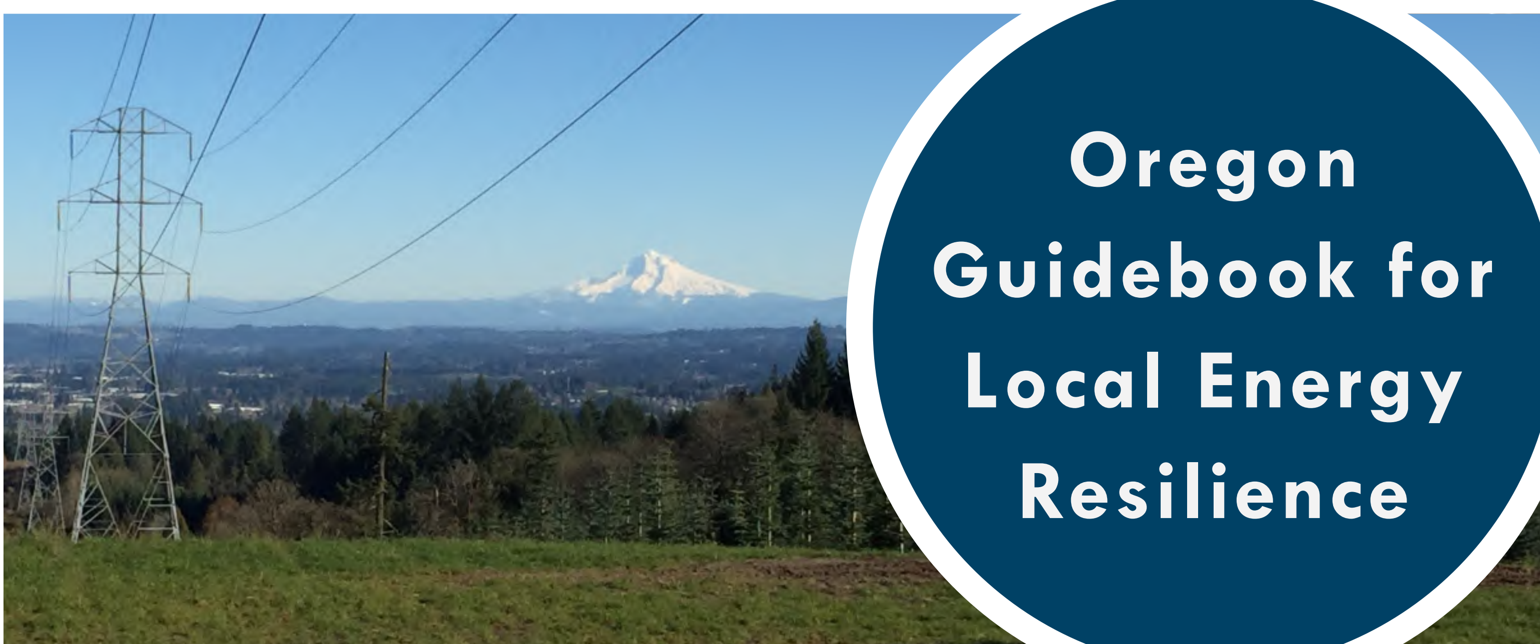


Oregon Guidebook for Local Energy Resilience

For Small and Medium Electric Utilities

OREGON DEPARTMENT OF ENERGY

2019

The core ideas in this guidebook were developed through a collaborative process led by the Oregon Department of Energy.

Thank you!

