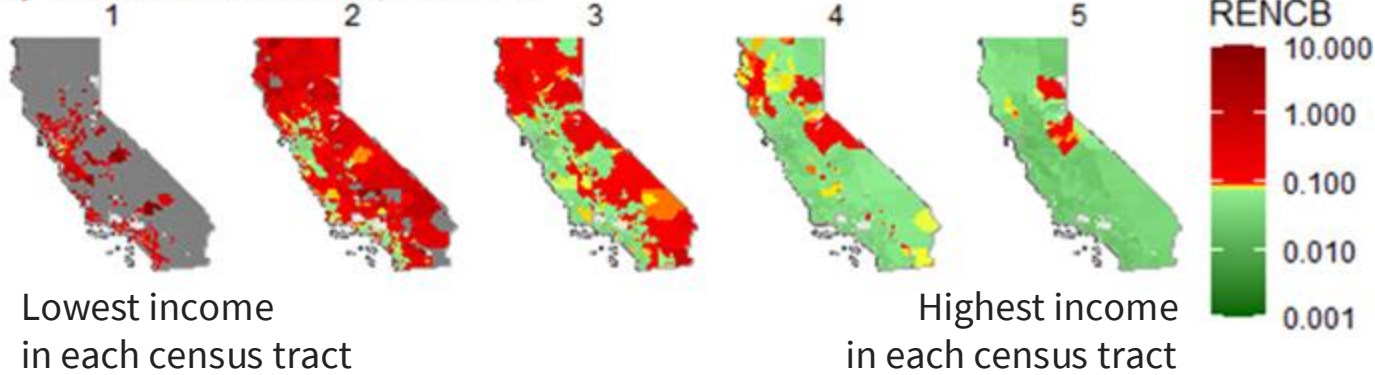
Factor	Sub-Factor
Land Use	Siting of Energy Resources
	Alternative Productive Uses
	Real Estate Impacts & Displacement
Public Health and Air Quality	Electricity Generation - Outdoor Air
	Transportation - Outdoor Air
	End Use - Outdoor Air
	Multiple Sources - Indoor Air
Water Supply and Quality	Water Supply - Consumption
	Water Supply - Withdrawal
	Water Supply - Quality
Economics	Energy Affordability - Household
	Economics and Jobs
	Workforce Development
Resilience	Affordability & Availability
	Remaining Costs/Impacts
Cross-Cutting Metrics	Equity
	Ecological Impacts
Safety and Risk	Wildfires
	Fires and Explosions
	Gas Leaks (H ₂ , CO ₂ , natural gas, ...)
Technology Dev	Hydrogen
	Direct Air Capture



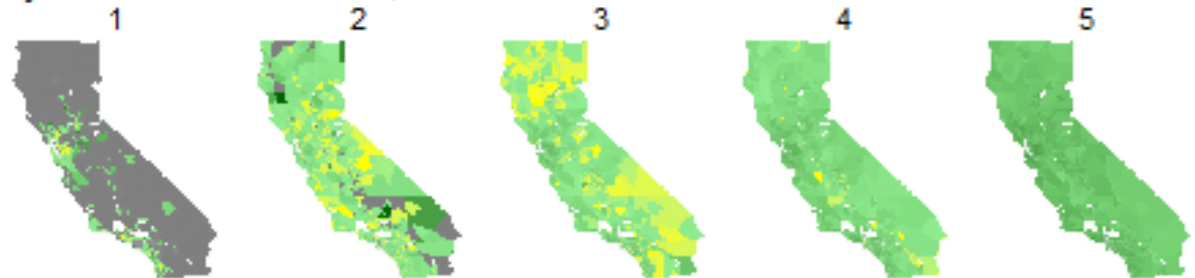
Resilience: Interventions Toward Equity

Resilient Energy Net Cost Burden (RENCB)

