SAND2019-2356PE

DESIGNING RESILIENT COMMUNITIES:
Stakeholder Advisory Group Meeting 2

PRESENTED BY

R. Jeffers, R. Broderick, K. Jones, S. Peterson, S. DeRosa, M. DeMenno

DESIGNING RESILIENT COMMUNITIES:
Review Project Objectives and SAG Vision

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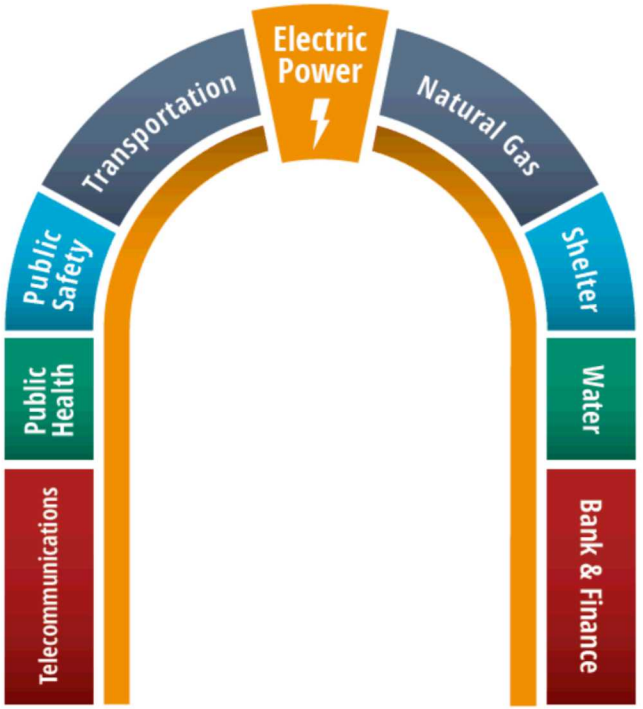
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Goals and Objectives

ENERGY RESILIENCE enables COMMUNITY RESILIENCE

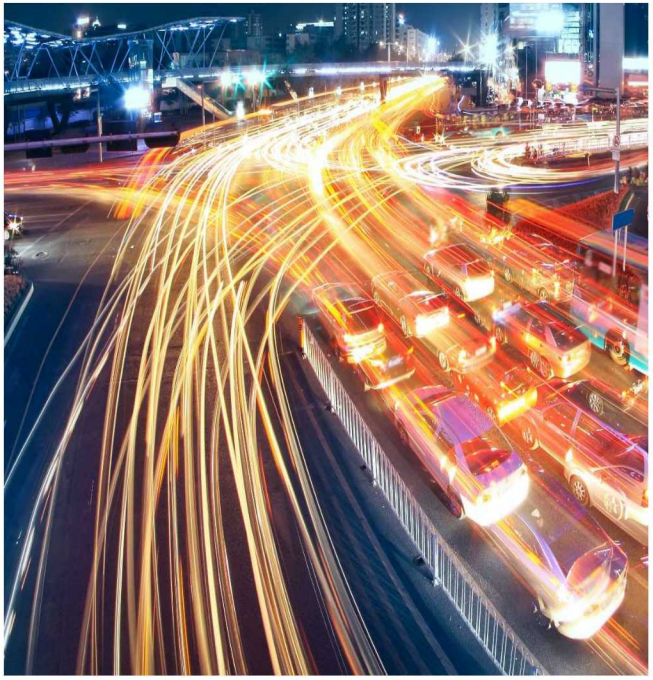
- We are using definition PPD 21 – resilience defined in context of multiple hazards, but not to be confused with sustainability and efficiency which are also important
- Grid planners are intimately familiar with reliability-focused planning – SAIDI and SAIFI metrics based on a collection of outages
- City planners may desire to keep critical services provided to the community
- Where do these metrics meet? It's in the loads, the feeders, the critical components of the grid that support our lives more than energy sales currently reflect



Goals and Objectives

CITIES PROVIDE OPPORTUNITY for ACTIONABLE ANALYSIS

- Cities are where the rubber meets the road for improving the lives of people through investment in infrastructure resilience.
- Cities provide the opportunity for actionable analysis.
- Cities and their infrastructure owners are the first line of defense against major disruptions



DESIGNING RESILIENT COMMUNITIES OVERVIEW

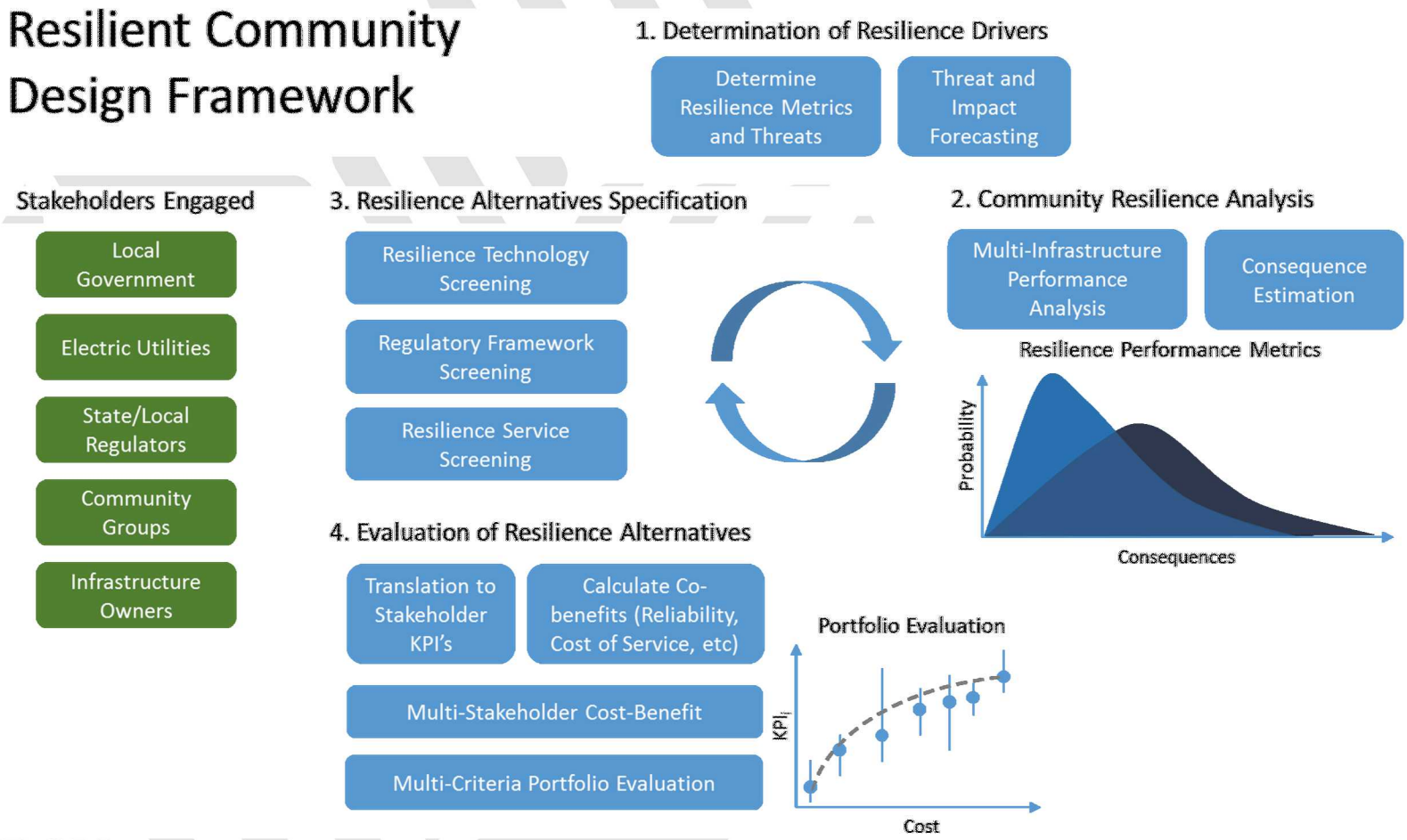
Objectives:

1. Design, validate, and release a framework for alignment of community resilience planning and grid investment planning
2. Demonstrate – with two city/utility pairs – how to overcome the most critical technical challenges to (1)
3. Analyze – alternative regulatory frameworks and utility business models that may better internalize resilience benefits
4. Build – one or more community resilience nodes enabled by distributed energy resources

We are here today to begin to accomplish objective (1), while informing objectives (2), (3), and (4)

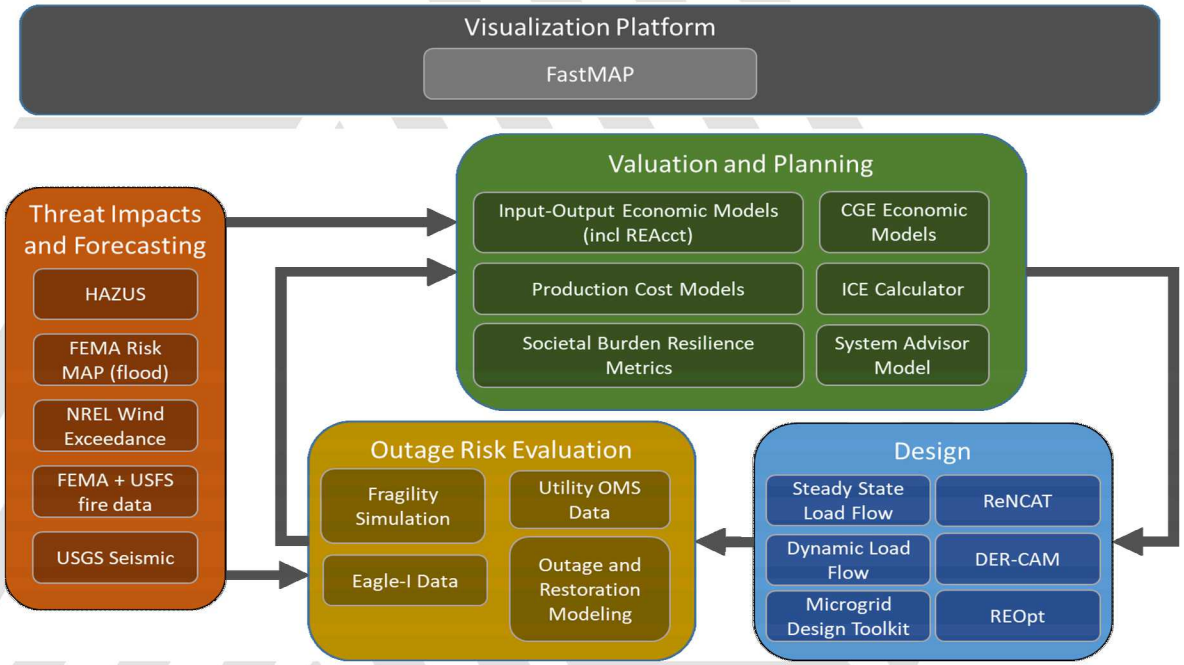
Designing Resilient Communities
Approach

Task 1: Development of a national framework for integrated, consequence-focused resilience planning



Designing Resilient Communities
Approach

Task 2: Analysis to demonstrate key aspects of the framework developed in task 1 with National Grid and CPS energy

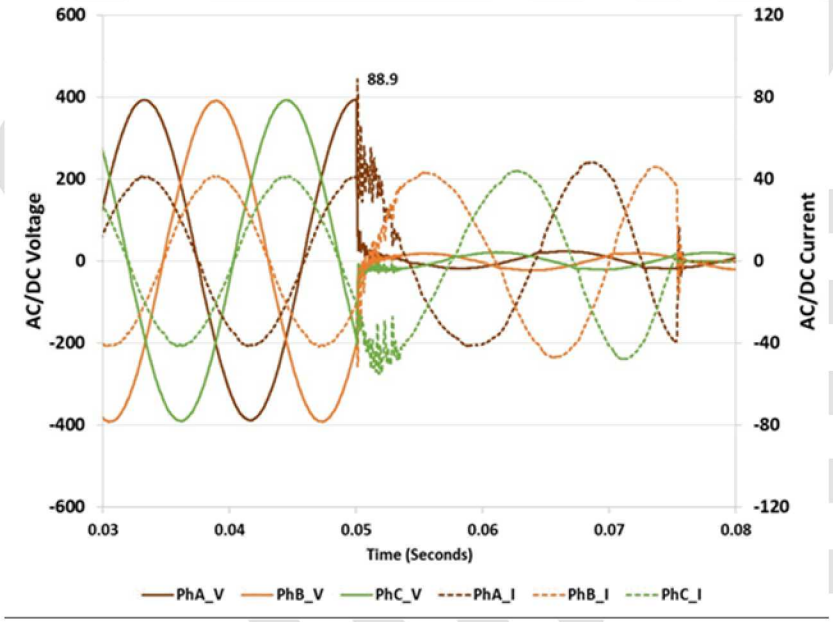


Task 3: Analysis of alternative regulatory frameworks and alternative business models

Designing Resilient Communities
Approach

Task 4: Demonstration and validation at scale of resilience nodes supported by clean DER technologies.

- Dynamic model for PV+ storage system + load in islanded, grid-tied, and transition
- Design and test at lab scale adaptive protection systems for inverter-based resilience nodes
- Design and implement at utility scale novel non-protection aspects of resilience nodes
- Design and implement at utility scale adaptive protection for inverter-dominated resilience node



Two areas of focus will likely be around EVs and transportation and the resilience for JBSA in San Antonio.

Stakeholder Advisory Group Vision

To create and hold four national outreach meetings with a Stakeholder Advisory Group (SAG) that will inform the technical and policy solution space for designing resilient communities

1. Sandia and 100RC formed a Stakeholder Advisory Group (SAG) to inform the development and validation of the Resilient Community Design Framework.
2. SAG members can provide invaluable feedback regarding the unique aspects of their jurisdictions that enable or discourage alignment of community-focused resilience planning with electric utility investment.
3. SAG meetings provide opportunities for project partners to learn from each other and provide information about emerging methodologies and technologies that can enhance grid and community resilience elsewhere in the nation.
4. The input from the SAG informs our framework to align community resilience planning and grid investment planning and guide our work with partners.

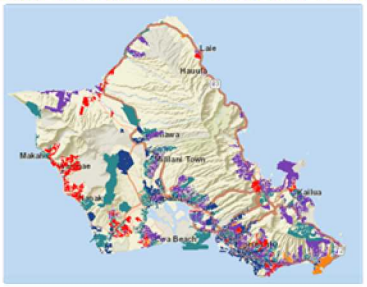
SANDIA and 100 RESILIENT CITIES

Sandia is working with the Department of Energy and 100 Resilient Cities to bring actionable resilience analysis to cities

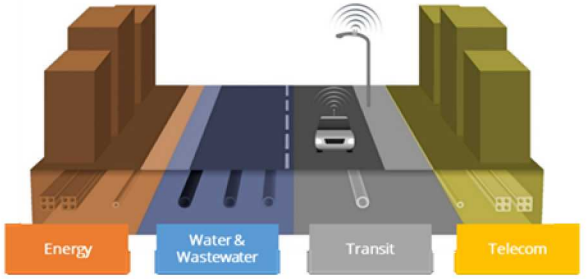
Key areas of concentration identified in July 2018 SAG Meeting

1. Defining, valuing and measuring resilience a clear need
2. Engaging stakeholders – the SAG has inherent value
3. Implementation - who does what in the process?
4. Rethinking regulatory frameworks and business models
5. Developing technical capabilities, especially to value a resilient grid's community benefits

HAWAII TACKLING REGULATION FOR RESILIENCE



BOSTON SMART UTILITIES VISION



NEW YORK INCREASING COORDINATION WITH CON EDISON

NORFOLK ST PAUL'S REDEVELOPMENT

Primary recurring challenge identified in July SAG Meeting

Misalignment of city, utility, and regulatory priorities and incentives: how do we break this logjam for each institution?

Conclusions from July 2018 SAG Meeting

- The SAG has independent value.
- Defining, measuring and valuing resilience is a shared challenge.
- Improved data strategies are required.
- Tools should go beyond evaluating technology impacts.
- A framework is more valuable when combined with an implementation strategy.

DESIGNING RESILIENT COMMUNITIES: A consequence-based approach for grid investment

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The Resilient Community Design Framework

Aligning City Resilience Planning with Electric Utility Investment Planning

or

Internalizing the Resilience Externality

Developing a Framework for Resilient Community Design

Resilient Community Design Framework

1. Determination of Resilience Drivers

- Determine Resilience Metrics and Threats
- Threat and Impact Forecasting

Stakeholders Engaged

- Local Government
- Electric Utilities
- State/Local Regulators
- Community Groups
- Infrastructure Owners

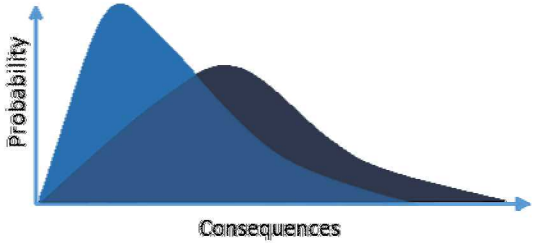
3. Resilience Alternatives Specification

- Resilience Technology Screening
- Regulatory Framework Screening
- Resilience Service Screening

2. Community Resilience Analysis

- Multi-Infrastructure Performance Analysis
- Consequence Estimation

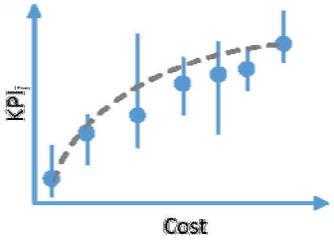
Resilience Performance Metrics



4. Evaluation of Resilience Alternatives

- Translation to Stakeholder KPI's
- Calculate Co-benefits (Reliability, Cost of Service, etc)
- Multi-Stakeholder Cost-Benefit
- Multi-Criteria Portfolio Evaluation

Portfolio Evaluation



Developing a Framework for Resilient Community Design

Determine Resilience Drivers

- Determine resilience metrics and threats
- Threat and impact forecasting

Community Resilience Analysis

- Multi-infrastructure performance analysis
- Consequence estimation

Resilience alternatives specification

- Resilience technology screening
- Regulatory framework screening
- Resilience service screening

Evaluation of resilience alternatives

- Translation to stakeholder KPIs
- Calculate co-benefits
- Multi-stakeholder cost/benefit
- Multi-criteria portfolio evaluation

What's different?

- Focus on measuring, predicting, and improving community performance during disruptions
- Link between grid performance and community performance is explicit
- No distinction between T vs. D investment
- Allows consideration of alternative regulatory approaches and alternative utility business models
- Resilience benefits ADD to blue-sky benefits (and could amplify)

Convergence on a common metric

- Resilience metrics can be used within multiple planning processes
- Each jurisdiction chooses the metric that works for them
- Within a jurisdiction, the metric is consistent and agreed upon

Electric Utility

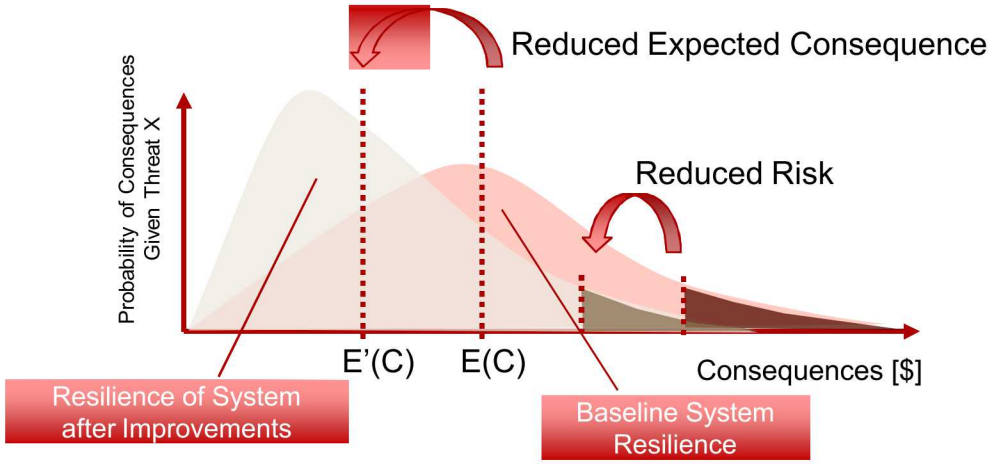
- Integrated Resource Planning and Capacity Expansion
- Integrated Distribution Planning
- Alternative Business Models and Retail Services

City Government

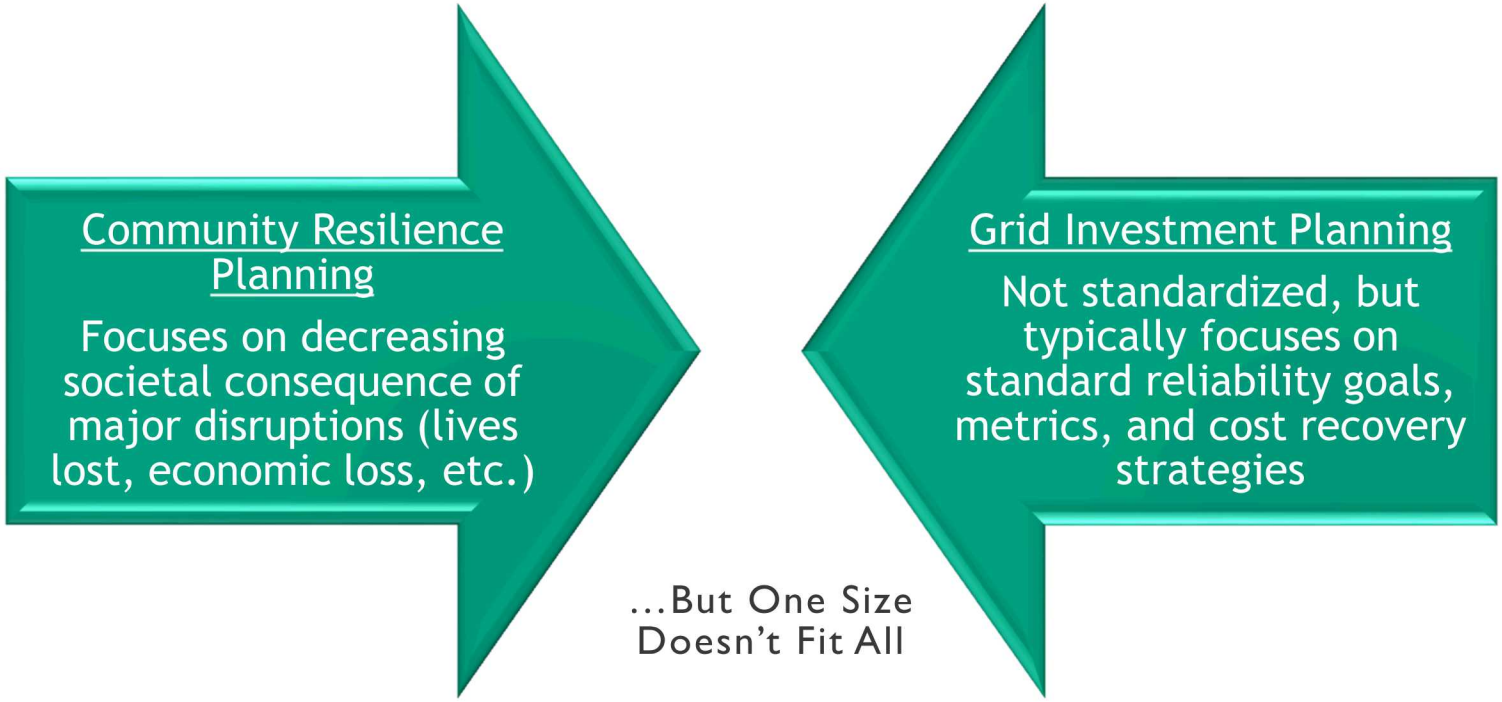
- Resilience and Mitigation
- Emergency Operations
- Sustainability
- Transportation
- Water/Wastewater
- Economic Development