Reviewers

Lori Koho
Oregon Public Utility Commission

Lisa Gorsuch
Oregon Public Utility Commission

Jeni Hall
Energy Trust of Oregon

Lee Hall
Bonneville Power Administration

Rebecca O'Neill
Pacific Northwest National Laboratory

Yumei Wang
Oregon Department of Geologic & Mineral Industries

Mike Harryman
Oregon State Resilience Officer

Sonya Andron
Oregon Office of Emergency Management

Dan Lauf
National Governors Association

Bridget Callahan
Sustainable Northwest

Diane Broad
Oregon State University

Utility Contributors

Debra Smith
Central Lincoln People's Utility District

Gail Malcolm
Central Lincoln People's Utility District

Randy Grove
Central Lincoln People's Utility District

Todd Simmons
Tillamook People's Utility District

Mel Damewood
Eugene Water & Electric Board

Tyler Nice
Eugene Water & Electric Board

John Dietz
McMinnville Power & Light

Greg Gardner
Blachly-Lane Electric Cooperative

Jeff Nelson
Springfield Utility Board

Brian Sharr
Emerald People's Utility District

Doug Barab
Emerald People's Utility District

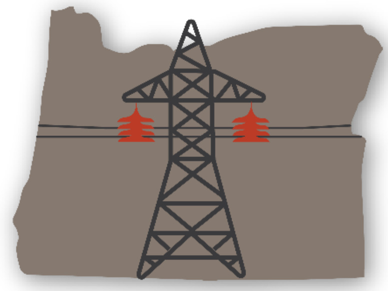
OREGON
DEPARTMENT OF
ENERGY

550 Capitol St. NE
Salem OR 97301
800-735-8055
www.oregon.gov/energy
askenergy@oregon.gov

Contents

The guidebook and its companion website are intended to serve as a centralized resource that identifies existing local energy resilience efforts in the state and across the country, highlights innovative projects and practices, and offers suggestions for incremental actions that can be taken. They are not intended to serve as a state-approved formula for achieving local energy resilience.

Introduction



The Oregon Department of Energy developed this *Oregon Guidebook for Local Energy Resilience* as a resource for Oregon's consumer-owned utilities (COUs). The guidebook is intended to help COU staff identify incremental actions they can take today to improve business continuity planning; develop a framework to prioritize investments in distributed energy resources; and better understand the role of local utilities within the context of federal, state, and local emergency management planning.

Why develop a guidebook focused on local energy resilience? As we will explore more in the sections that follow, resilience has become a topic of increasing interest in the energy sector in recent years. In Oregon, effects from climate change or a Cascadia Subduction Zone earthquake could pose significant threats to the resilience of the energy sector. Advances in technology and an overall focus on preparedness are creating new opportunities to improve energy resilience at the local level.

The guidebook will also serve as a resource for sharing information and practices among utilities in Oregon, as well as identifying opportunities and best practices from around the country. Each Oregon utility and the communities it serves are unique – they face unique threats and risks, have specific geographic considerations, and the resilience solutions that might make sense for one utility may not work as well for others. As such, this guidebook is not intended to provide a one-size-fits-all approach. And while this guidebook was developed for and in consultation with Oregon's COUs, ODOE recognizes that much of this information may also be helpful to staff working at investor-owned utilities or with local governments.

The *Guidebook* is divided into the following sections:

I. Resilience vs. Reliability
II. Understanding Resilience Threats
III. Location-Specific Considerations
IV. Utility Actions: Business Continuity Planning
   a. People
   b. Facilities
   c. Infrastructure
   d. Communications
V. Utility Actions: Distributed Energy Resources
VI. Federal, State, and Local Emergency Management Planning
   Utility Checklist: Local Energy Resilience Planning
   Online Resources: Local Energy Resilience Planning

Throughout the guidebook, you'll find highlights for:

Key Terms	Resilience at Work	Deep Dive	Take Action	Tools & Tips
Definitions adopted by ODOE	**Examples from local utilities**	**Links to related online content**	**Actions utilities can take**	**References to other resources**

The Oregon Department of Energy has also created a companion website that parallels the guidebook. Readers will find hyperlinks to corresponding sections on the website that provide in-depth background material, more details on examples cited, or additional resources. The website will be a dynamic, living resource for COUs with updated real-world examples, templates, and other guidance collected from utilities in Oregon and from around the nation.

The core ideas in this guidebook were developed through a collaborative process led by the Oregon Department of Energy, with Central Lincoln People's Utility District, the Office of Governor Kate Brown, and the National Governors Association (NGA). As part of this project, the team hosted several workshops and meetings, and made public presentations to engage COUs, State of Oregon agencies, local governments, and other stakeholders. In total, the team engaged staff from 21 of the state's COUs. In particular, we want to express thanks for the contributions of Central Lincoln PUD, Tillamook People's Utility District, Springfield Utility Board, Blachly-Lane Electric Cooperative, Emerald People's Utility District, Eugene Water & Electric Board, and McMinnville Power & Light, which helped develop Sections IV and V of this guidebook.

