ICARP Resilience Metrics White Paper

Draft for March 25, 2022 ICARP TAC Quarterly Meeting

Introduction

The Integrated Climate Adaptation and Resiliency Program (ICARP), established through Senate Bill 246 (Wieckowski, 2016), is a critical driver of California's strategy and leadership on climate adaptation and resilience. ICARP advances a cohesive and holistic response to the impacts of climate change by coordinating state and local adaptation efforts to support comprehensive planning and accelerate implementation. Through its enabling legislation, ICARP is centrally focused on efforts that advance climate equity and support integrated climate strategies, or those strategies that benefit both greenhouse gas reductions and adaptation. ICARP works to advance these priorities in planning and investment decisions through the development of decision-support tools, actionable climate science, guidance, technical assistance, and grant programs.

In 2017, ICARP developed a vision and set of seven principles that define the characteristics of a resilient California and guide implementation of adaptation actions to achieve the following long-term outcomes:

- **Resilient Social Systems**: All people and communities respond to changing average conditions, shocks, and stresses in a manner that minimizes risks to public health, safety, and economic disruption and maximizes equity and protection of the most vulnerable,
- **Resilient Natural Systems**: Natural systems adjust and maintain functioning ecosystems in the face of change, and
- **Resilient Built Systems**: Infrastructure and built systems withstand changing conditions and shocks, including changes in climate, while continuing to provide essential services.

Through this work, an important question began to emerge: *how can the state track progress over time and demonstrate success and to increase resilience across social, natural, and built systems?* Many state and local agencies have indicators and metrics that identify their progress towards a specific climate action and resilience goal. However, there was no consolidated set of metrics that demonstrated the State's overall progress in reducing climate risk and increasing resilience. The ICARP Technical Advisory Council (TAC), recognizing the need for a suite of comprehensive resilience metrics to help track progress and guide decision making across the state, recommended the development of resilience metrics as one of its key work priorities for 2020 - 2021.

Guided by participating members of the ICARP TAC, the Resilience Metrics Work Group (RMWG) met regularly between summary 2020 and fall 2021 to:

1. Inventory resilience metrics from entities throughout California and in other states, and internationally;

2. Identify how the state can measure built, natural and social resilience; and,
3. Identify the characteristics needed to demonstrate resilience across the state.

This report summarizes the findings of the ICARP Resilience Metrics Work Group and how this effort informed the 2021 CA Climate Adaptation Strategy update.

The Process to Understand and Define Resilience Metrics

In partnership with the RMWG, ICARP staff established a robust research and engagement process to best understand how to define and establish resilience metrics.

The RMWG's work included:

- Seven ICARP TAC Resilience Metrics Work Group public, virtual meetings;
- A public survey on resilience metrics efforts throughout California;
- State coordination through the Interagency Resilience Work Group;
- Coordination with the 2021 Update to the CA Climate Adaptation Strategy;
- Multi-state Resilience Metrics Workshop series co-led with the US Climate Alliance, RAND Corporation, and the World Bank.

Foundation Building

The ICARP RMWG met between summer 2020 and fall 2021. The goal of each meeting was two-fold: first, to build an evolving, shared understanding of how different types of entities (CA state agencies, other states, private sector/non-governmental organizations, local governments, and other countries) measure resilience; second to then use this understanding to advance the state's work to develop climate resilience metrics (see Appendix 1).

Building on the ICARP Vision and Principles, discussions centered on social, built, and natural system resilience. At the initial meeting in winter 2021, the ICARP RMWG discussed three foundational questions across these resilience systems:

1. Why do we want to measure resilience in built/social/natural systems?
2. How would we know if California has resilient built/social/natural systems?
3. Who's already measuring built/social/natural system resilience?

To provide more insight, ICARP staff also released a public survey to understand the landscape of resilience metrics work underway in California. The survey asked three questions:

1. Do you use climate resilience metrics in your work?
2. Have you come across climate resilience metrics from other organizations that you think could be useful to your work?
3. What do you think the state should measure to demonstrate its progress towards achieving climate resilience?

Through its role as the state's hub for resilience coordination and alignment, ICARP staff also convene the Interagency Resilience Work Group (IRWG), which is comprised of state agency representatives who work on climate resilience and adaptation (see Appendix 2).

The IRWG meetings provided an important venue to engage state agencies to understand if and how different state agencies measure resilience success in their respective programs. The first discussion focused on the same foundational questions asked of the ICARP work group, providing another robust suite of considerations to how the state should measure resilience across all three systems. Coordination through the IRWG also allowed ICARP staff to inventory and identify the many different resilience efforts already underway across the state.

