



Case Studies in Community Energy Resilience Planning

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About Pacific Northwest National Laboratory

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ICF, one of the world's foremost climate consultancies, helps public and private sector clients worldwide develop climate change policy, interpret and comply with regulations, assess and reduce greenhouse gas emissions, evaluate risks and identify opportunities to build resilience to climate change.

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1 Introduction and Overview

1.1 Introduction

As climate change brings more and more extreme weather threats to local communities, many are responding with proactive plans designed to make their communities more resilient in the face of increasing hazards. Because energy is the lifeblood of modern civilization, keeping energy systems resilient is a key common challenge in such planning efforts. Accordingly, many communities develop their resilience plans to reduce climate impacts on energy systems and related infrastructure to better protect their citizens from harsh conditions that can cause utility grid power outages that threaten their community's safety, health, and welfare. The U.S. Department of Energy Building Energy Codes Program (BECP), is helping communities address these challenges. In early 2023, BECP released a guide titled [Community Energy Resilience Planning for Extended Power Outages](#). This guide outlined planning approaches and best practices that local governments can use to establish effective plans for long-term power outages associated with climate threats.

This supplement report serves as a companion piece to that guide. It presents six detailed case studies of communities that have led the way in resilience planning and also highlights specific solutions in five other communities. To provide a representative sample of leaders in resilience planning, the authors engaged communities of varying sizes and in diverse geographic locations with varying climate hazards. These case studies were developed through research into the planning process and outcomes for each community and informed by interviews with the local planning officials that developed the plans. This report includes a summary of energy resilience planning concepts (presented in more depth in the guide), some common themes and approaches identified in evaluating community energy resilience planning efforts, and the case studies themselves. Its goal is to provide communities interested in energy resilience planning with concrete insights into the best practices being employed today. See Figure 1 for communities discussed in this report.

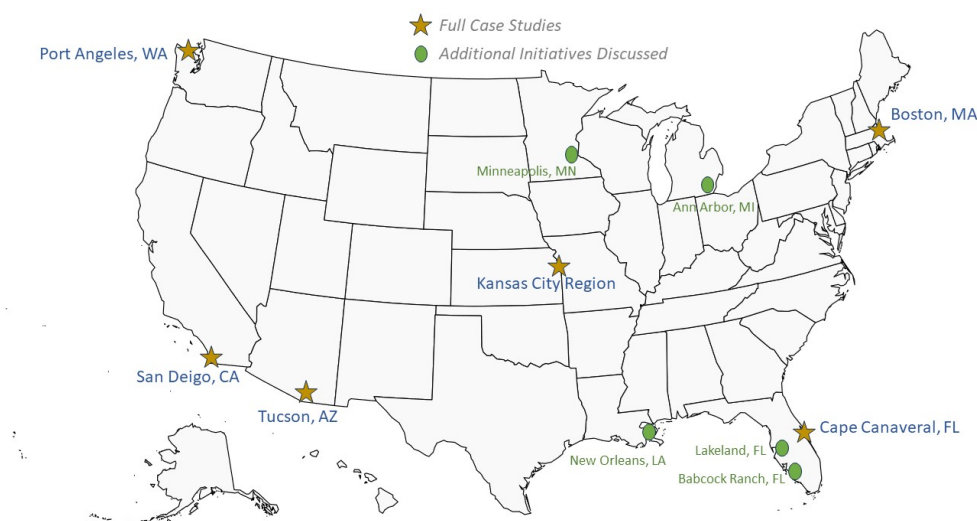


Figure 1: Map of resilience efforts evaluated in this report

This report also includes two appendices. The first is a table of individual resilience measures and activities included in the six resilience plans documented in the report. This appendix includes links to the plans discussed and page numbers where readers can find content about those measures. This table gives readers a simple-to-use list of actions to consider in community energy resilience planning. It is designed to make it easy to source language and details about these measures when considering them in a planning process. The second appendix is a table that captures many of the active community resilience efforts in the United States identified as part of the authors' research. While not exhaustive, it highlights other exemplary efforts that may be of interest to readers.

