Virtual Workshop: Enhancing Community Energy Resilience through FEMA BRIC

August 24-26, 2021
12:30-4:30 PM ET

Hosted by the National Association of State Energy Officials (NASEO), National Emergency Management Association (NEMA), and Business Council for Sustainable Energy (BCSE)

Virtual Meeting 101

- Please keep yourself muted during all presentations
- For any tech sessions chat Shemika Spencer or email sspencer@naseo.org
- There will be time for Q&A after each presentation.
  - Type any questions in the chat box or raise hand to be unmuted
    - You can send a message to the entire group or privately message one person

NASEO
National Association of State Energy Officials

NEMA® NATIONAL EMERGENCY MANAGEMENT ASSOCIATION

The Business Council for Sustainable Energy®

Day 3: Innovative Opportunities for Energy Sector Hazard Mitigation

Thursday, August 26th, 2021

12:30-4:30 PM ET

NASEO
National Association of State Energy Officials

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The Business Council for Sustainable Energy®

Day 3 Agenda

Session Times	Session Description
12:30-1:00 PM ET	Keynote and Opening Remarks for Day 3
1:00-2:00 PM ET	Hazard-Specific Solutions: Hurricanes, Extreme Wind, and Flooding
2:00-3:00 PM ET	Hazard-Specific Solutions: Wildfires, Droughts, Earthquakes
3:00-3:15 PM ET	Break
3:15-4:15 PM ET	Hazard-Specific Solutions: Extreme Heat and Cold
4:15 PM ET	Closing Remarks

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The Business Council for Sustainable Energy®

Welcome, Opening Remarks, and Keynote for Day Three

Speakers:

Moderator – **Scott Glenn**, Director, Hawaii Energy Office

Kelly Speakes-Backman, Acting Assistant Secretary and Principal Deputy Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy (US DOE EERE)

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Hazard-Specific Solutions: Hurricanes, Extreme Wind, and Flooding

Speakers:

Moderator – **Kristofor Anderson**, Director of Energy Resources, Georgia Environmental Finance Authority

Brenna Mahoney, Sustainability Specialist, Climate Resilience Team, PG&E

Darin Painter, VP of Sales, Stationary Power, Plug Power

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Success*! Public-private partnership to protect communities and infrastructure from climate change

PG&E and FEMA BRIC 2021

*proposal identified for further review from FEMA

Brenna Mahoney, PhD
Sustainability Specialist, PG&E Climate Resilience Team

Climate Resilience at PG&E

Focused on integrating forward-looking climate change data into PG&E decision-making.

PG&E is safer and more reliable, costs are contained.

PG&E's climate adaptation is in line with and directly supports adaptation planning throughout our territory.

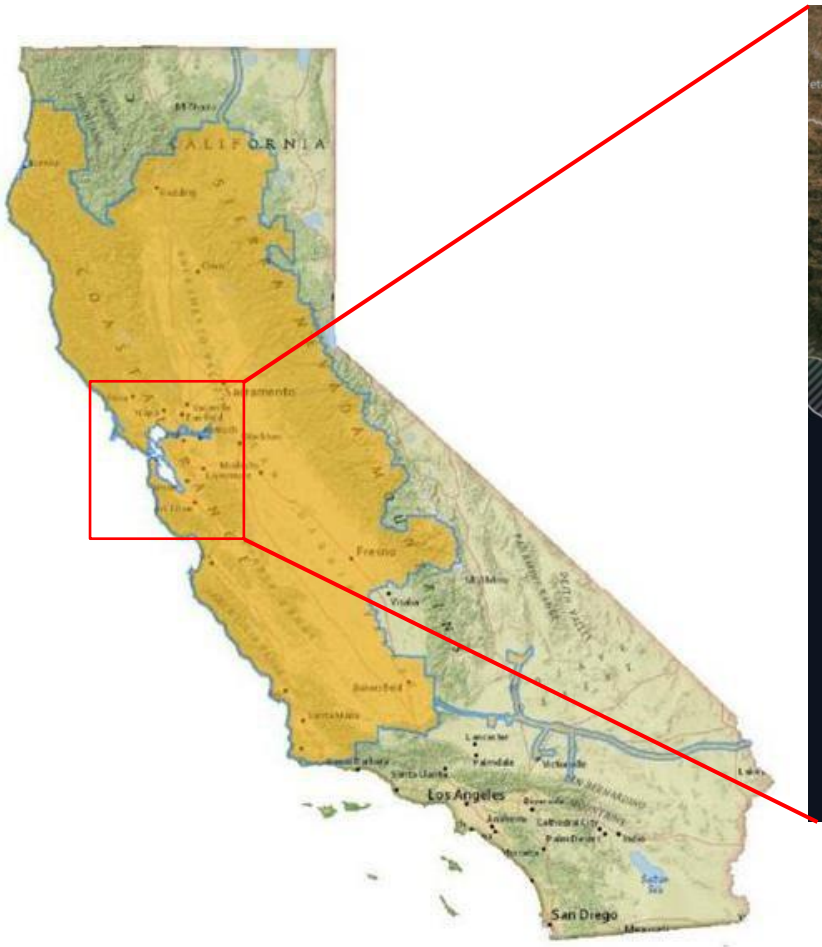
<u>Today's talk – FEMA BRIC proposal</u>

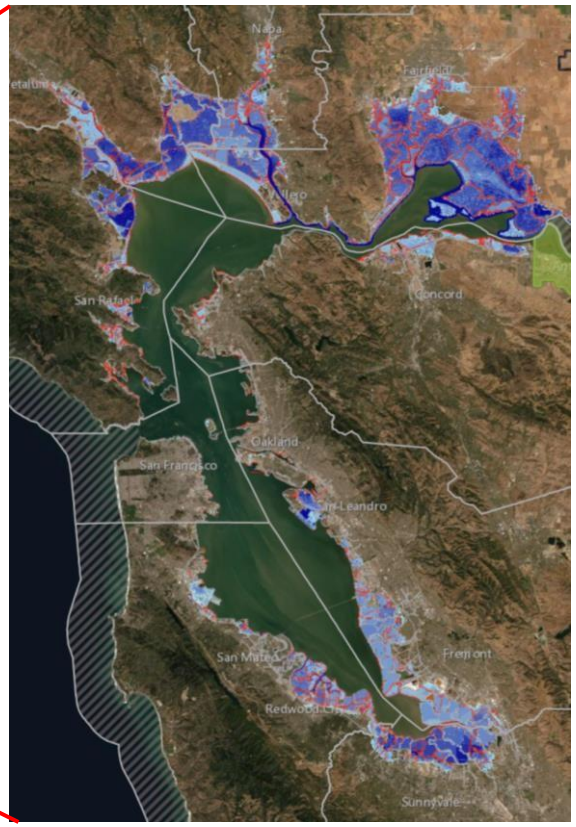
- PG&E brought together the stakeholders to:
  - Protect a critical regional substation from current and future flooding
  - Implement necessary flood protection for disadvantaged and vulnerable communities
- How did this project come to be?
- Lessons learned: working with local and state municipalities and agencies on building resilience to climate change?

PG&E territory

PG&E Delivers natural gas and electric service to ~16 million people throughout a 70,000 sq mi service area

Coastal flooding is a current and future concern





Bay Conservation and Development Commission (BCDC)
Ocean Protection Council: 3 feet sea level rise by 2050

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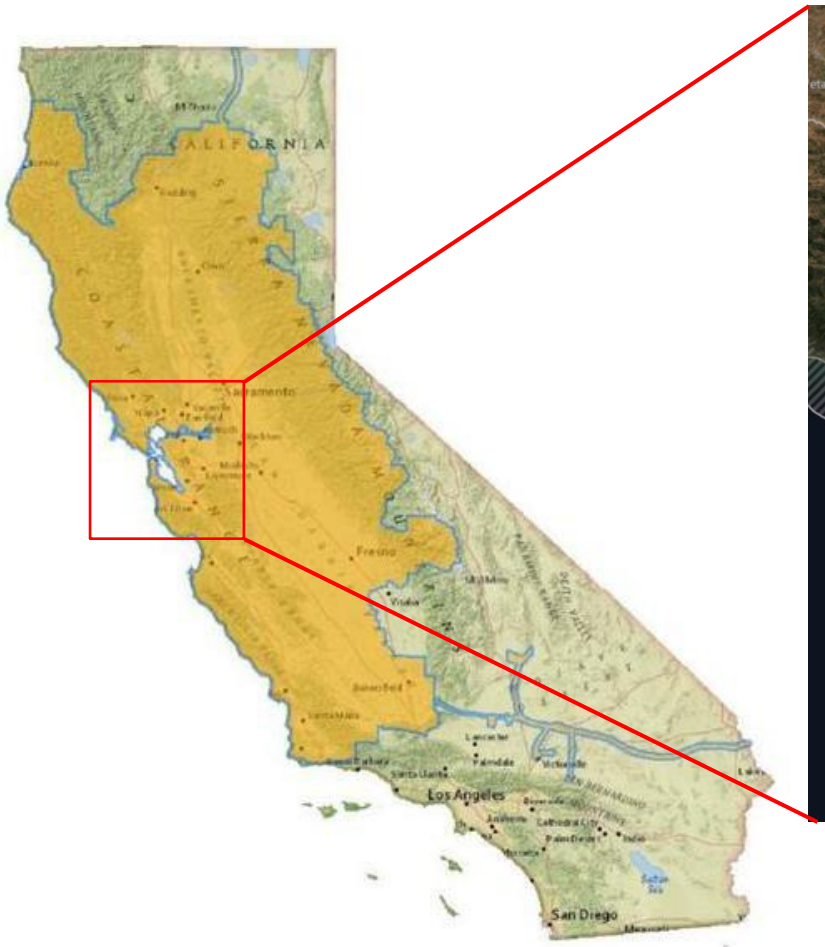
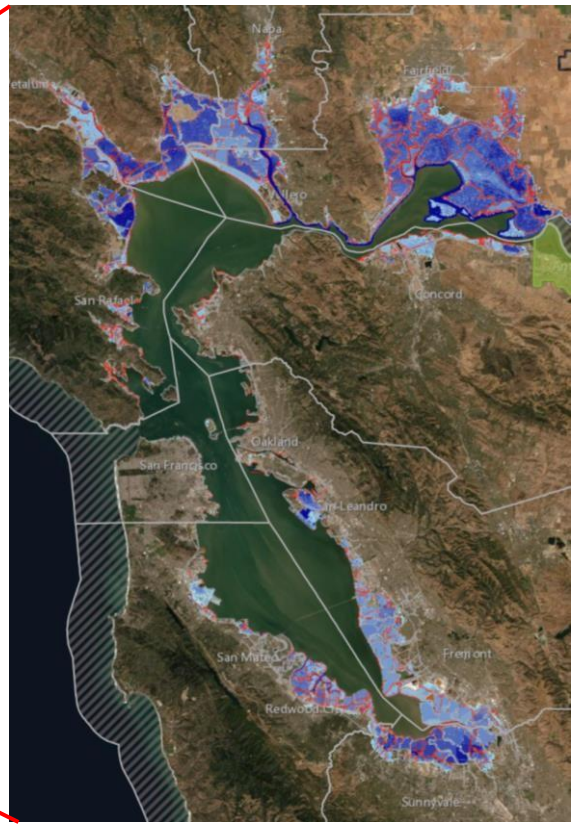




Bay Conservation and Development Commission (BCDC)
Ocean Protection Council: 3 feet sea level rise by 2050

PG&E Delivers natural gas and electric service to ~16 million people throughout a 70,000 sq mi service area

A plethora of concerns

- Communities
- Jobs
- Recreation
- Transportation
- Infrastructure
- Ecosystems

Vulnerable energy infrastructure

- Substations
- Transmission towers
- Facilities
- Electric and gas assets and operations

The Bay is rising. The time to come together to act is now

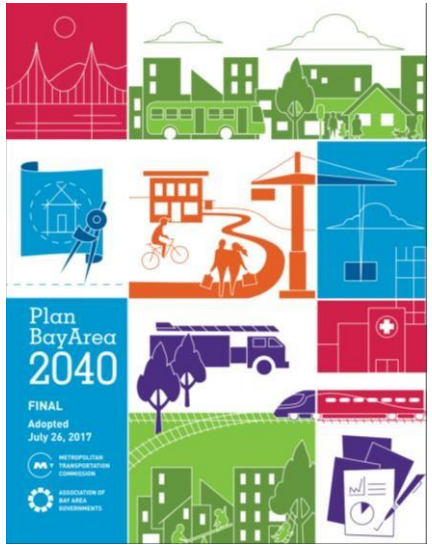
BAY ADAPT
REGIONAL STRATEGY FOR A RISING BAY

Regional shoreline protection

- Protect disadvantaged and vulnerable communities
- Prioritize nature-based solutions and restoration of critical habitat
- Protect critical infrastructure for communities

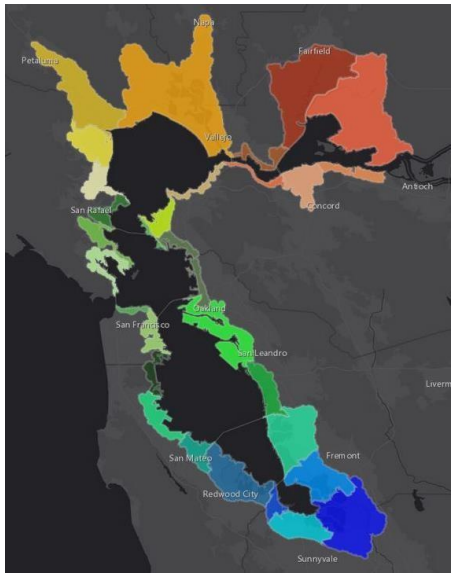
Need: funding for planning and implementation

How can PG&E participate as a stakeholder and as a leader for regional efforts?



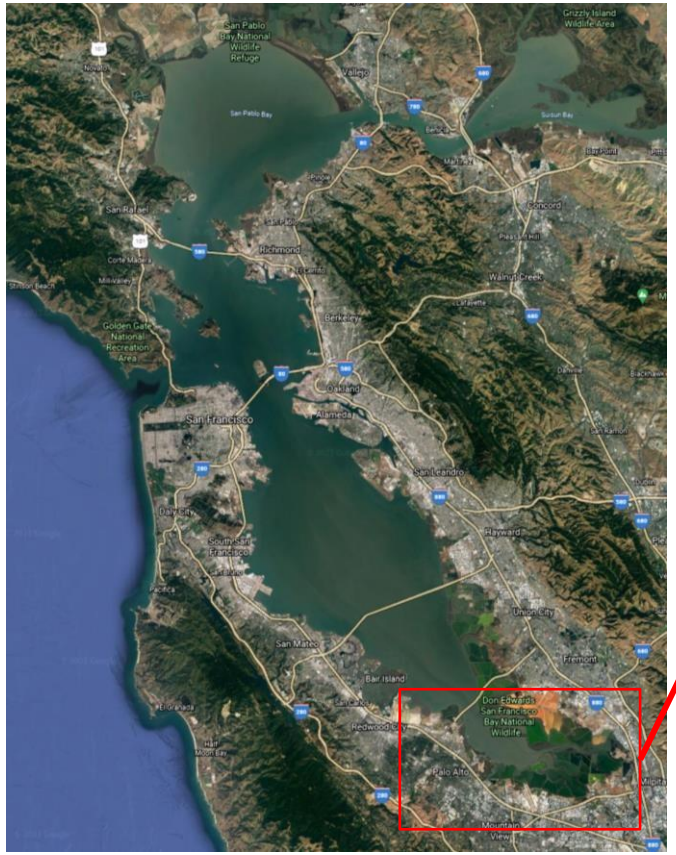
Equitable community planning

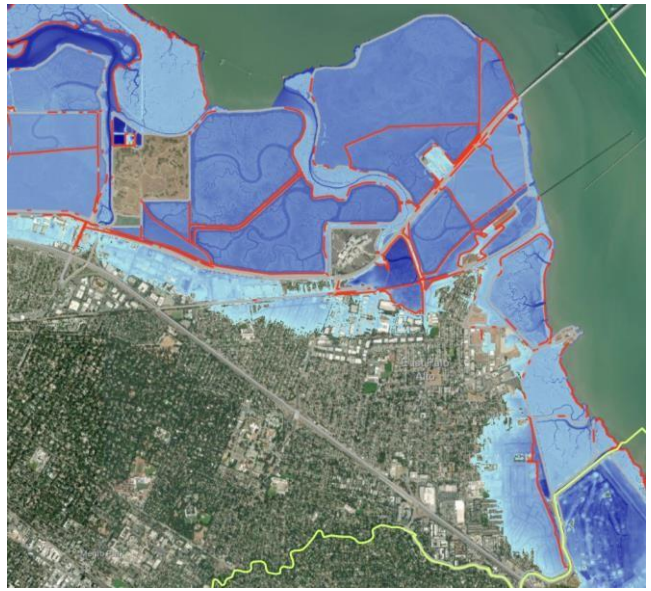
Restore tidal marshes and ecosystem services



Adaptation options for shoreline protection are grounded in best available science