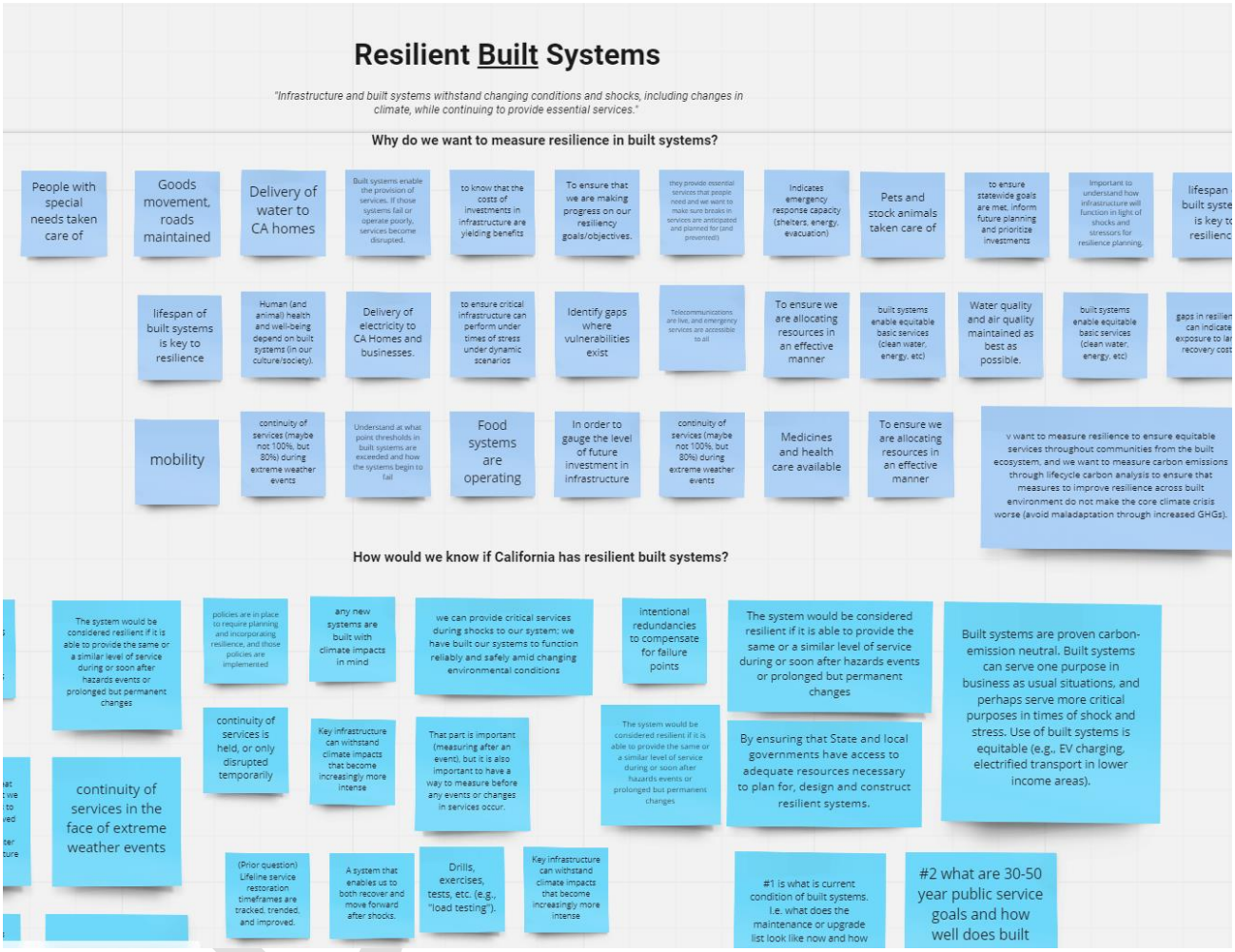

Figure 1: Screenshot capture of Miro Board discussion on built system resilience. Full meeting notes from this discussion are available on the OPR website.

Finally, in partnership with the U.S. Climate Alliance, the RAND Corporation, and the World Bank, ICARP co-convened a three-part workshop series with state representatives across the U.S. to better understand how – and if - they are working to measure resilience. These meetings highlighted that all states across the nation recognize the importance of measuring resilience and reduced risk, but most are at the early stages of developing comprehensive metrics across multiple sectors, climate impacts, and programs.

Findings

The research and deliberations across the efforts described above provided a broad range of perspectives and practices. This helped the RMWG develop a strong foundation and understanding of what is important to consider when measuring resilience outcomes. The following suite of climate resilience indicators are distilled from analysis of the many different deliberations and discussions.

Social System Climate Resilience Indicators

- Socioeconomic, demographic, and climate exposure data determine climate vulnerability
- Climate vulnerable communities participate in adaptation efforts through meaningful, informed, and long-term engagement
- Housing, transportation, and/or land use plans, policies, and investments consider the needs of climate vulnerable communities
- Equity and climate resilience are co-embedded in state investments
- Climate action plans and policies address health and equity
- Federal, state, regional, and tribal climate adaptation goals and plans are aligned
- Resources and funding are provided to jurisdictions for implementation of resilience projects and are equitably allocated to and for climate vulnerable communities
- Climate-related impacts on health, industries, and economies are measured, understood, and addressed
- Open space and natural places are accessed equitably
- Communities have strong social cohesion, trust, and social capital

Built System Climate Resilience Indicators

- Critical lifeline services and facilities, as well as transportation and water infrastructure, are accessible and reliable before, during and after climate-related disasters/events
- Continuity and restoration of services following planned or climate-/weather-induced disruptions is equitable
- Emergency response services before, during, and after climate-related disasters/events are equitable
- Critical infrastructure is resilient to climate impacts throughout the duration of its useful life
- Plans, codes, ordinances, resolutions address climate risk and climate adaptation
- Californians have equitable access to sustainable and resilient housing
- Nature-based solutions are implemented in the built environment
- Climate mitigation (greenhouse gas reduction) aligns with climate adaptation

Natural System Climate Resilience Indicators

- Nature-based solutions benefit natural and working lands
- Biodiversity and climate impacts and events on natural lands are measured, understood, and addressed
- Habitat and species are restored and preserved
- Ecosystem functions and natural processes are maintained

- Ecosystems, wildlife, and working lands adapt to and recover from climate stressors and impacts

These indicators are an important first step in helping the state demonstrate progress in increasing climate resilience, through existing and new programs.

Coordination with CA Climate Adaptation Strategy Update (2021)

The state launched the 2021 update to the CA Climate Adaptation Strategy (Strategy) early in the winter of 2021. Through robust interagency coordination and external stakeholder engagement, the Strategy oriented around six outcome-based priorities for building resilience:

- Strengthen Protections for Climate Vulnerable Communities
- Bolster Public Health and Safety to Protect Against Increasing Climate Risks
- Build a Climate Resilient Economy
- Accelerate Nature-Based Climate Solutions and Strengthen Climate Resilience of Natural Systems
- Make Decisions Based on the Best Available Climate Science
- Partner and Collaborate to Leverage Resources

For each priority, CA state agencies identified a suite of goals and actions, as well as associated timeframes and metrics to measure progress and enable accountability. The Strategy, released as a website, provides details on the priorities, goals, actions, and metrics.

The ICARP RMWG's resilience metrics initiative dovetailed with the 2021 update to the CA Climate Adaptation Strategy (Strategy). Accordingly, the metrics, actions, and goals in the Strategy reflect most of the indicators described above. The indicators identified through the ICARP RMWG work provided important high-level insight that helped shape and inform the metrics that were subsequently included in the Strategy.

In addition to informing the metrics included in the Strategy, the ICARP RMWG indicators can also inform a suite of new resilience programs and investments made through the historic 2021 climate budget.

In the ICARP work group's early scoping, many of the non-state agency participants discussed their own entities' needs for resilience metrics. Stakeholders sought indicators that defined broad collective goals, but also allowed flexibility to reflect local conditions and priorities. Therefore, in addition to informing state efforts to develop resilience metrics, the ICARP RMWG indicators can also provide a guide for local public agencies, the private sector, and communities.

Ultimately, it is through combined and collective work and accounting across state agencies and local partners that the entire state can demonstrate resilience success greater than the sum of the parts.