I. Resilience vs. Reliability

The Federal Energy Regulatory Commission[1] regulates the development and enforcement of reliability standards to ensure the reliable operation of the bulk electric system. Much of this work occurs through the North American Electric Reliability Corporation and its seven regional entities, including the Western Electricity Coordinating Council, which encompasses much of the western United States (including Oregon).

Key Term

Reliable Operation *(FERC Definition)*: Operating the elements of the bulk power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance or unanticipated failure of system elements.

There is increasing interest in the concept of *resilience* as a concept separate and distinct from the *reliable* operation of the bulk electric system. While *resilience* has become commonly used in the energy sector, there is no widely agreed upon definition.

For purposes of this guidebook, the Oregon Department of Energy[2] adopts the following definitions:

Key Term

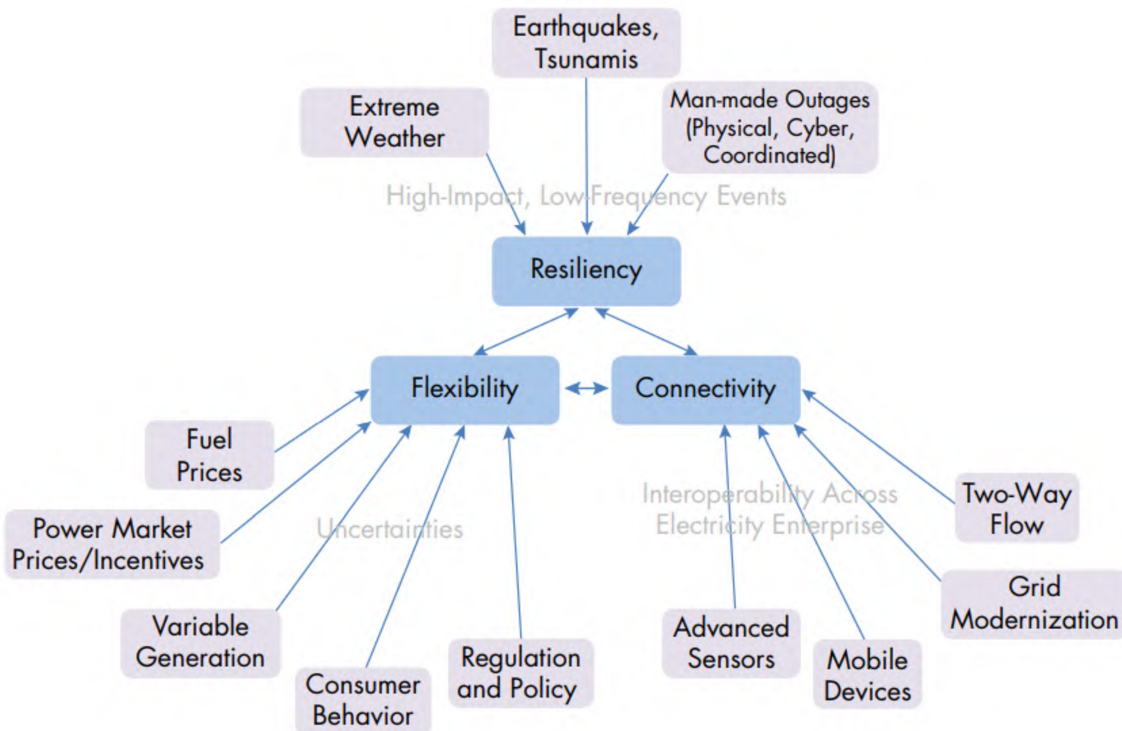
Resilience: The ability to prepare for and adapt to changing conditions and to withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally-occurring threats or incidents.

Energy Resilience: The ability of energy systems, from production through delivery to end-users, to withstand and rapidly restore energy delivery following non-routine disruptions of severe impact or duration.

Community Energy Resilience: The ability of a specific community to maintain the availability of energy needed to support the provision of energy-dependent critical public services to the community following non-routine disruptions of severe impact or duration to the state's broader energy systems.