Utilities Regulator

- Individual investment approval
- Rate Cases
- Integrated Resource Planning
- Alternative Regulatory Frameworks



Energy Resilience Supports Community Resilience…



Resilience shocks and stresses (regional differences in hazards, economic, political)

Electric utility configuration (municipal, investor-owned, cooperative) and horizontal/vertical integration

Options for Resilience Metrics

Performance-based, Attribute-based, and Hybrid

Familiar Territory: Reliability Metrics

$$SAIDI = \frac{Total\ Duration\ of\ Customer\ Interruptions}{Total\ Number\ of\ Customers\ Served}$$

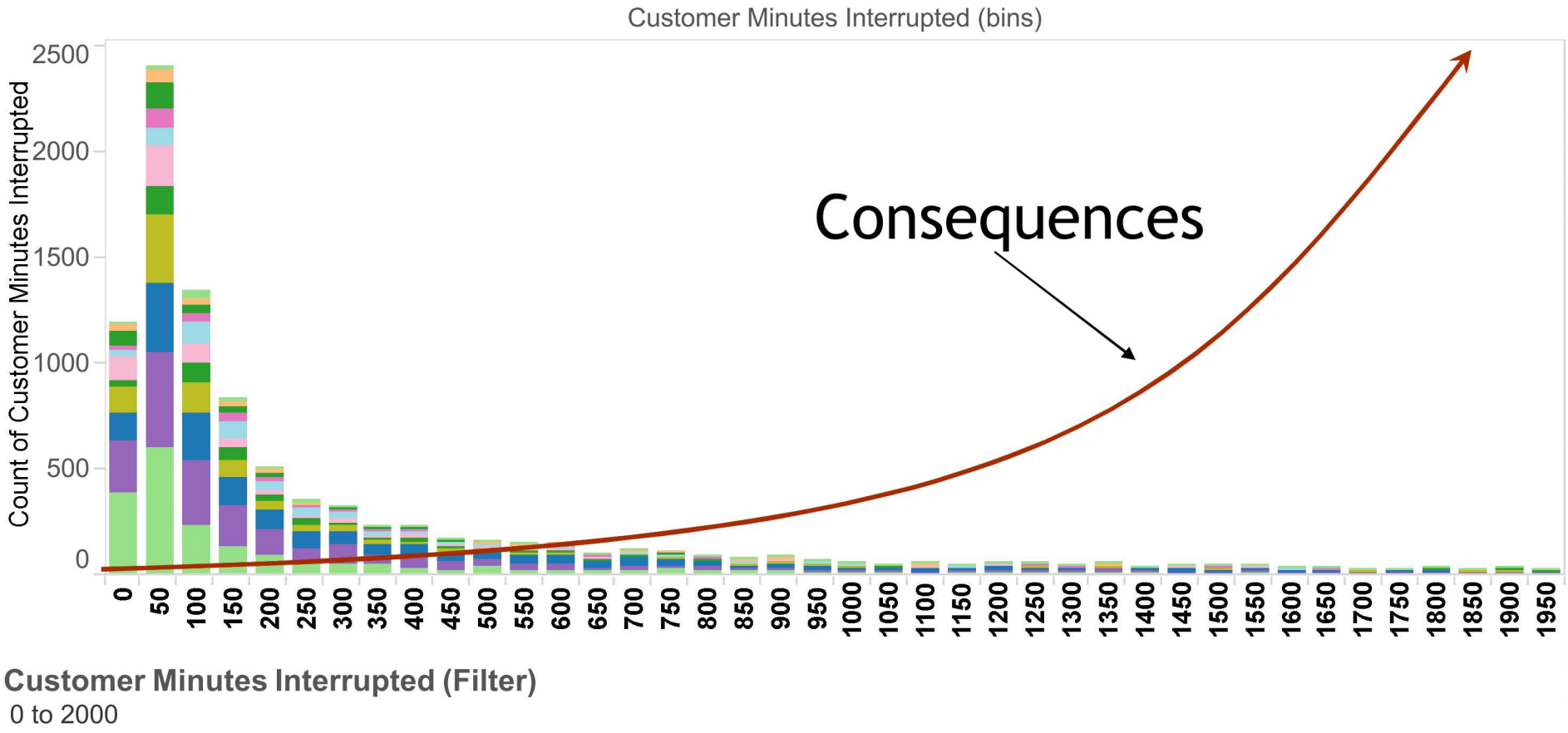
$$SAIFI = \frac{Total\ Number\ of\ Customer\ Interruptions}{Total\ Number\ of\ Customers\ Served}$$

$$CAIDI = \frac{Total\ Duration\ of\ Customer\ Interruptions}{Total\ Number\ of\ Customer\ Interuptions}$$

Standard measures of reliability have been used to evaluate investment effectiveness

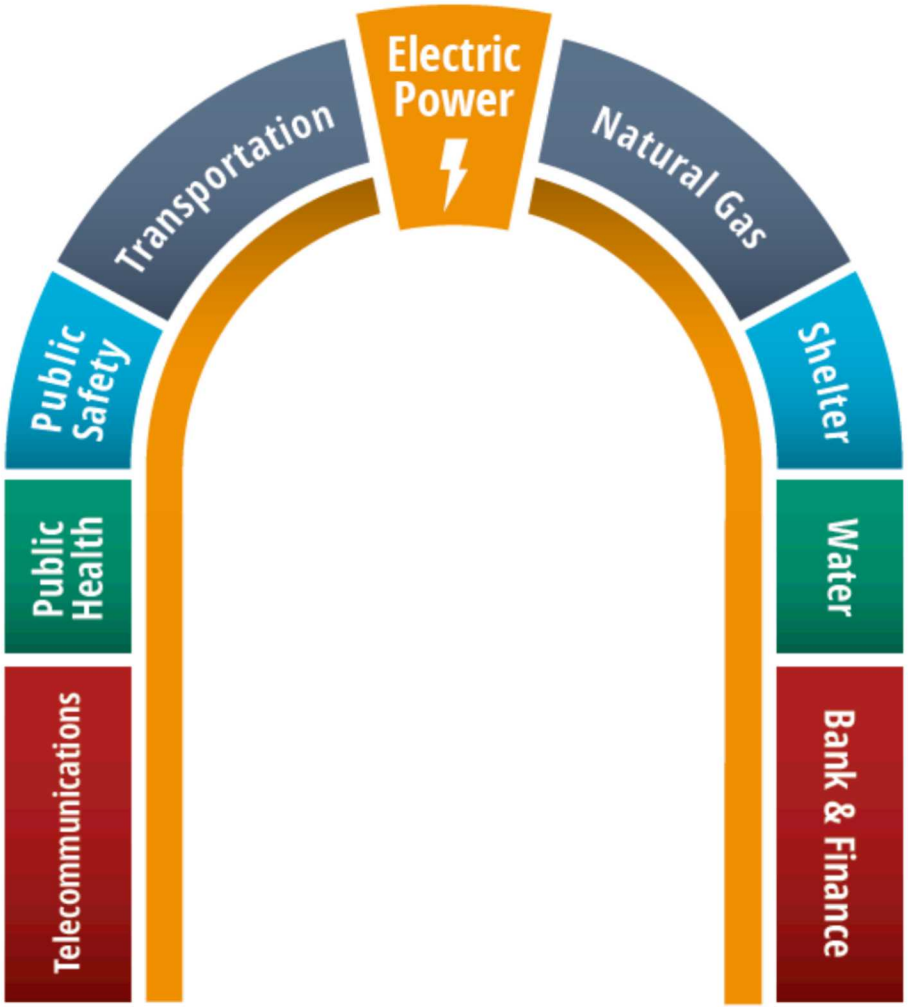
Reliability Metrics Do Not Capture Consequence

Histogram of Customer Minutes Interrupted, Selected Causes



Power system planners currently use reliability metrics and criteria to ensure a reliable grid. There is no standardized or accepted practice for resilience.

Energy Resilience Enables Community Resilience



The grid is the keystone infrastructure – central to the web of interconnected systems that support life as we know it

Metrics that Focus on Consequence

Measure Classification	Common Examples
Community Measures	Number of People Without Necessary Services
	Lives at Risk
	Societal Burden to Acquire Services
Economic Measures	Gross Municipal Product Loss
	Change in Capital Wealth
	Business Interruption Costs

Urban planners can be using **metrics of consequence** to their communities to define and plan for resilience

Examples of Utility Roles in Societal Consequences

Waste Disposal

Hurricane Florence floodwaters breach coal ash basin (September 2018)

https://www.pbs.org/newshour/nation/hurricane-florence-breaches-manure-lagoon-coal-ash-pit-in-north-carolina

https://slate.com/business/2019/01/pge-bankruptcy-fire-victims-corporate-responsibility-solar-energy.html

Electric Asset-Caused Wildfire Ignitions

PG&E had 486 fire ignitions associated with PG&E facilities in 2015-2016

Drivers:

- Vegetation contact with conductors
- Equipment failure
- Third-party contact
- Animal contact
- Fuse operation

PG&E Wildfire Risk

Identified as a risk in the Risk Assessment Mitigation Phase (RAMP) filed with CPUC in 2017. Specific to "fire ignitions and associated impacts resulting from interaction with electric assets."

"Major risk drivers and their relative importance [were] quantified and used as input in a risk model which then calculates probabilistic estimates for levels of impact, described as consequence attributes."

Used 12 different risk controls in 2016

Current metrics used to track the Wildfire risk:

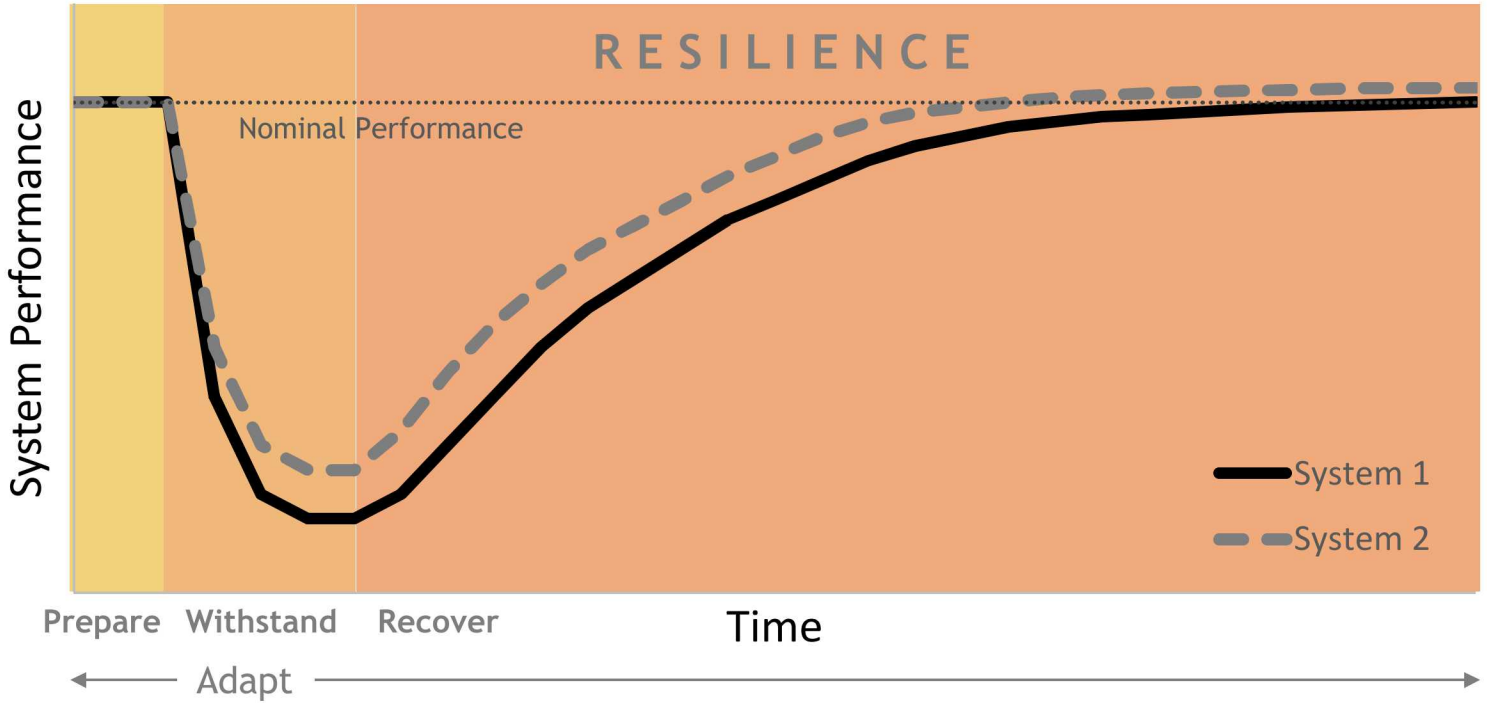
- Fire Ignitions
- Transmission and Distribution Wires Down
- 911 Calls Responded to Within 60 Minutes

Proposed accountability metrics for mitigations:

Mitigation	Proposed Metric	Targets (2020 through 2022)
Non-Exempt Surge Arrester Replacement	Exempt surge arresters installed per year	17,000 per year
Wildfire Reclosing Operation Program	Recloser SCADA installations in high-risk wildfire areas	More than 100 reclosers per year
Fuel Reduction and Powerline Corridor Management	Miles of work performed in target areas	720 miles per year
Overhang Clearing	Miles of work performed in target areas	4,800 miles per year
Targeted Conductor Replacement	Miles of conductor replaced in target areas	190 miles per year

2017 RISK ASSESSMENT AND MITIGATION PHASE REPORT OF PACIFIC GAS AND ELECTRIC COMPANY (U 39 M), November 30, 2017
CPUC, "Risk and Safety Aspects of RAMP Report of PG&E" Investigation 17-11-003, March 30, 2018

Performance-Based Framework for Resilience Metrics



1. Resilience is contextual – defined in terms of a threat or hazard
   - A system resilient to hurricanes may not be resilient to earthquakes
2. Includes hazards with low probability but potential for high consequence
   - Naturally fits within a risk-based planning approach

A resilient energy system supports critical community functions by preparing for, withstanding, adapting to, and recovering from disruptions

NIST: Categories of Resilience Metrics (Hybrid)

Recovery Times

Estimated based on combination of simplified modeling, past experience, and/or expert opinion

Consider:

- Original design criteria
- Distribution of physical damage
- Availability of resources
- Critical interdependencies

Economic Vitality

Economic development concerns include:

- Attracting/retaining businesses/jobs
- Tax base
- Poverty and income distribution
- Local services and amenities
- Sustainability
- Debt ratios

Social Well-Being

Address the hierarchy of human needs:

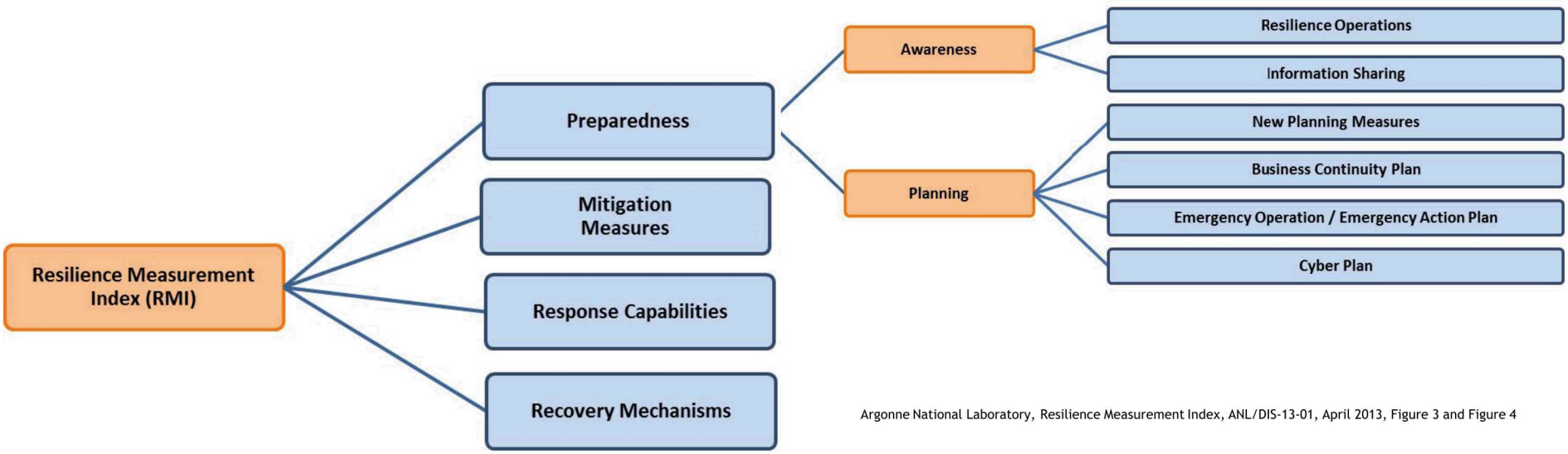
- Survival
- Safety and security
- Sense of belonging
- Growth and achievement

Measure Improvements

Proactive planning and implementation to produce a faster and more robust recovery

NIST Disaster Resilience Framework, 75% Draft, February 11, 2015

Attribute-Based Metrics (Argonne National Laboratory)



Argonne National Laboratory, Resilience Measurement Index, ANL/DIS-13-01, April 2013, Figure 3 and Figure 4

Attributes of a facility or infrastructure are aggregated across categories into an overall index

Resilience Metrics in Action

Supporting microgrid investment in Puerto Rico

Microgrid Benefit

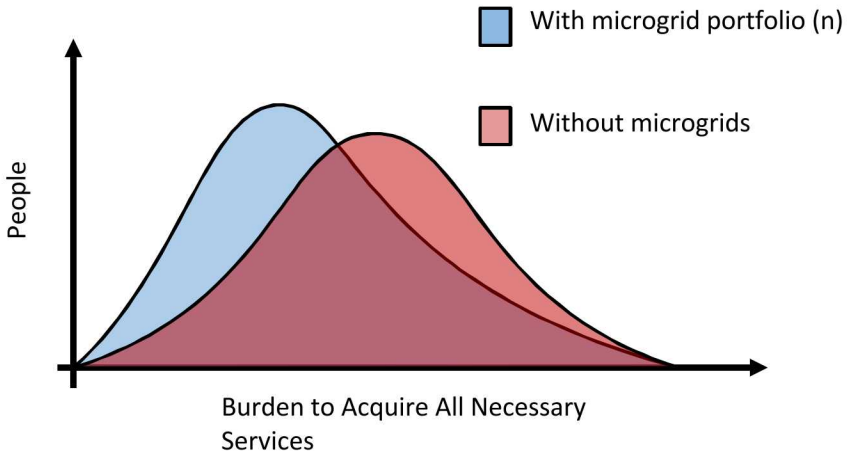
Goal is to:

- Assess microgrid impact resilience
- Choose optimal portfolio given all potential options

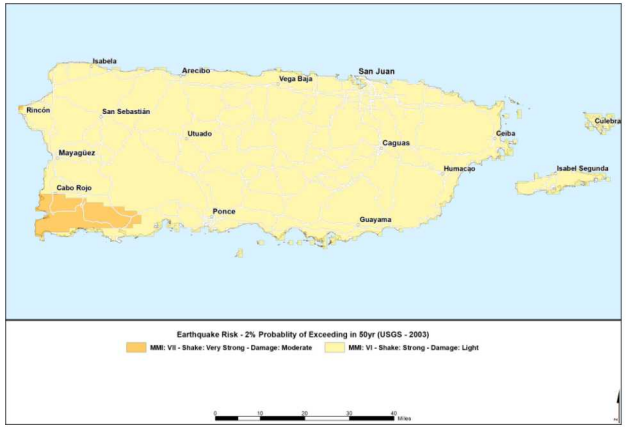
Effort
Average distance traveled to acquire service

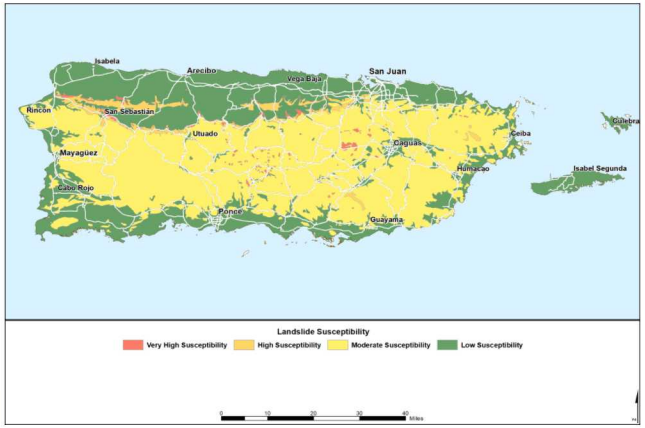
Ability
Median household income for census block group