Appendix 1: Overview of ICARP Resilience Metrics Work Group meetings, meeting materials, and agenda and discussion items

Meeting Date & Links	Agenda	Discussion
June 10, 2020	• Overview of Resilience Metrics and Measurable Outcomes • Lightning Round Talks on Climate Change Indicators and Resilience Metrics • Draft Scope of Work and Goals for Resilience Metrics Work Group	This meeting kicked-off the ICARP Resilience Metrics Work Group (RMWG). ICARP Staff presented a draft scope of work, goals, and roles for the Resilience Metrics Work Group. Lightning Presentations from: • Martine Schmidt-Poolman, CA Energy Commission – *Tracking Historical and Projected Changes to CA's Climate* • Carmen Milanes, Office of Environmental Health Hazard Assessment – *Indicators of Climate Change in California* • Dorian Fougeres, CA Tahoe Conservancy – *Resilience Metrics in the Lake Tahoe Basin*
Jan. 20, 2021	• Reviewed resilience metrics definitions and framing • Presented updated timeline • Began discussion on key components to demonstrate and measure systemic social, natural, and built resilience	After reviewing initial scope of work and framing, discussion focused on foundational questions to guide subsequent work: • Why do we want to measure resilience in built/natural/social systems? • How would we know if California has resilient built/natural/social systems? • Who's already measuring built/natural/social system resilience?

Meeting Date & Links	Agenda	Discussion
Feb. 24, 2021	• Provided overview of public survey results findings • Presented summary of Jan. 20 meeting discussions for TAC consideration and review • Expert presentations on non-state resilience metrics efforts.	Dr. Robert Lempert, RAND – *Overview on Resilience Metrics* Dr. Kimberly Clark, Southern California Association of Governments – *SCAG's Principles and Metrics for Jurisdictions and MPO's*

Apr. 21, 2021	• Provided overview of resilience metrics feedback collected to date
	• Introduced the six Climate Adaptation Strategy Priorities
	• Proposed process on developing the resilience metrics in coordination with the Climate Adaptation Strategy
		After reviewing the Climate Adaptation Strategy and resilience metrics process, discussion focused on the following questions to guide subsequent work:
		• Across the 6 priorities, what should the state measure?
		• How will the state show progress towards:
		  ○ Reducing risk to climate impacts
		  ○ Increased resilience to climate impacts

Jul. 21, 2021	• Described process of integrating state agency plans, goals, and metrics into the Climate Adaptation Strategy • Proposed a conceptual framework for resilience metrics and how it relates to the Climate Adaptation Strategy	After reviewing the Climate Adaptation Strategy process and resilience metrics conceptual framework, discussion focused on the following questions to guide subsequent work: • How will you use these metrics? • Who is your audience? • What type of indicator/metric will help you? • How will these help you in your work?

Meeting Date & Links	Agenda	Discussion
Oct. 20, 2021	• Provided overview of the draft Climate Adaptation Strategy and its relationship with ICARP resilience metrics • Expert presentation on non-state resilience metrics efforts	Dr. Letitia Grenier, SF Estuary Institute – *Landscape Resilience Framework*
Nov. 18, 2021	• Presented draft social system resilience indicators with comparison to the Climate Adaptation Strategy Priority 1 actions and metrics	Discussion focused on the following questions: • Are the draft ICARP social resilience indicators reflected in the Priority 1 actions and metrics of the Climate Adaptation Strategy? • Do these indicators and metrics help determine if we have achieved social system resilience? If no, what is missing?

Appendix 2: Interagency Resilience Work Group Membership

IRWG Representation
California Coastal Commission
California Energy Commission
California Natural Resources Agency
California Public Utilities Commission
California Tahoe Conservancy
California Volunteers
Delta Stewardship Council
Department of Conservation
Department of Fish and Wildlife
Department of Food and Agriculture
Department of Forestry and Fire Protection
Department of Housing and Community Development
Department of Insurance
Department of Parks and Recreation
Department of Public Health
Department of Resources Recycling and Recovery
Department of Transportation
Department of Water Resources
High Speed Rail Authority
Ocean Protection Council
Office of Emergency Services
Office of Environmental Health Hazard Assessment
Office of Historical Preservation
Office of Planning and Research
Sacramento-San Joaquin Delta Conservancy
San Francisco Bay Conservation and Development Commission
State Coastal Conservancy

State Water Resources Control Board
Strategic Growth Council

Appendix 3: U.S. Climate Alliance Resilience Metrics Workshop Series Event Proceedings Summer 2021

Overview

Developing resilience metrics is a key priority of the U.S. Climate Alliance's Resilience Working Group, a community of learning focused on sharing resilience best practices. As they increase their resilience efforts, many, if not all, Alliance states have started to develop or identify the need for a set of metrics to measure and track progress and guide future decisions. Conversations with state policymakers revealed that there is a significant need to develop or aggregate metrics to better understand whether resilience initiatives are resulting in the desired outcomes.

As a result of Alliance member states' feedback and requests, the U.S. Climate Alliance, RAND Corporation, and the California Office of Planning and Research (OPR) partnered to conduct a series of workshops on resilience metrics in May and June 2021. The workshop series was conducted virtually. Attendees included representatives from member states' planning, environmental protection, natural resource management, and other agencies, as well as outside experts from federal agencies, local governments, nonprofits, multilateral organizations, and the academic and consulting communities.

Key themes:

- *Use resilience priorities to inform metrics development*
- *Define audiences and users*
- *Build off existing metrics*
- *Invest in data collection and staff*
- *Commit to outcomes-based metrics*
- *Center equity when measuring resilience*
- *Embrace multiple start points, processes, and endpoints*

The Alliance's goal with the workshop series and this proceedings document is to support states as they develop or consider developing their resilience metrics. The series also informed the 2021 update to the USCA Governor's Resilience Playbook, due to be released in November 2021.

Potential Next Steps

Since the discussions highlighted several open questions and key needs, we hope they can be a springboard for future work on resilience metrics. Potential next steps, contingent on funding and resources, could include:

- Additional future convenings on resilience metrics, potentially aligned with their numerous functions and audiences

- A compilation of examples and case studies at the state, local, and potentially national level
- The development of guidelines or suggested processes for creating resilience metrics

We welcome input on next steps. Please reach out to USCA if you have suggestions (jphillips@usclimatealliance.org).