The Electric Power Research Institute convened stakeholders in 2016 to evaluate the ongoing transformation of the power sector – driven by low natural gas prices, flat growth in demand for electricity, increased deployment of renewables, and other emerging technologies – and identified resilience, flexibility, and connectivity as the three key challenges facing the sector.[3,4]

Figure 1: Attributes of the Power System (Electric Power Research Institute)



This guidebook considers several of the specific high-impact, low-frequency threats that pose resilience challenges to the electric power system in Oregon, and shares recommendations and best practices for steps that consumer-owned utilities can take to improve local energy resilience. In some instances, those recommendations and best practices could also address the challenges posed by flexibility and connectivity.

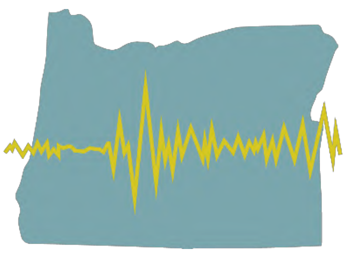
II. Understanding Resilience Threats

Electric utilities are already familiar with system reliability standards, metrics for defining and maintaining adequate levels of reliability, and the types of events that can trigger reliability events (e.g., routine severe weather events, downed trees, or the insufficiency of available generating resources to meet electricity demand). Generally, the electric industry has long been focused on reducing the frequency and duration of unplanned service outages that occur from such reliability events.

Other events can create threats to the resilience of the electric system – these types of events are often uncommon, but can result in severe impacts either in terms of the extent of damage or disruption, or in terms of the duration of the impacts.

Resilience Threats to Oregon's Electric Sector

Cascadia Subduction Zone Earthquake



The Cascadia Subduction Zone (CSZ) is capable of producing a megathrust earthquake registering a magnitude of 9.0 or higher off Oregon's coastline, with a devastating tsunami to follow.[5] This type of event has the potential to be similar to the Tohoku earthquake and resulting tsunami that devastated the Sendai region, including the Fukushima nuclear power plant, off coastal Japan in March 2011.[6]

Geologists have found that a rupture of the CSZ occurs approximately every 300 to 400 years, with the last rupture occurring on January 26, 1700 – or 319 years ago as of the publication of this guidebook.[7] The chance of a significant rupture of the CSZ occurring within the next 50 years is estimated to be between 15 and 20 percent.[8,9,10]

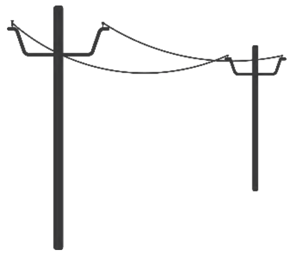
For a more in-depth consideration of the expected effects on Oregon's energy sector from a CSZ earthquake and tsunami, see Chapter 6 of the Oregon Resilience Plan.

Climate Change: Redefining Normal

Climate change will affect the frequency and intensity of short-term extreme events like wildfires, heavy snowfall, floods, and storm surges in certain parts of the state, in addition to average weather and hydrologic conditions over longer time horizons.[11,12] Climate change is projected to alter future conditions in such a magnitude that historical trends will no longer be a reliable predictor for future expectations, and a "new normal" for what constitutes expected average and extreme conditions will need to be integrated into decision-making.[13,14]

A more in-depth consideration of climate vulnerabilities and adaptation in Oregon's energy sector is discussed in Chapter 5 of ODOE's 2018 *Biennial Energy Report*.

Cyber and Physical Attacks



The U.S. Department of Energy, in consultation with the U.S. Department of Homeland Security, has identified cybersecurity and the potential for physical attacks as a significant threat to the energy sector.[15] The wide geographic reach of the electric grid makes it inherently vulnerable to physical attack. Meanwhile, the increased connectivity of the electric grid – while enabling significant new functionality around remote and automatic operation and the potential for dynamic pricing – creates new pathways for cyberattacks against the electric sector.

For more information on these threats, see the National Infrastructure Protection Plan: Energy Sector-Specific Plan published by the U.S. Departments of Energy and Homeland Security.

III. Location-Specific Considerations

A common theme throughout this guidebook is that there is no one-size-fits-all approach to improving local energy resilience. This is as true for the assessment of threats and expected effects on a specific utility as it is for the type of actions that a utility can take to improve local energy resilience. That said, there are several high-level actions that each COU can take to assess its vulnerabilities and develop a plan to improve local energy resilience.