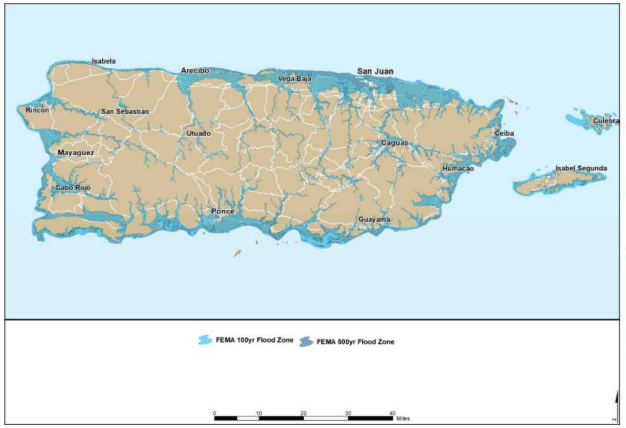
→ **Burden**



Threat Characterization

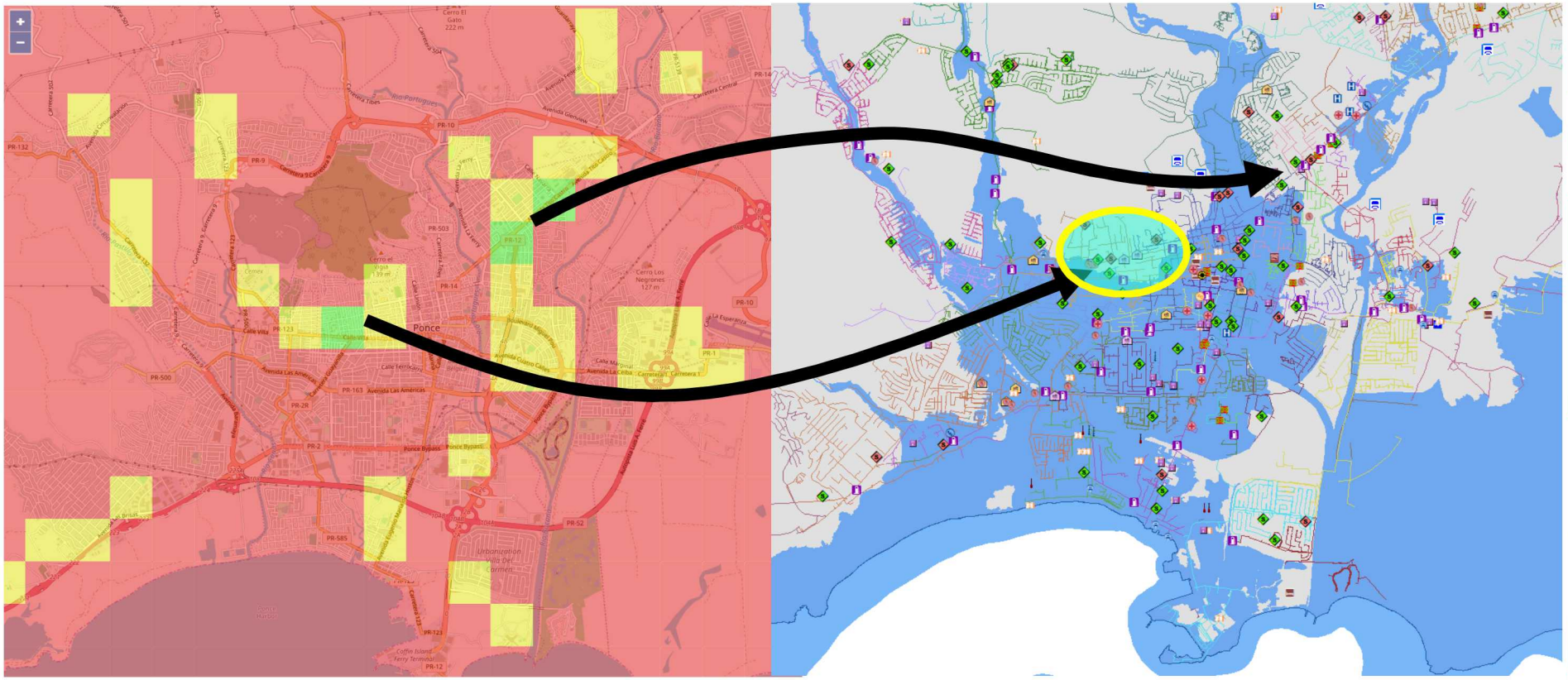




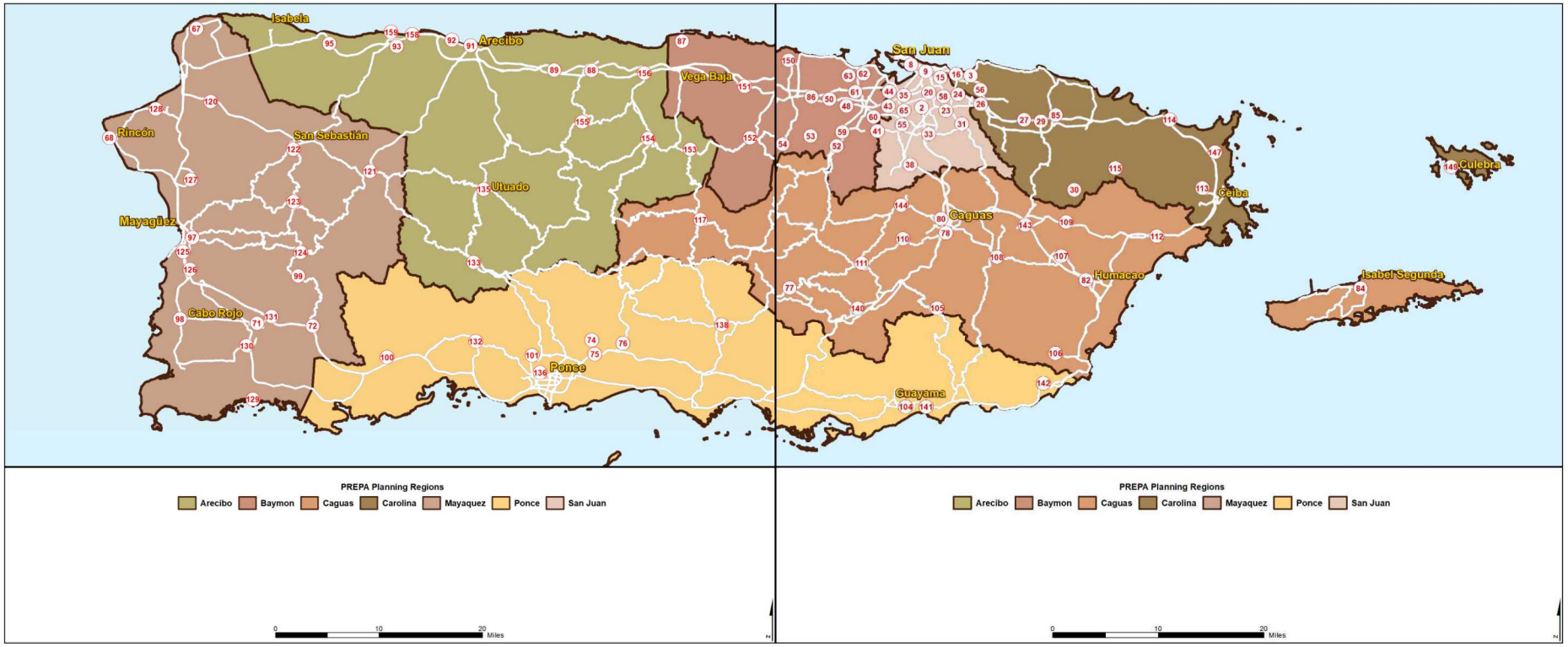


Hazard	Source	Threat Profile Used	50-yr Probability of Exceedance	Link
Flooding	FEMA FIRM	100-yr and 500-yr (return period)	39% (100-yr) 9.5% (500-yr)	www.fema.gov/flood-mapping-products
Wind	ASCE	100-yr and 700-yr (return period)	39% (100-yr) 6.9% (700-yr)	windspeed.atcouncil.org/
Landslide	USGS	Susceptibility: highest, high, moderate, low	N/A	pr.water.usgs.gov/public/online_pubs/mism_i_1148/index.html
Earthquake	USGS	Structure Damage: Moderate, Light	2%	earthquake.usgs.gov/hazards/hazmaps/islands.php#prvi

Filtering of Highest-Value Microgrids



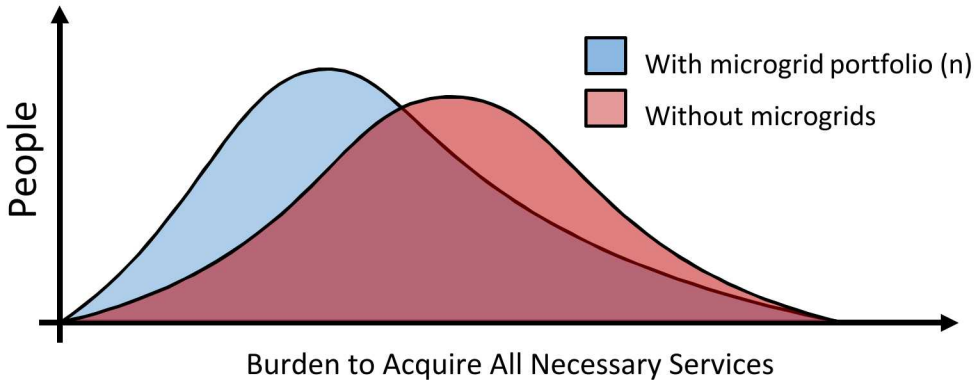
Design of Microgrid Alternatives



159 locations in total

Infrastructure Performance -> Societal Consequence

Advancing metric calculation for grid investment portfolio evaluation

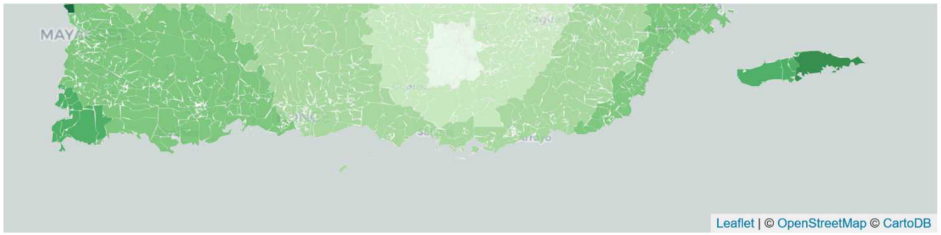


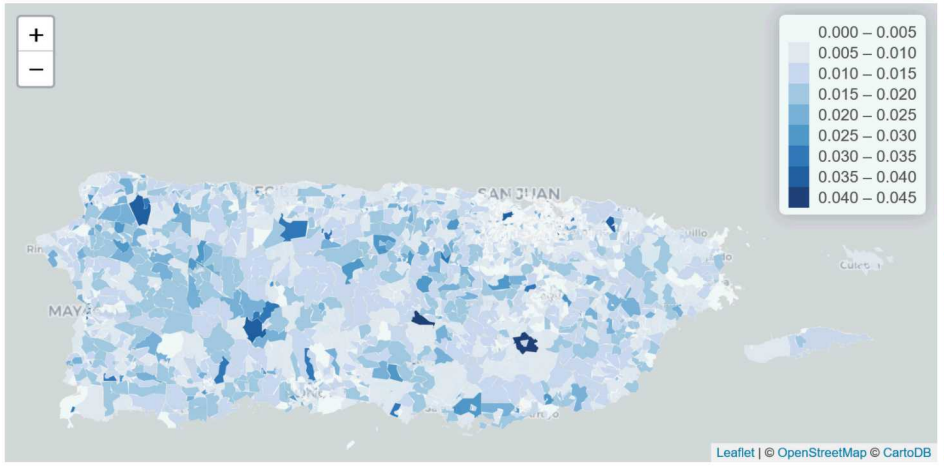
$$B_C = \sum_{inf} \sum_{pop} \frac{E_{inf,pop}}{A_{pop}}$$

Effort
Average distance traveled to acquire service

Ability
Median household income for census block group

→ **Burden**



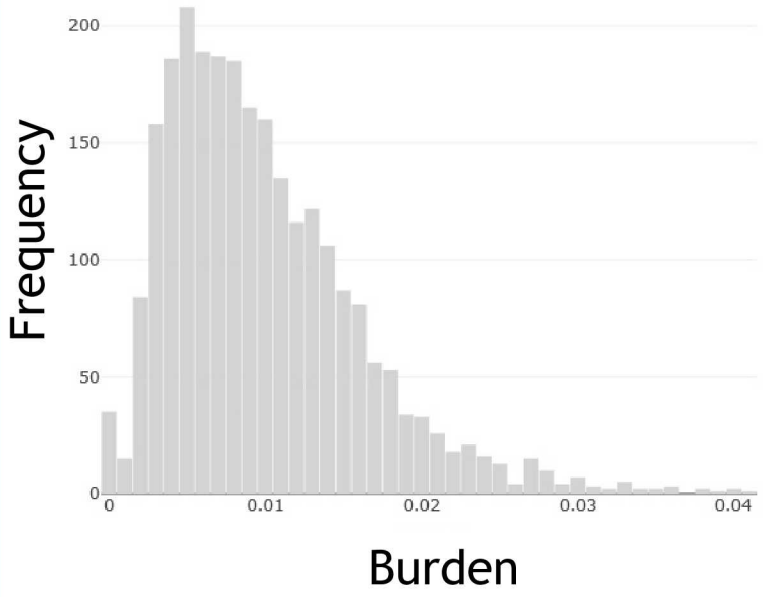


Jeffers et al. (2018) Analysis of Microgrid Locations Benefitting Community Resilience for Puerto Rico. SAND2018-11145

Baseline Resilience

Map of Total Burden to Acquire All Services in the Baseline Scenario (No Microgrids Built)

Histogram of Burden to Acquire All Services in the Baseline Scenario



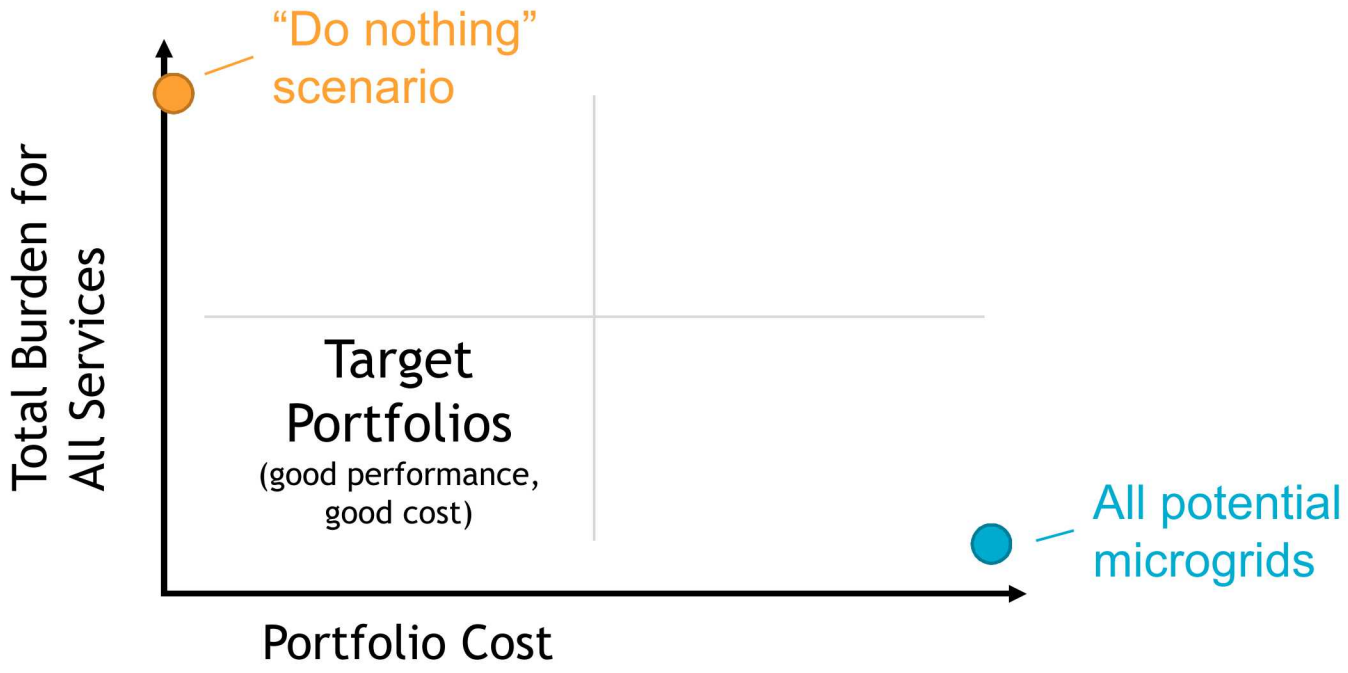
Assumptions

- City-wide blackout
- No infrastructure considered as reliable backup power

Evaluating Burden for Microgrid Portfolios

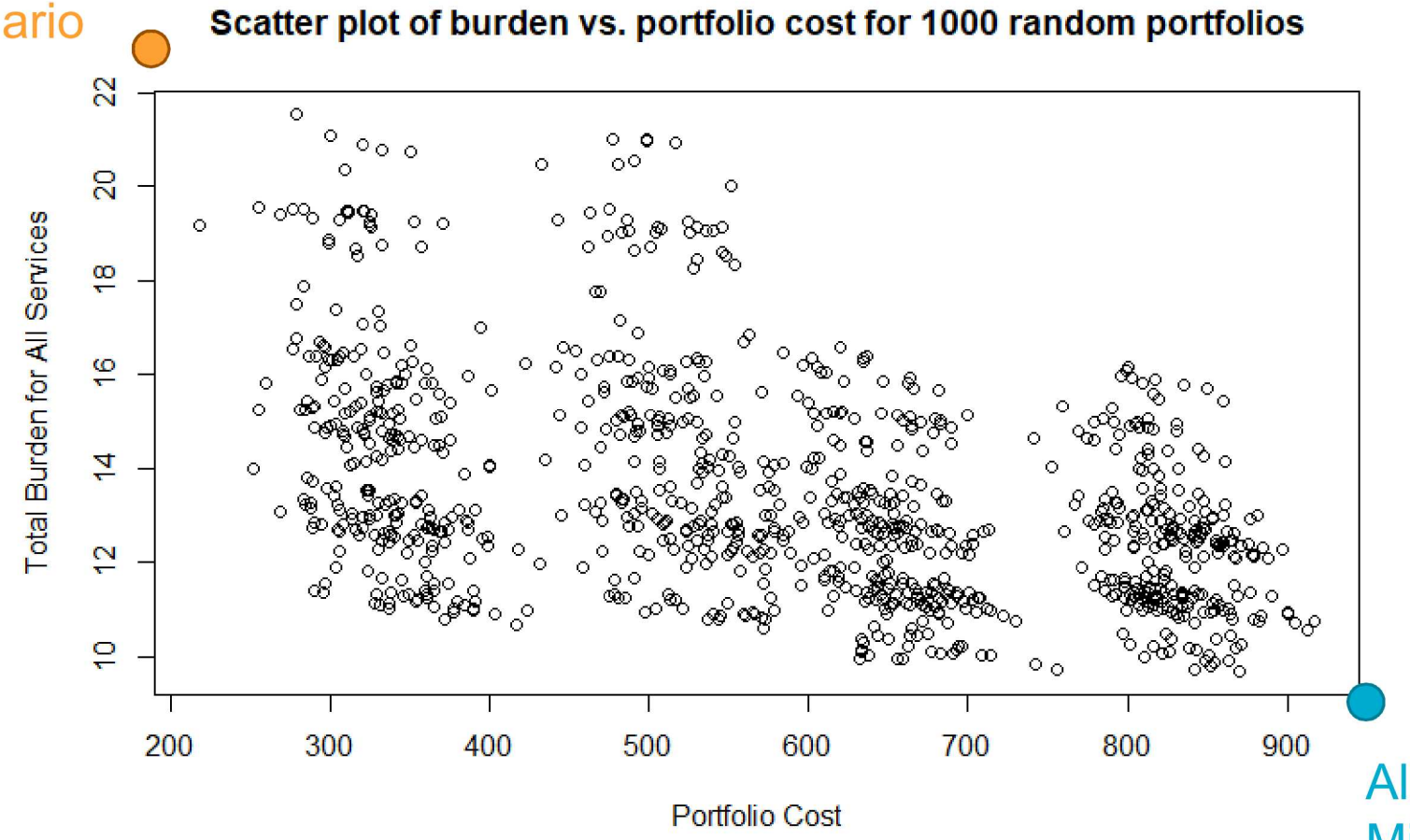
Recognize complementary nature of certain microgrids

Goal is to design a system of microgrids to decrease overall burden



Portfolio evaluation

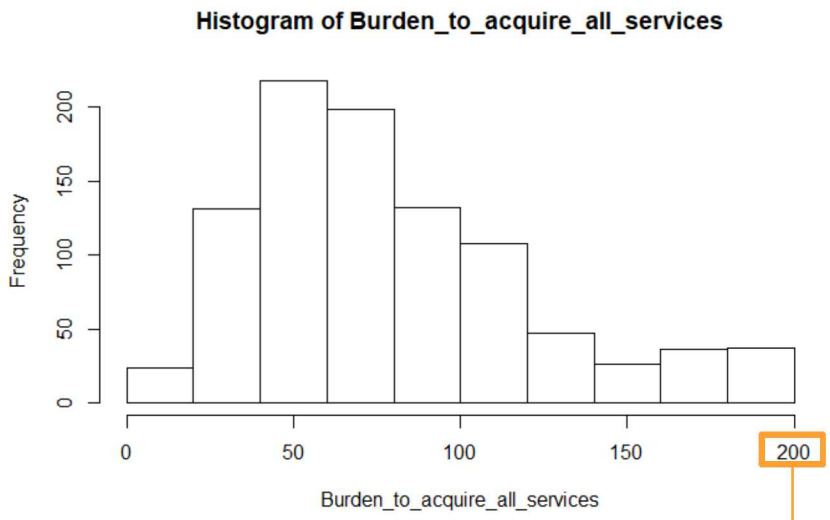
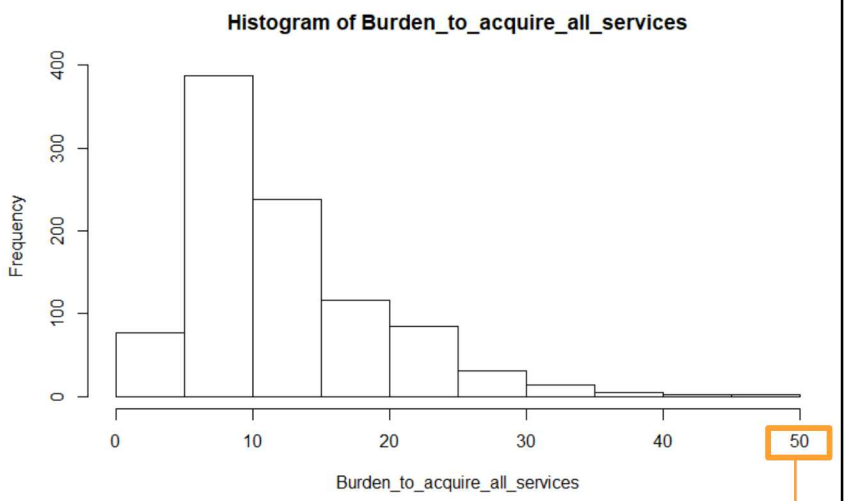
"Do nothing" scenario



All Microgrids

A large decrease in burden can be achieved for relatively low cost compared to all microgrids

Change in Burden with Microgrid Portfolio

"Do Nothing" Scenario	Example Microgrid Portfolio (34 microgrids)
	