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Pre-Workshop Survey Results

To help define the agenda and priorities for the workshop series and evaluate participants' starting points, the conveners conducted a pre-workshop survey in May 2021. Findings from the survey indicated that:

- Many Alliance states were not yet developing metrics, but were beginning to consider it
- Many states were considering resilience metrics to cover a variety of systems (including people, infrastructure, economy, ecosystems), rather than a specific subset
- Participants identified state decision makers, local governments, and the public as key audiences for resilience metrics
- Participants identified many potential uses of metrics, especially their use for determining the success of efforts to increase resilience and reduce risk and informing and influencing investments
- Key needs identified for the workshop series included:
    - The need to track progress like GHG mitigation targets, tracking, and reporting
    - The need for examples of metrics as well as best practices

Workshop Summaries

Day 1

The first workshop (May 27) aimed to connect states working on resilience metrics for shared learning and begin to create a community of practice. A short presentation established common definitions and described the variety of uses for resilience metrics, including process metrics as opposed to outcome metrics. State officials then communicated their state's status on developing metrics. Officials from the Colorado Resiliency Office, the New York Department of Environmental Conservation, the Minnesota Pollution Control Agency, and California OPR shared their progress developing their own resilience metrics, including, where applicable: their intended purpose and audience(s); the process of creating metrics; the data they use; and public-facing results of their work.

The second half of the workshop was spent in breakout discussions. One breakout room identified challenges in developing metrics, including: limitations of staff time, coordination and collaboration between agencies, and uncertainty around audience. Discussion in the second breakout room focused on why metrics are important, including their use in building political will to increase ambition on resilience.

More in depth information on Day 1 can be found here or below on page 10.

Day 2

The second workshop (June 20th), focused on research and case studies that addressed questions that arose during the first day. The first presentation focused on the World Bank Group's approach to evaluating resilience efforts in their portfolio. The World Bank Group found that prioritizing well-being (and not just asset losses) in risk assessments fundamentally changes the priorities for resilience planning. Elsewhere, the World Bank's efforts focus on measuring drivers of resilience (rather than attempting to measure resilience itself) to compare projects across countries.

After breakout room exercises that focused on different hypothetical scenarios, representatives from the National Institute of Standards and Technology (NIST) provided an overview of their resilience metrics research. One NIST project seeks to identify the empirical relationships between community functions and physical systems. The discussion touched on NIST's community resilience planning guide and two forthcoming tools: a resilience indicator inventory and a resilience measurement tool. A second session of breakout rooms brainstormed the main challenges facing state teams.

More in depth information on Day 2 can be found here or below on page 12.

Day 3

The third workshop (June 28th), focused on additional case studies and demonstrations to illuminate pathways to develop resilience metrics. Rear Admiral Ann Phillips (Ret.), the Special Assistant to the Governor for Coastal Adaptation and Protection for Virginia, provided introductory remarks, highlighting progress and obstacles for developing resilience metrics in the state. Representatives from Maryland Department of Natural Resources, the New York City Mayor's Office of Climate Resiliency, and the Southern California Association of Governments shared stories of developing resilience metrics at the local, regional, and state level. Breakout rooms provided attendees the opportunity for question-and-answer sessions with the presenters.

In the second half of the workshop, presenters from FEMA and the Argonne National Laboratory gave a demonstration of the Resilience Analysis and Planning Tool (RAPT), a GIS web map that combines census data, infrastructure locations, and hazards to support resilience analysis. Presenters from the City of San Diego and Headwaters Economics provided case studies on how to measure equity. Finally, the group discussed the forthcoming U.S. Climate Alliance Governors' Climate Resilience Playbook and how that can help advance the field of practice of resilience metrics.

More in depth information on Day 3 can be found here or below on page 14.

Key Themes from Workshops

The workshops consisted of state-to-state conversations, internal and external presentations, question-and-answer sessions, and breakout room exercises. The following themes arose in discussions:

Use resilience priorities to inform metrics development

- Choose metrics that align with adaptation and resilience strategic priorities in your state
- Aligning with adaptation and resilience strategic priorities will help to narrow what needs to be measured.
- Be careful of creating perverse incentives (e.g. such as prioritizing cost and thereby incentivizing maladaptive, but cost-effective strategies)
- Use metrics to incentivize both incremental and transformational change

Define audiences and users

- Different measurements may be (and likely are) appropriate for state executives, agencies, legislators, and local stakeholders.
- Processes are needed to develop metrics that are relevant to the most stakeholders
- Defining the audience is also impacted by who is developing resilience metrics within a state. In some cases, state planners are being handed resilience goals by policymakers, and in others, planners are developing resilience goals.

Build off existing metrics

- Using existing metrics will save time and money
- Existing metrics will also provide consistency that allows for comparison with past data

Invest in data collection and staff

- Participants identified funding, staff time, and coordination as a barrier to developing resilience metrics.
- Developing metrics for adaptation and resilience is a huge effort. Adequate funding and a dedicated workforce are needed.

Commit to outcomes-based metrics

- Outcomes-based metrics are essential for transparency, tracking progress, gauging effectiveness, building buy-in from other agencies, and generating political will.
- Outcomes-based metrics are the most important type of metric but the hardest to measure

- Process and input metrics are more straightforward to measure, but do not show the effectiveness of policies or communities' starting points.
- Examples of outcome metrics include community cohesion, meaningful engagement, trust in process, community ownership over projects, and community resilience

Center equity when measuring resilience

- Climate resilience metrics can incorporate equity in a number of ways, including by creating process-based metrics to evaluate procedural equity, incorporating equity-focused vulnerability and demographic data, and using measurements of disparities to prioritize resilience projects or pursue outside funding.
- Community engagement is essential and must be prioritized

Embrace multiple start points, processes, and endpoints

- There is no single correct path for choosing resilience metrics.
- States are at different stages in developing resilience indicators in processes that do not match perfectly.
- There are various starting points for developing resilience metrics across case studies and entities.
- An incremental and iterative approach can minimize costs and risks.
- A systems approach is key for dealing with complexity, even when considering a single hazard.
- High resolution analyses (which can provide insights for local planning) and more complex hazards may require a more focused effort.