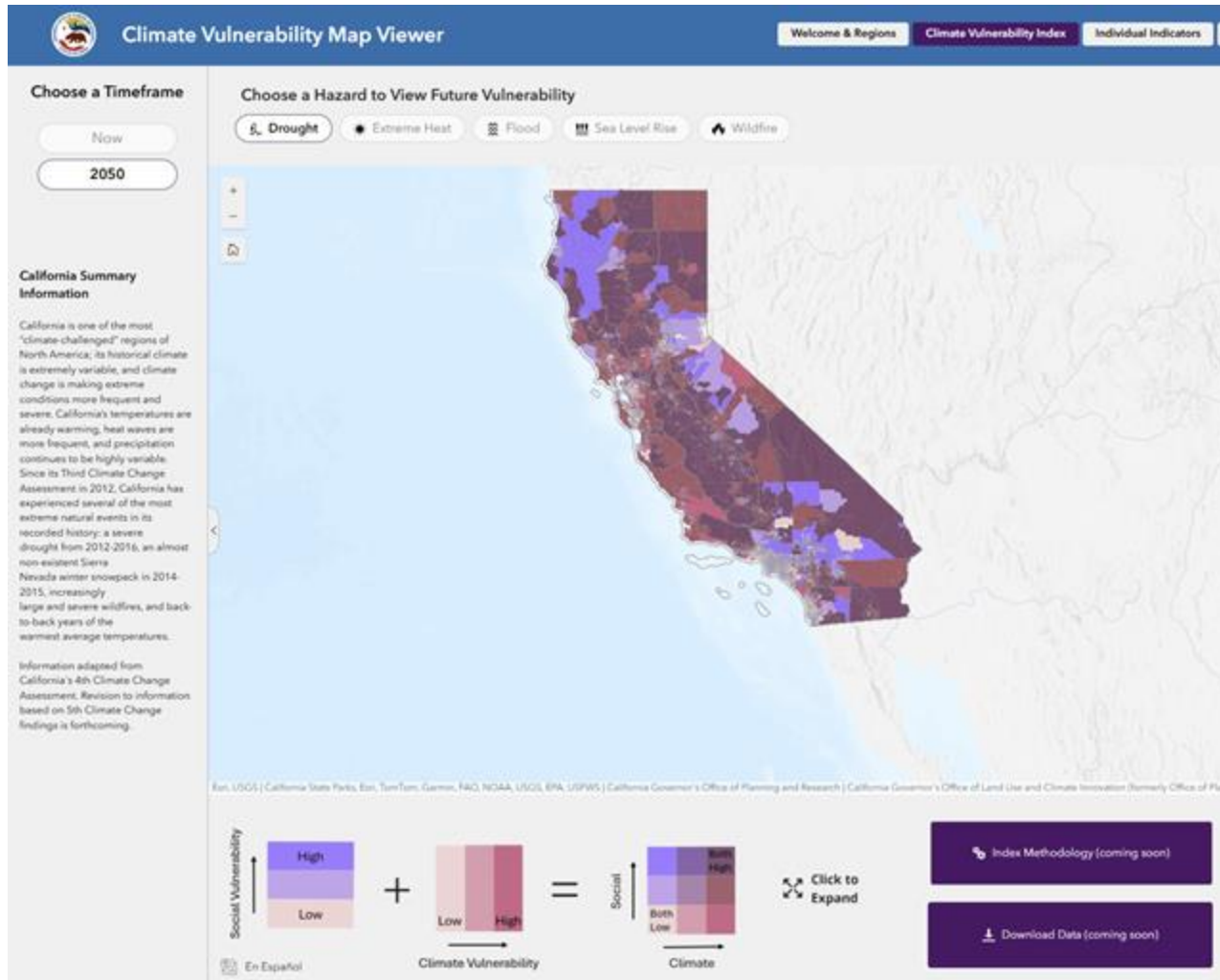
by Tract Income Quintile, California



by Tract Income Quintile, California



Integrating VCP into Risk Management



- For each and all hazards,
- For each (potential) intervention,
- How do (will) various VCP metrics and indices change?

Vulnerability & Readiness

Readiness	High	• Low risk • Monitor • Consider hidden vulnerable populations	• Invest in infrastructure • Cost share w/ community & businesses • Measure progress
	Low	• Does this exist? • Consider hidden vulnerable populations	• Invest in capacity development • Invest in infrastructure • Commit to infrastructure investments • Measure progress
		Low	High
		Vulnerability	

Questions & Discussion



Thank you!



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