Reduced frequency of high burden

Conclusions

1. Translating from infrastructure performance to societal performance is hard, but very likely worth the effort.

2. Development, validation, and standardization of methods and processes to integrate community resilience planning with grid investment planning is the critical next step to supporting regulatory and policy decisions

3. Understanding and incorporating the tradeoffs between resilience, sustainability, and efficiency will support resilience-inclusive investment planning

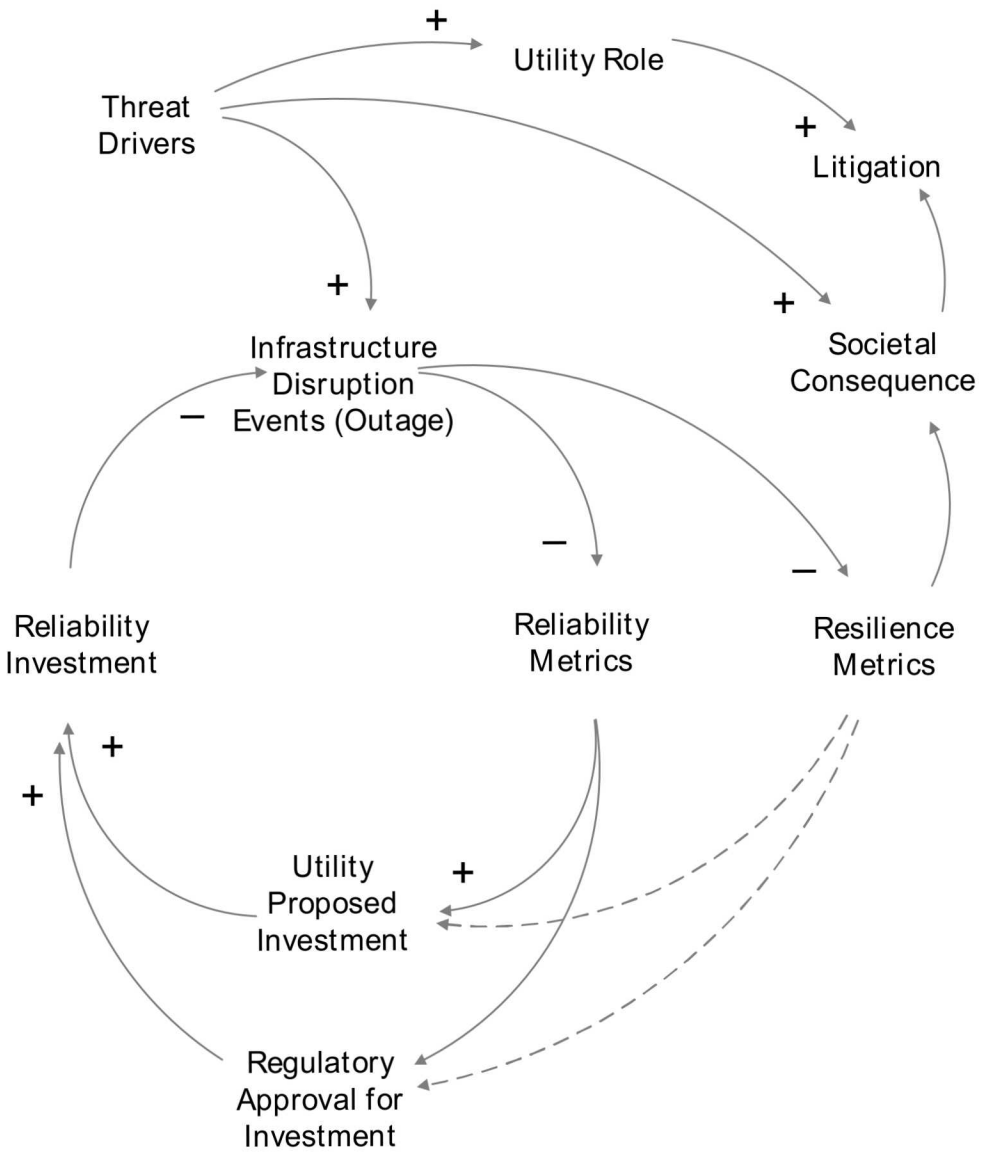
THANK YOU

www.sandia.gov/cities
Email: rfjeffe@sandia.gov

Backup Slides Follow

Dynamic Hypothesis

Dynamics between citizens (customers), regulators, and governments


Threat Drivers
Utility Role
Litigation
Societal Consequence
Infrastructure Disruption Events (Outage)
Reliability Investment
Reliability Metrics
Resilience Metrics
Utility Proposed Investment
Regulatory Approval for Investment
+
+
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+
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+
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−
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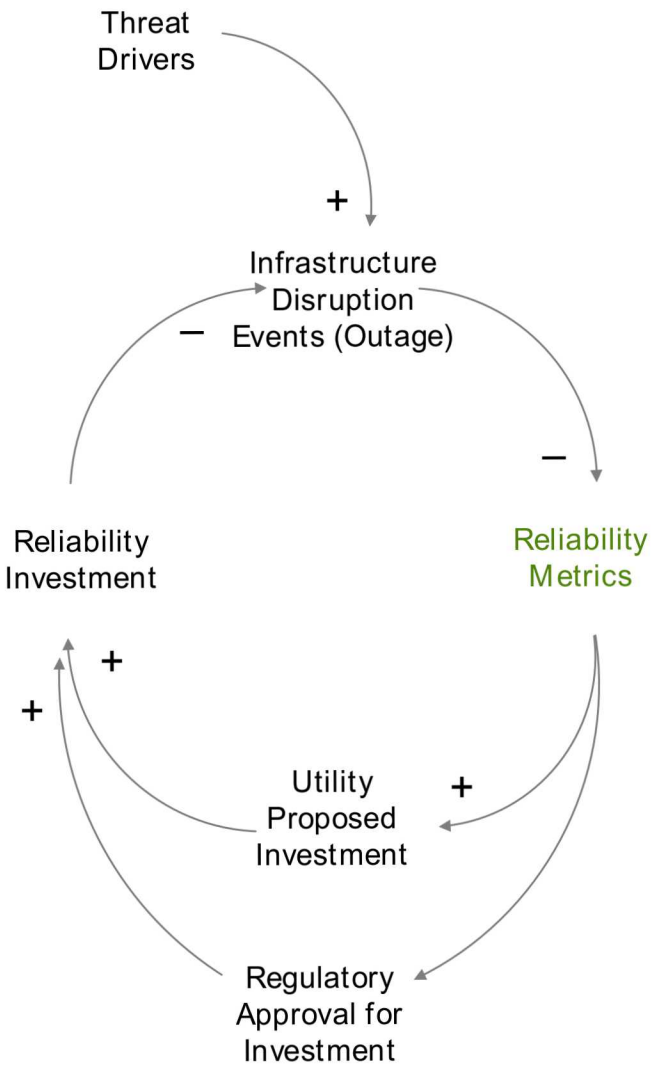
Threat
Drivers
+
Infrastructure
Disruption
Events (Outage)
–
–
Reliability
Investment
Reliability
Metrics
+
+
Utility
Proposed
Investment
+
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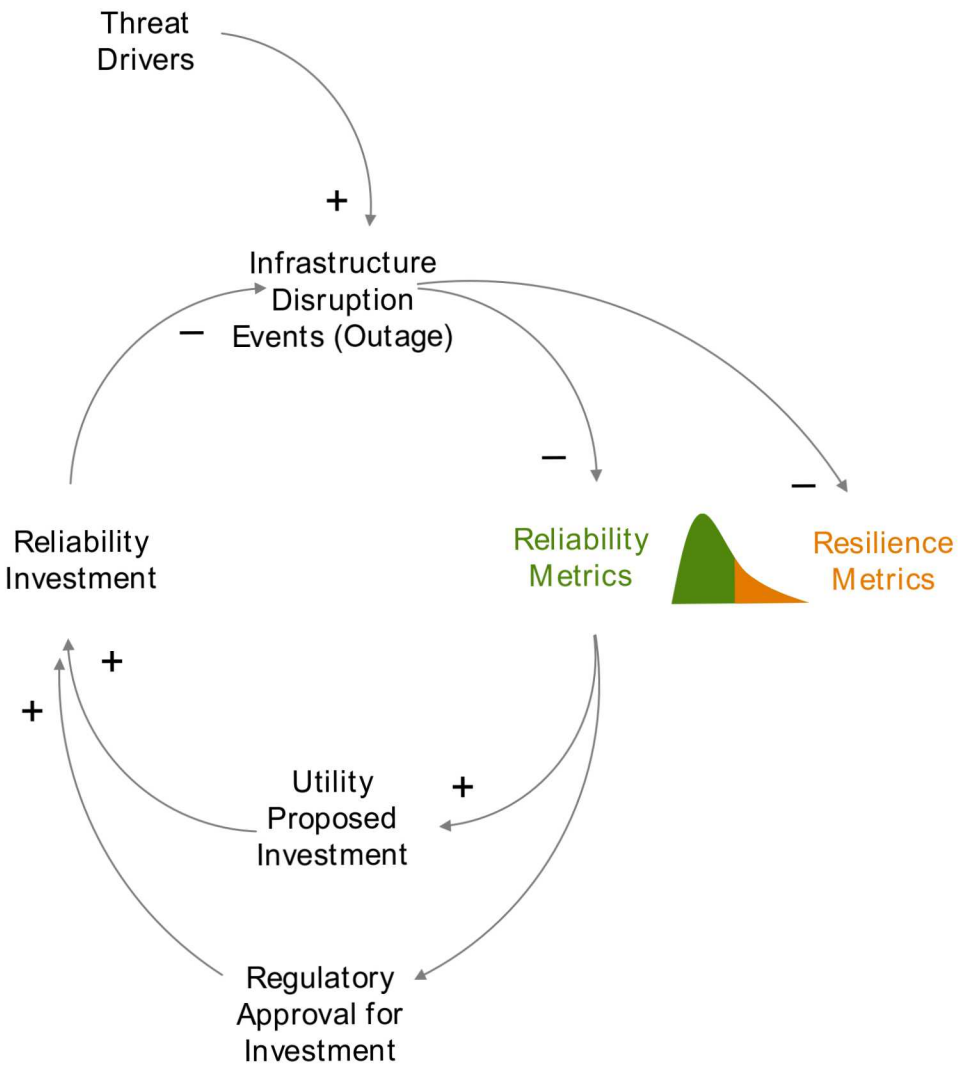
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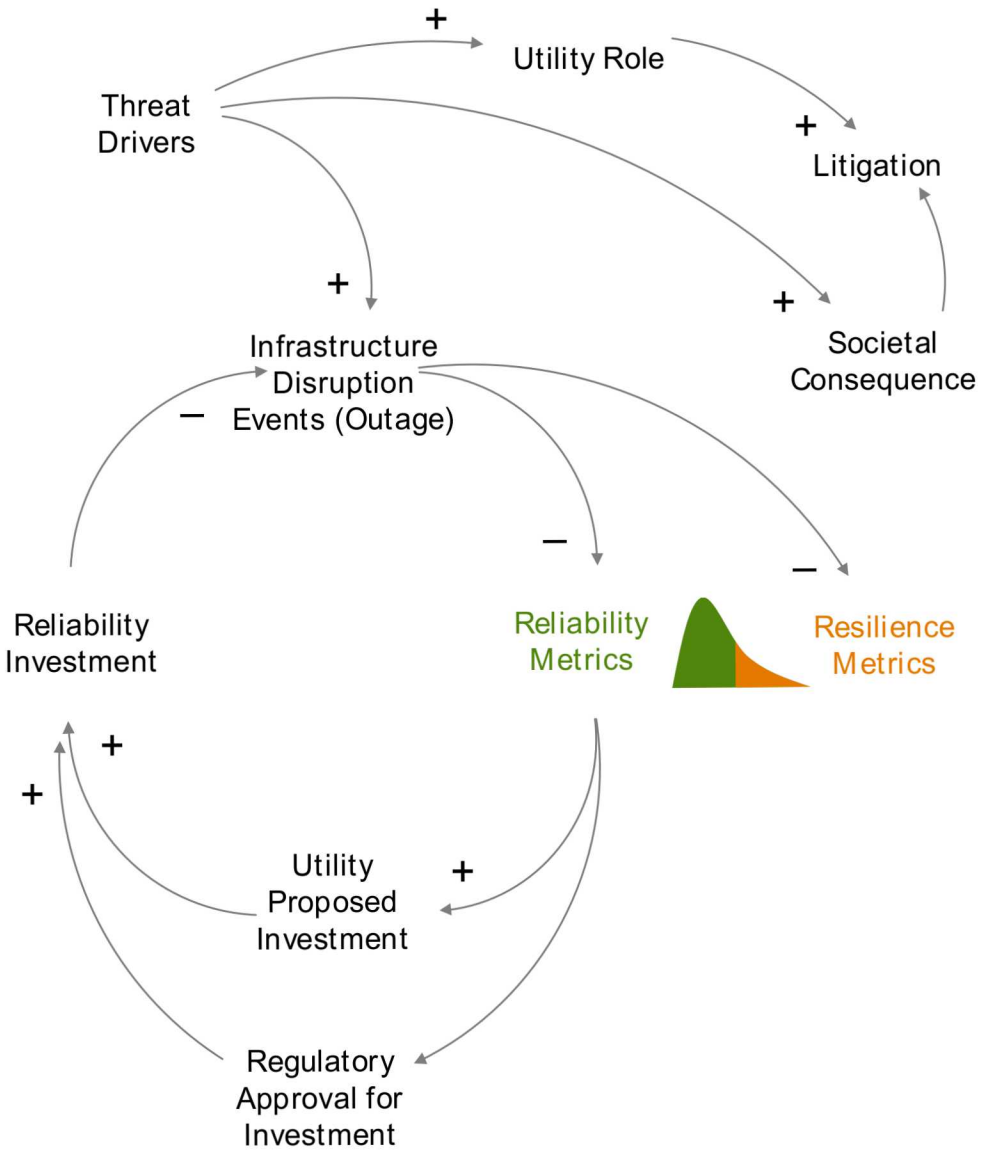
Threat Drivers
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Litigation
Societal Consequence
Infrastructure Disruption Events (Outage)
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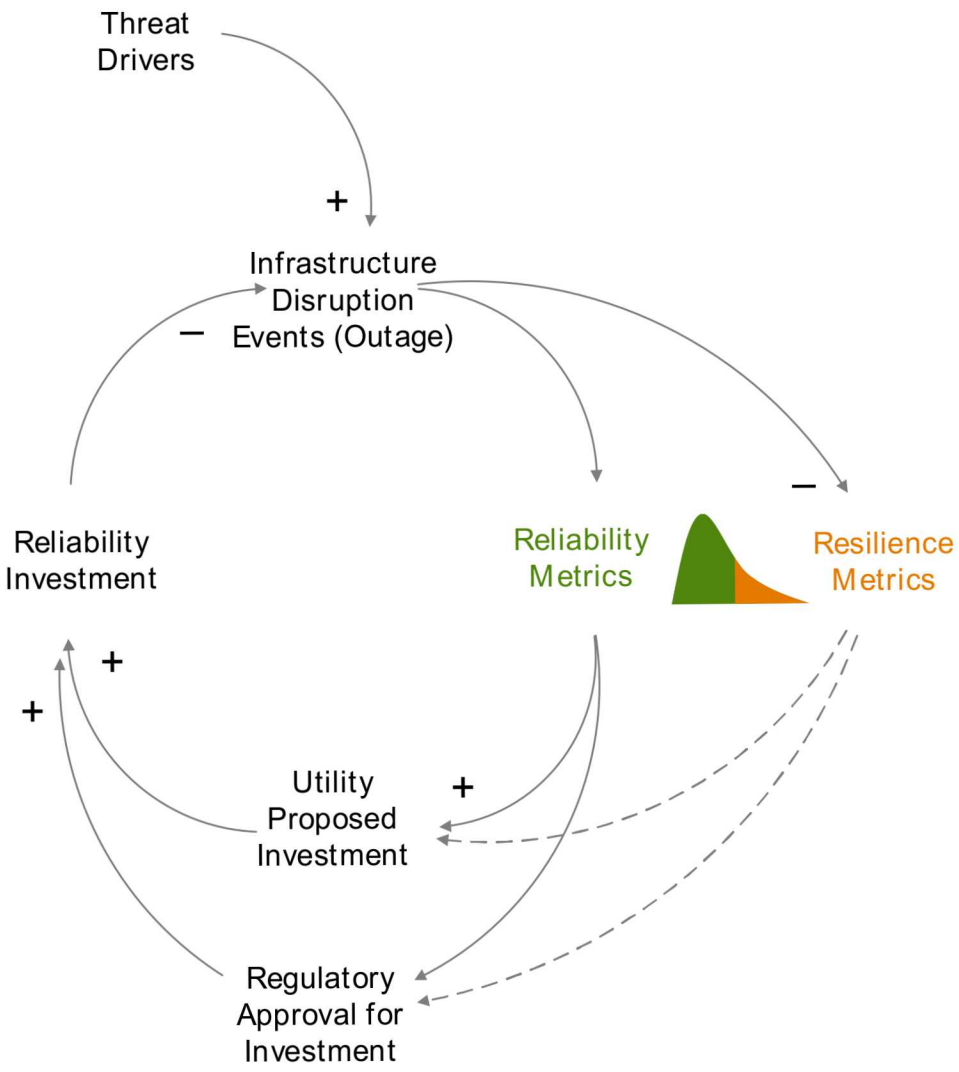
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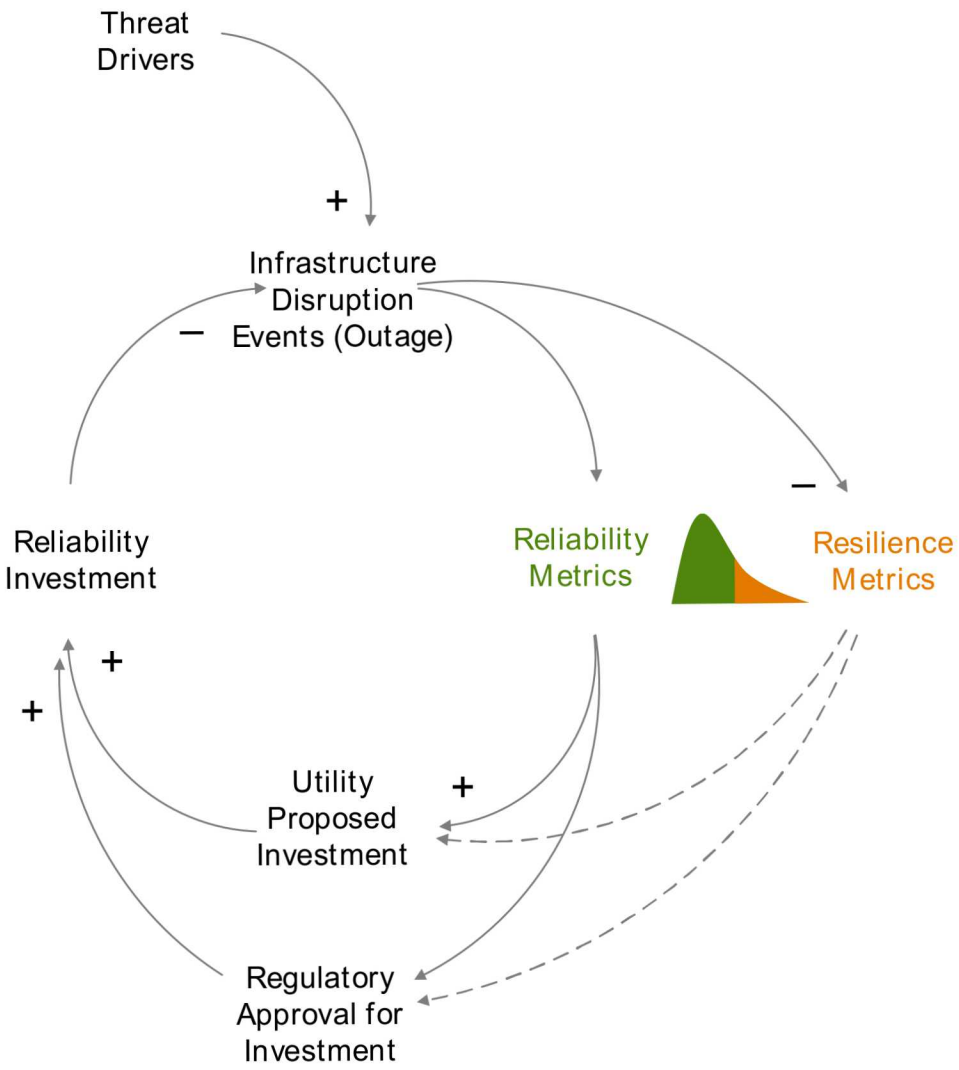
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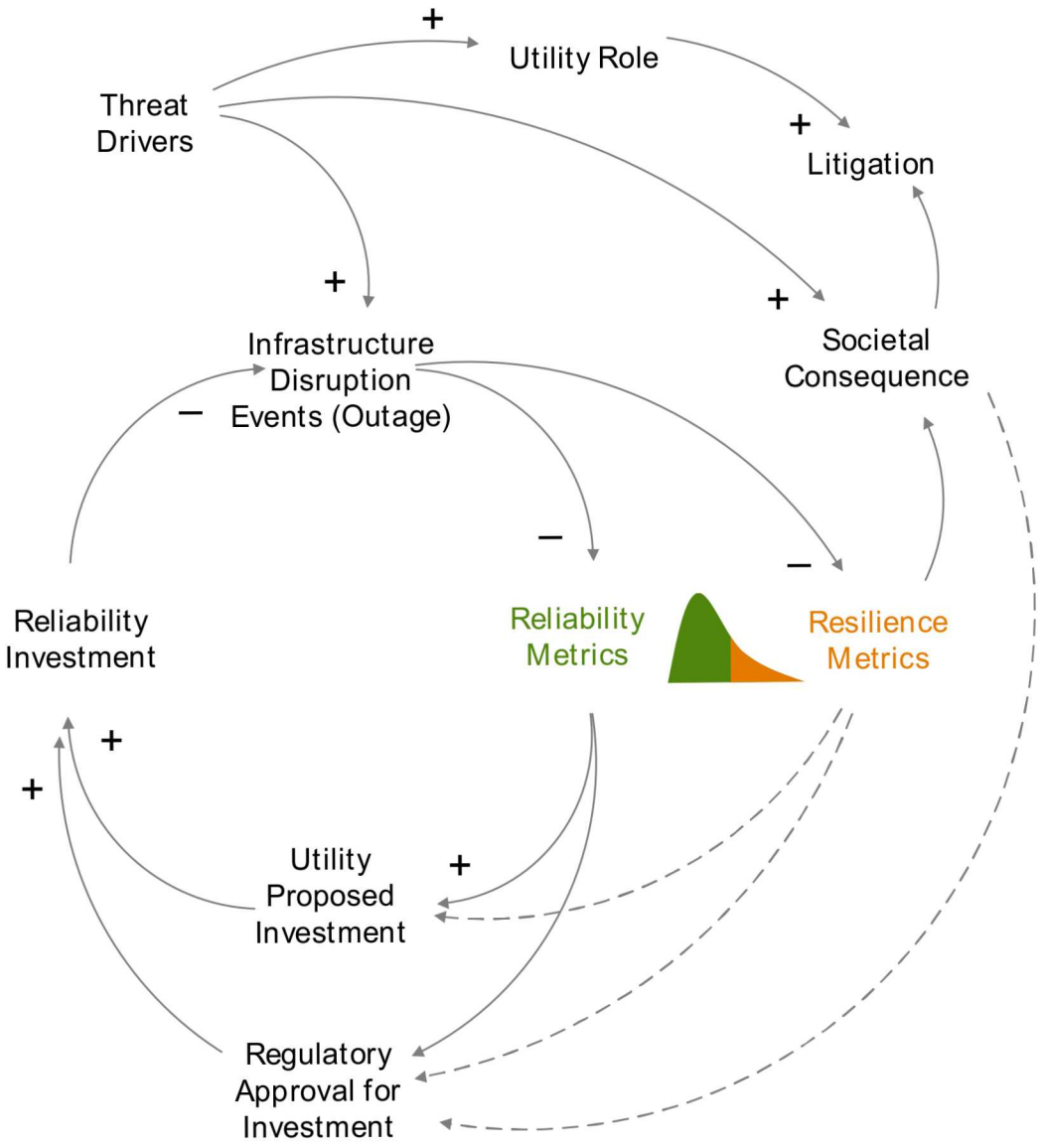
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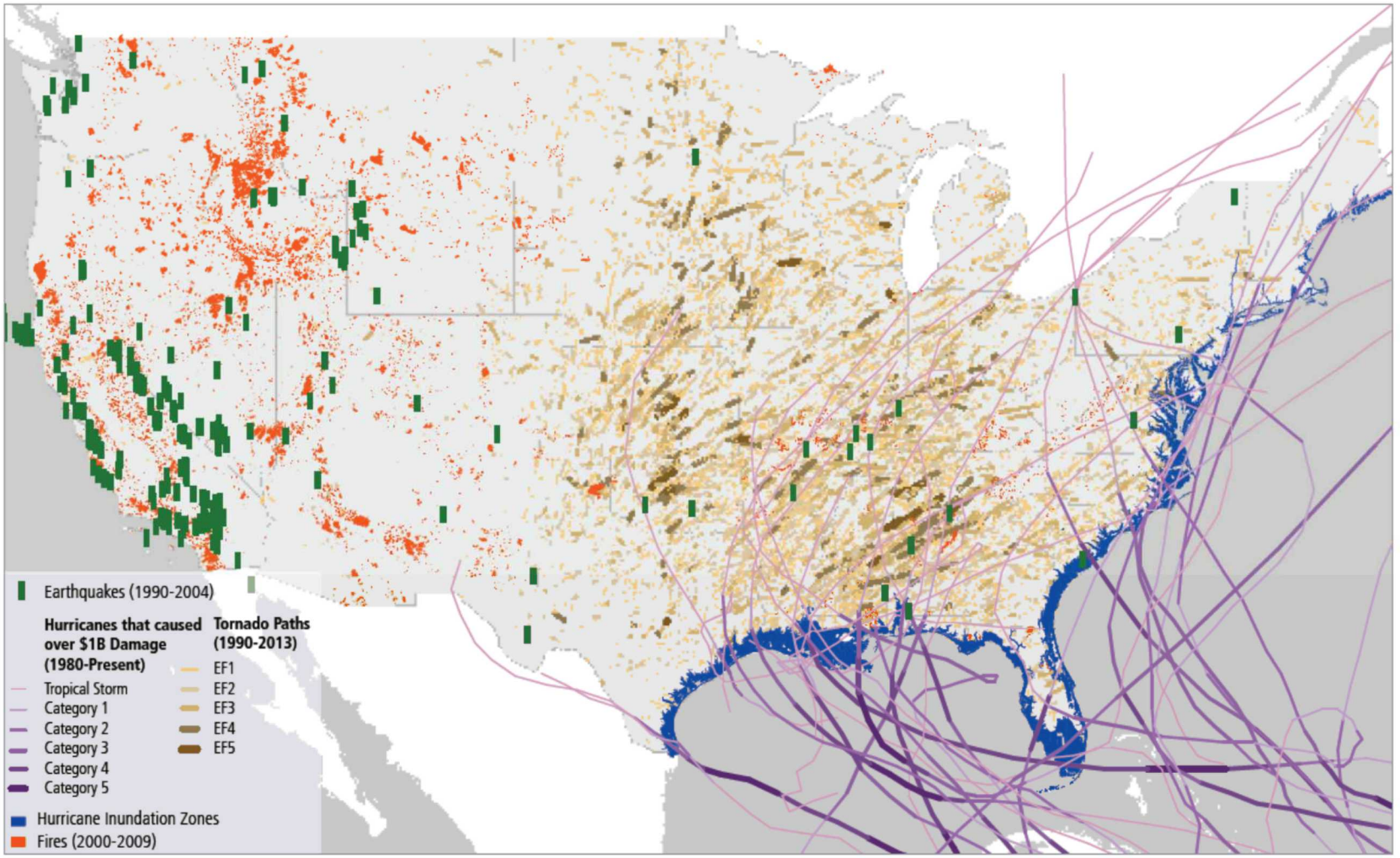
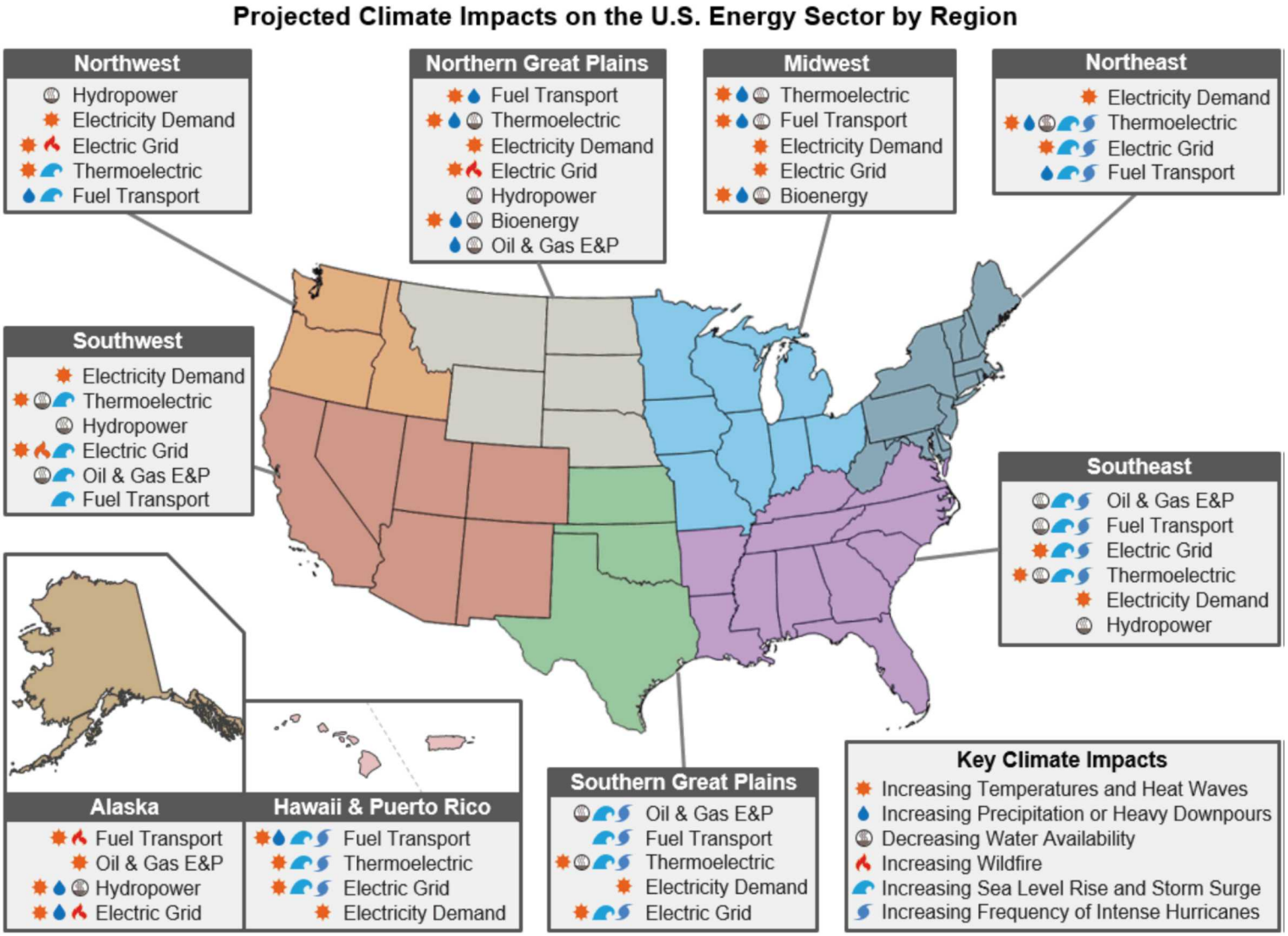
Historic Resilience Drivers