Resources Shared

US Climate Alliance Sharepoint Folders

- These include: agendas, workshop videos, presenter slide decks, and summary notes
- Day 1 (May 27)
- Day 2 (June 10)
- Day 3 (June 28)

State Resources:

- Colorado
  - Colorado Resiliency Framework
  - Resiliency Dashboard
  - Future Avoided Cost Explorer (FACE:Hazards)
- New York
  - NYS Climate Leadership and Community Protection Act
  - NYS Climate Leadership Coordinators
  - NYS Climate Smart Communities
- California
  - California Governor's Office of Planning and Research (OPR) Integrated Climate Adaptation and Resiliency Program (ICARP)
  - Adaptation Clearinghouse
  - Technical Advisory Council
- Maine
  - Maine Climate Council
- Maryland
  - Maryland Coastal Atlas
- Minnesota
  - Minnesota Executive Order 19-37
  - Climate Adaptation Planning Data Dashboard
  - Adapting to Climate Change in Minnesota (2017)
  - Minnesota GreenStep Cities
    - Climate resilience best practice actions and metrics
    - Metrics for climate adaptation
- New Mexico:
  - New Mexico Climate Risk Map
  - National Governors Association's State Resilience Assessment Planning Tool
  - New Mexico Climate Change Action
- Virginia
  - Virginia Coastal Resilience Master Planning Framework

- Virginia Executive Order Number 24: Increasing Virginia's Resilience to Sea Level Rise and Natural Hazards (2018)
- Virginia Executive Order 45: Floodplain Management Requirements and Planning Standards for State Agencies, Institutions, and Property (2019)

From External Presenters and Participants:

Rob Lempert, RAND Corporation

- Warren May, L., Lanna, S., Fischbach, J., Bongard, M.,... Bowling, J., *Pittsburgh Equity Indicators: A progress update on the state of equity in Pittsburgh. Annual Report 2018.*, City of Pittsburgh, 2019. https://pittsburghpa.gov/equityindicators/documents/PGH_Equity_Indicators_2018.pdf
- Finucane, Melissa L., Linnea Warren May, and Joan Chang, A Scoping Literature Review on Indicators and Metrics for Assessing Racial Equity in Disaster Preparation, Response, and Recovery. Santa Monica, CA: RAND Corporation, 2021. https://www.rand.org/pubs/research_reports/RRA1083-1.html
- Weilant, Sarah, Aaron Strong, and Benjamin M. Miller, Incorporating Resilience into Transportation Planning and Assessment. Santa Monica, CA: RAND Corporation, 2019. https://www.rand.org/pubs/research_reports/RR3038.html
- Knopman, Debra and Robert J. Lempert, Urban Responses to Climate Change: Framework for Decisionmaking and Supporting Indicators. Santa Monica, CA: RAND Corporation, 2016. https://www.rand.org/pubs/research_reports/RR1144.html

Susanne Moser, Susanne Moser Research and Consulting

- February 2021 presentation materials to USCA Resilience Working Group
- ResilienceMetrics.org (with support from NOAA)
- "The turbulent world of resilience: interpretations and themes for transdisciplinary dialogue", *Climatic Change*

Adam Parris, NYC Mayor's Office of Climate Resiliency

- State of Climate Knowledge 2021
- Building the Knowledge Base for Climate Resiliency report (NPCC 2015)
- NYC CoolRoofs initiative
- NYC Cool Neighborhoods Report

Kimberly Clark, Southern California Association of Governments (SCAG)

- Climate Adaptation Framework
- Includes the SoCal Adaptation Planning Guide with associated resources, including local jurisdiction and regional metrics as well as our Climate Talks Outreach Toolkit, among several other tools.

Marc Steele, University of California – San Diego

- City of San Diego CEI (Climate Equity Index)
- City of Chula Vista CEI

Patty Hernandez, Headwater Economics

- Neighborhoods at Risk
- Wildfire Risk to Communities
- Headwaters analysis of state distributions of FEMA Building Resilient Infrastructure and Communities (BRIC) funds

Chris Clavin and Jarrod Loerzel, National Institute of Standards and Technology (NIST)

- Community Resilience Planning Guide (overview)
- NIST Community Resilience Playbook
- Community Resilience Planning Guide (Volume 1)
- Community Resilience Planning Guide (Volume 2)
- Resilience Indicator Inventory (2018) (inventory update forthcoming)
- TraCR Database (resilience measurement tool due for release 2023/2024)

Benjamin Rance, FEMA, and Carol Freeman, Argonne National Laboratory

- Resilience Analysis and Planning Tool (RAPT)
- Community Resilience Indicator Analysis (CRIA) report

Resources shared by NOAA officials:

- O'ahu Resilience Strategy Includes a performance metric with each of the 44 strategies identified. These metrics are intended to help measure progress toward goals. Wide range of metrics used, but a few examples include creating positions, funding projects or pilot studies, developing/changing ordinances, number of people engaged.
- National Estuarine Research Reserve System (NERRS)'s work on successful adaptation: 5 of the 29 NERRS participated in a project on Successful Adaptation Indicators and Metrics. The reserve Coastal Training Programs worked with local and regional stakeholders, planners, and state agencies to develop an adaptation vision that addressed local community needs. Example agendas, facilitation tools, and job aids are available on the resilience metrics site.
- NOAA Digital Coast Toolkit developed by the NERRS Science Collaborative and Dr. Susanne Moser. Includes overview of adaptation, evaluation and monitoring and detailed description of 6 steps to develop and use adaptation indicators and metrics

Workshop Agenda

Day 1

- Welcome and Introductions - Jenn Phillips, U.S. Climate Alliance (USCA)
- Resilience Metrics Primer & Framing – Robert Lempert, RAND
- USCA Resilience Metrics Survey Results – Jenn Phillips, USCA
- State Round Robin Presentations – Juliette Hart, CA Governor's Office of Planning and Research (OPR)
    - Colorado (Anne Miller/Marguerite Harden, CO Resiliency Office)
    - New York (Rob Breen, NY Department of Environmental Conservation)
    - Minnesota (Sharon Stephens, MN Pollution Control Agency)
    - California (Juliette Hart, CA OPR)
- State Round Robin Quick Highlights – Juliette Hart, CA OPR
    - Opportunity for all state attendees to discuss their work and/or goals for the workshop
- Breakout Discussions and Report Out - ALL
- Goals for Days 2 & 3 – Jenn Phillips, USCA
- Closing

Day 2

- Welcome, Day 1 Recap - Jenn Phillips, U.S. Climate Alliance (USCA)
- Stage Setting for Day 2 – Juliette Hart, CA Governor's Office of Planning and Research (OPR)
- Metrics for What? How to Define & Characterize – Stephane Hallegatte, World Bank, and Rob Lempert, RAND
- Breakout Discussions - ALL
- Process of Developing Metrics – Chris Clavin and Jarrod Loerzel, National Institute of Standards and Technology (NIST)
- Breakout Discussions and Report Out - ALL
- Goals for Day 3 and Closing Discussion - Jenn Phillips, USCA, and Juliette Hart, OPR