1.2 Community Energy Resilience Planning

This supplement, like the planning guide, focuses specifically on the “energy” side of community resilience planning. Most communities develop a comprehensive, multi-sector approach that includes preparation for extreme weather events affecting physical infrastructure, human health, and other considerations in addition to energy infrastructure. Within that larger resilience frame, there are specific challenges and potential solutions that relate to maintaining access to energy and dealing with the consequences of its sudden absence in a community. When thinking about the right ways to ameliorate these impacts, one can consider four stages of energy resilience as pictured in Figure 2.

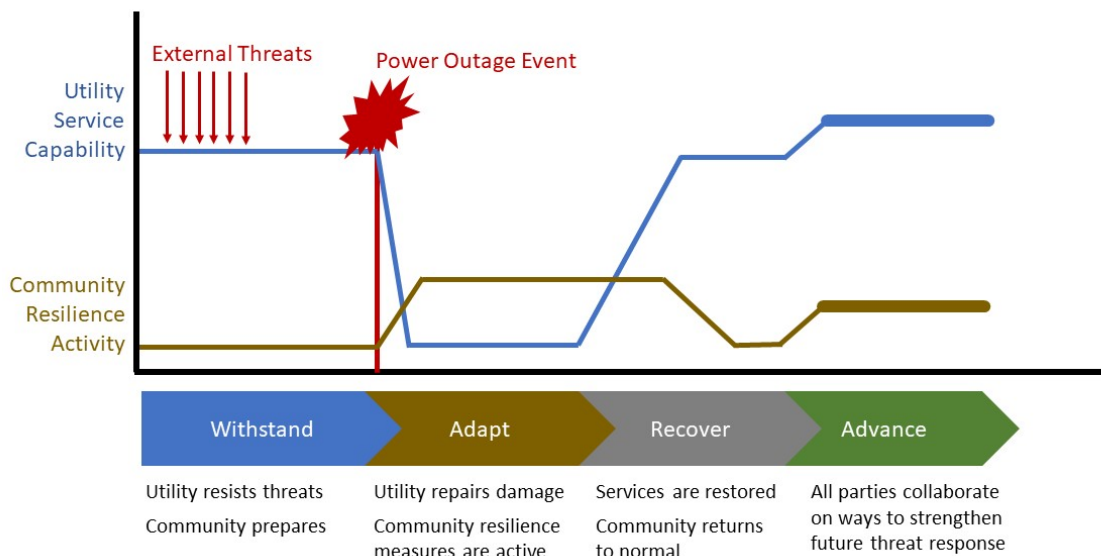
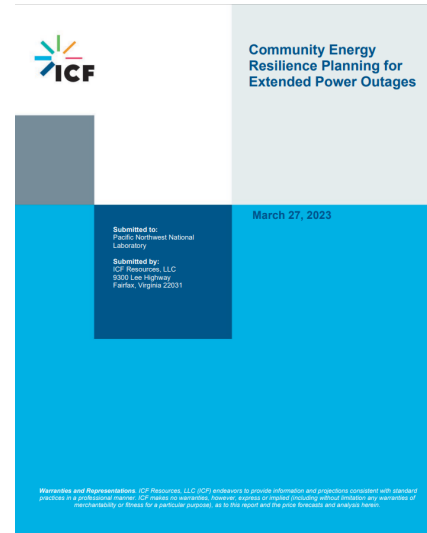


Figure 2: The four stages of energy resilience

- **Stage One: Withstand** – What can a community do to keep its energy system up and running during times of climate stress? Much of this is the principal responsibility of the serving utility companies, but there are many ways that local governments can support this work.
- **Stage Two: Adapt** – When energy infrastructure fails, solutions need to be in place to ensure that loss of power and energy does not cause negative health or safety impacts on people or severe impacts on businesses. This stage is where a lot of community planning comes into play.
- **Stage Three: Recover** – What mechanisms are in place for getting daily operations up and running again after a major outage event? Again, while much of this work is incumbent upon utility companies, there are actions communities can take that dovetail with reconnection efforts.
- **Stage Four: Advance** – How can communities learn lessons from outage events so that they are better prepared to withstand, adapt, and recover during future climate events?