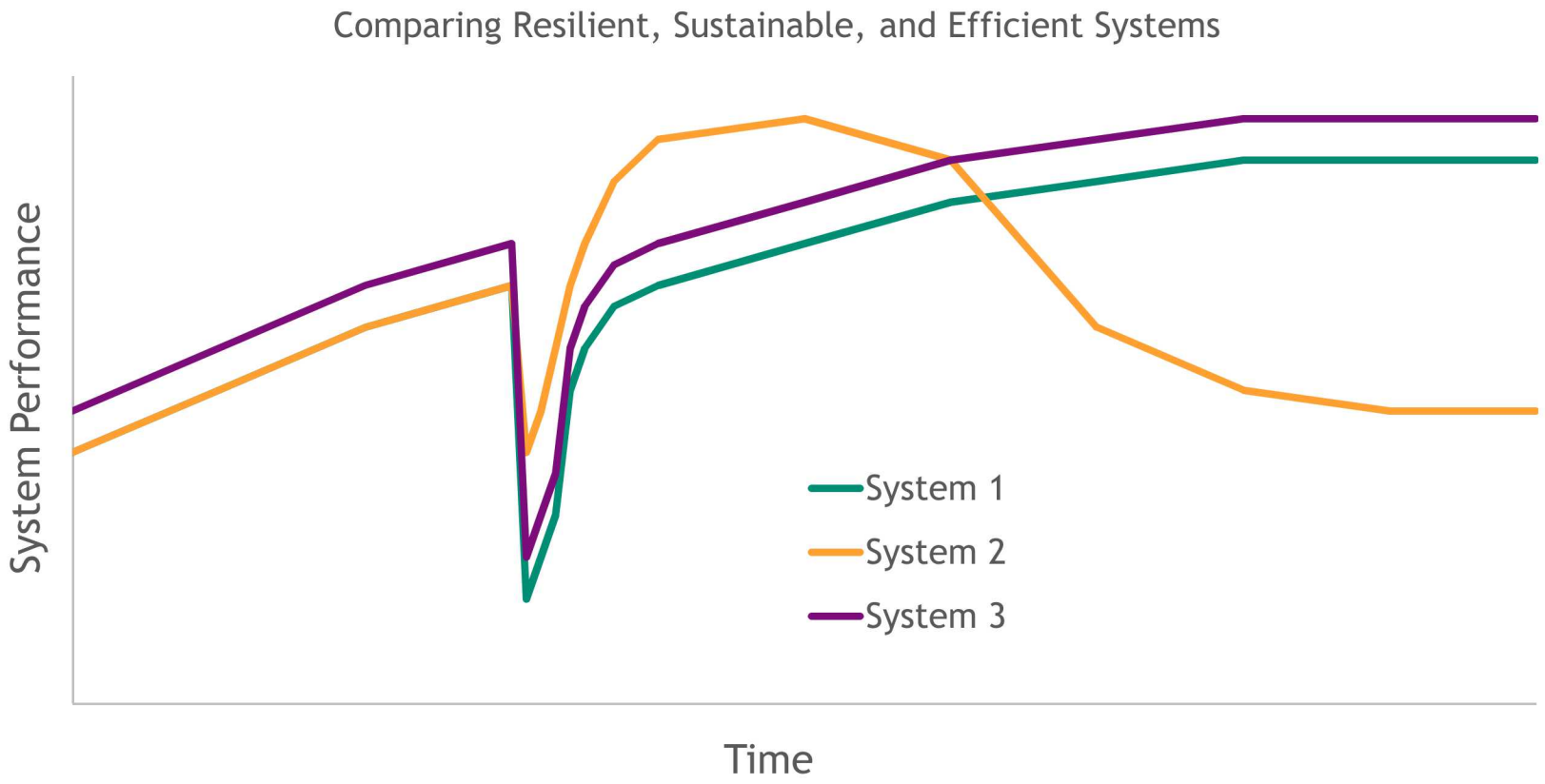
QER Report: Energy Transmission, Storage, and Distribution Infrastructure, April 2015, Page 2-5

US historic drivers of extended outage include: tornado, hurricane, wildfire, earthquakes, and coastal inundation

Projected Infrastructure Impacts

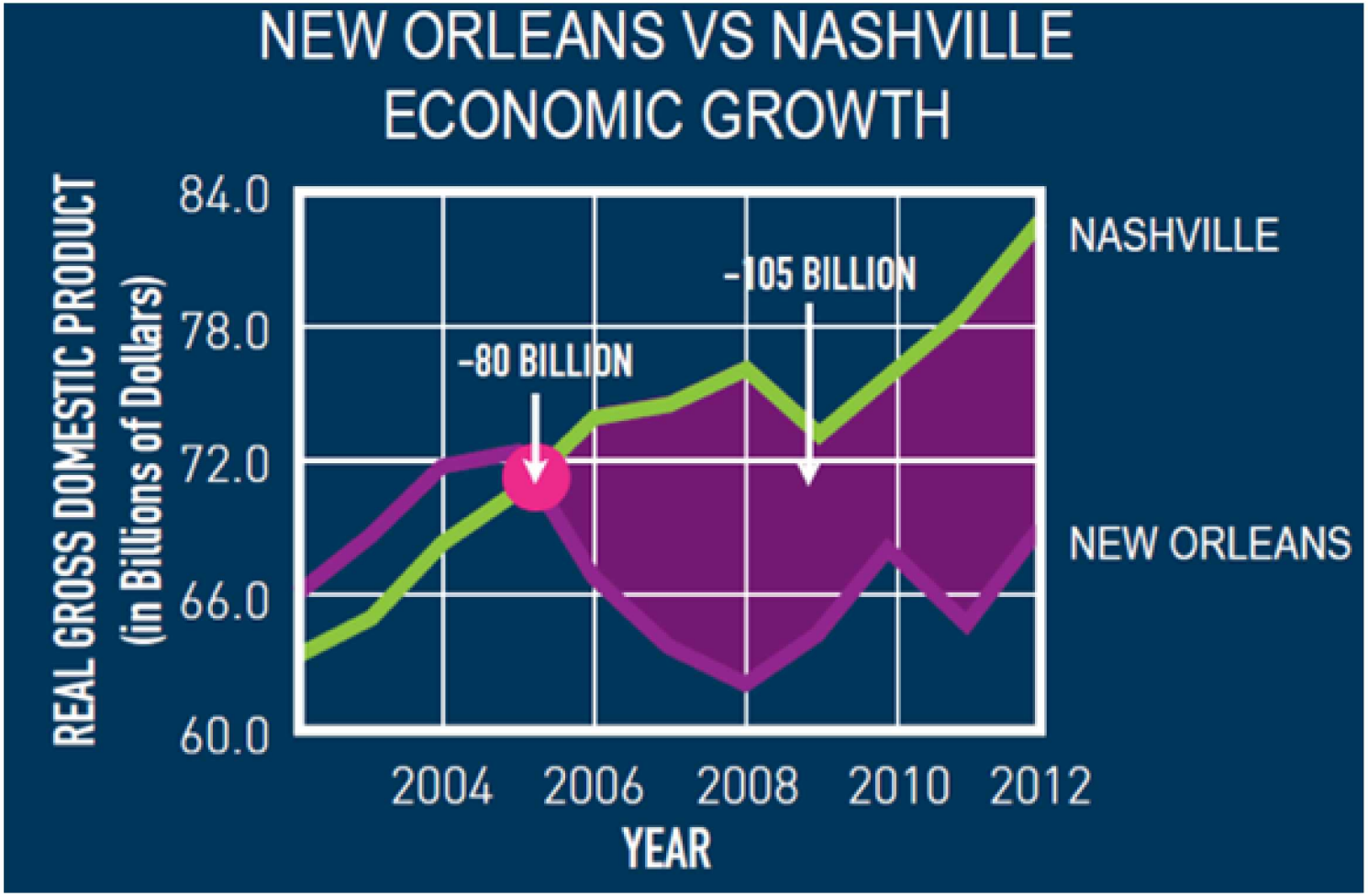


TRADEOFFS – RESILIENCE, EFFICIENCY, SUSTAINABILITY



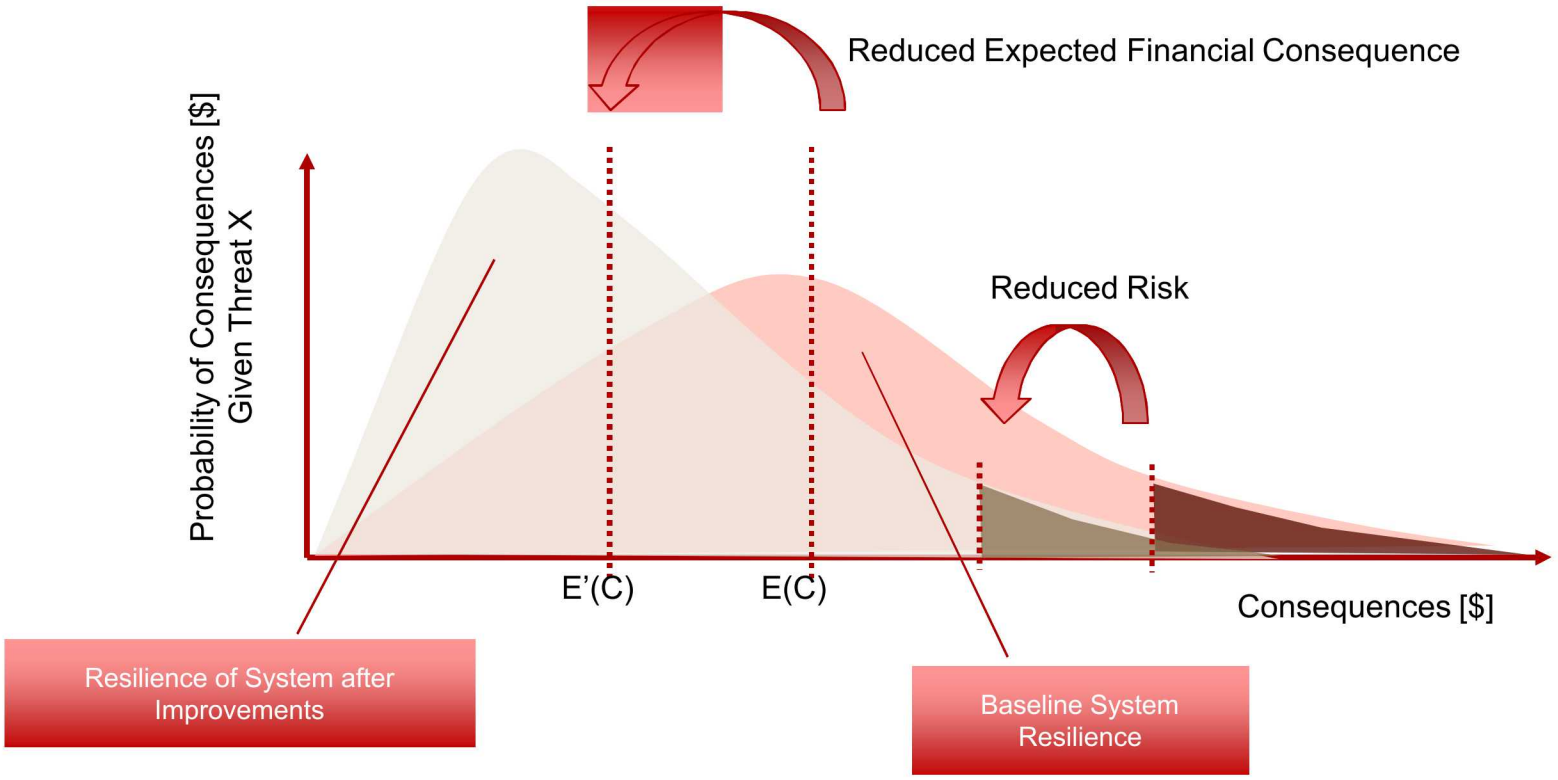
Tradeoffs between resilience, efficiency, and sustainability require integration of planning and analysis techniques