Day 3

- Welcome, Day 1 and 2 Recap - Jenn Phillips, U.S. Climate Alliance (USCA), Rob Lempert, RAND Corporation, and Juliette Hart, CA Governor's Office of Planning and Research (OPR)
- Building Urgency for Resilience in Virginia, Rear Admiral Ann Phillips (Ret.), VA Special Assistant to the Governor for Coastal Adaptation and Protection
- Case Studies in Creating Resilience Metrics
    - State of Maryland - Allison Breitenother, Maryland Department of Natural Resources
    - New York City – Adam Parris, NYC Mayor's Office of Climate Resiliency

    - Southern California Association of Governments - Kimberly Clark, Southern California Association of Governments (SCAG)
- Breakout Discussions and Report Out - ALL
- Community Resilience and Resilience Analysis and Planning Tool (RAPT) –
    - Benjamin Rance, FEMA, and Carol Freeman, Argonne National Laboratory
- Measuring Equity
    - Climate Equity Indicators in San Diego - Marc Steele, USCD
    - Measuring Racial Equity and Rural Capacity – Patty Hernandez, Headwater Economics
- Metrics in the USCA Resilience Playbook - Joyce Coffee, Climate Resilience Consulting, and Jenn Phillips, USCA
- Closing Discussion and Next Steps - Jenn Phillips, USCA, and Juliette Hart, OPR

Resilience Metrics Workshop: Summary Notes

Resilience Metrics Workshop Day 1

Welcome and Introductions

Goals of the workshop

- Connect states
- Share/outline pathways to develop metrics
- Identify shared principles for scalability, standardization, and replication
- Help states move forward on resilience metrics efforts

Resilience Metrics Primer & Framing (from Robert Lempert)

- Resilience metrics are important for improving policy action, monitoring and reporting to track progress over time, and to clarify how resilience is defined.
- Resilience metrics (RM) can be inputs (financial, staff, time, etc.), outcomes (future counterfactuals, things we are trying to avoid, so can either be observed or projected), or process based (quality of plan, quality of planning process, due diligence)
- Challenges are numerous, and include:
    - Keeping things concise
    - Comparability of metrics
    - Cost of measuring
    - Many conceptions of resilience
    - Many audiences for resilience
    - Measuring what's important, as opposed to what's easy to measure
    - Avoiding perverse incentives
    - Being both comparable and contextual
    - Attributing cause and effect
    - Co-producing metrics with those using them
    - Incentivizing both incremental and transformational change

Survey Results

- Many states not yet developing metrics, but thinking about them
- Metrics to focus on all systems – people, infrastructure, economy, ecosystems
- Audience - state decision makers, local governments, public
- Metrics to help across many areas, especially to determine success of efforts to increase resilience and reduce risk; inform and influence investments
- Workshop expectations and needs:
    - Need to track progress similar to GHG mitigation targets, tracking, and reporting

- Need examples of metrics as well as best practices
- Venue to explore whether this is something we should pursue as a state
- Learn from one another no matter what stage

State Round Robin

- **Colorado:** Working on the CO Resiliency Framework, a state resiliency plan with 6 priority areas (which include 45 community-level indicators) and 10 state-level indicators. The team has designed 305 metrics so far and is working on dashboards and data visualization of these resilience metrics. (Link to framework here; state dashboard here.)
- **New York:** Trying to conform with Paris Agreement Article 7 on Resilience Monitoring and Evaluation. NY adaptation planning is helping state agencies develop resilience metrics for vulnerability assessments. As part of its Climate Smart Communities program and Climate Leadership and Communities Protection Act (CLCPA), the state has a new community-based metrics initiative called the NYS Climate Leadership Coordinator initiative. So far, the NY team has identified 172 metrics and is planning a visualization tool for its online dashboard. EJ communities are given a special focus in the state's work.
- **Minnesota**: Minnesota's resiliency and adaptation action team is one of five climate action teams created by EO 19-37. 15 state agencies are involved in the overall process. 10 people are on the R&A working group for the MN Climate Action Framework (2022). Next steps are establishing a resilience metrics WG with other agencies, involving UMN in RM efforts, and incorporating climate equity, all by early 2022.
- **California**: CA's Integrated Climate Adaptation and Resiliency Program (ICARP) is the main program. Technical Advisory Council and Adaptation Clearinghouse are the main engines. The CA team has completed a public survey and is in process of updating their state adaptation strategy. Through the update to the strategy, CA will identify existing resilience metrics and where more need to be developed to demonstrate progress towards reducing risk and increasing resilience across social, built and natural systems.
- **Maine**: Maine's climate plan has 8 broad strategy areas focusing on mitigation and adaptation. Still developing RMs, which have been much harder to develop than mitigation metrics. Has found that process metrics are easier to measure than outcome metrics. We want to track progress and program effectiveness, especially to policymakers at local level and in state legislature.
- **New Mexico**: We have begun a climate resilience gap assessment using an adaptation of the National Governors Association's State Resilience Assessment Planning Tool. We are surveying our 28 executive agencies to assess the state's resiliency. We will publish a climate resilience map soon. Our assessment work will be used to develop BRIC projects to develop an adaptation plan and build local and tribal capacity for planning.

Breakout Room 1

- **Discussion 1:** Wherever you are in the process, what's stopping you from taking the next steps in developing your metrics?
    - Limitations of available staff time
    - Challenge of taking a multi-hazard approach, being sure to capture changing climate conditions rather than silo-ing single climate hazards
    - Developing indicators for inland/non-coastal areas
    - Coordination and collaboration – overcoming governance problems, ensuring buy-in from other agencies for collecting data
    - Attribution issues: wrestling with attribution of activities to underlying climate risks as opposed to ongoing status quo work or environmental hazards
    - There's demand for a mitigation analogue for metrics for resilience – knowing that's not possible, challenge of identifying outcomes that are relevant to the most stakeholders
    - Uncertainty around who the audience is for metrics being developed. Is it the governor's office, state agencies, local stakeholders (environmental justice advocates), legislature? And does a single set of metrics function well for all of those entities?
- **Discussion 2:** It's 2028, a publication is doing a feature story about your state's successful work on climate resilience metrics. What does the story say about what success looks like and how you got there?
    - Mark Lowery (NYS DEC): I hope whoever is sitting in my chair would say that we worked with stakeholders, especially communities, to build metrics that are useful for communities