Take Action

A utility that evaluates the range of potential threats to its service territory will be better positioned to take actions to improve local energy resilience:

- ☐ Identify the specific resilience threats in the utility's service territory
- ☐ Evaluate the likelihood of occurrence for each of these potential threats
- ☐ Identify the expected effects on the utility and the communities it serves from these threats, and estimate the severity and duration
- ☐ Assess the dependency of the utility and the communities it serves on the state's bulk energy systems (e.g., liquid fuel delivery system and electric or gas transmission network) and transportation networks, and how impacts to those systems might have local consequences

Emerald People's Utility District, for example, developed a hazard mitigation plan[i] in which it evaluated the probability of future natural hazard events significantly affecting the district's facilities. As part of that process, it provided the following time intervals expected between such events occurring in its territory:[16]

Resilience at Work

Emerald People's Utility District Assessment of Future Natural Hazards

- **Windstorms** – annual, with one to several events each year
- **Earthquakes** – 50 to 100 years for small to moderate events, 250 to 500 years for major earthquakes on the Cascadia Subduction Zone
- **Snow/Ice Storms** – 25 to 50 years
- **Wildfires** – 10 to 25 years
- **Landslides** – 5 to 10 years
- **Floods** – 10 to 25 years
- **Volcanic Events** – 1,000 years or more

Local Resources

After developing a comprehensive threat assessment, a utility should consider the availability of existing, and the potential for new, local resources as it develops strategies to improve local energy resilience. Following a CSZ earthquake, for example, the state's bulk energy systems and transportation network are likely to be severely disrupted for several months – or even a year – in many parts of the state. In such a circumstance, local energy resources will have added value both to the utility and to the communities it serves.

[i] See page 30 for more information on the development of hazard mitigation plans and the potential for utilities to develop an annex to existing plans adopted by local governments.

Take Action

A utility developing a plan to improve local energy resilience should:

- ☐ Identify utility-owned local generating resources and consider whether those resources have "blackstart" capabilities in the event of a major grid disruption
- ☐ Develop an inventory of stockpiled equipment and ensure storage facilities are in locations expected to experience minimal damage and to remain reachable following an event
- ☐ Identify which of the utility's commercial or industrial customers have on-site generation capabilities (e.g., diesel or propane generators, or combined heat and power)
- ☐ Develop an assessment of the potential for new distributed generation capacity in the utility's service territory (e.g., solar, biodigesters, wind, landfill gas)
- ☐ Identify any existing energy storage capabilities (both in terms of grid-connected batteries, but also in terms of liquid fuel storage) within the utility's service territory and the potential to develop additional capacity
- ☐ Conduct a technical assessment to identify the types of investments required to segment or island portions of the distribution grid following a major disruption

Coordination with Local Governments and Critical Service Providers

Local and county governments play a leading role in responding to emergencies and major events that might cause severe disruptions to the energy system. The role of local governments is considered in the broader context of federal and state emergency management planning efforts in Section VI of this guidebook.

In addition, the *Oregon Resilience Plan* identified critical interdependencies between the energy system and the delivery of critical public services, such as medical, police and fire, schools, local government, and community shelters.[17] Following a major disruption to energy systems, the delivery of these critical public services could be severely limited, with devastating results for local communities. These impacts are likely to be felt even more acutely by vulnerable populations, such as those living in long-term care facilities or in disadvantaged communities.

Take Action

Utilities should coordinate with local governments to develop plans to improve local energy resilience that prioritize community needs:

- ☐ Connect with local governments to identify what types of emergency planning they have done and the extent to which those plans consider the resilience of local energy systems (e.g., what assumptions have local governments made about timelines for restoration of power?)
- ☐ Identify the interdependencies of the delivery of critical public services with the resilience of the energy sector
- ☐ Identify whether critical public service providers have on-site back-up generation capabilities, or if not, whether they have identified other energy contingency plans
- ☐ Evaluate whether there are opportunities to make strategic investments in coordination with local governments and critical service providers to maximize community energy resilience benefits