THESE MEASURES ARE INTERDEPENDENT



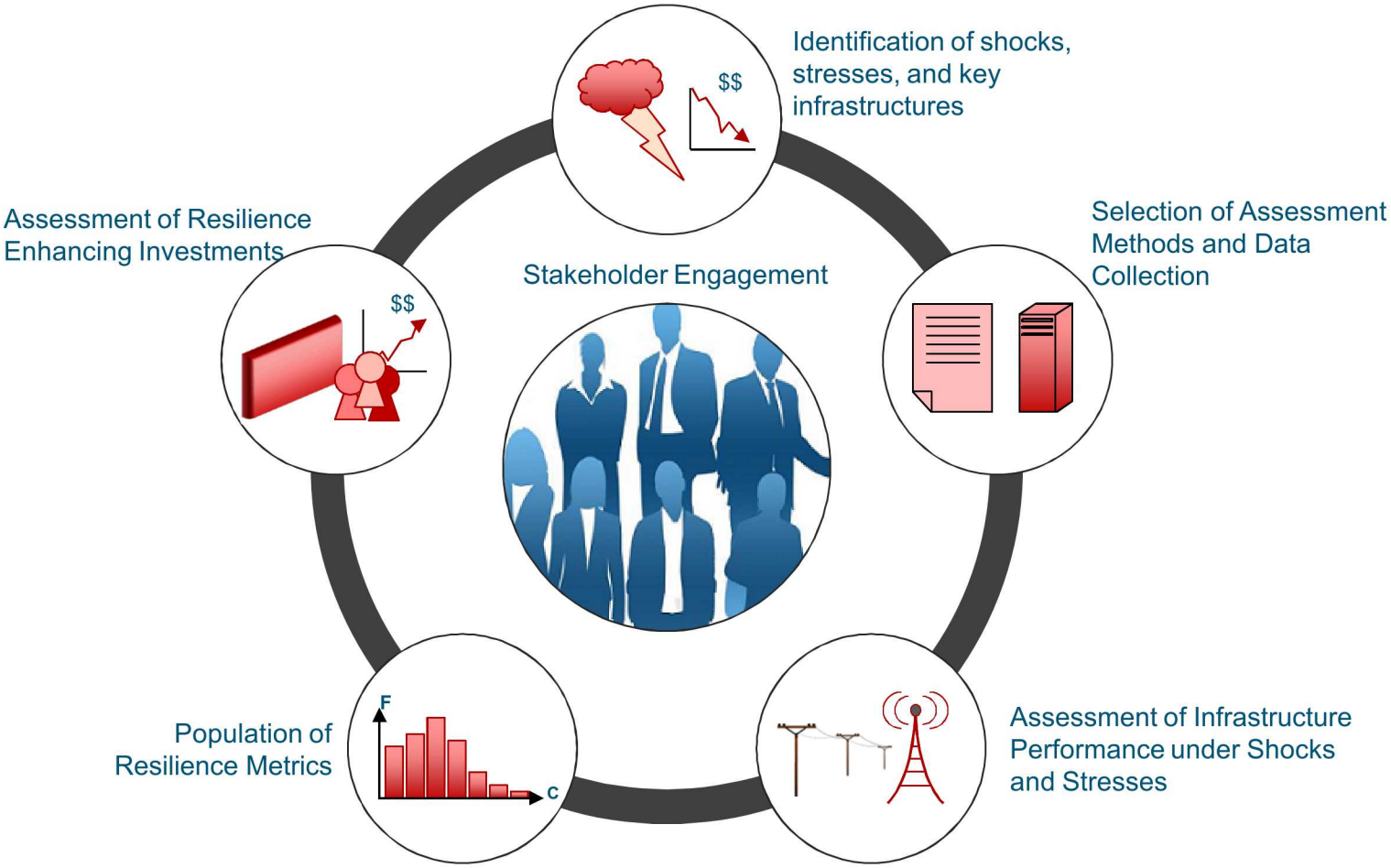
The value of a resilient society may depend on the interplay between resilience, efficiency, and sustainability

INTEGRATION around RESILIENCE METRICS



Integration between urban system and power system planners could center around a **consequence-based metric**

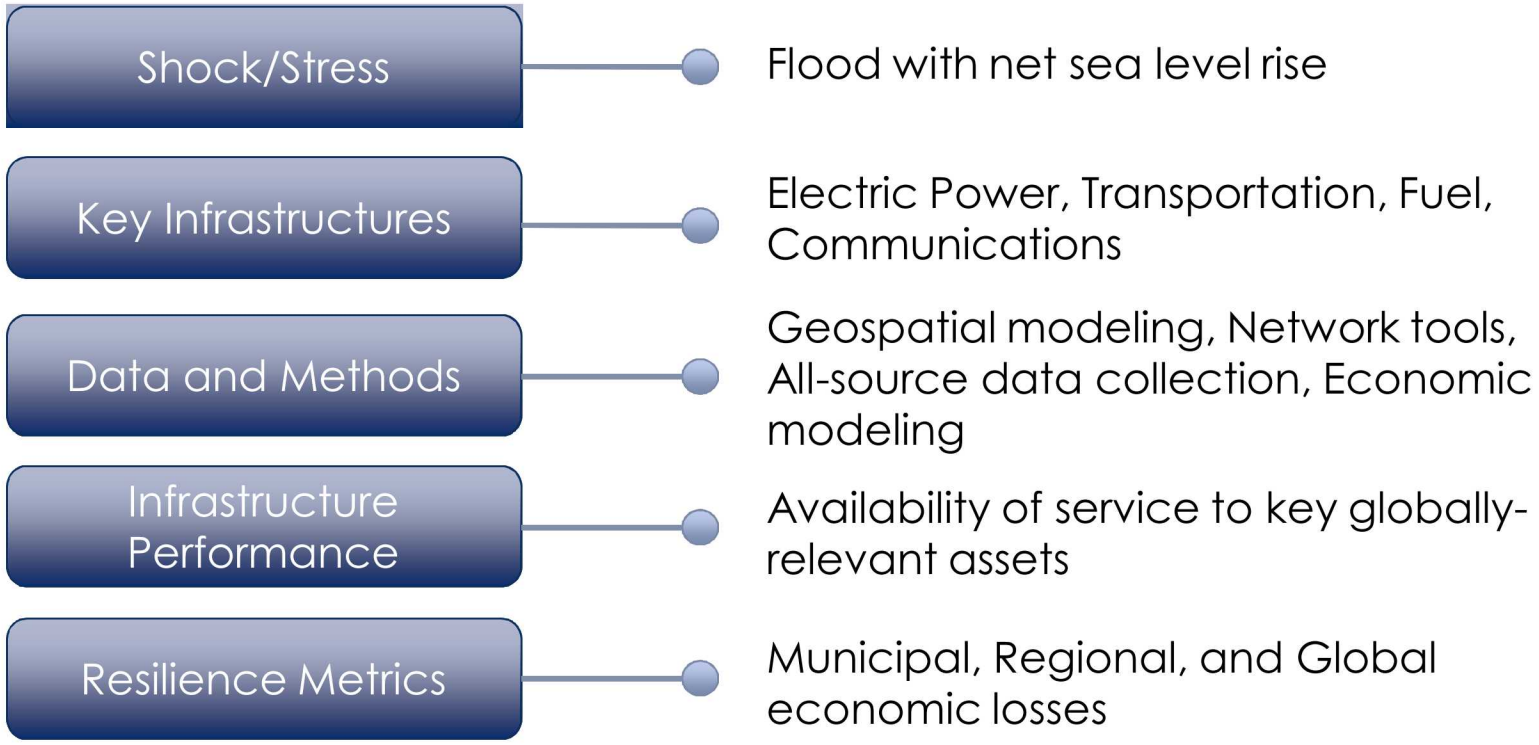
URBAN RESILIENCE PLANNING PROCESS



With urban stakeholders at the core, Sandia is using a multidisciplinary, science-based approach to quantify and improve urban resilience.

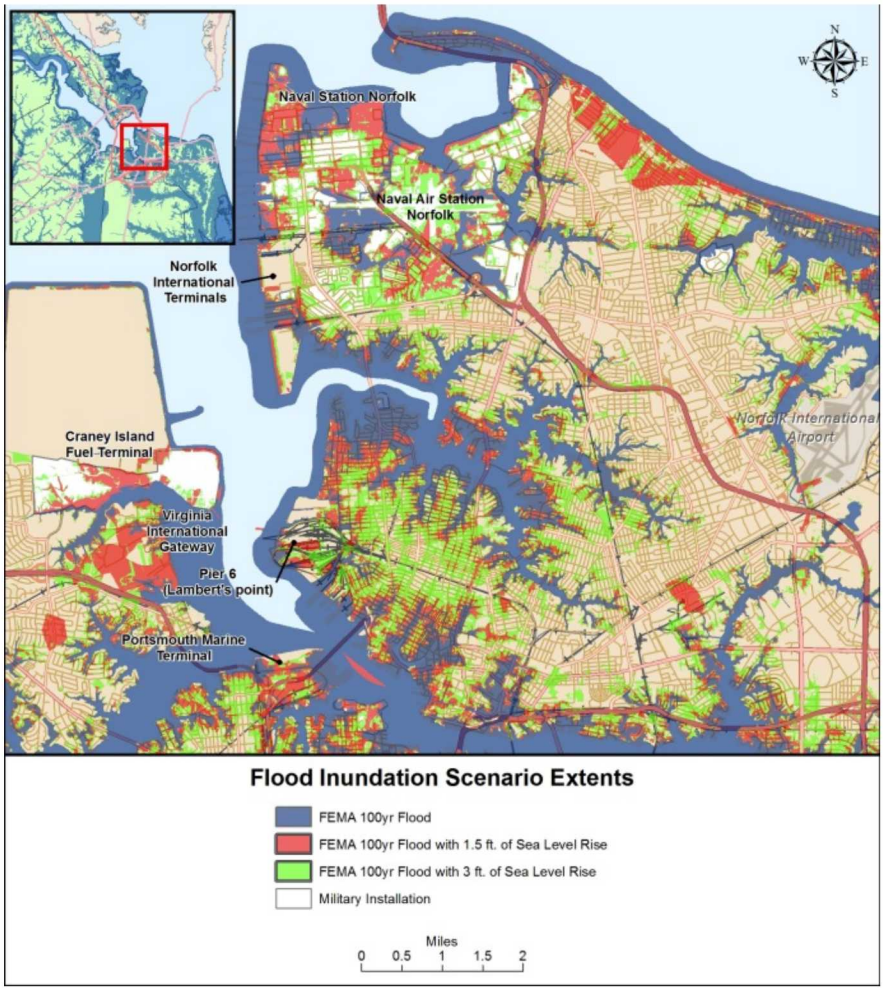
CASE STUDY: NORFOLK, VA

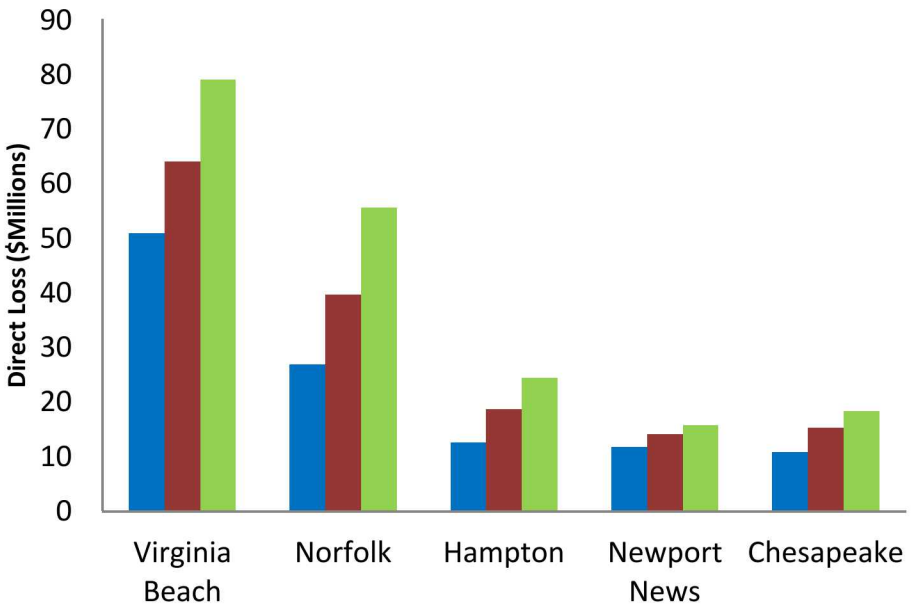
- What will the flood of the future look like in Norfolk?
- When Norfolk floods, who feels it?



Norfolk focused on an economic metric of consequence, and was concerned about their impact to other communities

CASE STUDY: NORFOLK, VA



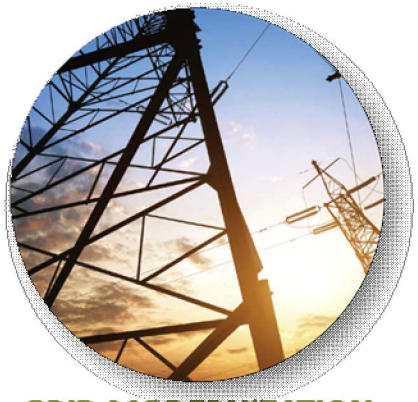


Summary of four day direct and indirect losses for three flooding scenarios

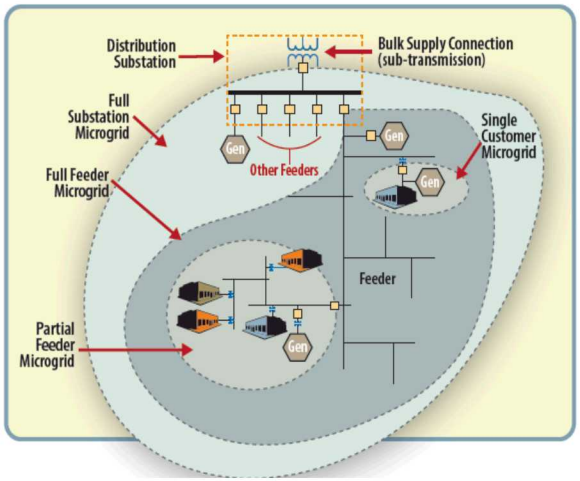
	100yr+0ft	100yr+1.5ft	100yr+3.0ft
Annual Direct Losses	$135 M	$182 M	$231 M
Annual Indirect Losses	$219 M	$296 M	$375 M
Total	$354 M	$478 M	$606 M

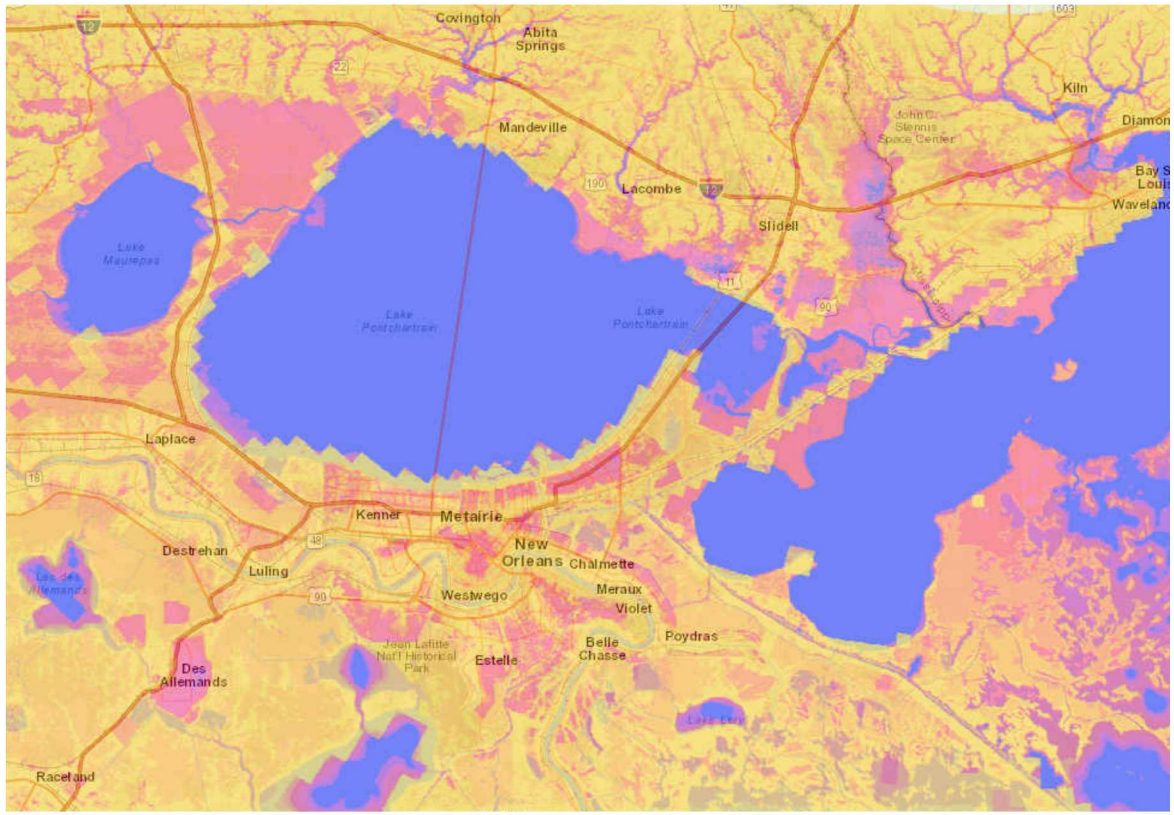
Sandia quantified the economic consequences of increased flooding due to net sea level rise for Norfolk

CASE STUDY: NEW ORLEANS, LA



GRID MODERNIZATION LAB CONSORTIUM

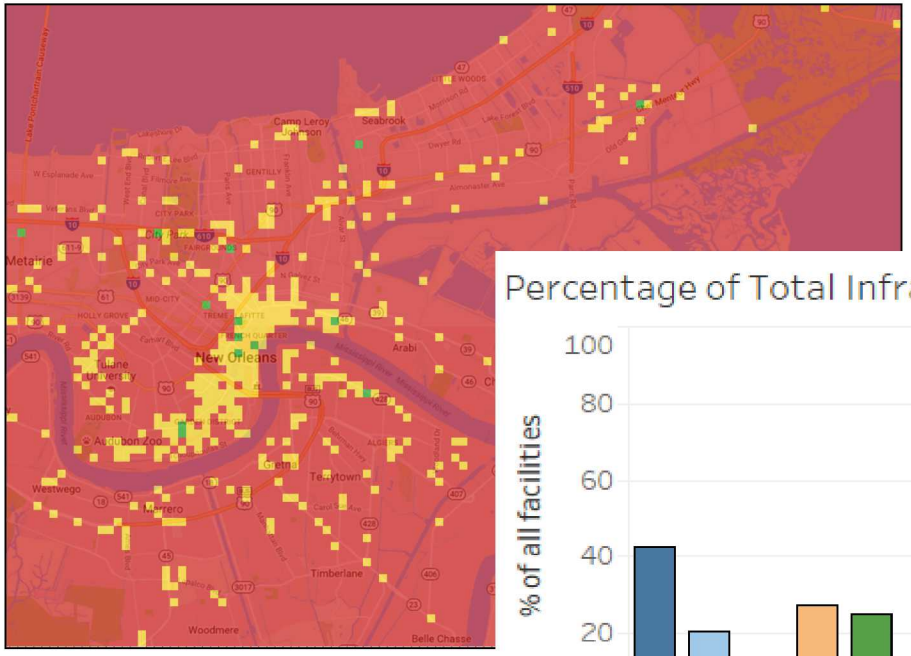


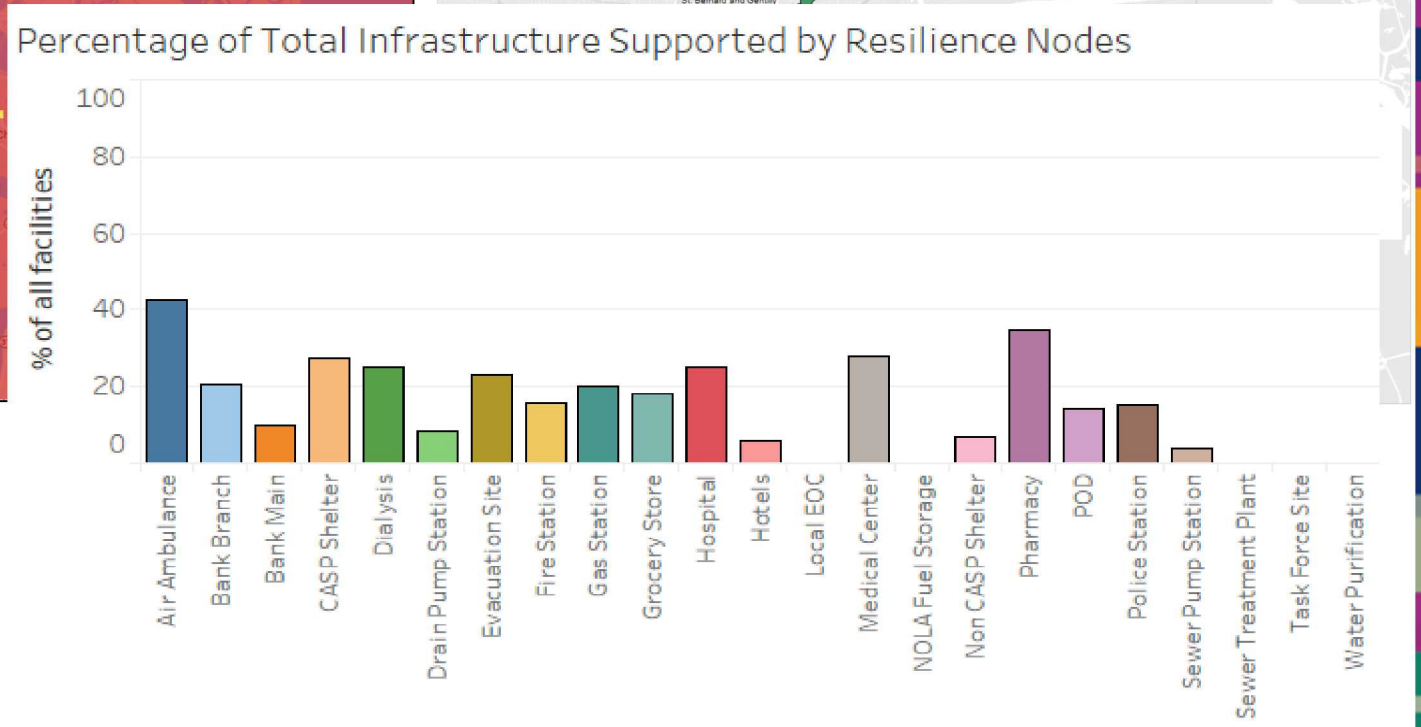


Results of Hurricane Inundation Modeling for New Orleans and surrounding regions

New Orleans is focused on the grid modernization solutions that will decrease societal consequence of major grid outages

CASE STUDY: NEW ORLEANS, LA





A system of "resilience nodes" supported by technologies such as microgrids can provide a wide range of services to the population

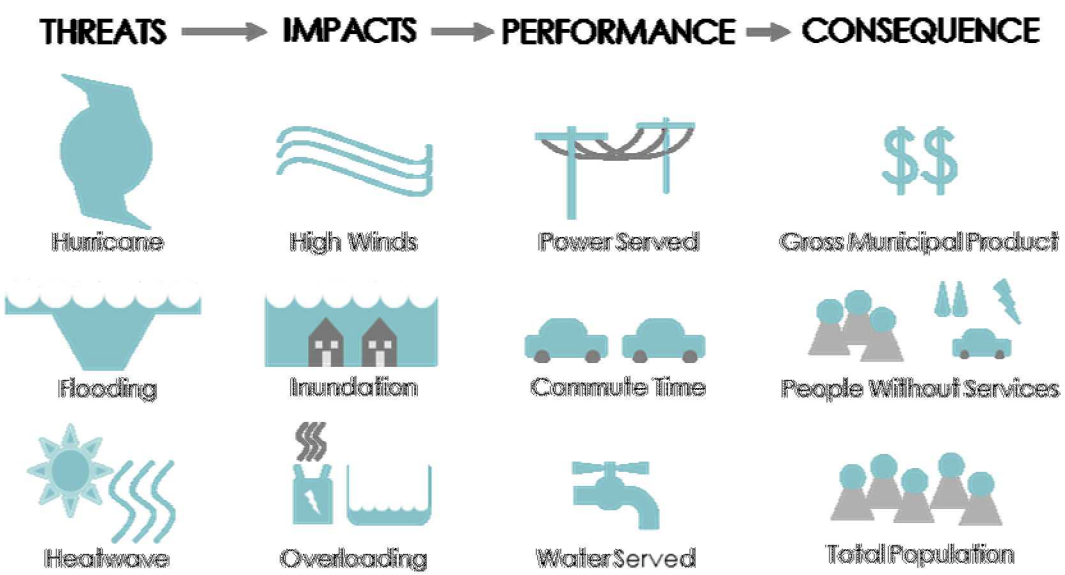
DESIGNING RESILIENT COMMUNITIES OVERVIEW