Breakout Room 2

- Why metrics are important:
    - CT: Convincing influencers (e.g., elected officials) resilience is important – by identifying the hazards, vulnerabilities and exposure
    - CT: Regulatory exposure to determine if policy needs to be changed to mainstream
    - MN: Funders and financers to claim resources for resilience, especially in competition with the better-resourced greenhouse gas reduction sector
    - MN: Constituent relations/communications to answer "How is the government spending your tax dollars and why?"
- Influences that drive the creation of resilience metrics
    - MN: 7 cabinet level insist on it – grass tops require them for outlining a framework
    - NJ: Civil servants, service delivery need them for prioritization
    - World Bank, confirmed by MN and New York: Inviting and listening for metrics from the community, including qualitative

Resilience Metrics Workshop Day 2

Presentation by Stephane Hallegate, World Bank Group

- Prioritizing well-being (and not just asset/economic losses) in risk assessments will fundamentally change your priorities for resilience planning
- Example: In the Philippines, a government risk assessment would have prioritized downtown Manila for climate resilience efforts because it focused on economic indicators of projected loss rather than including measurements of well-being and accounting for poverty.
- Elsewhere, the World Bank's efforts focus on measuring drivers of resilience rather than resilience itself to compare across countries
- The World Bank is moving towards evaluating resilience efforts across their portfolio at the country level
- Moving resources to earlier in project planning (to ensure risk assessments) can minimize overall costs and increase resilience of projects
- Measuring resilience of the project and measuring resilience through the project
    - A project asset/output is resilient
    - Project outcomes are aimed at building resilience

Breakout Room 1A

- **Question:** Your neighbor is debating whether to begin by focusing on "just" one climate impact or focusing on multiple hazards/climate impacts. What questions would you have for them to make your recommendation? What are the pros and cons of each option?
- Summary:
    - What is the scale of the project/resolution of the analysis? How complex is the hazard? High resolution analyses and more complex hazards may require a more focused effort – at least initially.
    - No matter what you need systems thinking is essential – even if you start with one hazard. They often interact and can increase risk.
    - How much political will and finance/funding? Two things required to move a project: political will and finance/funding
    - What is the problem scape and what policy levers are available? These influence what metrics you can track.

Breakout Room 1B

- **Question:** Your neighbor's community is threatened by flooding that will become increasingly worse. Their adaptation plan aims to move people currently living in the flood plain to higher ground and covert the area in the flood plan to park land. What indicators should they use to monitor the progress and success of their plan?
- Summary:

- Ensure risk is actually decreasing through the move to the new area
- Second, engineering and socioeconomic factors
- Third, combining objective and subjective metrics: feelings, income, etc.
- Fourth, ensure you use a long time horizon
- Measure the quality of life for people who are stuck at the original location

Breakout Room 1C

- **Question:** Your neighbor's community suffers from significant racial and income-based inequalities. In addition, the community faces significant risk from climate change. What indicators should the community use to guide the development of a climate resilience plan?
- **Summary:** A mix of quantitative metrics and process-based metrics would be most appropriate.
  - Suggested quantitative metrics include: linguistic isolation, housing burden, risk exposure broken down by race, GIS overlays of communities' exposure to hazards
  - Process-based metrics include who decisionmakers are, qualitative data on quality of governance, and impressions of community members to show how resilience planning is addressing inequality.

Presentation by Chris Clavin and Jarrod Loerzel, NIST

- NIST is conducting research to identify the empirical relationships between community functions and physical systems (including measuring the time to recovery of community function after a disruption, a resilience metric) with a focus on a community scale
- NIST already has a six-step community resilience planning guide for buildings and infrastructure systems to help communities: characterize resilience goals; inform hazard mitigation planning; integrate resilience into other resilience plans; develop resilience standards to evaluate resilience benefit of projects
- Their research is trying to build a model that links the fragility of elements in the built environment to social outcomes like housing and displacement. i.e. the empirical relationship between community functions and physical systems
- Their team is developing two tools, both of which combine measurements of physical and economic systems:
  - An indicator inventory – to test indicator development and provide it as a resource to communities
  - The TraCR database – a resilience measurement tool that will be externally available (due for release 2023/2024)

Breakout Room 2A: Stepwise Processes

- There is risk inherent in choosing metrics because they may guide future decision-making, and the wrong metrics may lead to hollow or misguided policies in pursuit of better numbers. They may have lots of negative externalities.
- Some members have minimal time and can't go through an extensive public participation process in developing their metrics – what should they do?
- New metrics will cost money (administrative burden of collecting more data) – can states use existing metrics as much as possible (as CO is doing)?
- An incremental and iterative approach can minimize costs and risks
- Issues with indexed approaches
    - Indices are useful but they can create tradeoffs – sometimes disaggregated is better
    - Indices can be very misleading: comparing apples to oranges
    - Cannot haphazardly adapt metrics/indices from one geographic and socio-political setting to another – what biases are built into the metrics and the process used to develop rating scales, etc.
- Need to take stock of where you are and consider what you can reasonably do
- Definitions matter
    - Comparing disadvantaged communities in different geographic contexts in NY State with different hazards, etc. to respond to the law or to the stakeholders; how do we determine measures that can span these different contexts?
    - How is resilience defined in a specific context

Breakout Room 2B: State Needs: Data, Tools, Resources

- There are costs to collecting new data – many want to avoid reinventing the wheel or collecting entirely new data.
- Right now efforts are siloed, not just between states but between different agencies and local vs. state efforts. How do state metrics integrate with local metrics?
- The most important things to measure (community cohesion, meaningful engagement, trust in process, community ownership over projects) are hard but essential to measure
- States may encounter legal obstacles to using publicly available data or data produced by outside entities (such as citizen science organizations or think tanks), like privacy issues, or at the very least are not publicly mandated to use social vulnerability data.
- Stepwise processes vs a menu of resources (or a "plug and play" model)

Wrap-up Thoughts from Susi Moser

- There are common insights across different levels of government
- Big open question: will states' resilience metrics be both effective *and* sufficient?