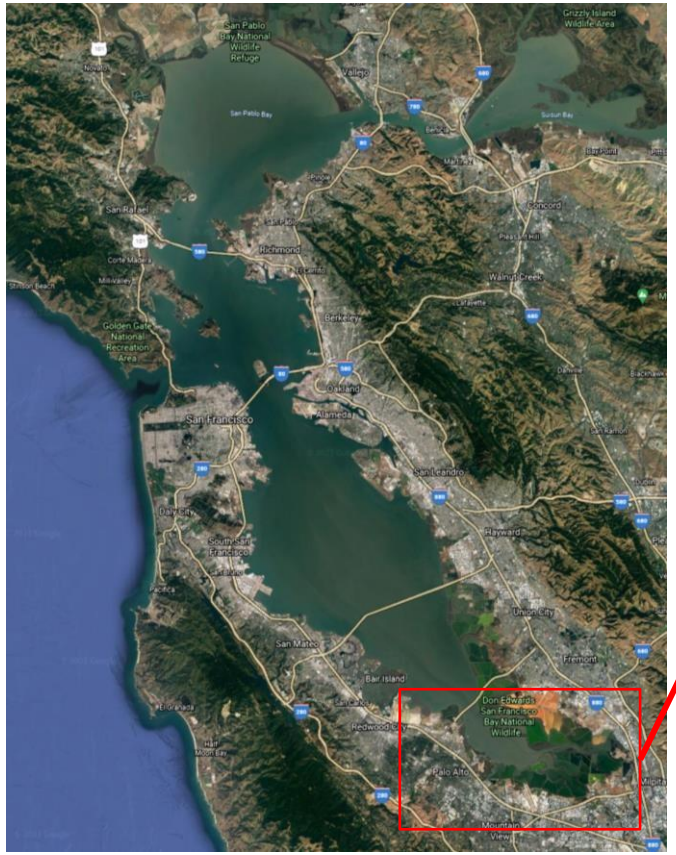
Project Area





3 feet SLR ~2050

Vulnerable communities

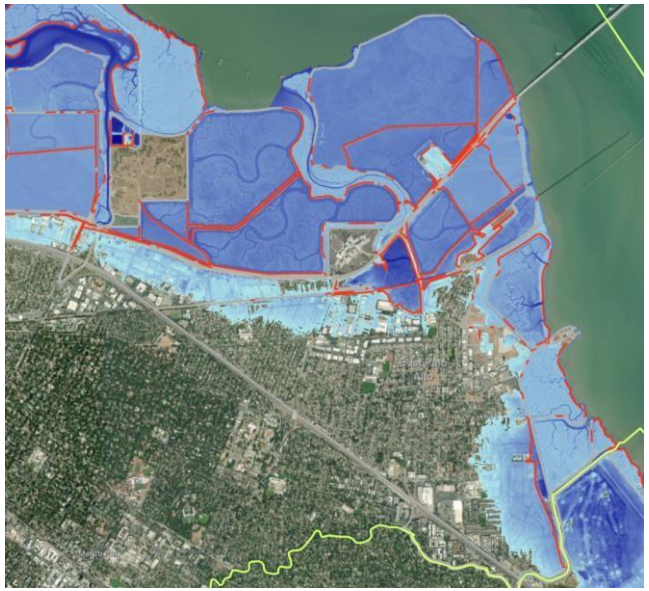


Disadvantaged communities:

- City of East Palo Alto
- Bell Haven Neighborhood (Menlo Park)
- Parts of Redwood City

Critical regional infrastructure

- CalTrans Highway 84
- PG&E Substation

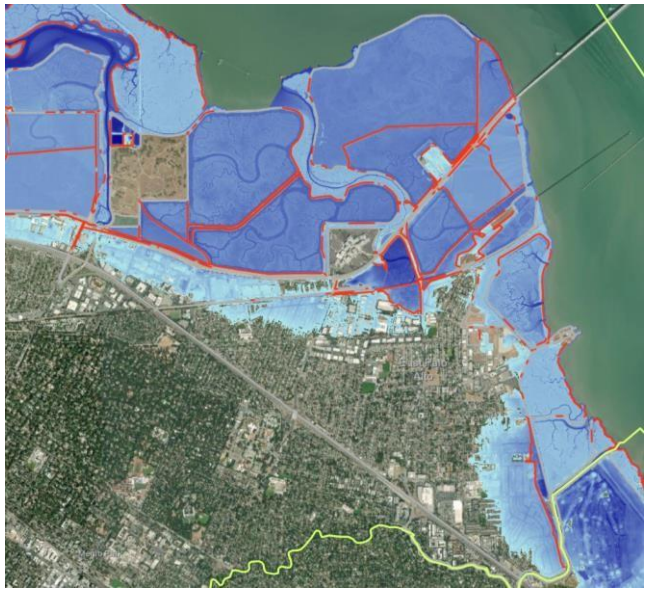


3 feet SLR ~2050

Ravenswood Substation

230kV transmission substation that directly connects to distribution substations

Extensive flooding: de-energization of substation



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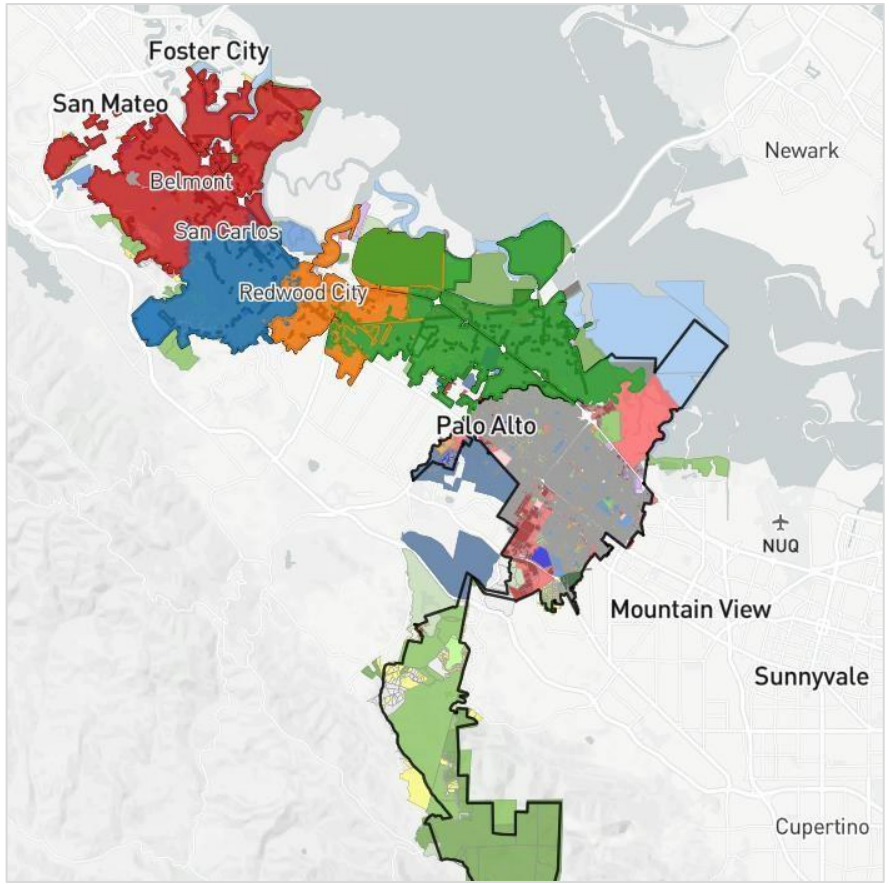
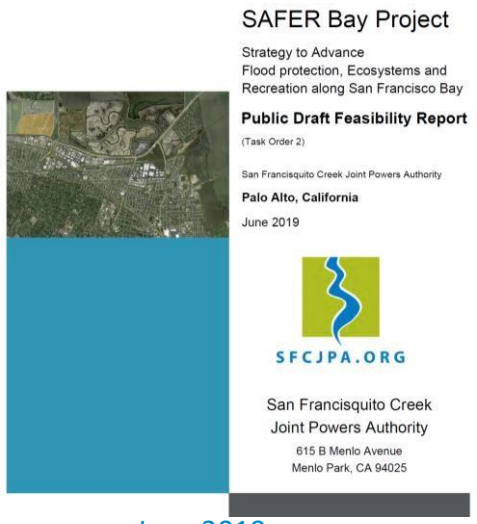


296,183 PG&E Customers would lose power in 2050 in a 1–100-year storm

Laying the groundwork for the BRIC application

- Planning, stakeholder and public engagement, and development of options for this shoreline has been ongoing since 2016 and led by the San Francisquito Creek Joint Powers Authority and other regional entities



June 2019

June 2020

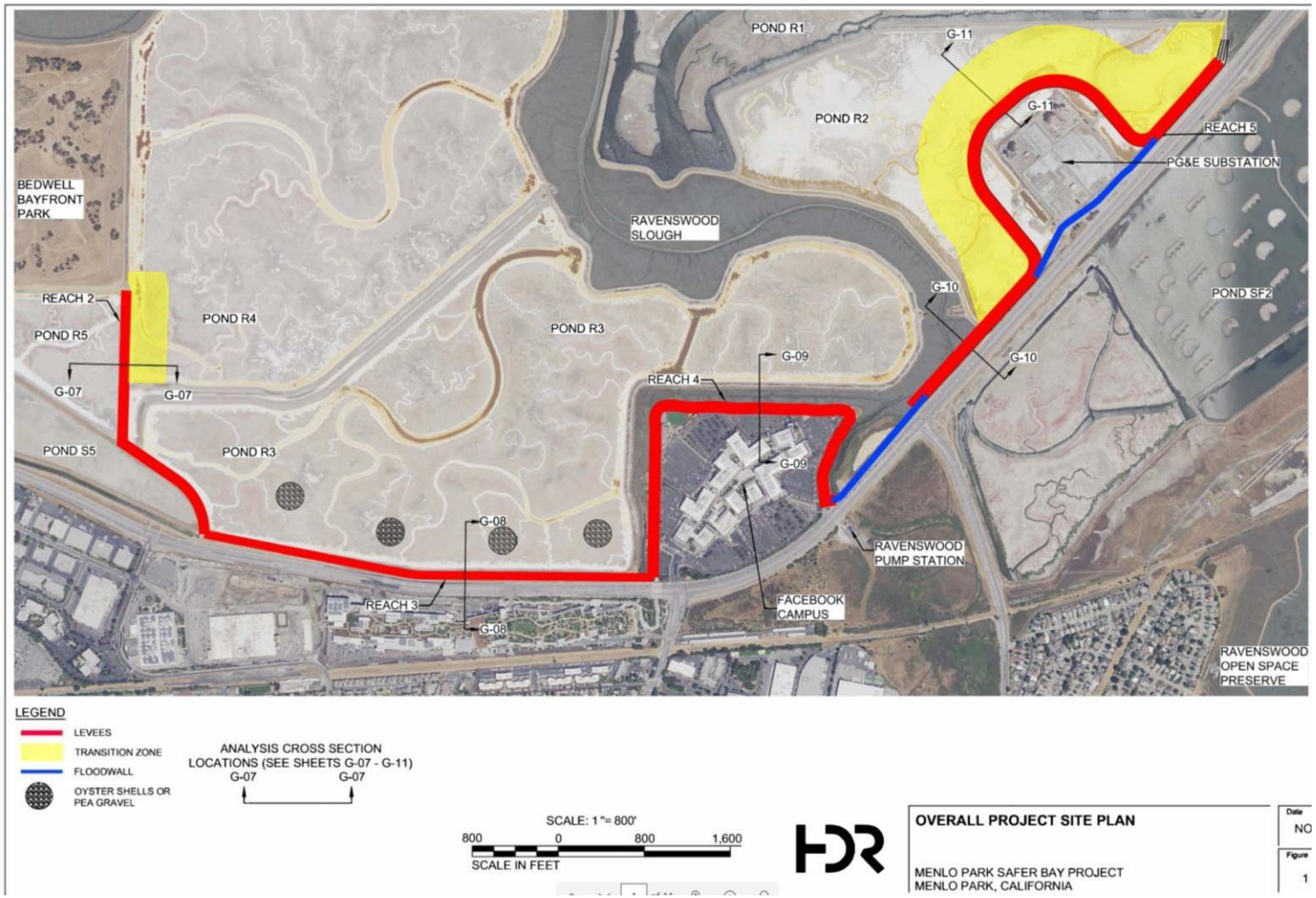
- Result: Regional agreement on options to mitigate flooding, protect communities, and implement wetland restoration (restoration of over 550 acres of former salt ponds to tidal marsh)
- Need: Funding for implementation

PG&E has been an active and engaged stakeholder throughout

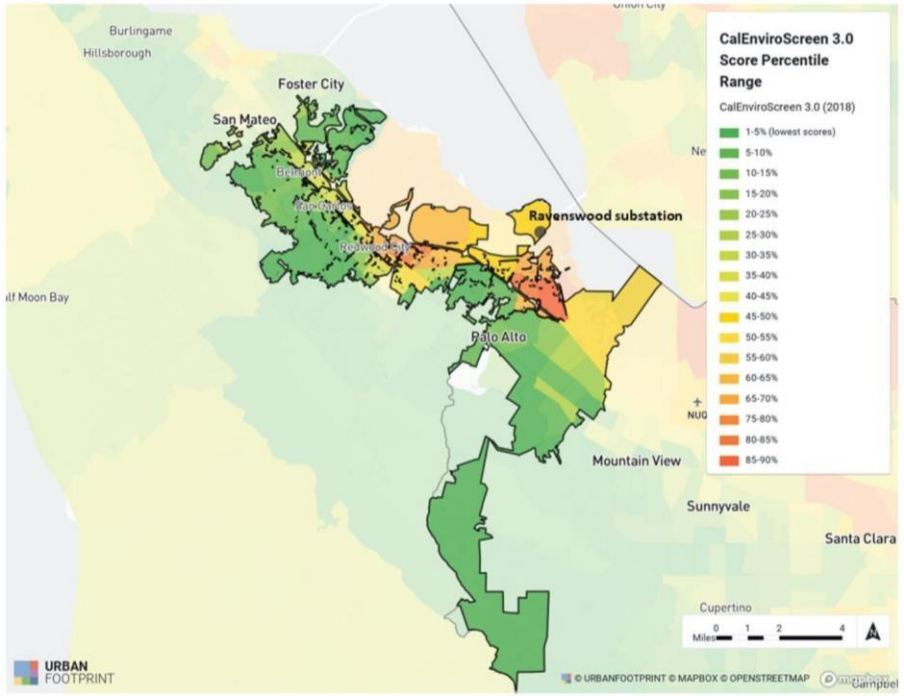
PG&E lead start and coordination of FEMA BRIC proposal cn

- Summer 2020 PG&E informed by US Fish Wildlife Service about berm damaged and short-term repair
- Fall 2020 PG&E Brings together stakeholders to apply for BRIC funds

Menlo Park SAFER Bay BRIC Proposal



Project Impact Area



Population low-income*	6.5% (19,338 persons)
Population below the Federal poverty line	9% (26,842 persons)
Population qualified as Disadvantaged Vulnerable Community residents per CPUC for purposes of adaptation planning	8% (23,416 persons)
Population with high CalEnviroScreen score**	17% (50,013 persons)
Population with Healthy Places Index scores below California average***	19% (57,295 person) are in areas in the bottom half of the Healthy Places Index.

Project impact:

- 296,183 people
- Disadvantaged communities
- 213,000 jobs
- 1632 medical baseline customers

Benefit-cost ratio of 9 to 1

Uses nature-based solutions

26 Letters of support:

- 6 elected officials
- 2 municipalities
- 6 regulatory and governmental agencies
- 12 non-governmental agencies

<u>Total project cost: $67 million</u>

- Matching funds:
  - PG&E share: $10 million
  - Facebook share: $7.8 million
- Requested FEMA share: $50 million

CITY OF MENLO PARK · Pacific Gas and Electric Company · FACEBOOK · U.S. Fish & Wildlife Service · Caltrans · METROPOLITAN TRANSPORTATION COMMISSION · South Bay Salt Pond Restoration Project · Coastal Conservancy

Lessons learned

- Local communities are the leaders in climate adaptation
- Partnership is key and private companies can be great partners!
- BRIC proposal was a win-win
- PG&E
  - California's climate hazards are our climate hazards
  - Work with local communities to identified shared vulnerabilities and adaptation options for the resilience of our customers and communities
  - Work with state energy and emergency services offices for a more resilient California
  - We encourage other private companies / energy companies to do the same

Thank you!