- Objectives:

1. Design, validate, and release a framework for alignment of community resilience planning and grid investment planning
2. Demonstrate – with two city/utility pairs – how to overcome the most critical technical challenges to (1)
3. Analyze – alternative regulatory frameworks and utility business models that may better internalize resilience benefits
4. Build – one or more community resilience nodes enabled by distributed energy resources

We are here today to begin to accomplish objective (1), while informing objectives (2), (3), and (4)

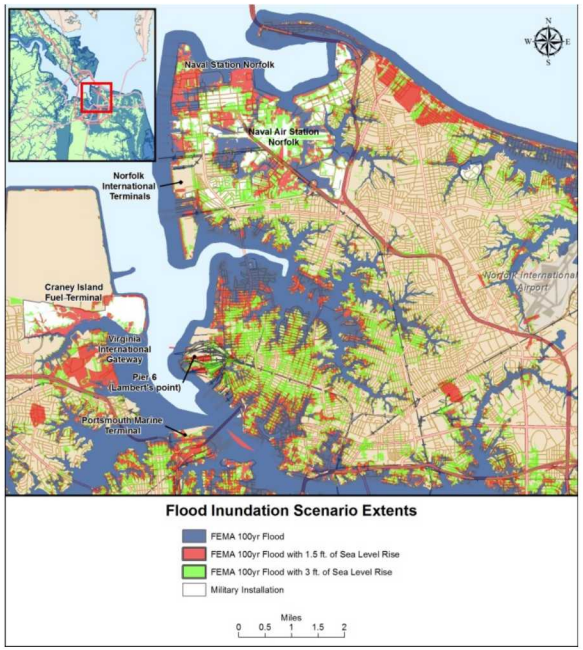
1. DETERMINATION OF RESILIENCE DRIVERS

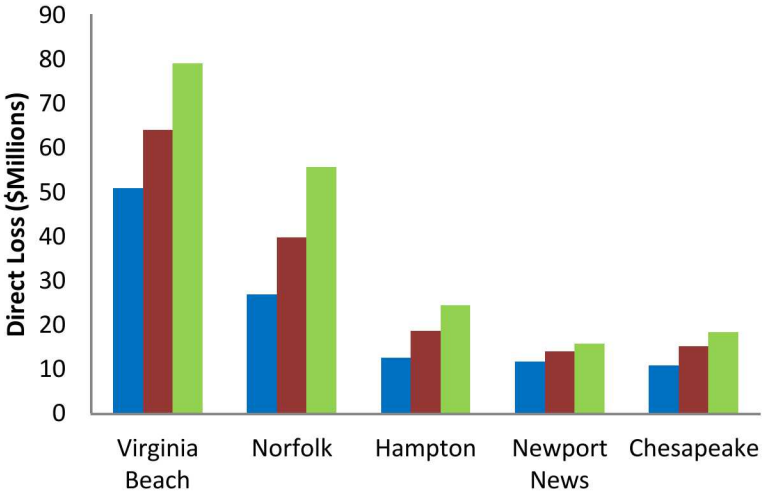


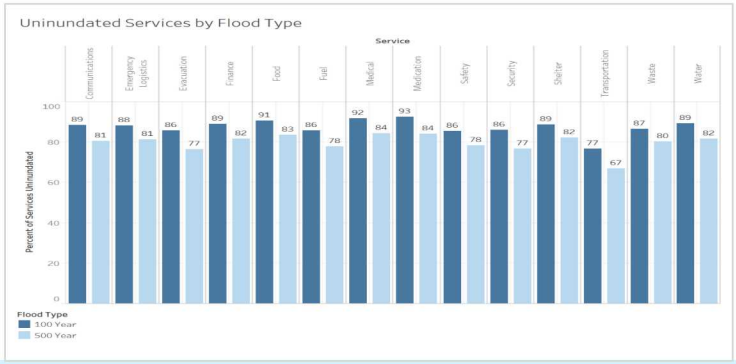
Measure Classification	Common Examples
Community Measures	Number of People Without Necessary Services
	Lives at Risk
	Societal Burden to Acquire Services
Economic Measures	Gross Municipal Product Loss
	Change in Capital Wealth
	Business Interruption Costs

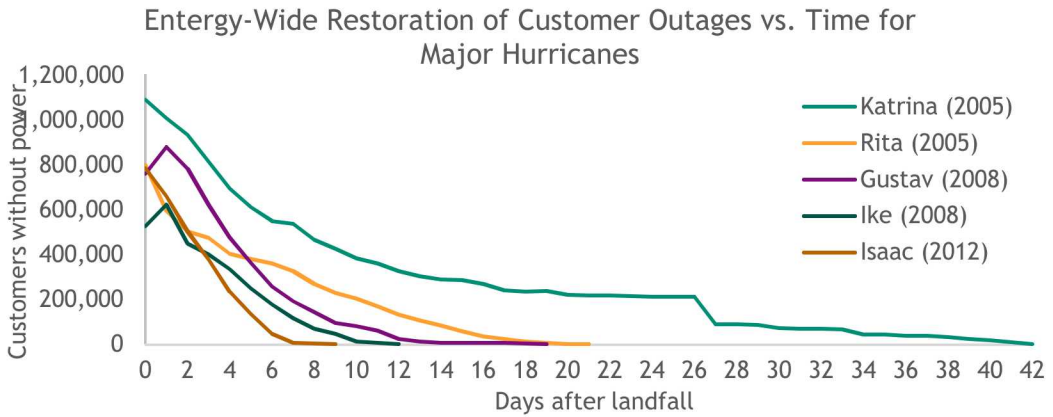
Deciding what we want to be resilient to, which infrastructure systems matter the most, and how we will determine consequence to our communities

2. COMMUNITY RESILIENCE ANALYSIS (BASELINE)



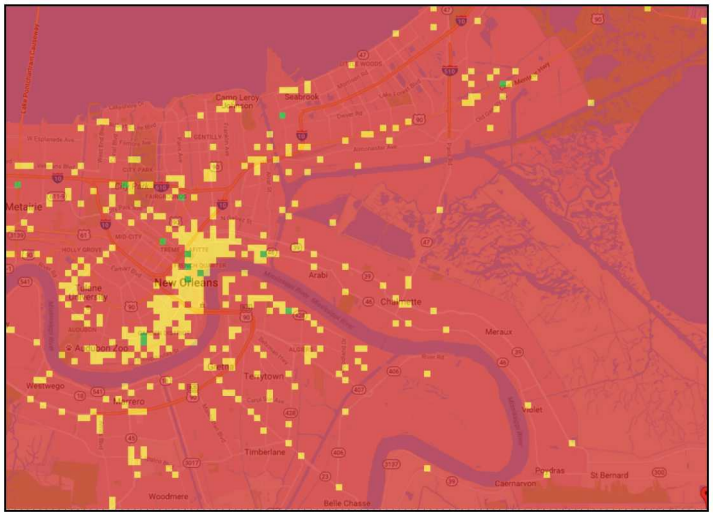


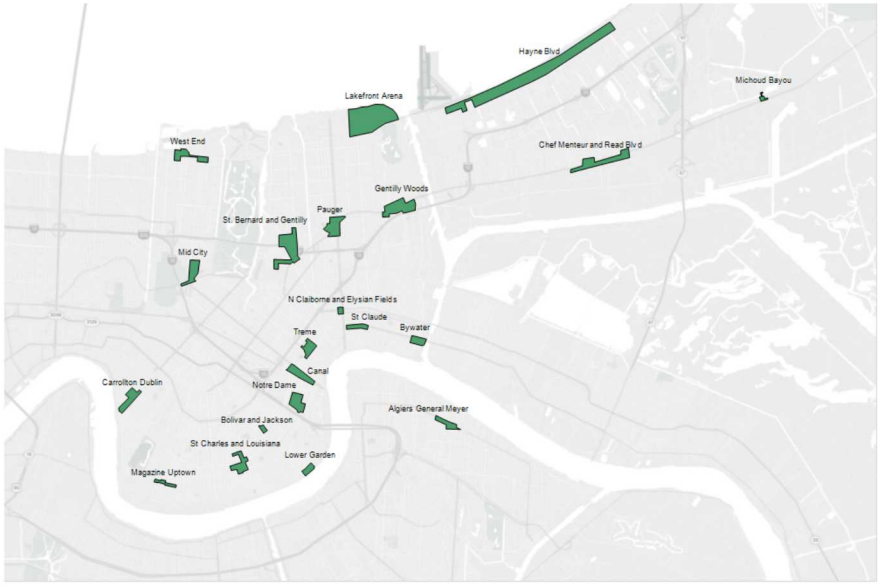


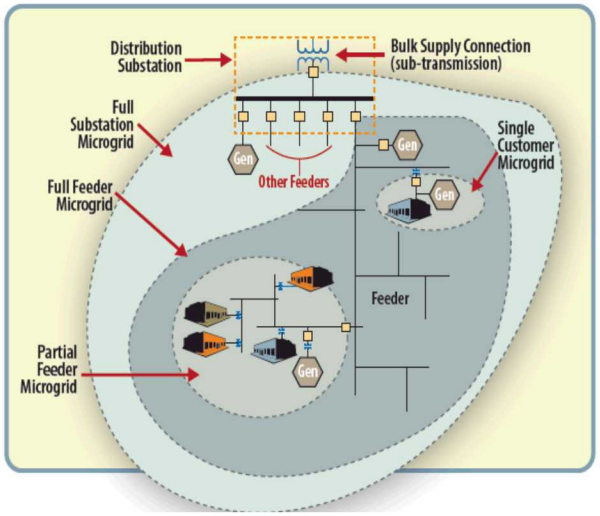


Understanding the current community risk – in units of consequence – to extreme events over a planning horizon

3.SPECIFICATION OF RESILIENCE ALTERNATIVES





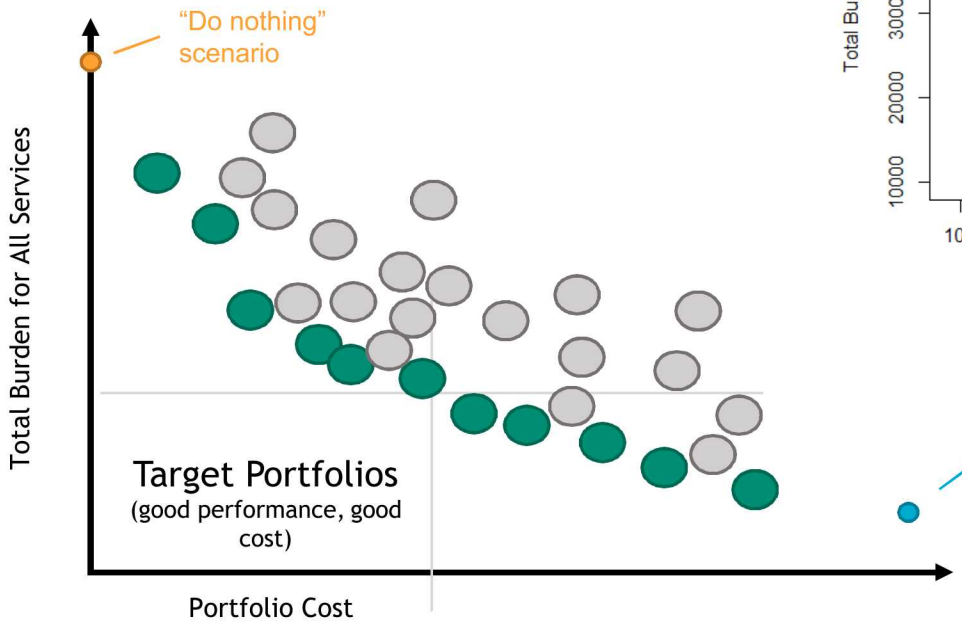


- Alternative investments
  - Utility, city, or third party
- Alternative regulatory approaches
  - Performance-based
  - Incentives-based
  - Cost causation
- Alternative utility business models
  - Resilience as a service
  - Increased integration with insurance products

Proposing alternatives requires design capabilities inclusive of consequence-based resilience metrics

4. EVALUATION OF RESILIENCE ALTERNATIVES

- Evaluation based on resilience performance in addition to:
  - Blue sky cost benefit
  - Sustainability metrics
  - Other?



Evaluation depends on the evaluator and the specific planning process.

PRIMARY ITEMS FOR FEEDBACK

- Are we ready to coalesce around a common resilience definition?
- What are the critical components of a community resilience plan? How do these components depend on a resilient grid?
- What does improved integration between municipalities and utilities focused on community resilience planning look like? How would it be beneficial?
- What are the capabilities – if developed – that would best enable this integrated planning framework?
- What is the ideal role of the regulator in this integrated planning framework?
- What have we missed? Who else should be in this SAG?

Feel free to capture these questions, but don't worry, we'll ask them again

CONCLUSIONS

1. Infrastructure owners, particularly electric utilities, are not adequately incentivized to improve resilience – especially community resilience

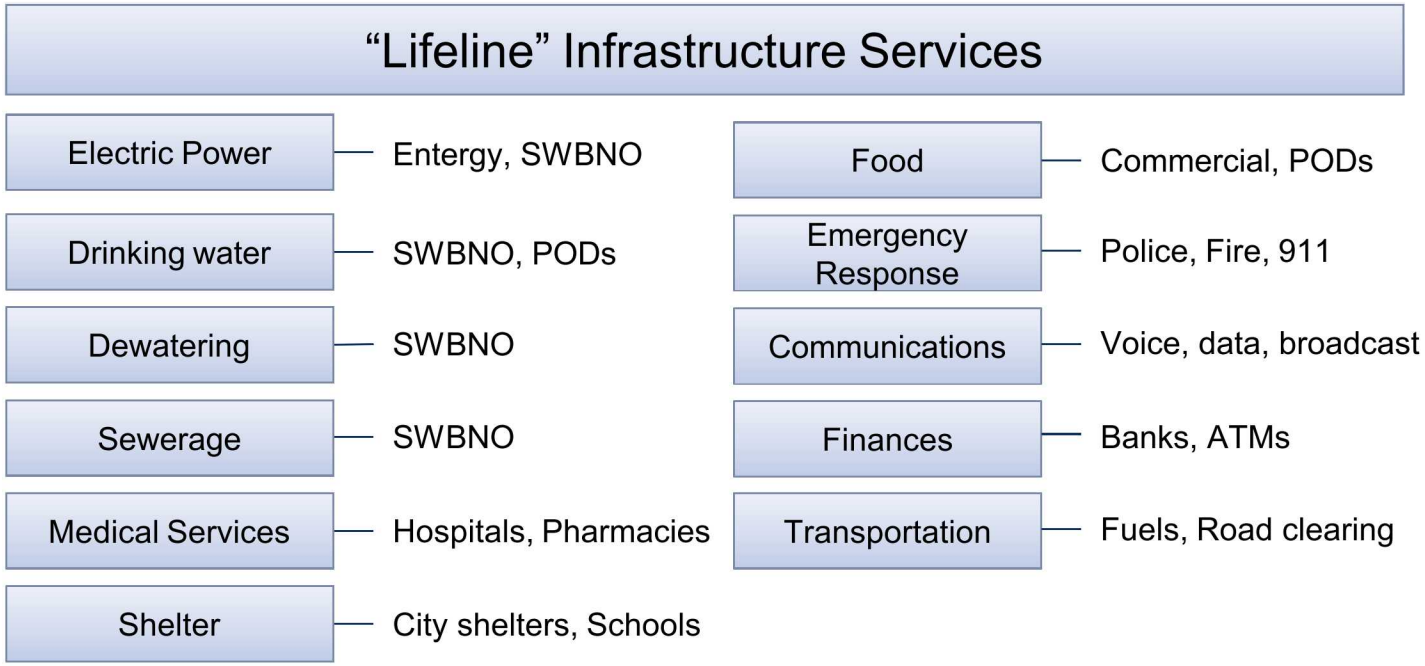
2. Development, validation, and standardization of methods and processes to integrate community resilience planning with grid investment planning is the critical next step to supporting regulatory and policy decisions

3. Understanding and incorporating the tradeoffs between resilience, sustainability, and efficiency will support resilience-inclusive investment planning

THANK YOU

www.sandia.gov/cities
Email: rfjeffe@sandia.gov

RESILIENT COMMUNITIES HAVE RESILIENT INFRASTRUCTURES

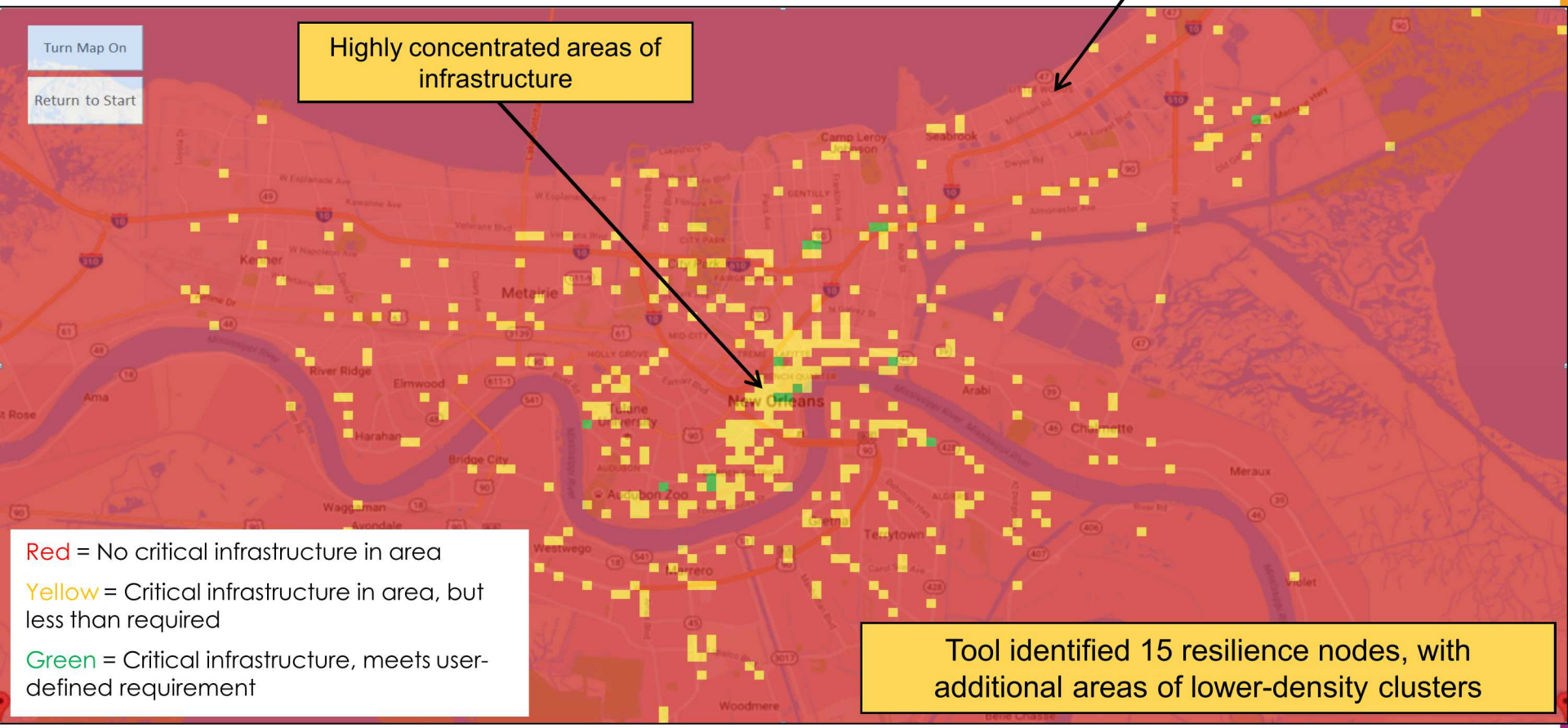


Mapping services to infrastructures

- Single infrastructures (e.g. large "discount" stores) can provide multiple services
- A single service (e.g. clean water) can be provided by multiple infrastructures

Design the system to provide a full array of services to the entire population given the design basis threat(s)

ReNCAT SCREENING and RESILIENCE NODES

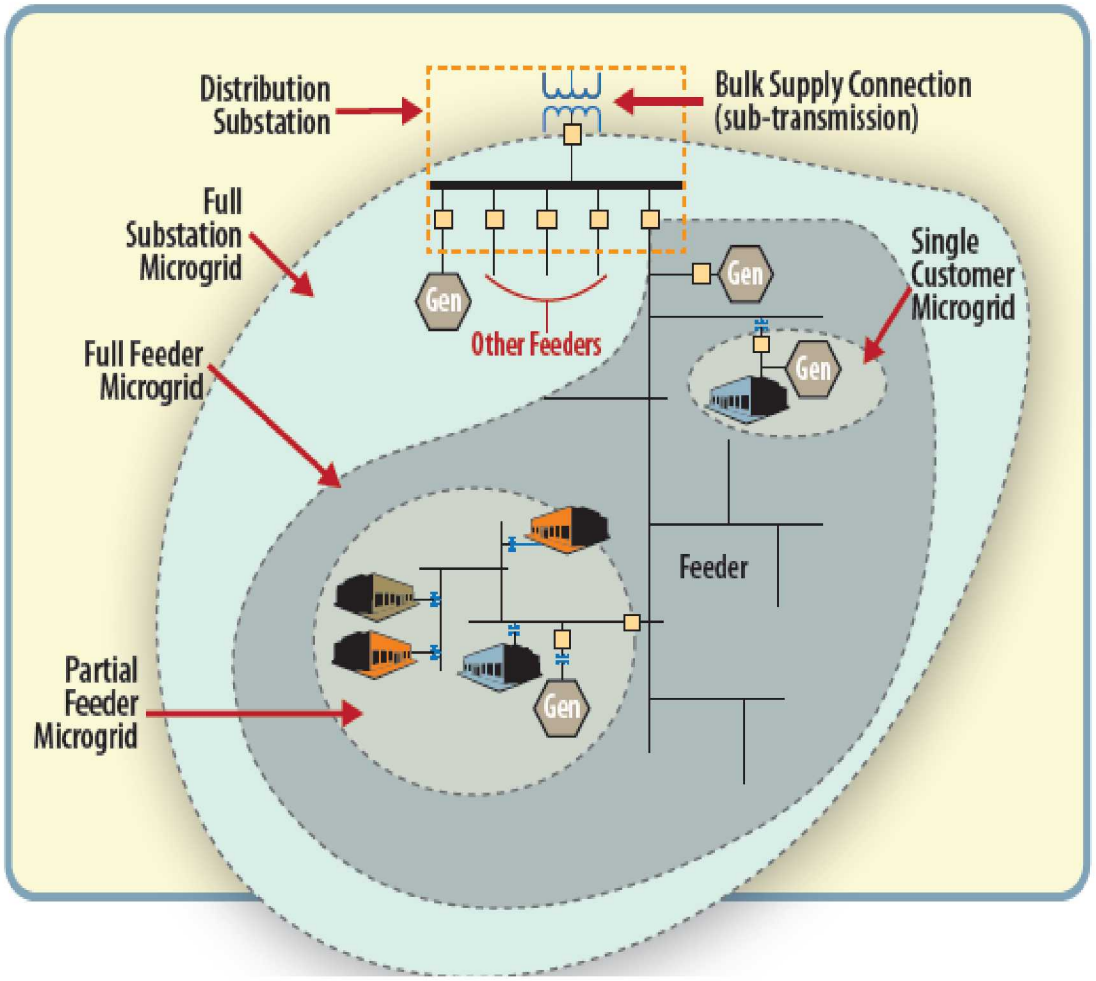


Resilience nodes are areas where several infrastructure services are clustered in a small geographic area, enabling effective microgrid solutions