<table>
<tr><th colspan="2">Location-Specific Considerations</th></tr>
<tr><td>Threat Assessment:
Types of threats (e.g., earthquake, tsunami, landslide, liquefaction, wildfire, ice, cybersecurity, etc.)
Expected timeframe for occurrence or reoccurrence of threats
Projected effects from different threats to utility's energy infrastructure</td><td>Duration of Disruptions:
Whether disruptions to infrastructure (e.g., road network, telecommunications, electric transmission, and liquid fuels) can be expected to last for hours, days, weeks, or months</td></tr>
<tr><td>Relationship to Bulk Energy Systems:
Assessment of the specific dependencies of the utility on bulk energy system deliveries:
Electric transmission system to energize the local distribution system
Liquid fuel deliveries (via truck, rail, pipeline, or marine vessel) to re-supply generators and utility trucks</td><td>Availability of Local Resources:
Is there potential to develop distributed energy resources within the utility's service territory? Such as:
Diesel or propane generators
Combined heat and power
Distributed renewables (e.g., solar, biodigesters, wind, and landfill gas)
Batteries
Microgrids that can island from the bulk power grid</td></tr>
<tr><td>Interdependencies Between Local Energy Providers and Other Critical Public Service Providers:
Evaluate the extent to which specific interdependencies exist between the delivery of energy and the delivery of other critical public services in the community:
First responders
Communication systems
Healthcare providers
Community shelters
Local government
Transportation systems</td><td>Existing County/Municipal Emergency Planning Efforts:
Identify opportunities to coordinate or better align with existing county or municipal emergency planning efforts:
Identify current county or municipal emergency plans
Develop personal contact between the utility and county or municipal emergency managers
Brief local and county governments on utility emergency plans and local energy resilience efforts</td></tr>
</table>

IV. Utility Actions: Business Continuity Planning

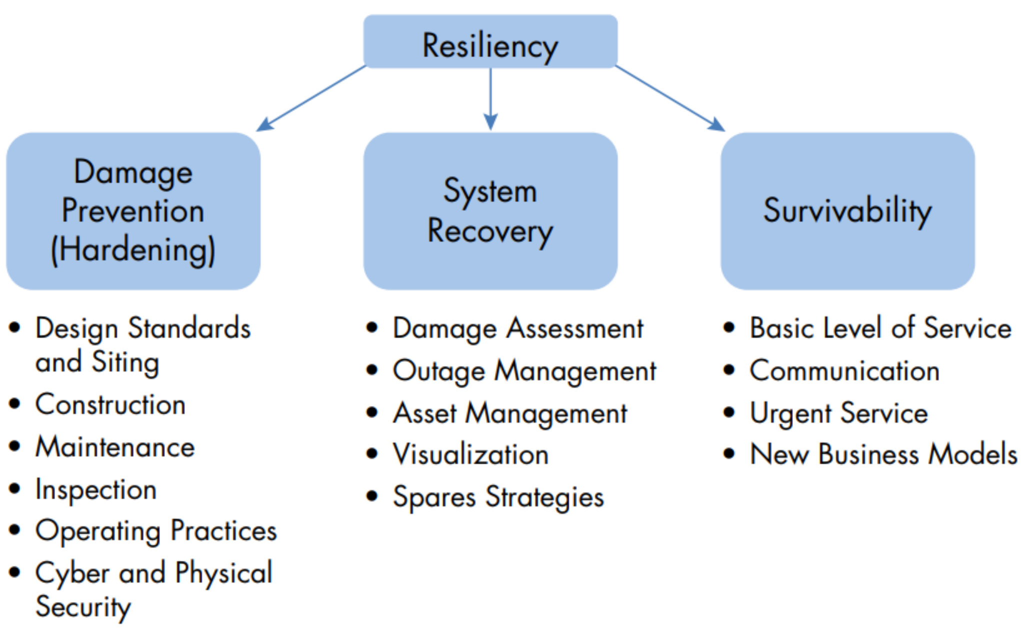
This section summarizes specific actions that individual consumer-owned utilities in Oregon have already taken to improve business continuity planning[18] – that is, how utilities are taking actions today to ensure they are better prepared and able to function following a major disruption tomorrow.

Key Term

Business Continuity Planning (BCP) helps ensure that an organization can continue to perform its essential functions, provide essential services, and deliver core capabilities during a disruption to normal operations. Effective business continuity activities provide a baseline capability and represent the minimum standard required by a comprehensive, integrated national continuity program.