- There are likely different roles for different scales of government in measuring resilience
- What the decisions the resilience metrics are used to inform may help narrow down what really needs to be measured

Resilience Metrics Workshop Day 3

Building Urgency for Resilience in Virginia – Rear Admiral Ann Phillips (Ret.), VA Special Assistant to the Governor for Coastal Adaptation and Protection

- Virginia's coastal resilience and adaptation efforts focus currently on sea level rise and coastal flood hazards.
- Admiral Phillips' present efforts are to better understand the climate risks, resilience challenges, and adaptation costs in order to build political will
- Ideally, efforts will help prioritize the limited public dollars available for resilience and create processes that will last through multiple administrations

Presentation by Adam Parris, New York City Mayor's Office of Climate Resiliency (MOCR)

- Much of MOCR's work draws on the New York City Panel on Climate Change (NPCC)
- Climate Knowledge Exchange and the State of Climate Knowledge 2021 report
    - Meant to answer the question: Who gets to decide what research?
    - Incorporates procedural/process equity, an important part of equity in environmental justice approach
    - The project is a needs assessment on climate research needs.
    - The goal was to connect with people on the ground in neighborhoods, especially those who have been made vulnerable by racial and other forms of inequity. We talked to them about research needs and where were the highest priorities with respect to resiliency and adaptation.
    - Metrics being considered: participant learnings, number of participants, funding for participants, partnerships, and other process metrics
- Resources and other projects mentioned:
    - Building the Knowledge Base for Climate Resiliency report (NPCC 2015)
    - NYC CoolRoofs initiative
    - NYC Cool Neighborhoods Report

Presentation by Allison Breitenother, Maryland Department of Natural Resources

- Climate change governance in Maryland is primarily through the Maryland Commission on Climate Change (MCCC)
- The MCCC's adaptation and resiliency working group is run out of the Maryland Department of Natural Resources (DNR)

- The MD DNR partnered with the University of Maryland Center for Environmental Science to develop a report card on adaptation progress. We hope the report card will help us with prioritization to let us know where we need to focus our efforts
- The state is also working on an adaptation framework, in which metrics will align with priorities. Indicators selected: Planning, Flooding, Socioeconomic, Ecosystem.

- One idea under consideration are resiliency opportunity zones to be used as a prioritization tool for where resiliency projects are needed.

Presentation by Kimberly Clark, Southern California Association of Governments (SCAG)

- SCAG represents many southern California local governments. To develop its climate strategy, including adaptation and resiliency metrics, SCAG performed extensive outreach, including with community-based organizations and the Climate Talks Box (a booth at live events to test out climate communications strategies)
- Outreach findings were meant to assist local jurisdictions practitioners, broader stakeholders, and elected officials
- Research showed that images and statistics that convey information about quality of life are most important for the general public (maps were generally seen as less helpful/harder to understand)
- SCAG's metrics framework identified outcome-oriented and process-oriented metrics
- Jurisdictional vs Regional metrics:
    - Jurisdictional – Resilient Communities, Natural Environment, Infrastructure and Built Environment, and Processes. Outcomes and processes.
    - Regional: Overall indicators of climate change impacts and vulnerability, etc.

Breakout Room 1 – Q&A with Southern California Association of Governments

- SCAG's outreach at public events consistently found that people preferred infographics with basic descriptive statistics more than maps (because reading a map is a skill that not all people have)
- On divisive politics: SCAG's regional planning exists at the intersection of state and local planners. SCAG operates in the political context of who has the most control over land use decisions and wants to bring in local jurisdictions that are more protective. It's very political. (Notably, SCAG got unanimous support from its board for our climate emergency vote.)
- On pitfalls to avoid: Getting past the fatalistic view. Tell the story that adaptation is necessary and it's about improving quality of life.
- Climate-related hazard zones were defined using federal data on wildfire areas, sea level rise (2m), areas with more than 30 days of extreme heat, and 100-year floodplains. Because of local concern about wildfires, discussing this topic was a gateway to discussing other hazards.

- To limit the scope of climate impacts to consider, SCAG aimed to couch its tools in the general planning process and consider what local governments could make progress on or impact.

Breakout Room 2 – Q&A with Maryland Department of Natural Resources

- The group discussed potential pitfalls in choosing metrics (i.e., what can go wrong)
- In Maryland's experience:
    - Lack of funding meant that metrics were limited to MD's coastal areas.
    - General disagreements on what to measure caused a communications issue with stakeholders when they were being engaged.
- Collective outcomes were preferred over activity tracking (i.e. process metrics)
- Approximately 70% of metrics were already being tracked. For the remaining 30%, at times 2 older indicators were combined for a new indicator

Community Resilience and Resilience Analysis and Planning Tool (RAPT) – Benjamin Rance, FEMA, and Carol Freeman, Argonne National Laboratory

- FEMA's Community Resilience Indicator Analysis (CRIA) project: the team conducted a literature review and catalogued 73 distinct methodologies. After applying inclusion criteria for further analysis, the team identified eight methodologies.
- The team then identified the indicators used in 3 or more of the eight methodologies, which resulted in 20 commonly used indicators. The research process and findings are are in the full CRIA report.
- The CRIA Aggregate Resilience indicator does not show hazards, but shows the relative resilience of different geographic areas
- An example of methodologies analyzed include the University of South Carolina Hazards & Vulnerability Research Institute's Baseline Resilience Indicators for Communities (BRIC) and the CDC's Social Vulnerability Index (SVI).
- The RAPT tool combines three types of data: population data from Census, infrastructure data pulled from Homeland Infrastructure Foundation-Level Data (HIFLD) Open, and hazard layers from NOAA and others.
- Equity-focused indicators include percent of population with disabilities, among others.

Climate Equity Indicators in San Diego - Marc Steele, USCD

- San Diego needed a city-centric analysis that sufficiently targeted vulnerable communities for climate impacts, with a localized view of "disadvantaged communities" (as opposed to the stricter definition in state legislation (SB 535)).
- The project conducted a stakeholder engagement process and sought to align with CalEnviroScreen datapoints and the city's existing climate goals
- The result: the Climate Equity Indicator (CEI) score.

- The team found that there is a racial pattern to communities with lower "access to opportunity," which is how they define "communities of concern."
- The city is now attempting to integrate CEI into its existing planning efforts, including prioritizing communities of concern for city projects.
- Limitations of CEI:
    - Census tract data doesn't map perfectly to jurisdictions
    - The index does not account for interaction between indicators

Measuring Racial Equity and Rural Capacity – Patty Hernandez, Headwater Economics

- Demographic and economic metrics are important for helping areas access funding
- Lower income and rural communities have failed to be competitive in the latest round of BRIC applications
- Feedback from FEMA: Applicants from these areas failed to do storytelling about their disinvested-in communities and their vulnerability to climate impacts
- Overall, it's a losing strategy to only invest in wealthier more well-off communities
- Headwaters' approach to helping lower income communities advance resilience:
    - 1) Show existing disparities
    - 2) Provide insights
    - 3) Tell a story about vulnerable populations and exposure to climate risk
- Maine map: 90% of places don't have in-house planning staff
- Headwaters' free Neighborhoods at Risk tool can help identify vulnerable neighborhoods in your community. The top indicators change for each community/census tract based on the relevant vulnerabilities for that context
- Headwaters also helped create the USDA Wildfire Risk to Communities tool