Appendix

Menlo Park SAFER Bayproject

Working together to protect critical infrastructure

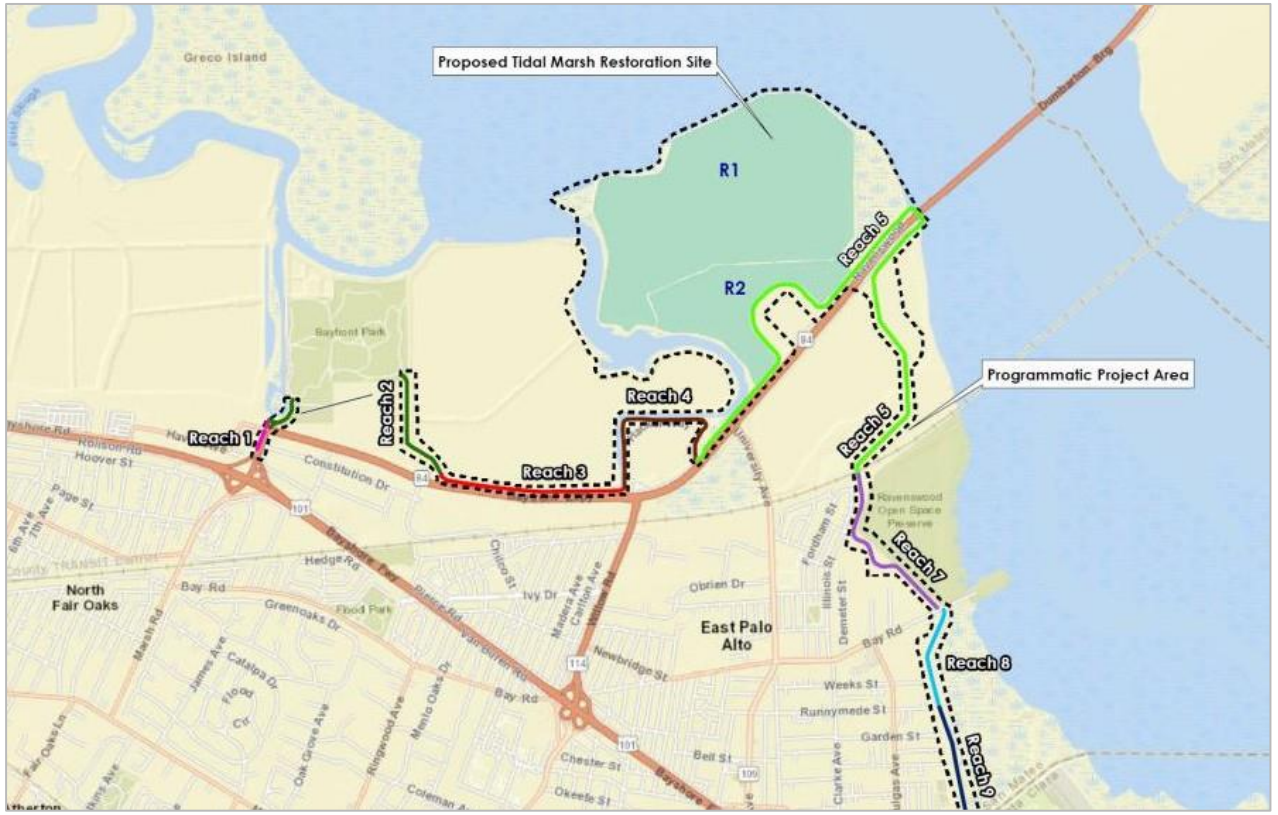
FEMA announced the Building Resilient Infrastructure and Communities (BRIC) program in summer 2020.

We identified an opportunity to partner with Menlo Park and other local and regional stakeholders on a BRIC application.

Working together, PG&E and the project partners developed the Menlo Park SAFER (Strategy to Advance Flood protection, Ecosystems, and Recreation) BayProject.

If funded, the project will protect infrastructure and communities along more than nine miles of Bay Area shoreline from projected sea-level rise.

Using nature-based solutions, the levee will allow for habitat restoration of over 550 acres of former salt ponds, and it will increase public recreational access. Construction of the project will create jobs and engage local communities at every step.



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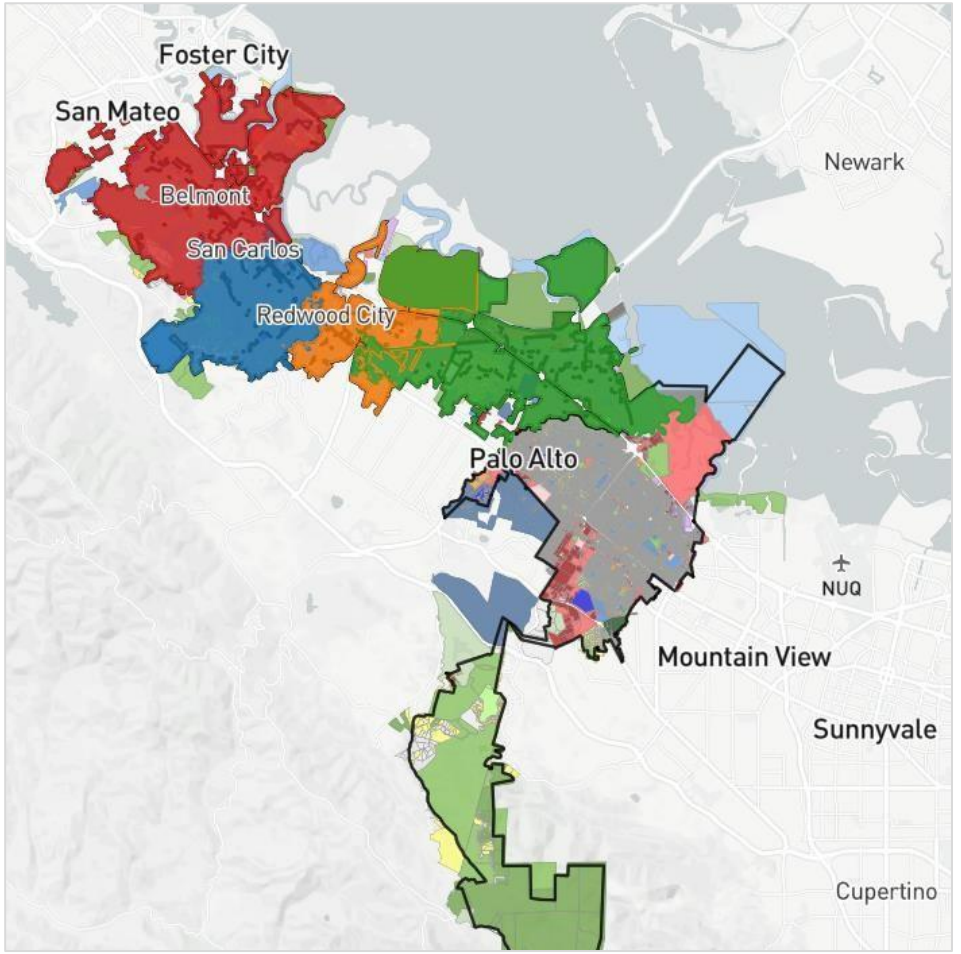
Future conditions w/ 3.5ft. Sea Level Rise (SLR)						
Recurrence interval scenario	**Substation Inundation depth, ft.**	**Impact to Substation**	**Flood Event duration, days**	**Drainage duration, days**	**Repair time, days**	**Total loss of service time, days**
Scenario 5 10-year + 3.5 ft SLR (10% ACE)	2	SPCC system overwhelmed by water: De-energization required Battery charger and DC system destroyed.	1	5	2	8
Scenario 6 50-year + 3.5 ft SLR (2% ACE)	2	SPCC system overwhelmed by water: De-energization required Battery charger and DC system destroyed.	2	5	2	9
Scenario 7 100-year + 3.5 ft SLR (1% ACE)	2	SPCC system overwhelmed by water: De-energization required Battery charger and DC system destroyed.	3	5	2	10
Scenario 8 500-year + 3.5 ft SLR (0.2% ACE)	2	SPCC system overwhelmed by water: De-energization required Battery charger and DC system destroyed.	3	5	2	10



California's climate hazards are PG&E's hazards

PG&E Climate Vulnerability Assessment: In 2020, the California Public Utilities Commission (CPUC) ordered all California IOUs to conduct a detailed climate change vulnerability assessment of their assets, operations, and services

Data: Cal-Adapt, CA Ocean Protection Council, USGS, NOAA, and best available science and practices.

Community engagement plan: better understand the needs of our customers in disadvantaged and vulnerable communities. Allow us to co-create adaptation strategies with local governments and community groups.

Managed by the Climate Resilience Team

PG&E Delivers natural gas and electric service to ~16 million people throughout a 70,000 sq mi service area

- Temperature
- Coastal flooding
- Precipitation
- Wildfire
- Drought-driven subsidence
- Cascading impacts

BRIC Workshop

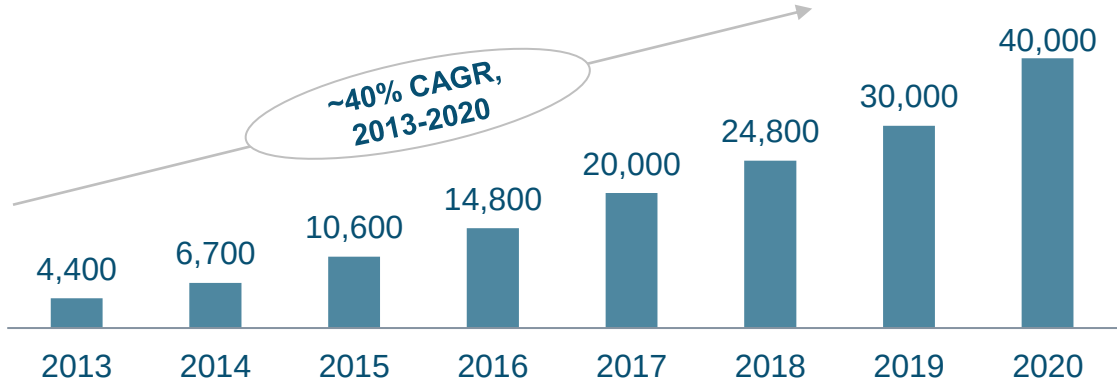
The Global Leader in the Green Hydrogen Economy

Key Performance Characteristics

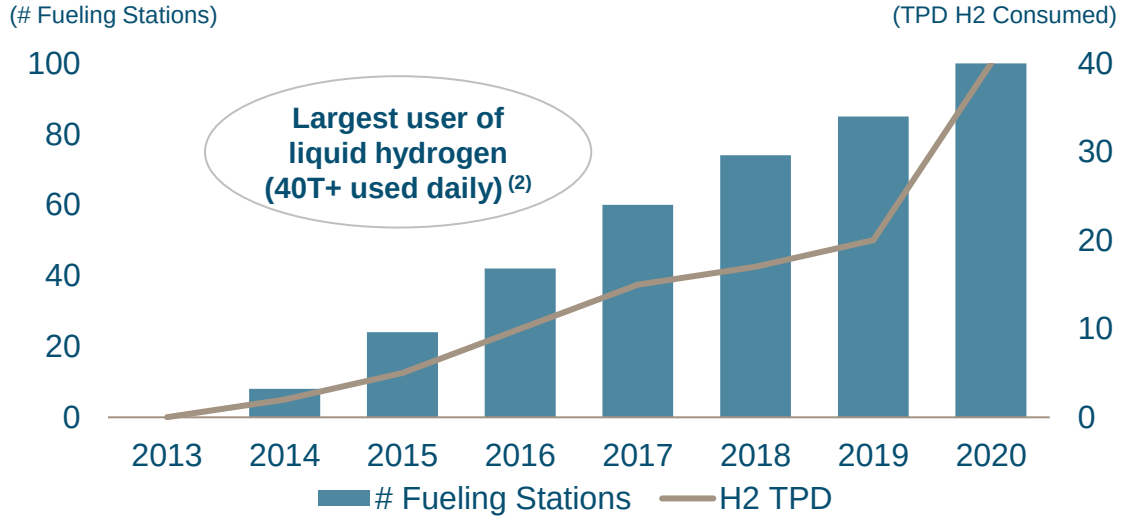
- 1st to create a market for HFC technology
- Strong patent portfolio and proprietary know-how
- 43 trademarks and trademark applications
- ~70% blue chip customer base
- ~700MM operating hours (1Bn+ miles)
- Significant runway available in core forklift market
- Future applications represent tremendous addressable markets
- 40 MM fuelings
- Installed base creates foundation for recurring revenue

Source: Internal Data Collected via SiteView
Notes:
1. Rounded figures, excludes stationary units
2. Reflects liquid hydrogen required to fuel 40,000 installed base of forklifts, assuming each requires 0.9kg hydrogen per day

Cumulative Hybrid Fuel Cell Units Installed (1)



Hydrogen Infrastructure and Fuel Consumption (2)



Source: Internal Data Collected via SiteView

Fuel Cells For Stationary Power

The Push To Eliminate Diesel

Microsoft, one of the world's largest data-center operators, announced they will eliminate diesel fuel by 2030

Amazon pledged to make the largest U.S. e-commerce company net carbon neutral by 2040

Walmart announced it is targeting zero emissions across the company's global operations by 2040

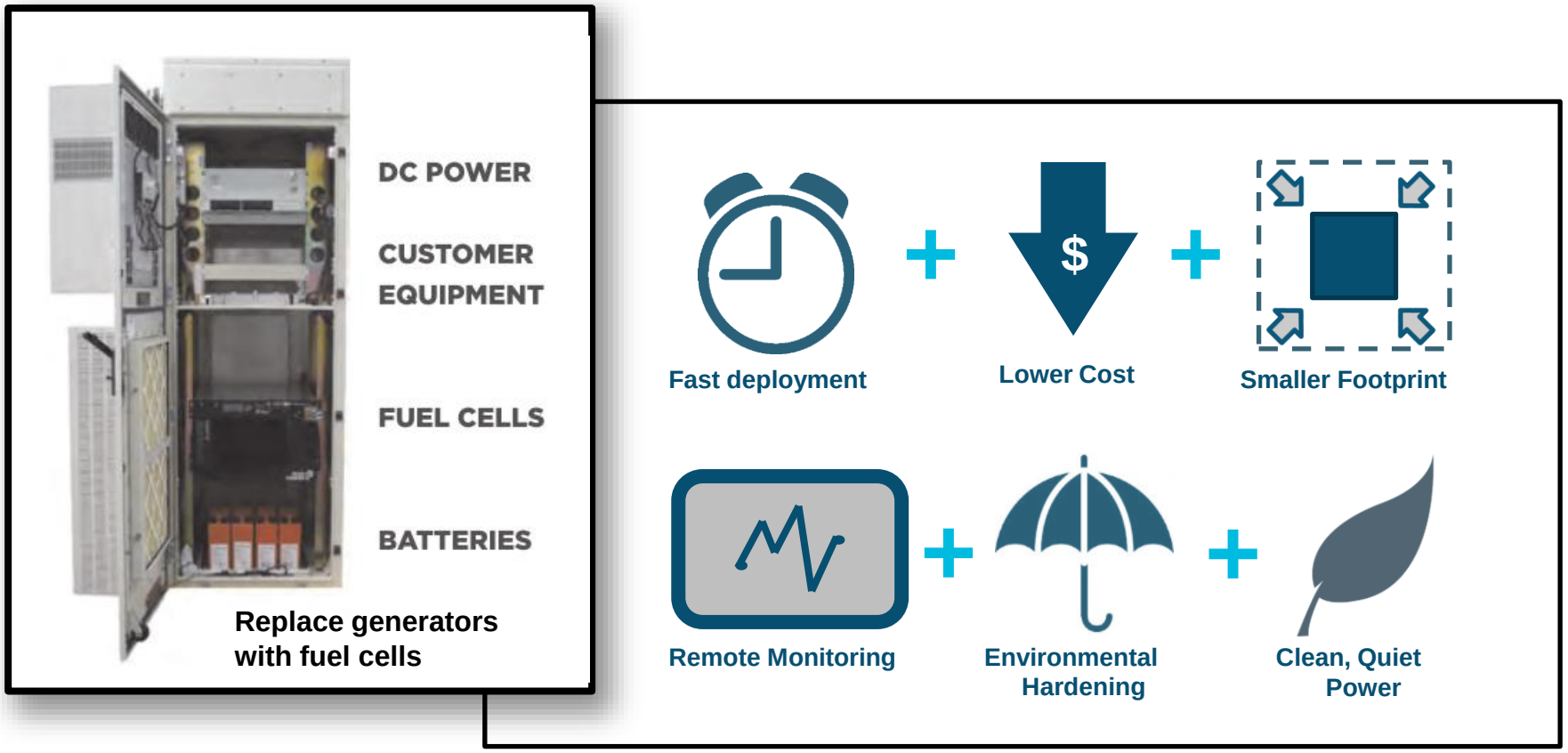
Google has made a commitment to operate on 24/7 carbon-free energy in all its datacenters and campuses worldwide by 2030

GenSure

Stationary Power Applications

Critical Backup	Distributed Generation	Microgrid/Energy Storage
Hyperscale Data Centers Retail Backup **Critical facilities**	Delivery Fleet EV Charging Remote Operations (Mining/Drilling) Event Rental Fleet Power Prime Power Generation	**Remote Microgrids** **Utility Microgrids** **Community Microgrids** ESS Renewable Firming
Port Electrification	**Transportation**	**Telecom Networks**
Cold Ironing TRU Electrification Port Vehicle Charging	**Rail Crossings** **Rail Signals and Comms** **Roadway Signals** **Roadway Signage**	**4G/5G Networks** **Rural Broadband** CPUC Resiliency Upgrades 5G Telecom Expansion

Backup Power Value Proposition



Simplicity through integration provides savings

Critical Power Applications

Critical Power Backup: Value Proposition

- Smaller Footprint
- Higher Power Density
- Low TCO for Wireless Base Stations & Wireline Nodes
- Noise Reduction

Demonstrated with the Southern Company – ~500 sites deployed

High Power Fuel Cell Generator: Value Proposition

- Reduces Noise Pollution
- Reduces Air Pollution
- Improves Reliability
- Improves Response Time
- Zero-emission Power – Scalable in 1 MW Increments

Diesel Engine Replacement

Typical Installations

- Multiple applications across industries
- Critical facilities and networks
- Zero emissions

Fuel Cells vs. Generators

- Fuel Cells - Fewer mechanical parts / increased availability
- Fuel Cells - Lower cost of ownership / reduced maintenance
- Fuel Cells - Hydrogen has unlimited shelf life / greater reliability
- Fuel Cells - Zero emission technology
- Fuel Cells - Lower incidence of theft
- Fuel Cells - Remote management capable

Fueling Solutions Overview

Plug's Vision for Green Hydrogen

Economic Value, Environmental Sustainability

Realizing the multi-faceted benefits our H2 strategy delivers.