BECP's guide [Community Energy Resilience Planning for Extended Power Outages](#) elaborates on these steps and provides guidance on how communities can think about and plan for exposure to extreme events and associated energy outages (particularly for groups at higher risk). It discusses the unique impacts of different kinds of climate threats and outlines the major categories of technical solutions that can be brought to bear. Finally, the guide provides recommendations on how to engage community members in developing a plan with strategies that will gain buy-in from community members, government agencies, and other stakeholders. Many of those methods and solutions are on display in the case studies presented in this supplement.



2 Common Elements of Climate Resilience Plans

2.1 Common Themes

As the authors of this report researched community resilience planning efforts across the United States and interviewed some of the leaders of these efforts, it became clear that each community's planning process is somewhat unique, reflecting its unique size, composition, history, culture, and institutional capacity. But some themes and principles emerged as common to the integrity, credibility, and ultimately to the success of the plans. Those included:

- **Engage and include.** Reach out to affected communities, especially vulnerable and disadvantaged communities that have been historically burdened by environmental impacts and are most at risk from climate hazards. Listen to their needs and concerns; shape plan actions to meet those needs and address those concerns. Also engage other offices across local government, so that there is buy-in from those who will have roles in implementing the plan. Inclusive engagement is what builds the trust that makes any plan work for the whole community, and for the long term.
- **Analyze and prioritize.** Identify and analyze specific actions systematically, using available tools and consistent, concrete criteria. Prioritize actions using these criteria, while being sure to consider community needs. Bundle actions into broader strategies and classify them by type or sector. This approach makes for a more robust, defensible, and transparent process and a more credible and robust plan.
- **Define implementation details.** Whether in the initial plan or a follow-up effort, there needs to be enough detail to chart a pathway to implementation for each priority action. Those details include who/what agency is responsible, what steps are involved, and funding sources.
- **Get expert help.** In some cases, outside experts can help with technical aspects of the plan, such as detailing and modeling certain actions, or helping to manage community engagement. Local academic experts may be available, as may consultants. But community members and government staff need to own and oversee the resilience planning efforts because they are the ones who best understand local needs and they will be the players driving implementation.
- **Live the plan.** The most successful plans don't wind up gathering dust on a shelf—they are treated as living documents that get updated as new information, new needs, and new resources come to light. Updating the plan every few years can help, as can an implementation plan that gets turned into agency agendas, capital and operating budget requests, and other practical forms. Having explicit reporting responsibilities around plan success and needed refinements is another way to ensure that it remains relevant and updated.

2.2 Most Common Types of Resilience Actions

The communities represented in these case studies chose hundreds of specific actions, and because each community faced its own set of climate hazards, and is somewhat unique in geographic and demographic terms, each plan had its own priorities and areas of emphasis. Looking across the whole set of plans, however, the following common action types emerged:

- **Biodiversity.** Protecting and restoring key habitat areas, and otherwise helping threatened and endangered species to survive and thrive, was common to many plans.
- **Building codes and other development policies.** Making sure new buildings can withstand key climate hazards was a common action. Energy codes, because they can both reduce outage risks by reducing peak loads and keep buildings more comfortable during energy outages, play a key role. Since in most states, local governments are limited to adopting codes set by state law and regulation, some communities went beyond construction codes to issue non-binding development guidelines that encourage developers to go beyond minimum codes, and to include other features such as stormwater management and wildfire resistance (see Figure 3).



Figure 3: Understanding building codes¹

- **Building retrofits.** Upgrading existing buildings to improve energy efficiency and structural integrity can also reduce outage risks through peak demand reduction, reduce building damage, and provide shelter-in-place capabilities.