The examples and best practices in this section are divided into four core categories of business continuity planning: people, facilities, infrastructure, and communications. The content was derived primarily from interviews conducted by the Oregon Department of Energy with staff from seven of the state's COUs in the summer of 2018. This information has been supplemented by additional guidance developed by the Federal Emergency Management Agency.[19] Many of the examples cited here are consistent with the three dimensions of improving resilience identified by the Electric Power Research Institute: damage prevention, system recovery, and survivability.[20]

Figure 2: Three Dimensions of Improving Resilience (Electric Power Research Institute)



People

Utility management and staff are the most important asset when it comes to a utility being able to perform its essential functions following a major disruption. There are several actions utility leadership can take to better prepare the utility and its employees to maintain business continuity, such as creating a culture of preparedness, adopting devolution plans, and requiring resilience and preparedness training for employees.

Take Action

The following are some of the actions that COUs can take to better prepare their people:

- ☐ **Culture of Preparedness:** Develop a culture at the utility that acknowledges the seriousness of threats and the importance of preparation for those threats in the workplace and at home.
- ☐ **Safety Trainings:** Incorporate safety trainings into regular staff meetings.
- ☐ **ICS Training:** Train management and/or staff in FEMA's Incident Command System (ICS) so that they are better prepared to plug in to emergency response operations. For more information on ICS, see Section VI below.
- ☐ **Succession and Devolution Planning:** Develop clear succession plans for key utility positions in the event that regular staff are unable to perform duties and/or fewer staff are available to execute more responsibilities to perform the utility's essential functions.
- ☐ **Employees with Disabilities:** Be aware of employees with disabilities that may need unique assistance (e.g., physical limitations or difficulty hearing alarms or emergency messages) following a major event and identify co-workers who can assist them.
- ☐ **Mutual Aid:** Establish mutual aid agreements with utilities in other parts of the state, region, and country; train staff to be familiar with and able to implement mutual aid arrangements during routine storms and disruptions.

Take Action

The following are some of the actions that COUs can take to better prepare their people (continued):

- ☐ **Cross Jurisdictional Engagement:** Encourage staff to participate in resilience planning and coordination meetings with state and local governments, and in regional exercises to prepare for responding to disaster situations.
- ☐ **Go Bags:** Encourage utility staff to build personal "Go Bags" and equip utility vehicles with Go Bags that include items like first aid kits, masks, flashlights, non-perishable food, and water filtration devices.
- ☐ **Digitize Personnel and Financial Records:** Digitize (and safely store) personnel and financial records to improve the utility's ability to restore business operations following a major event.
- ☐ **Stay or Go:** Depending on the event, utility staff may need to shelter-in-place or evacuate on short notice. Utilities should develop clear plans and protocols for either outcome, including identifying a process for how a determination will be made about which is appropriate.
- ☐ **Ongoing Education:** Utilize on-site trainings, regularly-scheduled meetings, and newsletter announcements to communicate with staff about threats facing the utility, impacts that could be expected, techniques and strategies for surviving major events, and the importance of personal preparedness.

Tools & Tips

Build a Kit: FEMA has developed guidance to help individuals to develop personalized "Go Bags" to meet their needs following a major event: www.ready.gov/build-a-kit

Key Term

Mutual Aid Agreements: Electric utilities have established several mutual aid organizations across the country. These organizations often serve as the "first responders" to facilitate utilities helping one another during times of crisis.

Learn more about two of the mutual aid organizations commonly joined by Northwest utilities:

- Western Regional Mutual Assistance Group (WRMAG)
- American Public Power Association – Mutual Aid Program

Resilience at Work

Blachly-Lane Electric Cooperative Focus on Preparedness

Blachly-Lane is working with its employees to ensure they are personally prepared. As part of its safety and wellness program, the utility has provided a "go bag" for each employee to take home, which includes essential materials, including a drinking water filter. Recognizing that employees would have a hard time getting to work if they were worried about their own families at home, Blachy-Lane also gave employees the option to purchase additional go-bags if needed.

Learn more about the types of actions that specific Oregon COUs are taking to improve the resilience of their utilities by better preparing their people.

Facilities

Will the utility's main facilities (headquarters, offices, operations center, substation control houses, etc.) withstand the impact of anticipated resilience threats and remain operational? This can be difficult to evaluate in circumstances where the potential effects from a particular threat may not be certain. It is easier, however, to assess those effects when the threat is better understood, such as a CSZ earthquake.