Green Hydrogen Network

Our green hydrogen network will accelerate many fuel cell applications. The first successful one being the materials handling industry.

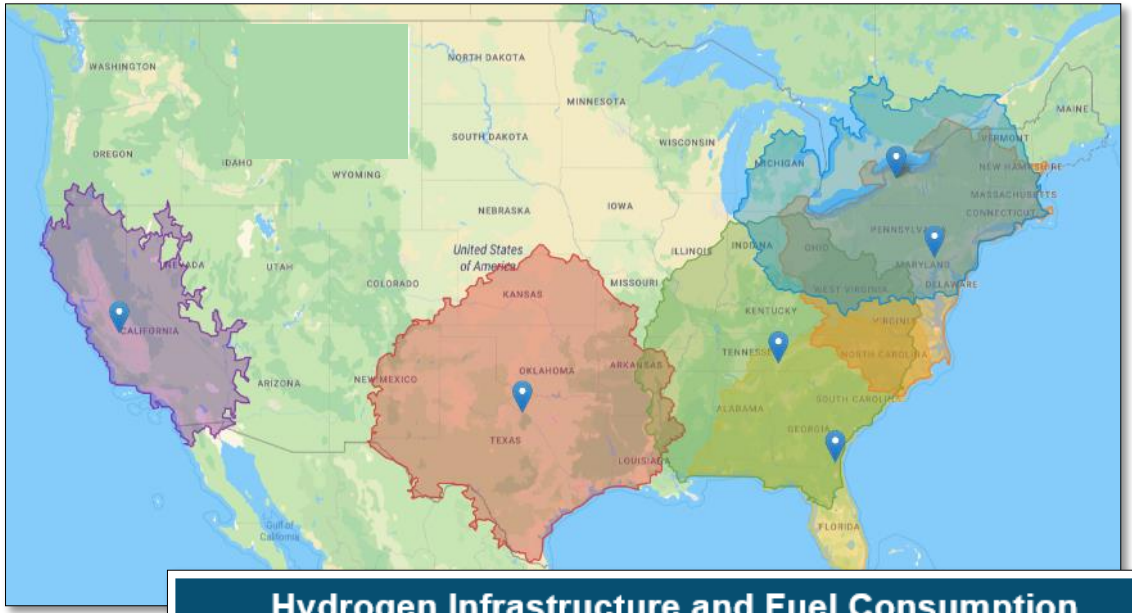
Cost Roadmap

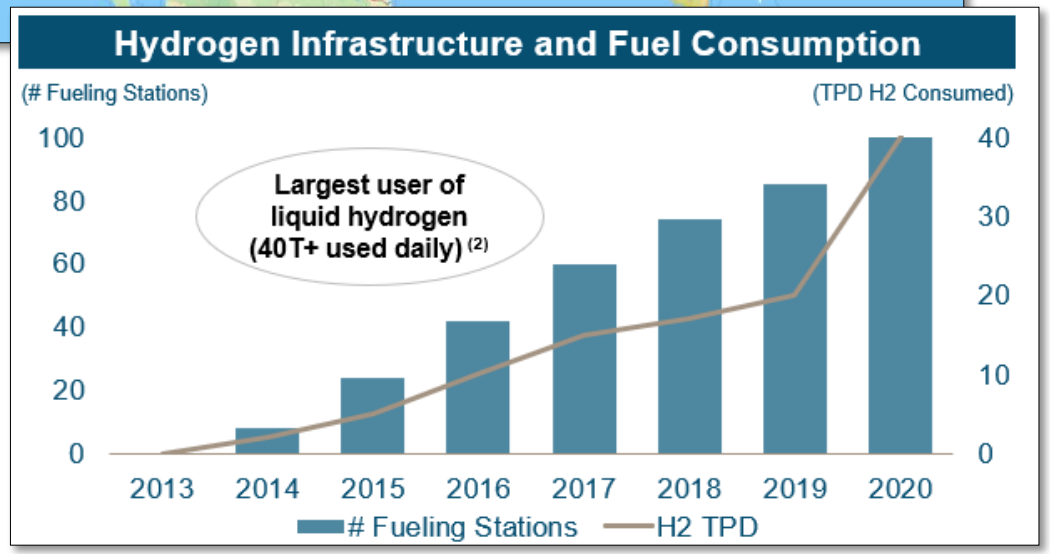
Turn low-cost and declining renewable power into high-value hydrogen fuel.

Domestic energy resources strengthen energy and national security while providing tremendous environmental benefit.

Investment Returns

Investments in green hydrogen provide attractive returns as well as immediate cost savings and strengthened customer relationships.

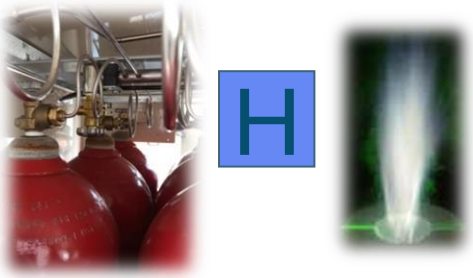




Hydrogen Fuel Comparisons - Safety

Hydrogen Properties

- Rapidly disperses - the lightest element
- Colorless, odorless, tasteless, & non-toxic
- Flammable from 4% - 75% in air



Energy Content Comparison

6 Cylinders of H2

=

3 Gallons of Diesel

=

4.7 Gallons of Propane

Hydrogen Volume	Propane BTUs (1 Gallon = 91,600 Btu's)	Diesel BTUs (1 Gallon 139,000)
1 Cubic Foot = 275 Btu	Equivalent Gallons	Equivalent Gallons
1 Cylinder = 260 Cu Ft	0.8	0.5
Fuel Wing = 6 Cylinders	4.7	3.1

Fueling Services

GENFUEL

Complete Fuel Service Offering

- Complete support services
  - Initial fueling
  - Refueling
  - Disaster recovery
  - Preventive maintenance
  - Live call center 24x7x365
  - All fuel logistics handled for customer
- Disaster recovery support
  - Partnerships with service companies for delivery
  - Agreements in place for fuel sourcing
    - Leverage Plug Power assets where available
- Remote monitoring is available or Customer NOC dispatched
- Services offered driven by project commitment

Hurricane Performance Overview

Major Hurricane Performance - Michael & Zeta

- Plug Power fuel cells provided critical backup power at 191 sites during Michael & Zeta
- Impacted sites spread across three states and multiple Operations regions
- Outages averaged just under two days with some outages exceeding 13 days
- Total outage time supported of over 7,500 hours

Hurricane Performance – Lessons Learned

- Pre-storm preparation is critical
  - Fuel source availability / alternatives
  - Personnel / asset prep
- Successful fueling response throughout recovery
  - Highly mobile fueling assets - limited access issues experienced
  - Multiple Plug Power-managed fuel sources improve response time
  - No competition with diesel / propane fuel sources
- Intelligent asset management improves efficiency
  - Near real-time automated fuel level monitoring & dispatching
  - Close communication between Plug Power Services & Customer Operations teams

Tax Credit Information

Tax Credit Overview

The fuel cell tax credit applies to a percentage of fuel cell system costs, up to a maximum of $3,000 per kilowatt of fuel cell rated power.

- 2017, 2018, 2019: 30%
- 2020, 2021, 2022: 26%
- 2023: 22%

Wrap-up

GenSure: Powering Your Possibilities

GENSURE

Industry Leading Design

- Redundancy, Reliability, Scalability

Field Proven

- Successfully deployed in networks worldwide

Extensive Support Capabilities

- Experienced and proven global support capabilities

Deployment Ready

- Mature product design and immediate deployment capabilities

PLUG POWER

Corporate Headquarters
968 Albany Shaker Road, Latham, NY 12110

West Coast Office
15913 E. Euclid Avenue, Spokane, WA 99216

plugpower.com

Hazard-Specific Solutions: Wildfires, Droughts, Earthquakes

Speakers:

Moderator – **Adam Schultz**, Lead, Electricity & Markets Policy Group, Oregon Department of Energy

Dinesh Sharma, Head of Products, Jupiter Intelligence

Don Wingate, Vice President, Utility and Microgrid Solutions, Schneider Electric

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The Business Council for Sustainable Energy®

Sustainability
Efficiency
Resilience

Don Wingate – Schneider Electric

Hazard-Specific Solutions: Wildfires, Droughts, Earthquakes

Aug 26, 2021

Life Is On | Schneider Electric

Schneider Electric. How most may know us

An Energy Management and Industrial Automation company

$35B Global Sales
($7B in US)

140,000 Employees
(19,000 in US)

$2B R&D Investment
(5% of Annual Sales)

Serving five key end markets


Buildings


Datacenters


Infrastructure


Industry


Residential

Enabled by our powerful brands

MV/LV Protection & Control

SQUARE D by Schneider Electric

Leader Position

Critical Power

APC by Schneider Electric

Leader Position

Building Products

t.a.c by Schneider Electric

Top 5

Industrial & Process Automation

Andover Controls

invensys

Top 5

EcoStruxure

Digital IOT Solutions

Weather events create an Energy Crisis for People, Communities, Commerce

We need to mitigate before it breaks & embrace an Energy Transition – FEMA BRIC to the rescue!

The Energy Transition is Creating Challenges and Opportunities

Organizations must navigate a complex and rapidly-evolving energy landscape

Costs

50%

Increase in U.S. utility transmission & distribution costs in the past decade

Sustainability

100% by 2035

Federal: **new ambition for 100% clean power by 2035**

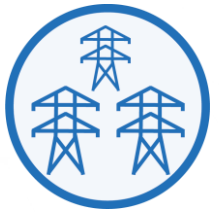
State: **30+ states have enacted established Renewable Portfolio Standards**

Corporate: **Accelerating ESG commitments including Scope 1 and 2 emissions reductions targets**

Resilience

$600B

Economic damage in the U.S. from large-scale climate and weather disasters between 2016-2020



Reliability

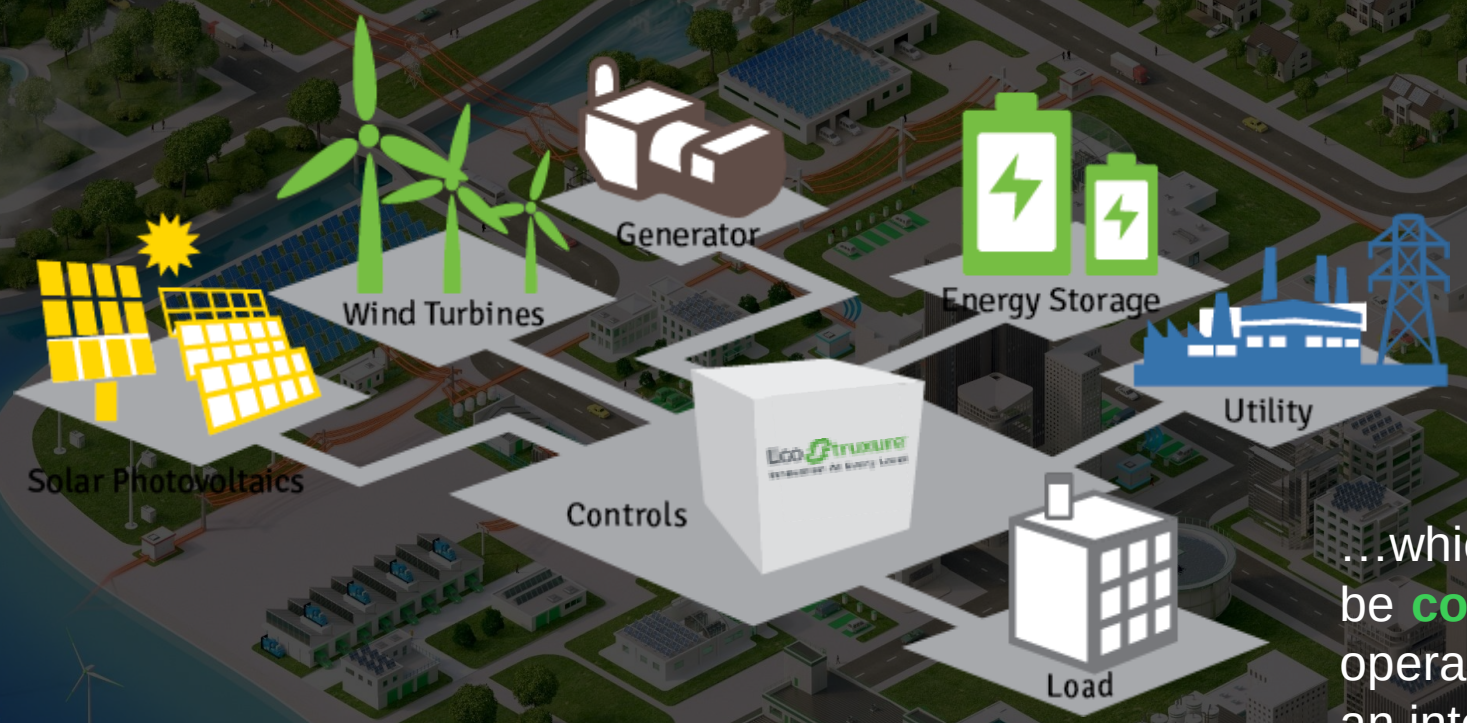
383

Major "electric disturbance events" took place in 2020, up from 150 in 2017

Challenges are interrelated and create feedback loops

What is an Advanced Microgrid?

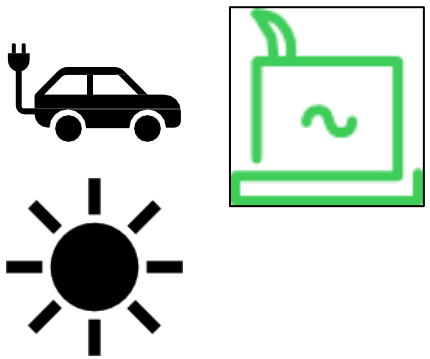
An **integrated energy system** consisting of **interconnected loads** and **distributed energy resources** (DER) within a defined electrical boundary…

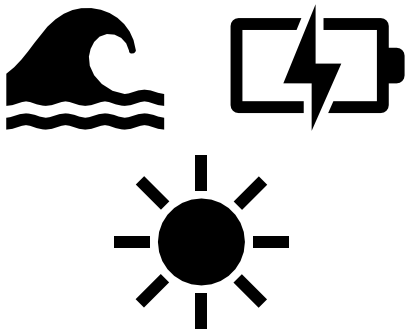


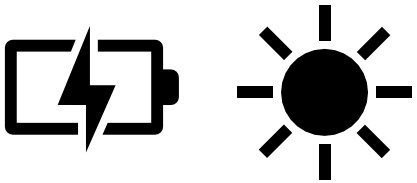
…which as an integrated system can be **controlled as a single entity** and operate in **parallel with the grid** or in an intentional ***islanded*** mode.

A Distributed Grid – One Practical & Proven Solution

Sample Projects – Proactive Actions







However, customer self-deployment of microgrids entail..

Capital

Complexity

Risk

Points to Consider:

- Embrace Microgrid for a distributed Grid
- Streamline Grant Application Process
- Simplify grid interconnection agreements
- Embrace Public Private Partnerships and EaaS business models
- Don’t wait for the next disaster

BREAK

3:00-3:15 PM ET

NASEO
National Association of State Energy Officials

NEMA® NATIONAL EMERGENCY MANAGEMENT ASSOCIATION

The Business Council for Sustainable Energy®

Hazard-Specific Solutions: Extreme Heat and Cold

Speakers:

Moderator – **Kirsten Verclas**, Senior Program Director, Electricity Program, NASEO

Tanya Bodell, Executive Director of Energy, President of the Northeast Energy and Commerce Association (NECA), and Chair of the Town of Cohasset Alternative Energy Committee, National Grid

Paul Wilkins, Vice President, Federal Policy, Bloom Energy

Ellen Franconi, Senior Research Engineer, Building Codes Program, Pacific Northwest National Laboratory

NASEO
National Association of State Energy Officials

NEMA® NATIONAL EMERGENCY MANAGEMENT ASSOCIATION

The Business Council for Sustainable Energy®

Case Study: Town of Cohasset

Hazard-Specific Solutions: Heat and Cold

Presented to:

NASEO-BCSE-NEMA Energy Resilience Workshop on FEMA BRIC

August 26, 2021

Town of Cohasset Massachusetts

Alternative Energy Committee

Contents

Objective: Summarize the energy supply reliability and resiliency challenges tied to adverse weather events and how the Town of Cohasset is pursuing microgrids as a solution.