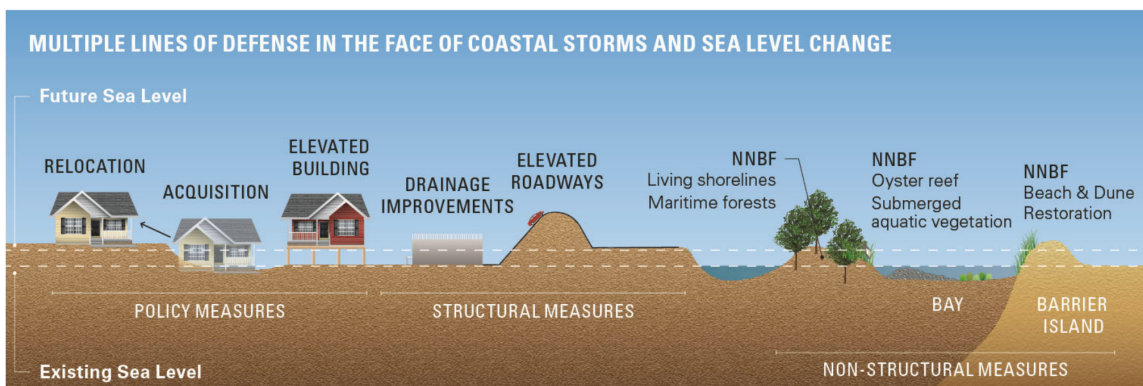


Figure 4: Integrated approach to flood risk management with multiple lines of defense²

- **Coastal zone management.** Many of these communities have ocean shorelines subject to storm surge, sea level rise, and high wind hazards. Their plans thus typically address such risks by

¹ [Understanding Building Codes](#), National Institute of Standards and Technology (2022).

² [Nature Based Coast Flood Mitigation Strategies](#), City of Virginia Beach, Moss, A., A. Brazeau, J. Greenspan-Johnston, T. Miesse, X. Liu, B. Batten, and M. Bailey (2019).

improving management of coastal areas, from reef and beach nourishment to sea wall construction and coastal infrastructure hardening (see Figure 4).

- **Flooding management.** Not only coastal areas, but river floodplains and other topographies are vulnerable to flooding from heavy rains. Planned retreats that move buildings and infrastructure out of such areas, stormwater management measures, and other actions were common plan elements.
- **Green infrastructure.** Some of these actions serve flood management purposes, but also include things like green roofs, tree canopy expansion and other urban forestry and agriculture measures, permeable paving materials, and other actions that provide multiple benefits.
- **Heat mitigation.** Many communities took action to protect people from extreme heat, through cooling centers, increasing natural and constructed shading, and the use of cooler materials for roofing and paving. Refer to Figure 5 for insights into the factors influencing or mitigating urban heat islands.