CONSIDERING MICROGRIDS WITHIN SYSTEM DESIGN

Advanced microgrids:

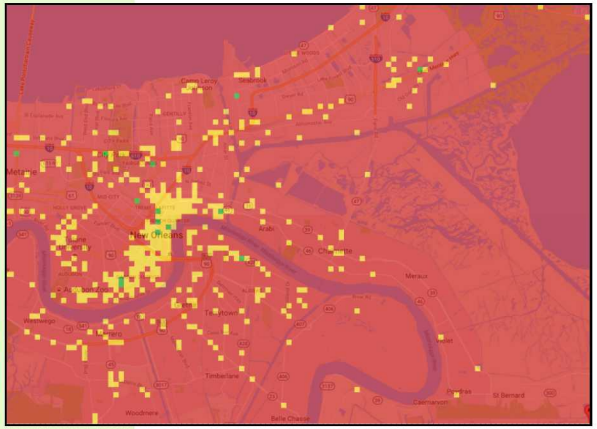
- Distributed Energy Resources (DERs)
- Locally-hardened distribution infrastructure
- One or more points of common coupling to the utility
- Microgrid controller and microgrid protection
- Largest cost is often generation and hardening of assets

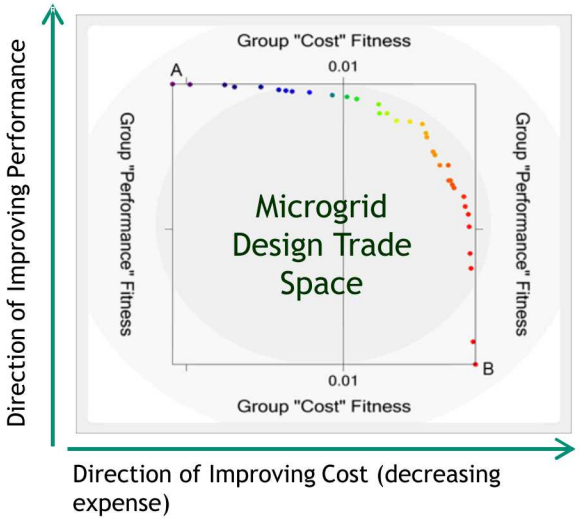


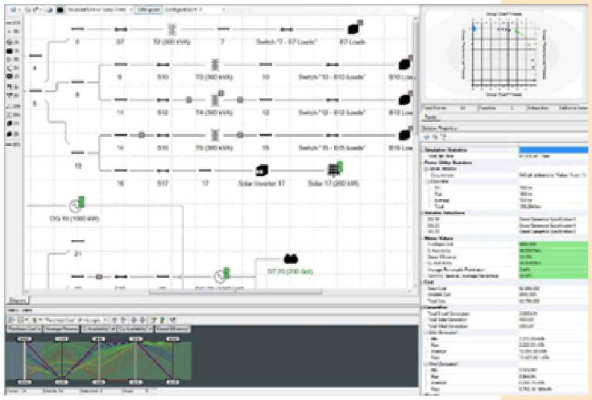
Advanced microgrids are not "turn-key," each may be designed to provide different services (resilience, sustainability, efficiency)

ASSESSMENT METHODS and DATA COLLECTION

ReNCAT: Resilient Node Clustering Analysis Tool - Optimize selection of buildings with resilient energy supply for increased community resilience based on consequence-focused resilience metrics

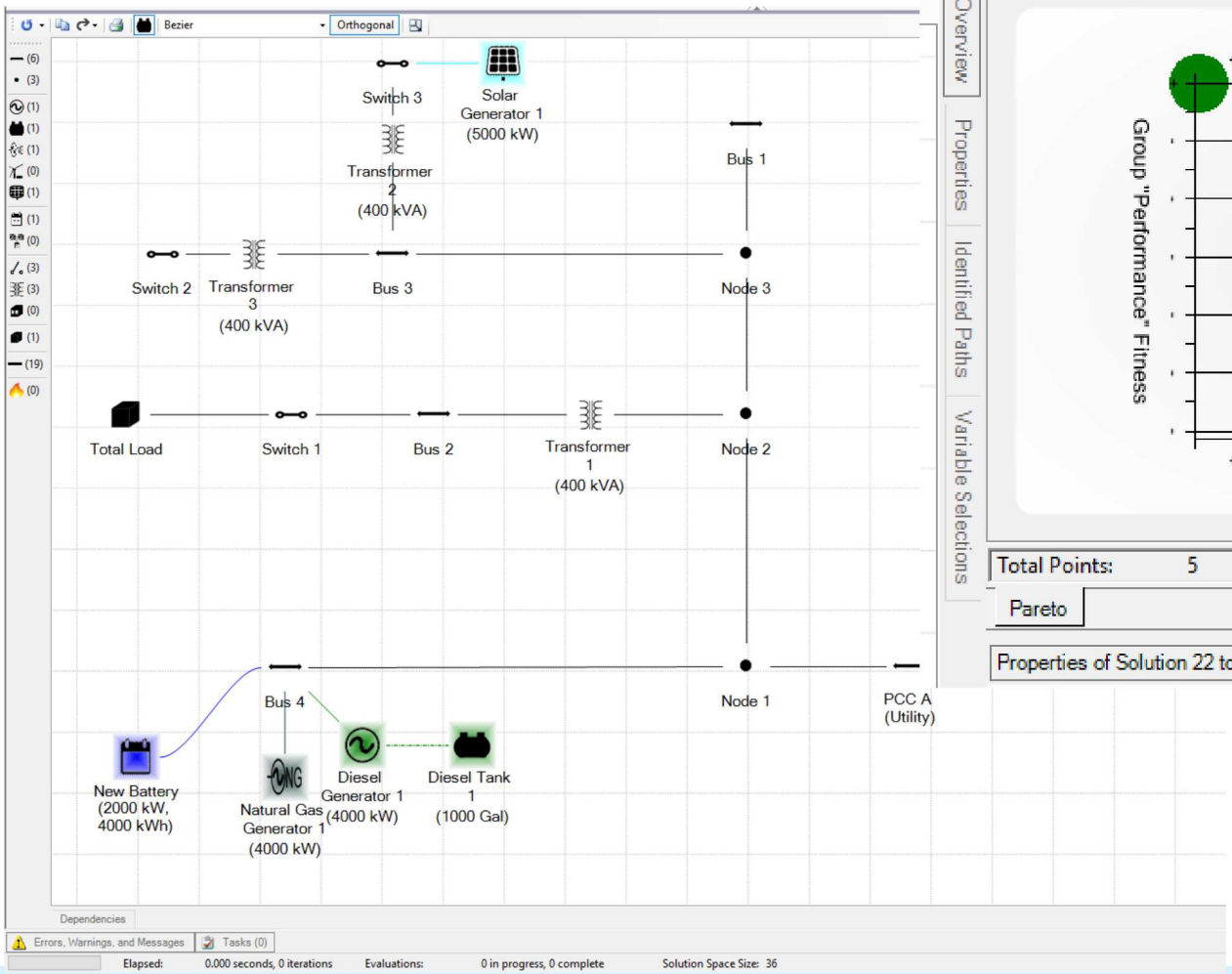


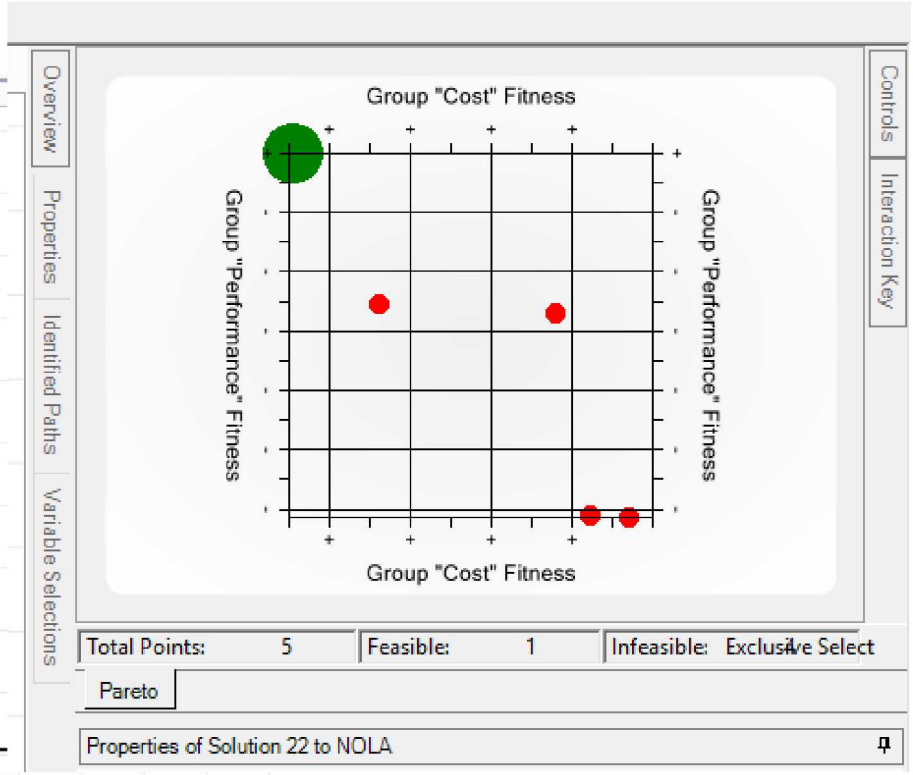




MDT: Microgrid Design Toolkit – optimizes technology selection and sizing for individual microgrids based on multiple metrics

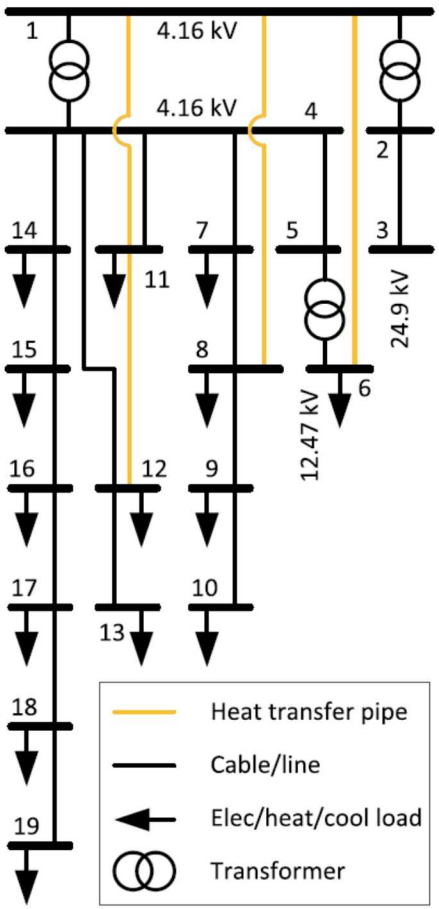
SIMULATION + OPTIMIZATION of INDIVIDUAL MICROGRIDS

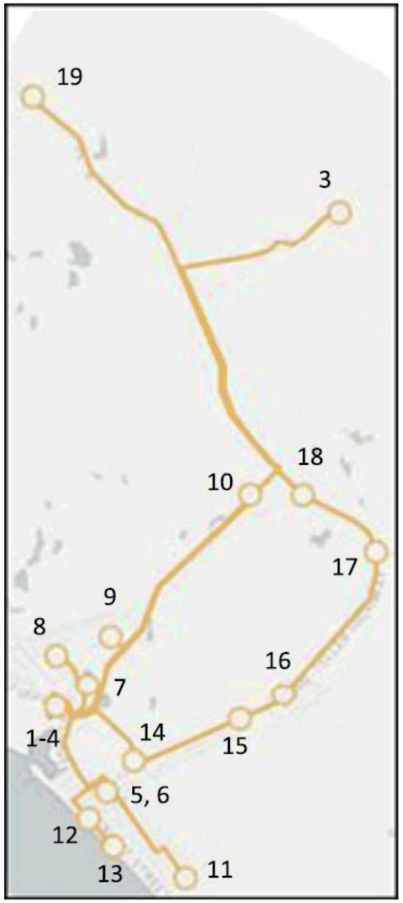


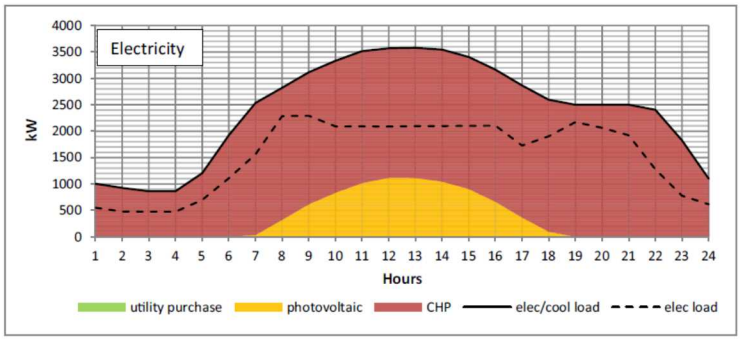


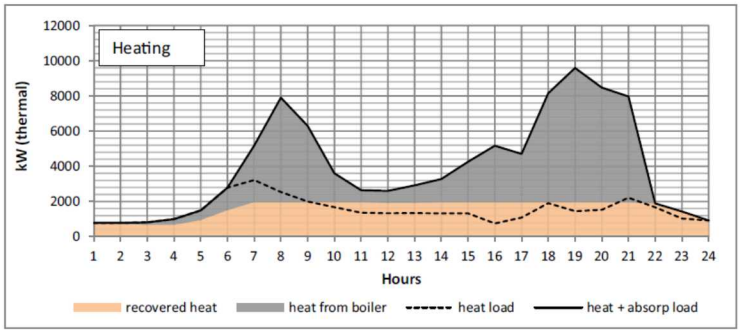
The Microgrid Design Toolkit (MDT) allows specification of probabilistic design basis threats, evaluation of microgrid performance during islanded mode, and filtering of design portfolios based on pareto efficiency

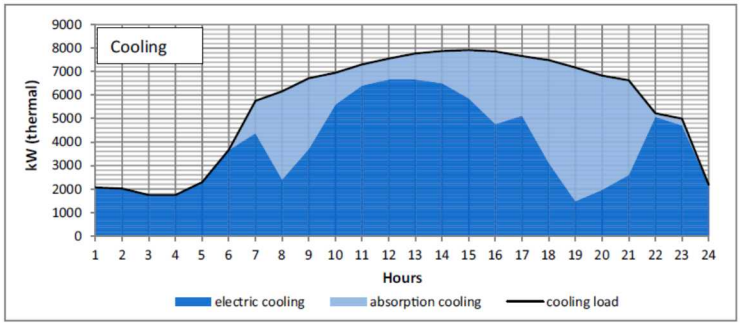
OPTIMIZING THERMAL+ELECTRICAL for ALL GOALS





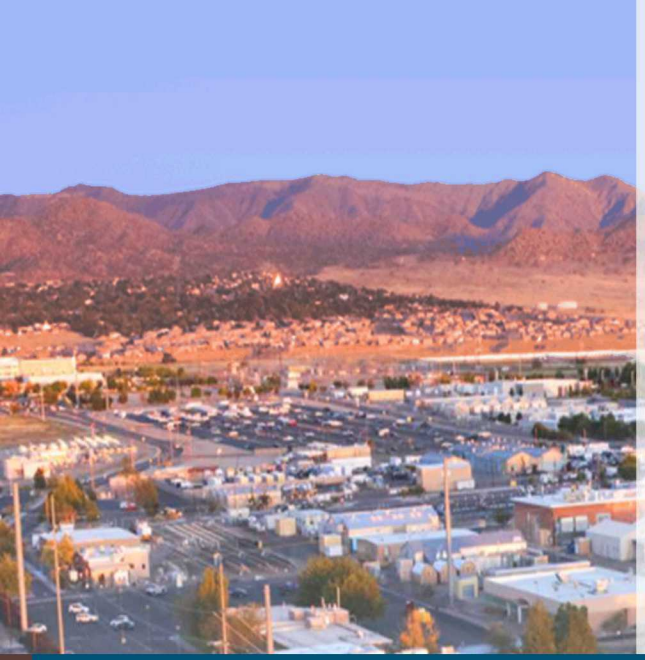






Mashayekh et al (2017), Mashayekh et al (2018)

The Distributed Energy Resources Customer Adoption Model (DER-CAM) optimizes for least-cost operation and capacity expansion of coupled thermal electrical systems (often microgrids)



Defining, Valuing, and Measuring Resilience

Working Group 1

Second Meeting of the Designing Resilient Communities Stakeholder Advisory Group (January 23-24, 2019)

Working Group Members

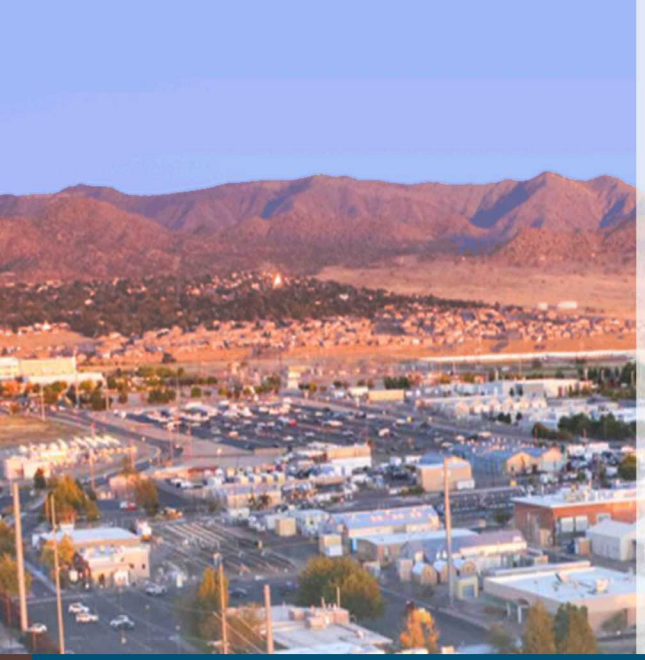
- Facilitator(s):
  - Bobby Jeffers, Sandia National Laboratories

- Working Group Members:
  - Katherine Jones, Sandia National Laboratories
  - Haik Musesesian, LADWP
  - Bill Herriott, LADWP
  - Harmony Smith, National Grid
  - Sabrina Bernstein, City of Los Angeles
  - Kyle Spencer, City of Norfolk
  - Jenn Kallay, Synapse Energy Economics
  - Sara Peterson, University of Buffalo

- Potential Additional Members:
  - Name, Organization

Working Group Report Out

- Key themes from discussion
  - Checklists/ Polling
    - What data do we want to collect?
    - How often do we want to update?
    - MOU
  - Mapping
    - vulnerabilities & resilience (threat-specific)
    - Systems & interdependencies
    - New critical infrastructures
  - Wait for event to learn about insufficiencies?
    - Ex: hospital backups, other water utilities
  - Quantify "near miss" + limitations
    - Ex: PV decreasing peak day load & assisting with outages
  - Exercises
  - How do we know how things should be updated / should be rebuilt if destroyed?
    - Be specific in planning
    - Have a process
    - FEMA – know the rules
- Initial priorities for working group
  - Tools and data for planning & populating metrics
  - Stakeholder involvement in planning/ exercises (processes) & examples of best practices
    - Keep running list of stakeholders (may be threat-specific); mapping stakeholders
  - MOUS →
    - Examples?
    - Parties involved?
    - Which cities have MOUs with each other?
    - What do internal MOUs within cities look like/ which cities have them?
- Workplan and communication strategy
  - Share plans, programs, lessons learned
  - Major report
    - Comes with [lens]/ discussion post
  - Mapping stakeholders → the key people who act v. those who don't have huge impact
- Questions



Rethinking Regulatory Frameworks and Utility Business Models

Working Group 2

Second Meeting of the Designing Resilient Communities Stakeholder Advisory Group (January 23-24, 2019)

Working Group Members

- Facilitator(s):
  - Robert Broderick, Sandia National Laboratories
- Working Group Members:
  - Nick Patané, Aaron Gross, Kai Wu, Kiera Zitelman, Mark McVey, Rocky Mould, Asa Hopkins, Chuck Goldman, Mercy DeMenno, Robert Broderick
- Potential Additional Members:
  - PUCs
  - Other political principals

Working Group Report Out

- Key themes from discussion and initial priorities for working group
  - Review current cases and proceedings.
  - FEMA process- to make it proactive. Standards to rebuild.
  - "beyond our statutorily authority" issue.
  - Performance based vs cost of service?
  - Convince regulators that resilience is in scope.
  - Microgrid tariff in Hawaii.- resilience as a service..
  - NY Private sector. Market failure. Offset tariff (CHP-2015), standby rates. 5 customers. Large commercial.. CON ED as partner.
  - Small Location nature of resilience. Projects- how to rate base the critical services that are covered.
  - Insurance mindset.

- Workplan and communication strategy
  - Workplan
    - mapping different stakeholders and incentives for resilience
    - menu of options for regulatory, policy/planning, metrics targeting or enabling related to resilience (e.g., scorecard)
    - comparative use case (e.g., IOU- regulated vs retail competition)
  - Communication
    - Phone meeting once a month.
    - Get on ECN- sharing resources

- Questions
  - IREC type model to support cities on regulatory case ? Interconnection stds example.