Agenda:

- Challenge
- Conceptual Framework
- FEMA BRIC Grant Opportunity

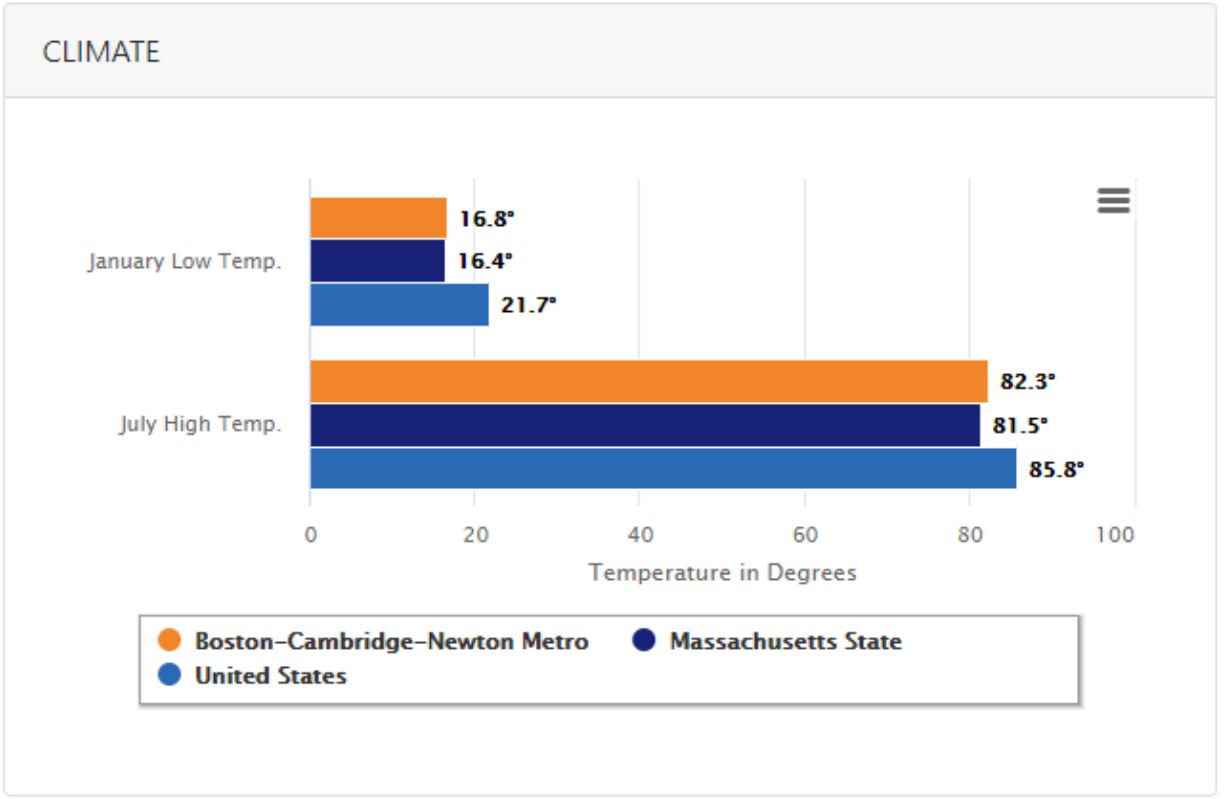
The Town has looked at the options and is pursuing a microgrid

Challenge

Case Study: Town of Cohasset

Challenge

Cohasset, MA is a lovely place to live . . .

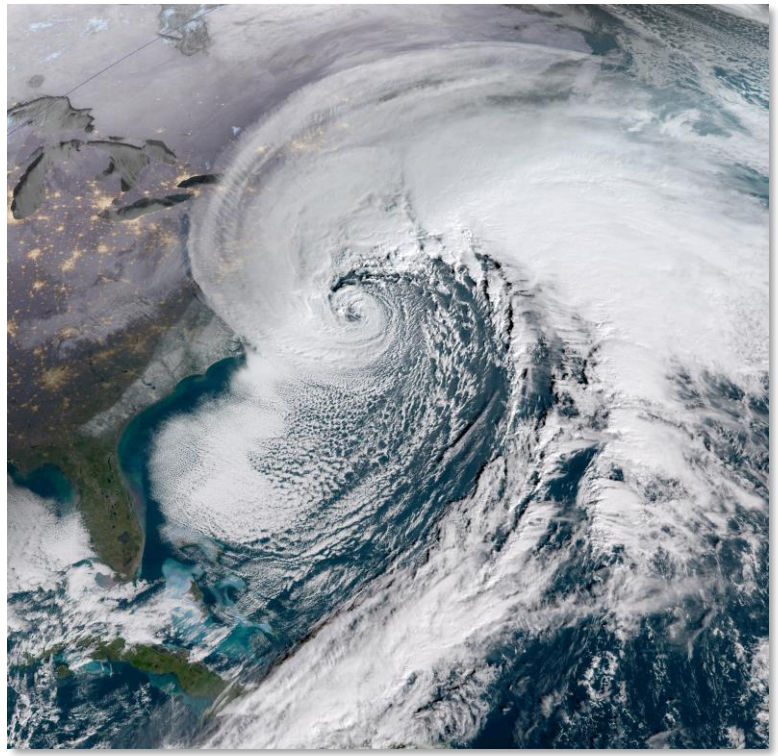


. . .until extreme weather conditions occur

Challenge

Living by the ocean with trees creates challenges

January 2018 Cold Snap

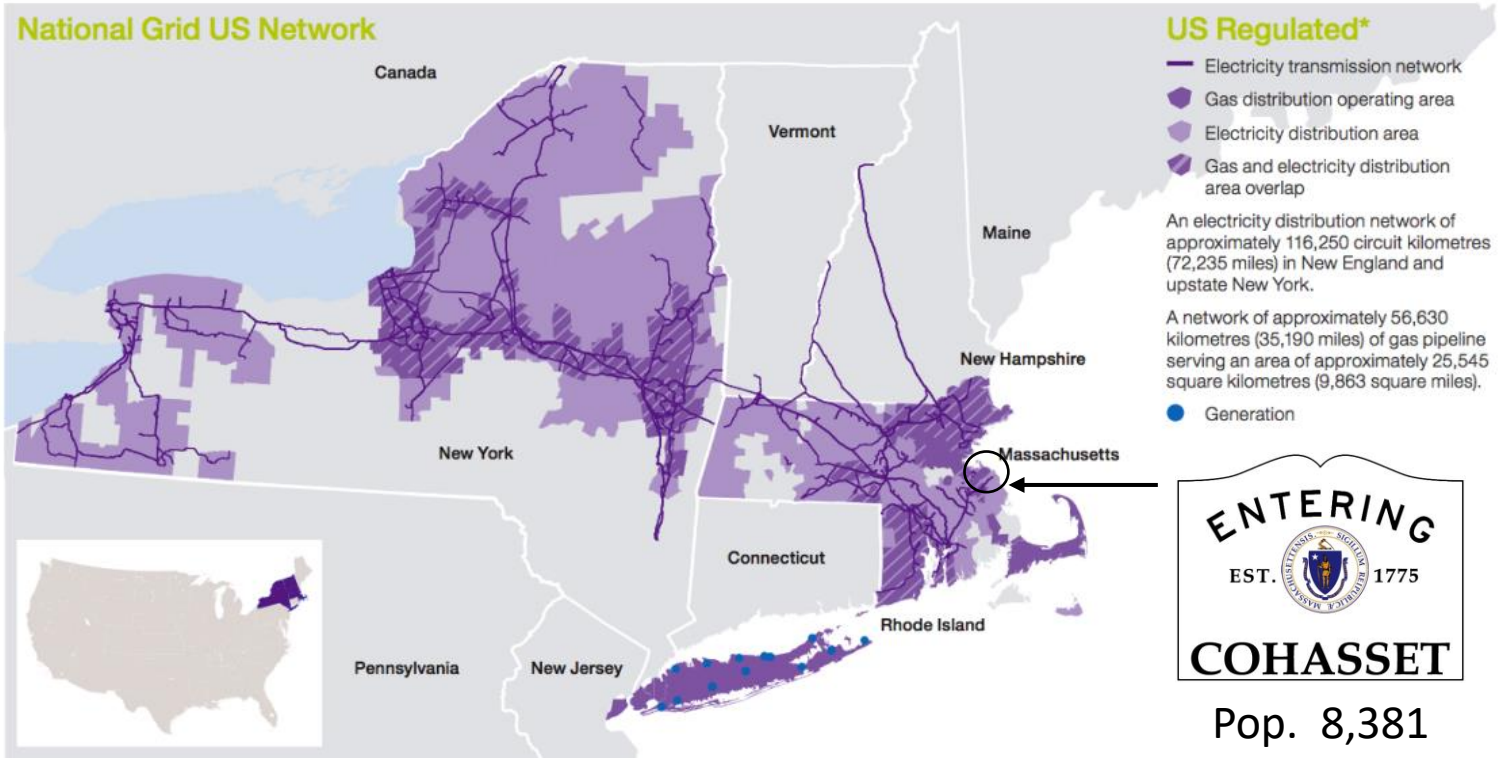


Extreme weather challenges the Town's reliability and resiliency

Challenge

We are literally at the end of the line

National Grid Service Territory and Transmission Network



Pop. 8,381

Source: National Grid, http://ngrid-ftp.s3.amazonaws.com/MASysDataPortal/MA-DPU_ARR2018_2018-04-17_REDACTED.pdf

National Grid delivers gas and manages the transmission and distribution wires

Peak load in Summer ~17.5 MW
Peak load in Winter ~10 MW
Annual Load ~ 55 GWh

Challenge

The Town already has reliability and resiliency issues

Different Measures of the Problem (2018 Data)

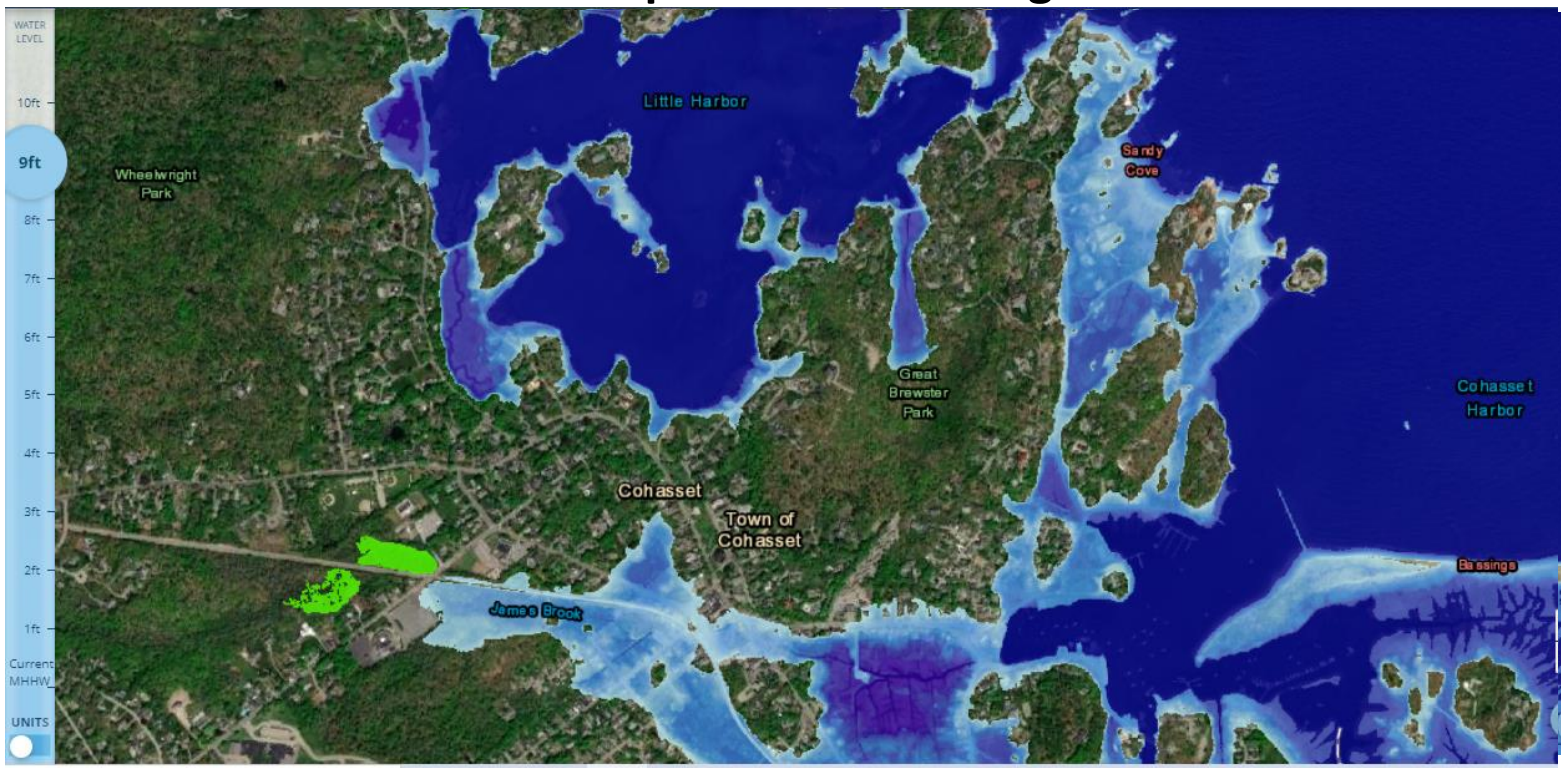
Measure of Impact	National Average	Cohasset Average	National Grid MWEC Ranking of Primary Substation and Feeder Line (Worst out of 1,162)
Reliability:			
Number of Outages	1.5	25	
Customer Interruptions	1.1	5	5th and 8th
Resiliency:			
Outage Duration (hours)	1.36	5	2nd and 4th

Imagine an entire town without electricity for five days in the middle of winter

Challenge

It is only going to get worse

Downtown and Harbor Impact of Storm Surges and Sea Level Rise



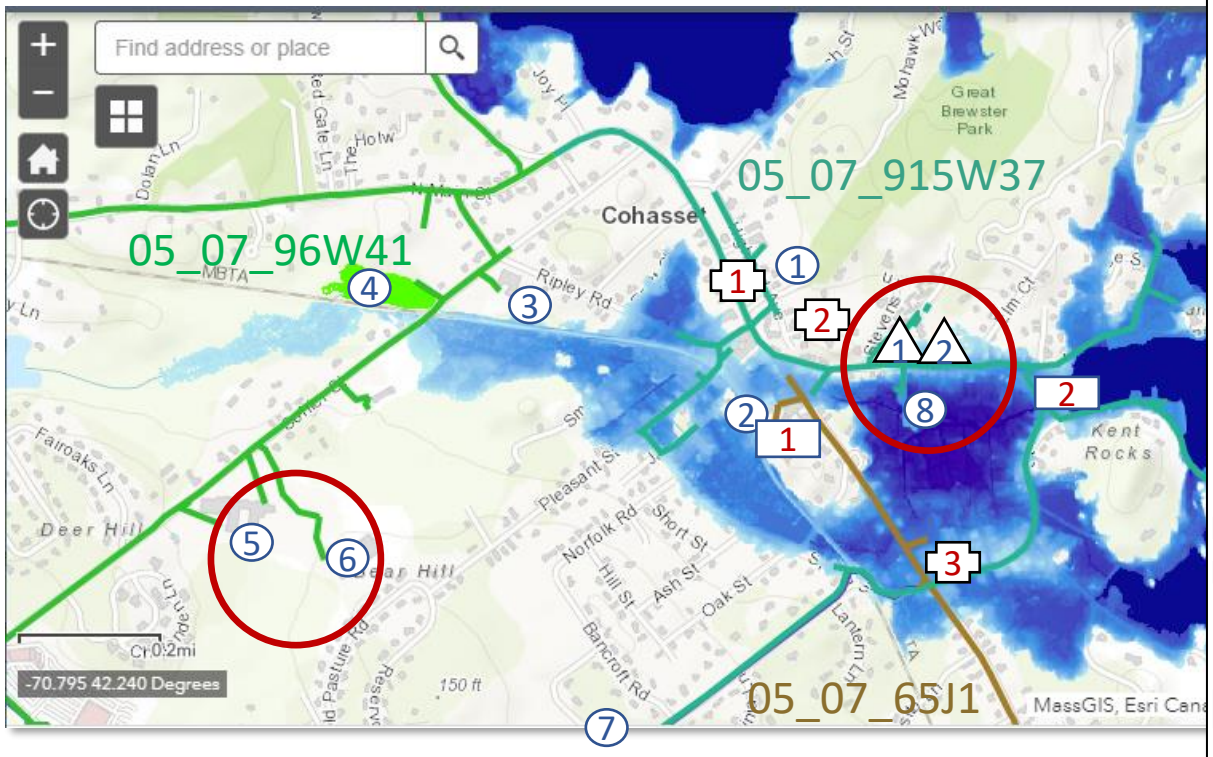
Source: NOAA Sea Level Rise Viewer, https://coast.noaa.gov/slr/#/layer/slr/7/-7881014.371877762/5197025.723513146/15/satellite/none/0.8/2050/interHigh/midAccretion