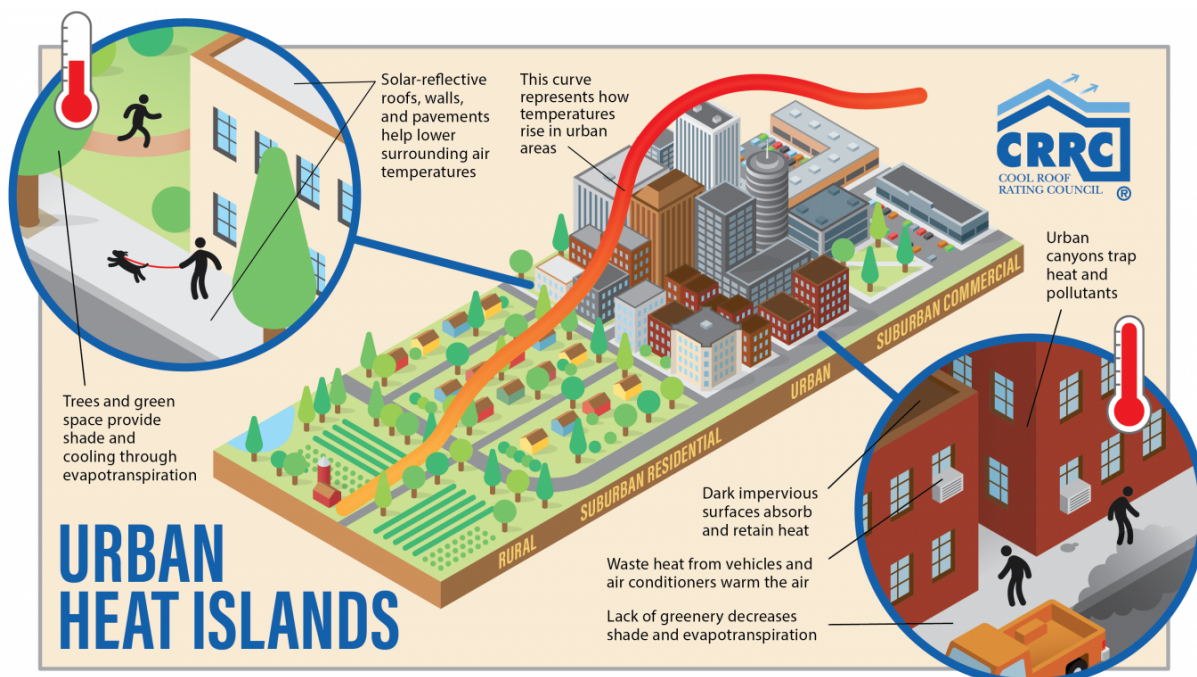


Figure 5: Factors that contribute to or mitigate urban heat islands³

- **Nature-based solutions.** These span a wide range of actions that typically provide multiple benefits. They include protecting and expanding natural habitats such as forests, marshes, and beach dunes, and encouraging plant species that are more resistant to climate hazards.
- **Renewable power supply solutions.** Some plans include locally-sited power generation actions, typically using renewable power technologies that are not vulnerable to fuel supply interruptions, with solar PV and battery storage the most typical choice. These solutions are typically integrated with public facilities, community resilience hubs, or planned residential developments.
- **Resilience hubs.** Many plans call for community-based facilities that can provide key services during emergencies including power outages. They are often planned with power supply solutions

³ [Urban Heat Island Mitigation](#), Cool Roof Rating Council.

that can operate during grid outages and provide services ranging from shelter to food supply to health care and cell phone charging.

- **Sustainable agriculture and food security.** These solutions typically include building relationships with and supporting local farmers, supporting community gardens and farmers markets, and encouraging sustainable agriculture practices in the region that can reduce flooding risk, reduce water pollution, and increase crop resilience.
- **Transportation.** These actions range from electrifying public fleets and transit vehicles to supporting community mobility solutions such as bike lanes and EV charging facilities. In some cases, resilience hubs provide EV charging.
- **Water and wastewater management.** Actions can include diversifying and increasing water supply options, rainwater retention at the building scale, separation of storm and sewer drainage, stormwater retention lagoons, and wastewater treatment actions.
- **Wildfire mitigation.** These actions can vary from encouraging/requiring noncombustible building materials, creating firebreaks, managing forests to reduce wildfire fuel, and limiting development in wildfire prone areas.

2.3 Making Use of This Information

Every community will have unique needs when it comes to climate resilience – both because of differing climate impacts and because of different development choices and resident needs. Developing a successful community resilience plan is about understanding those unique needs and then deciding which of the areas listed above should get the most focus in your effort. Communities with a strong focus on sustainability may want to lean into nature-based solutions and energy supply options that rely heavily on clean energy. Communities with a larger population of elderly residents or those with health challenges may want to focus more on resilience shelters, on-site generation, and other options to combat extreme temperatures. Dialing the focus of your effort in to your community’s unique needs is the critical first step to establishing buy-in and yielding impact.

PNNL has developed a list of case studies demonstrating exactly how communities of varying sizes and with different challenges have developed successful resilience plans focused on their unique drivers. Section 3 presents those case studies.