Storm surges and flooding already are occurring

Challenge

Flooding will only create bigger challenges

Special Flood Hazard Areas and Potential Sea Level Rise



Source: National Grid, https://ngrid.apps.esri.com/NGSysDataPortal/MA/index.html

Town Buildings at Risk

1. Town Hall
2. Recreation Center
3. Library/Rec
4. Senior Center
5. Deer Hill School
6. Osgood School
7. Cohasset High School
8. Waterworks Station

Police Station

Fire Station

Churches

1. Second Congregational
2. St. Stephen's
3. St. Anthony's

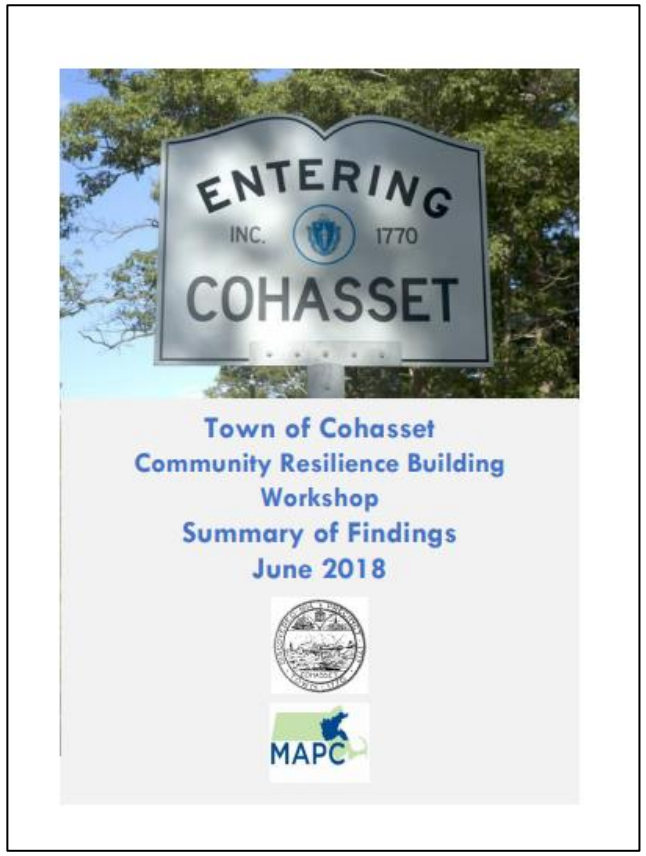
Hotels

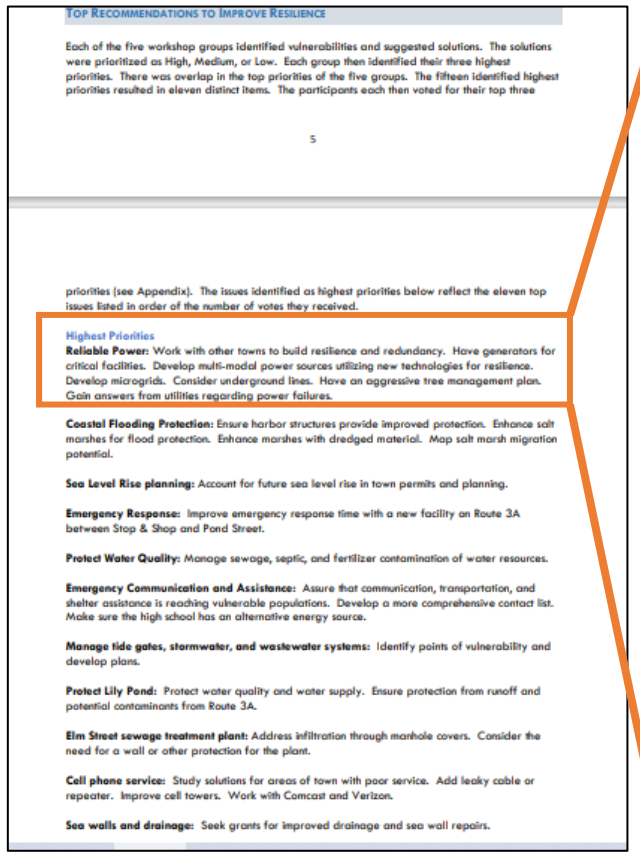
1. Red Lion Inn
2. Cohasset Harbor Inn

The good news is that we have managed so far with 13 backup generators

Challenge

Our hazard assessment identifies energy supply as at risk





TOP RECOMMENDATIONS TO IMPROVE RESILIENCE

Each of the five workshop groups identified vulnerabilities and suggested solutions. The solutions were prioritized as High, Medium, or Low. Each group then identified their three highest priorities. There was overlap in the top priorities of the five groups. The fifteen identified highest priorities resulted in eleven distinct items. The participants each then voted for their top three

5

priorities (see Appendix). The issues identified as highest priorities below reflect the eleven top issues listed in order of the number of votes they received.

Highest Priorities

Reliable Power: Work with other towns to build resilience and redundancy. Have generators for critical facilities. Develop multi-modal power sources utilizing new technologies for resilience. Develop microgrids. Consider underground lines. Have an aggressive tree management plan. Gain answers from utilities regarding power failures.

Coastal Flooding Protection: Ensure harbor structures provide improved protection. Enhance salt marshes for flood protection. Enhance marshes with dredged material. Map salt marsh migration potential.

Sea Level Rise planning: Account for future sea level rise in town permits and planning.

Emergency Response: Improve emergency response time with a new facility on Route 3A between Stop & Shop and Pond Street.

Protect Water Quality: Manage sewage, septic, and fertilizer contamination of water resources.

Emergency Communication and Assistance: Assure that communication, transportation, and shelter assistance is reaching vulnerable populations. Develop a more comprehensive contact list. Make sure the high school has an alternative energy source.

Manage tide gates, stormwater, and wastewater systems: Identify points of vulnerability and develop plans.

Protect Lily Pond: Protect water quality and water supply. Ensure protection from runoff and potential contaminants from Route 3A.

Elm Street sewage treatment plant: Address infiltration through manhole covers. Consider the need for a wall or other protection for the plant.

Cell phone service: Study solutions for areas of town with poor service. Add leaky cable or repeater. Improve cell towers. Work with Comcast and Verizon.

Sea walls and drainage: Seek grants for improved drainage and sea wall repairs.

Highest Priorities

Reliable Power:

- Work with other towns to build resilience and redundancy.
- Have generators for critical facilities.
- Develop multi-modal power sources utilizing new technologies for resiliency.
- **Develop microgrids.**
- Consider underground lines.
- Have an aggressive tree management plan.
- Gain answers from utilities regarding power failures.

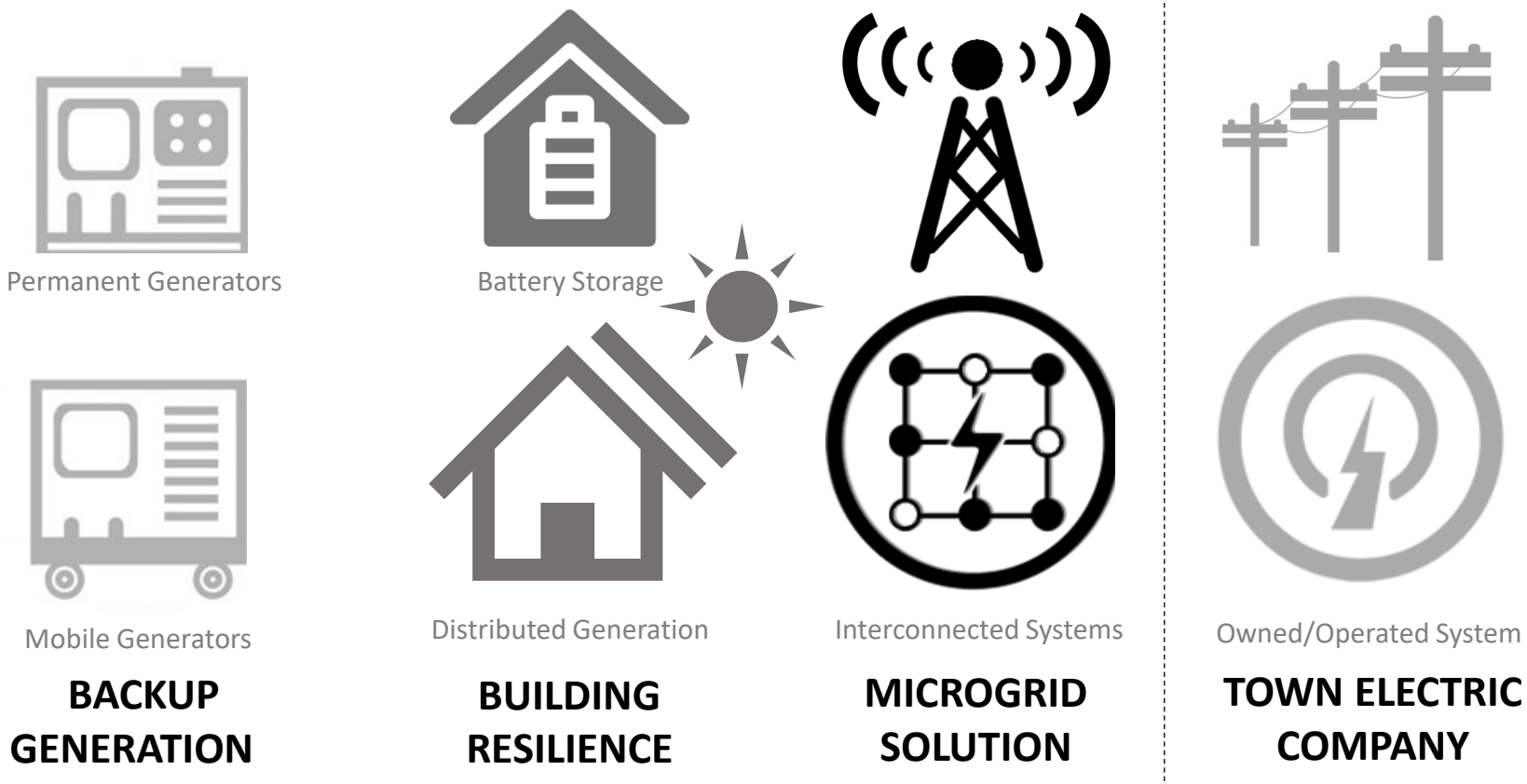
The resilience workshop identified microgrids as a potential power solution

Conceptual Framework

Case Study: Town of Cohasset

Conceptual Framework

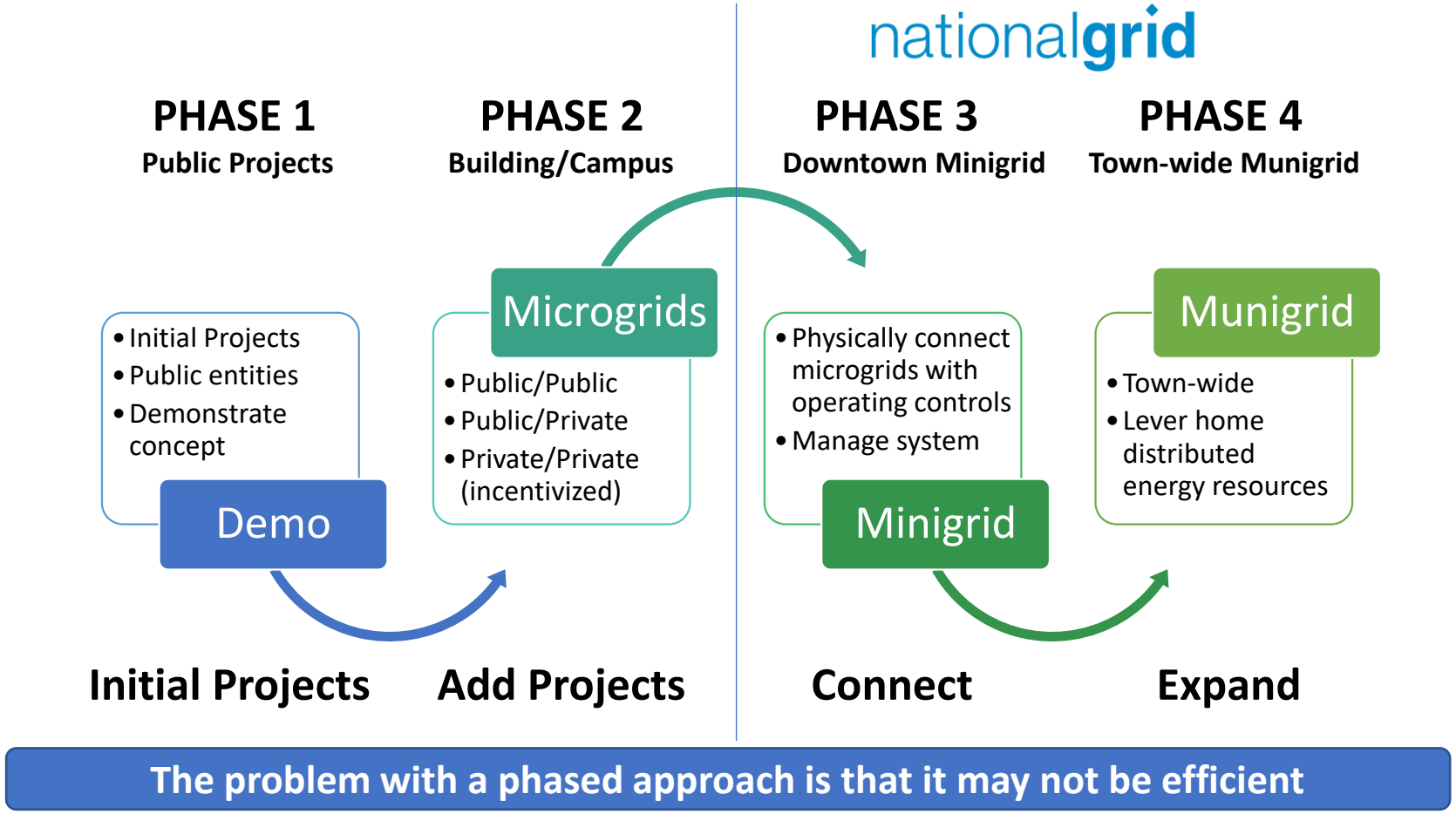
There are many ways to mitigate reliability hazards



Microgrids can be incorporated into or an alternative to a town electric company

Conceptual Framework

The Town initially contemplated a phased approach



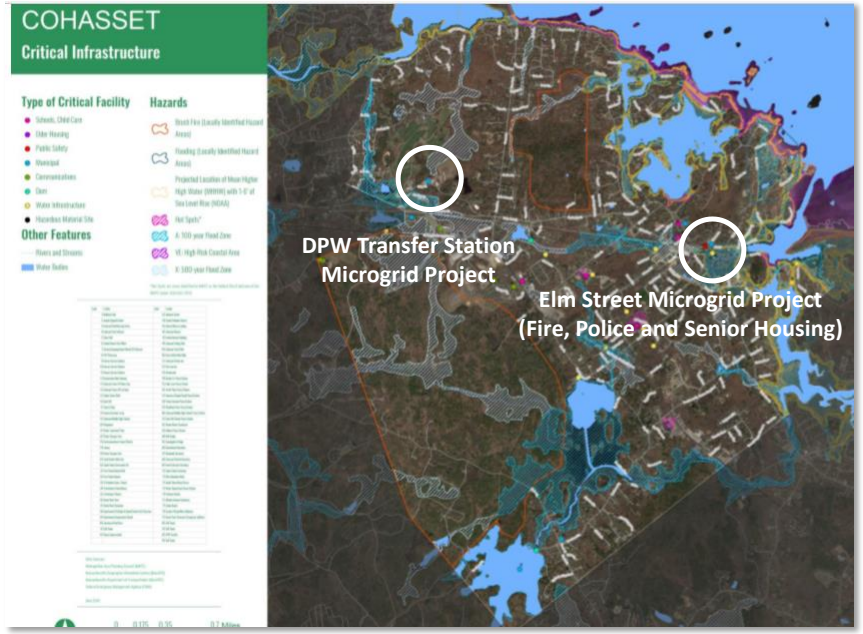
The problem with a phased approach is that it may not be efficient

Conceptual Framework

Is it best to invest in multiple minigrids or the entire town?

PHASE 1

Public Projects



PHASE 4

Town-wide Munigrid

nationalgrid

It just may be easier to create a town-wide munigrid for reliability

FEMA BRIC Grant Opportunity

Case Study: Town of Cohasset

FEMA BRIC Grant Opportunity

Nearly $1 billion for projects like Cohasset

National Competition for Mitigation Projects

- $919 million (est)
- Plus any funds not awarded to states or tribal territories
- 75% Federal contribution / 25% non-federal cost share
- $50 million cap per sub-application

Microgrids are Eligible Projects for Mitigation Grants

FEMA has funded microgrids under the Hazard Mitigation Grant Program (HMGP) and is an eligible project for funding in the Building Resilient Infrastructure and Communities (BRIC) program. In order to be eligible, all Hazard Mitigation Assistance program requirements must be met, including Mitigation Planning, Technical Feasibility and Effectiveness, Cost-Effectiveness, and Environmental Planning and Historic Preservation (EHP) considerations. A short description of these program requirements are below:

- Project Scoping – Depending on the program, project scoping funding may be an appropriate first step towards developing a fundable subapplication for the implementation of a microgrid project.
- Mitigation Planning – Subapplicants must have a FEMA-approved Hazard Mitigation Plan that identifies the risks, vulnerabilities, and proposed mitigation strategies that will be fulfilled by the implementation of a microgrid project. Private nonprofit organizations are not subject to the same requirements as subapplicants.
- Technical Feasibility and Effectiveness – A subapplication must demonstrate that the proposed microgrid is designed in accordance with relevant industry standards to accomplish the intended risk reduction. Examples include the Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (IEEE 1547) and the Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (IEEE 2030) , End-Use Applications, and Loads).
  - The subapplicant must illustrate that the project is either a stand-alone solution (incorporating new control capability, load management systems, DERs, or storage solutions into an already resilient grid) or a component of an overall solution (new

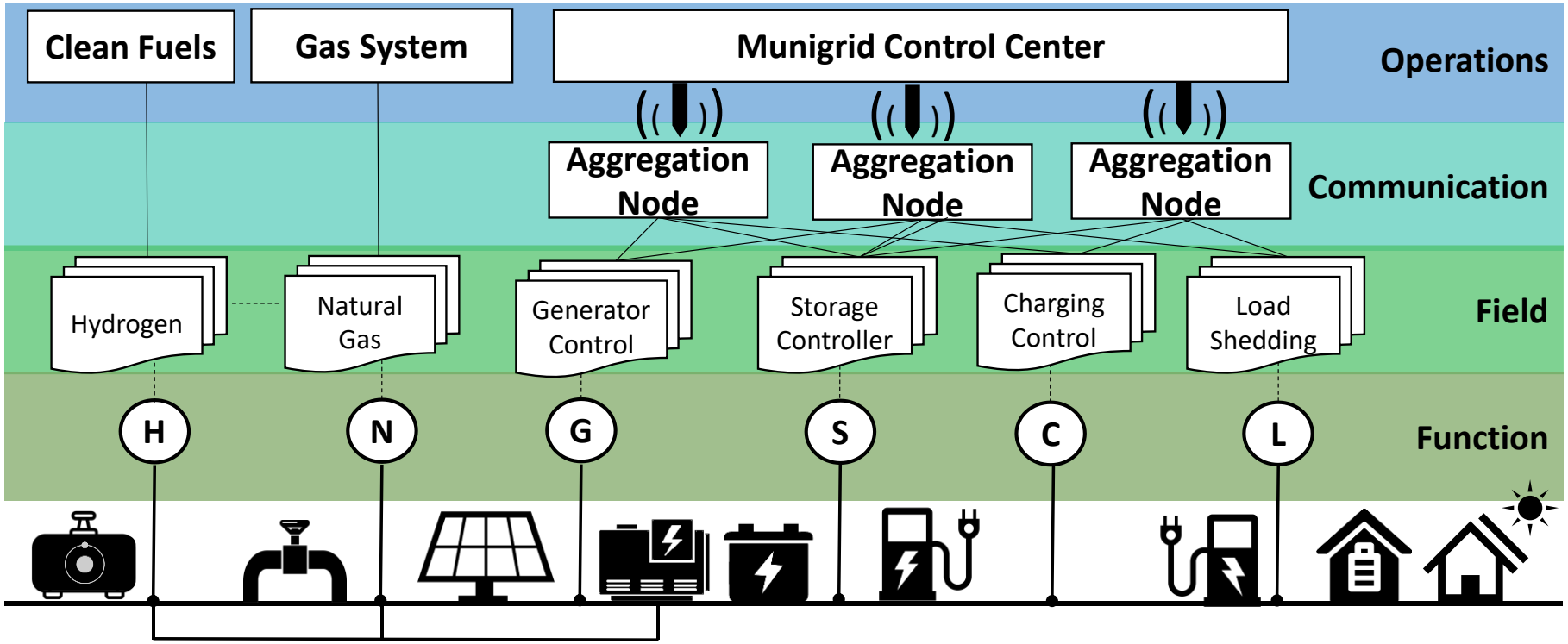
Hazard Mitigation Assistance Grant Funding for Microgrid Projects | FEMA.gov

Cost sharing can include state grants, in-kind services and market revenues

FEMA BRIC Grant Opportunity

A munigrid would leverage multiple energy resources

PHASE 4: General Microgrid Structure



National Grid has the opportunity to fuel switch and try hydrogen

FEMA BRIC Grant Opportunity

Generation, distribution upgrades and software required

Key Pieces of the Microgrid Puzzle

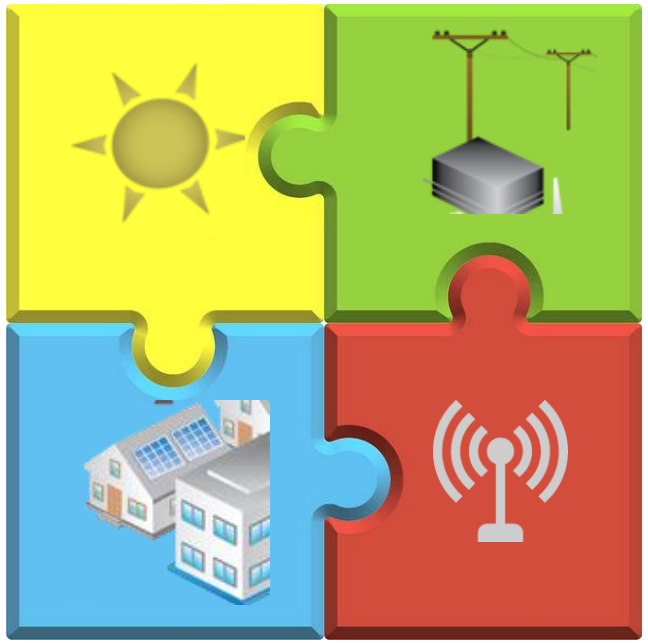
GENERATION

- Existing 450 kW solar array
- Solar/batteries?
- Electric buses?
- Hydrogen plant?
- Hydrogen/natural gas blend?

VIRTUAL POWER PLANT

- Identification of essential load
- > 271 homes with generators
- Town's 13 backup generators
- Solar switches/protection

MassSave and Green Communities have helped us to decrease load



DISTRIBUTION SYSTEM

- Technical design of system
- Upstream common costs/protection
- Upgrades to handle DERs
- Switches to island
- Automation

MICROGRID MANAGEMENT

- Optimize microgrid operations
- Software to manage assets
- Utility or Outsourced
- Market-based revenues

Investment in infrastructure and information is required

FEMA BRIC Grant Opportunity

A multi-disciplined team can answer complex questions

Town of Cohasset Massachusetts

nationalgrid

MAPC Metropolitan Area Planning Council

Massachusetts Clean Energy Center

Technical Advisors:

GE consulting

EPRI Electric Power Research Institute

Nexant Now a part of Resource Innovations ri

Microgrid Equipment/Managers:

Schneider Electric

SIEMENS

Renewable Storage Developers:

Palmer Capital Corporation Merchant Bankers

solect Smart Solar. Smart Business.

AMERESCO Green • Clean • Sustainable

HYDROGEN Solutions Corporation

QUESTIONS TO BE ANSWERED:

1) Can a microgrid solve a small town's power supply, reliability and resiliency problems?
2) What is physically required to isolate and operate a community-wide microgrid?
3) How much generation does a community need to meet its critical energy needs?
4) Can residential backup generation be used as a Virtual Power Plant (VPP) with incentives for citizens who contribute?
5) Can solar and batteries suffice or is another generation solution required to manage the system?
6) Who benefits from a community-wide microgrid and by how much?
7) Who benefits and what could a microgrid tariff look?

Lessons learned would benefit the entire energy ecosystem

FOR ILLUSTRATION PURPOSES ONLY

FEMA BRIC Grant Opportunity

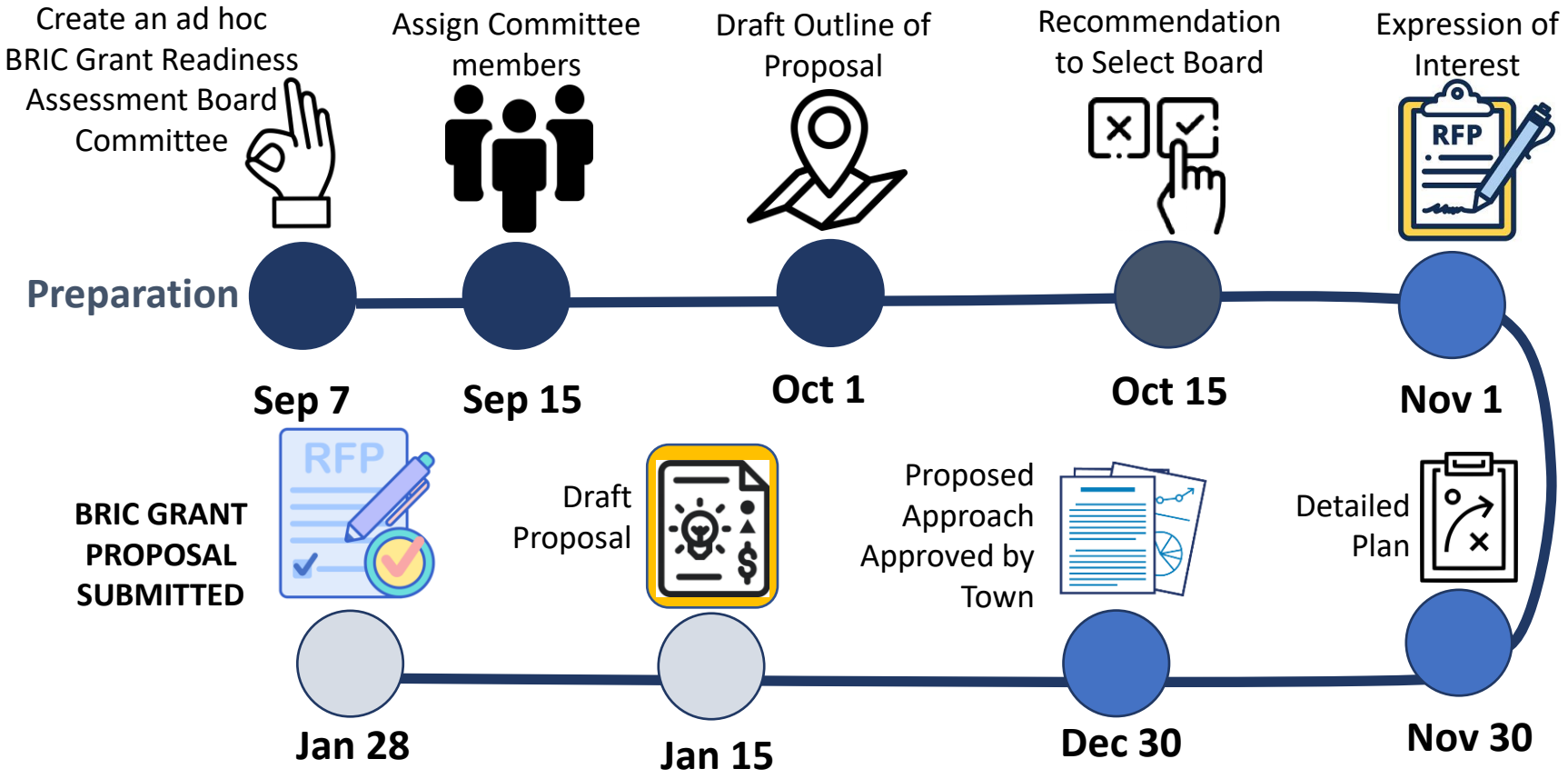
What could a cost-share look like?

1) **TOWN OF COHASSET**
   - 25% salary of dedicated staff and 100% of in-kind support
   - Accelerated replacement (roofs, buses, generators, etc.)
   - Upfront capital investment, reimbursed by enterprise fund
     - Town power purchases and renewable credits
     - Residential “reliability” sales or property tax assessment
     - Market revenues (capacity, energy sales)
2) **MASSACHUSETTS STATE CONTRIBUTION**
   - In-kind technical support
   - State grants
3) **NATIONAL GRID**
   - DPU Socialized Ratebase
   - Investment covered by Microgrid Tariff
4) **EPRI** – Technical Advice and Study Grant funding
5) **VENDORS** – 10% to 25% cost reduction to be part of a leading community-wide microgrid project

Total costs and cost sharing depend on project design and implementation costs

FEMA BRIC Grant Opportunity

Timeline: The rest of 2021



The process will define final project scope, costs and sharing resources

Questions

Tanya Bodell
Chair, Alternative Energy Committee
tbodell@cohassetma.org
+1-617-416-0651

Michelle Leary
Procurement and Contracts Manager
mleary@cohassetma.org
+1-781-383-4100 ext. 5114

Pacific Northwest
NATIONAL LABORATORY

NASEO Community Energy Resilience Workshop

Considering the Energy-Resilience Nexus in Energy Codes

Ellen Franconi,
Pacific Northwest National Laboratory
Building Energy Codes Program

August 26, 2021

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

DOE supports the advancement of Building Energy Codes

As part of its legislative mandate to advance model building energy codes, the U.S. Department of Energy (DOE) is accelerating efforts to make American buildings more efficient, resilient, and clean

2018 International Building Code (IBC)

2018 International Residential Code (IRC)

2018 International Fire Code (IFC)

2018 International Energy Conservation Code (IECC)

2018 International Mechanical Code (IMC)

2018 International Plumbing Code (IPC)

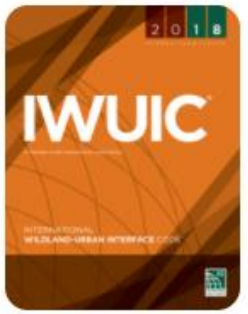
2018 International Fuel Gas Code (IFGC)

2018 International Existing Building Code (IEBC)

2018 International Property Maintenance Code (IPMC)

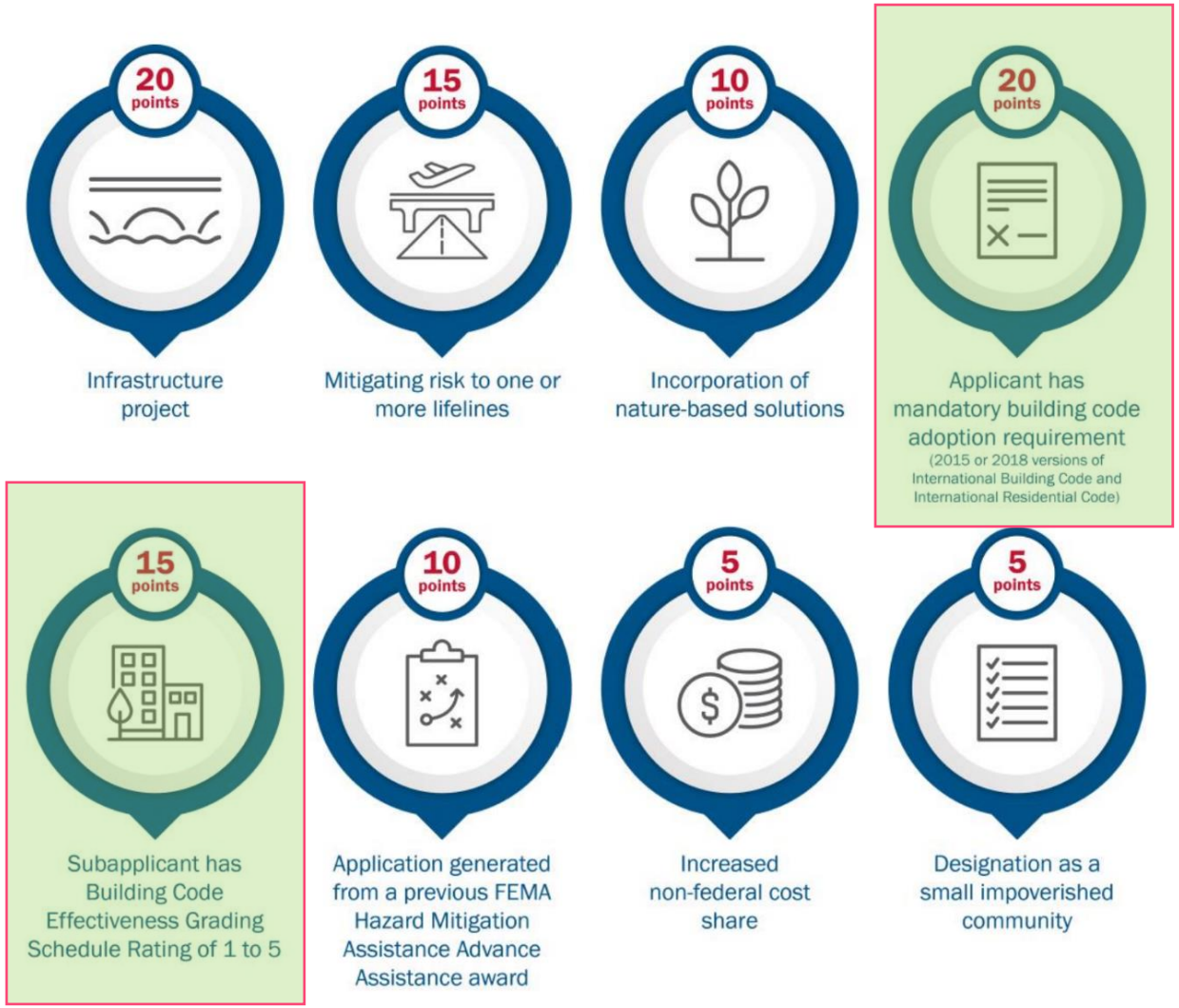
2018 International Green Construction Code (IGCC)

2018 International Swimming Pool and Spa Code (ISPSC)



2018 International Wildland Interface Code (IWUIC)

Building Codes and FEMA BRIC



BRIC National Competition Technical Criteria and Point Values

35 of 100 points are related to Building Codes

The resilience benefits of adopting current building codes are well documented

- More lives saved; fewer people injured.
- Fewer people displaced and for shorter periods.
- More people can shelter in place while waiting for repairs.
- Wellness increases; mental trauma is reduced.
- Social and business disruption is reduced.
- Faster recovery from a disaster.
- Reduced loss of income.
- Continued public services, including to underserved communities.

National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded	Exceed common code requirements	Meet common code requirements	Utilities and transportation	Federally funded
Overall Hazard Benefit-Cost Ratio	4:1	11:1	4:1	6:1
Riverine Flood	5:1	6:1	8:1	7:1
Hurricane Surge	7:1	Not applicable	Not applicable	Too few grants
Wind	5:1	10:1	7:1	5:1
Earthquake	4:1	12:1	3:1	3:1
Wildland-Urban Interface Fire	4:1	Not applicable	Not applicable	3:1

Source NIBS Natural Hazard Mitigation Saves: 2018 Interim Report

The resilience benefits of adopting current building codes are well documented except for energy codes

- "Traditional" Building Codes are intended to address natural hazards that are short in duration, but impactful to building structures

- Energy Codes are intended to save energy and costs for the life of the building but can also improve **passive survivability** and **the ability to shelter in place**

Energy code advancement efforts are starting to address the efficiency - resilience nexus

Current purpose

- Minimum efficiency requirements of buildings for design, construction, and operation
- Utilization of on-site renewable energy resources

Future additions

- Criteria for communication and controls to provide building demand flexibility in support of increased use of renewable energy resources

New emerging features

- Passive survivability
- Net zero energy performance
- Demand flexibility
- Electrification
- Decarbonization

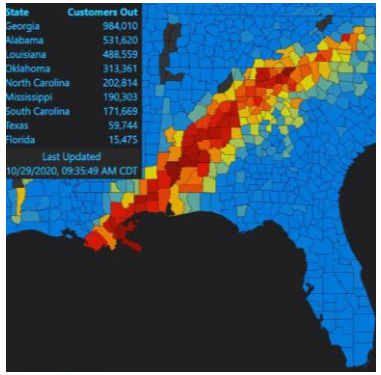
Valuation of Energy Efficiency for Energy Resilience

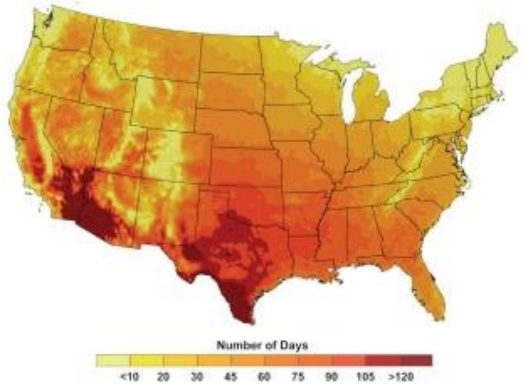
Collaboration between PNNL, NREL, and LBNL

Pacific Northwest NATIONAL LABORATORY

Hazard Region Risk Assessment

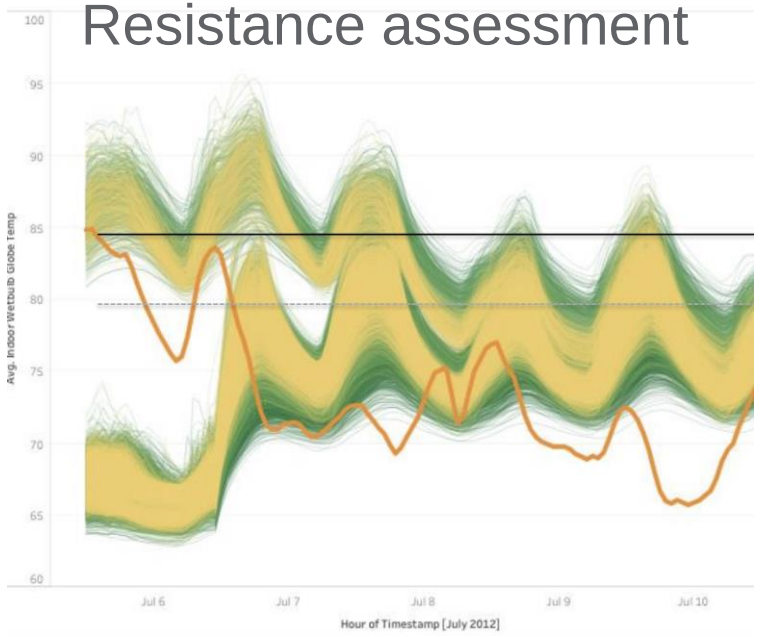
Integrated risk assessment of power disruptions and **extreme temperature events**





Building Simulation of Mitigation Measures

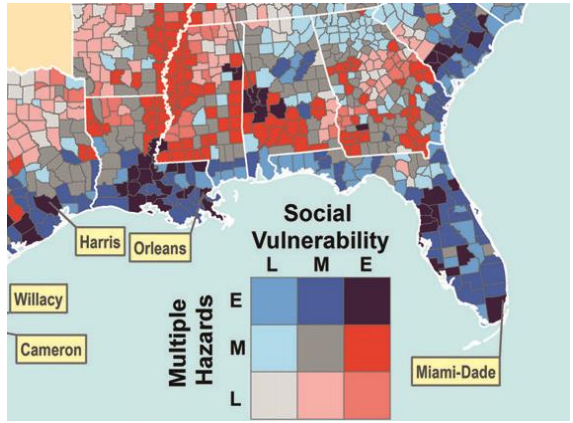
Resistance assessment

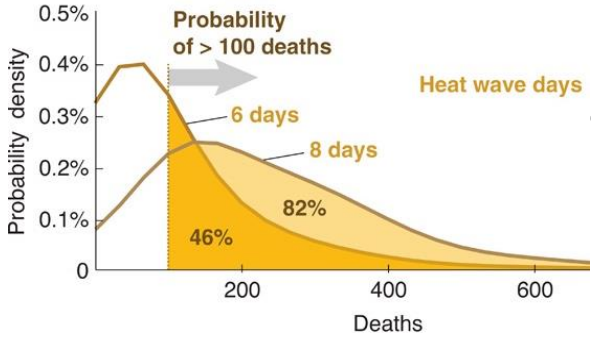


Building design and mitigation measures that compliment, conflict, or have no impact on resilience

Vulnerability, Damage, and Loss Analysis

Assess vulnerability and value at risk





Valuation of Energy Efficiency for Energy Resilience
Project scope and work product

Pacific Northwest NATIONAL LABORATORY

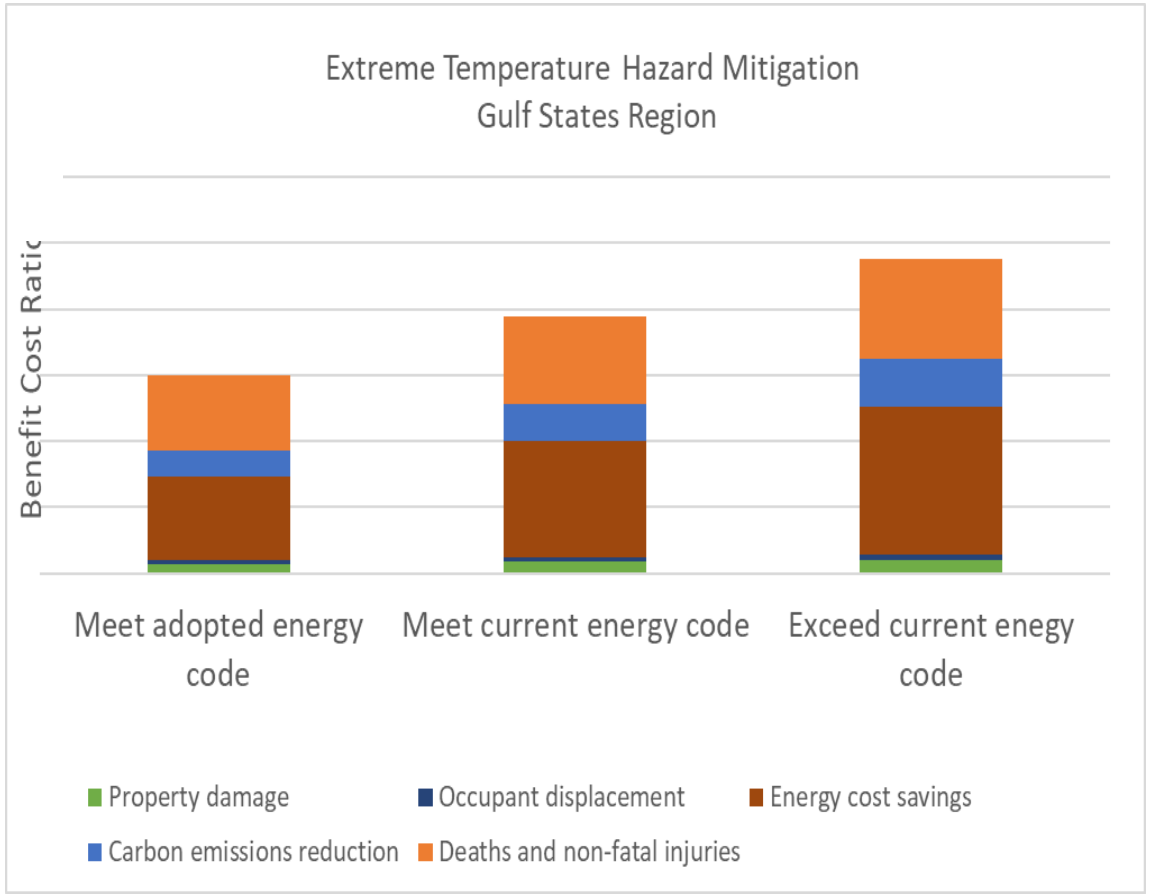
Project Overview

- Extreme heat and cold event analysis
- Ability to shelter in place
- Development of standardized valuation methodology

Efficiency, Energy Storage and Renewables Mitigation Measure Analysis

- Impact on occupant health and property damage during event
- Impact on annual energy, carbon, peak demand
- Benefit-cost analysis
- Value of current energy code adoption

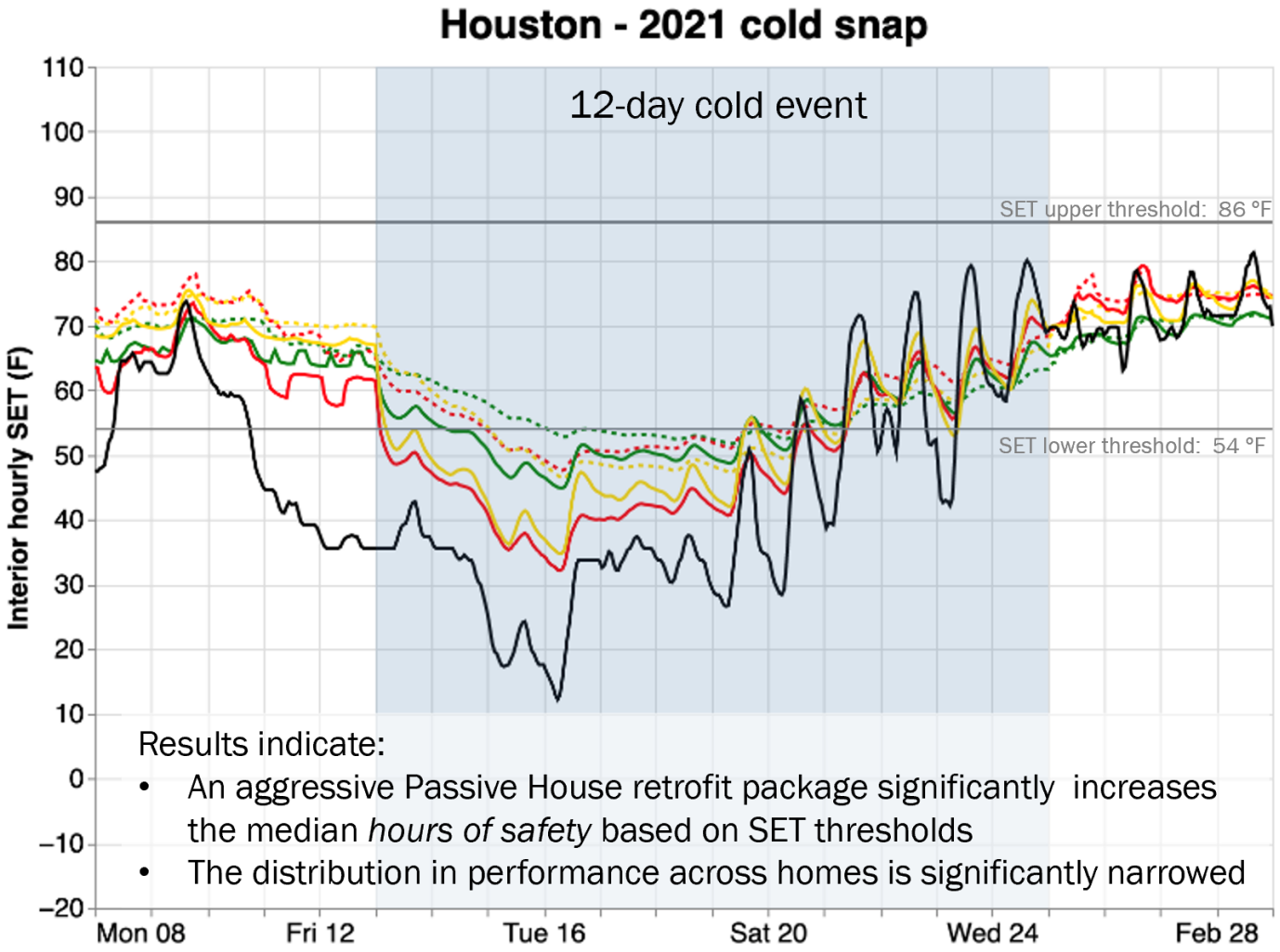
Example Work Product



*Example graphic, do not cite. Although reduced mortality provides a significant value, it is highly dependent on assumptions about probability of joint outage and weather event.

Valuation of Energy Efficiency for Energy Resilience

Mitigation impact on passive survivability metrics



- 95th %ile SET-hour home
- 50th %ile (median) SET-hour home
- 5th %ile SET-hour home
- 95th %ile home with PHIUS upgrade
- 50th %ile home with PHIUS upgrade
- 5th %ile home with PHIUS upgrade
- Outdoor dry bulb temperature (F)

PHIUS upgrade

- Attic insulation: R49
- Above-ground wall insulation: R25
- Below-ground wall insulation: R17
- Slab insulation: R20
- Windows: U = 0.29, SHGC = 0.26
- Infiltration: 0.5 ACH50
- Mechanical ventilation: ERV sensible efficiency = 60%

Note: Results are based on NREL ResStock modeling of representative single-family homes in Houston during the 2021 Winter Storm event

Energy Codes Save

Please let us know how our work in energy code advancement can support your energy resilience projects.

Ellen.Franconi@PNNL.gov

Carmen.Cejudo@PNNL.gov

Closing Remarks and Key Takeaways

Campbell Delahoyde, Senior Program Manager, NASEO

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End of Day 3 and the Workshop

Thank you!

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