Take Action

The following are some of the actions that COUs can take to improve the resilience of their key operational facilities:

- ☐ **Facilities Assessment:** Conduct geotechnical, seismic, and structural analysis of key utility facilities (e.g., operations center, business centers, warehouses) to better understand the capabilities of individual facilities.
- ☐ **Vulnerability and Risk Assessment:** Conduct a comprehensive vulnerability and risk assessment to understand the threats to utility facilities and the scope of expected damage from different threats, and conduct an analysis of mitigation costs. This type of assessment can be integrated into the utility's Capital Improvements Plan (CIP) and/or Asset Management Plan to help the utility prioritize investments.
- ☐ **Alternate Sites:** Evaluate whether it may be necessary to stand up alternate facility sites (e.g., headquarters or operations center) following a major disruption, identify locations for such sites, and incorporate these considerations into utility planning.
- ☐ **Remodel/Retrofit/Relocate:** Remodel, retrofit, or relocate key utility facilities to withstand anticipated threats (e.g., seismic retrofits or relocate a key facility out of liquefaction zone or flood inundation zone).
- ☐ **On-site Power:** Expand the capabilities of on-site resources to provide back-up power for utility facilities, such as expanding storage tanks for diesel or propane generators or by deploying solar and battery storage systems.
- ☐ **Staff Accommodations:** Expand facilities to provide essential services (e.g., sleeping cots, kitchen facilities, food, toiletries, etc.) in the event that staff need to be housed on site for an extended period of time to maintain critical functions.

Resilience at Work

Central Lincoln People's Utility District Strengthened Facilities

Central Lincoln PUD completed a Facilities Plan in 2014, which recommended replacing the utility's primary operations center. The operations center was constructed more than 60 years ago, had outlived its useful life, and was located in the tsunami inundation zone. The facility provided operational support for the Central Lincoln's entire system and was critical to ongoing operations. In 2015, Central Lincoln began the process to sell bonds, purchase land and construct a new operations center. Construction of the new operations center was completed in 2017. The new primary operations center is located outside the tsunami inundation zone and meets the seismic standards for an essential facility.

Learn more about the types of actions that specific Oregon COUs are taking to improve the resilience of their operational facilities.

Electric Infrastructure

In addition to the utility's key operational facilities, electric utilities also maintain a significant amount of electric infrastructure, including poles and wires, substations, and generation assets. While threats to these infrastructure assets may be similar to those facing utility operational facilities, the vulnerabilities and the degree of impact can be very different. Utility transmission and distribution lines, for instance, cover a wide geography that makes them vulnerable to a wider array of geotechnical threats from landslides, flooding, wildfires, or tsunami inundation. Meanwhile, electric substations contain pieces of equipment that have unique vulnerabilities to earthquakes and cyber and physical attacks. Further, as digitally connected metering and control devises become more prevalent across the grid, cybersecurity threats become an increasing concern.

Take Action

The following are some of the actions that COUs can take to improve the resilience of their infrastructure assets:

- ☐ **Vulnerability and Risk Assessment:** Conduct a comprehensive vulnerability and risk assessment to understand threats to utility infrastructure and the scope of expected damage from different threats, and conduct an analysis of mitigation costs. This type of assessment can be integrated into the utility's Capital Improvements Plan (CIP) and/or Asset Management Plan to help the utility prioritize investments.
- ☐ **Substations:** Retrofit or rebuild equipment to the latest seismic design standards, including bolting down power transformers and replacing rigid components with more flexible materials.
- ☐ **Transmission Towers and Distribution Poles:** Evaluate the ability of transmission towers and distribution poles to withstand the effects of expected threats, including high winds and seismic forces.
- ☐ **Relocation:** Relocate infrastructure assets out of tsunami inundation or flood zones, or reroute existing transmission and distribution lines out of liquefaction or landslide zones.
- ☐ **Sensors:** Install seismometers and other sensors (e.g., ShakeAlert or AlertWildfire) to provide remote monitoring and advanced warning capabilities that can initiate shutdown procedures to protect equipment in the event of an emergency.
- ☐ **Digitize Engineering Records:** Digitize (and safely store) engineering records to improve the utility's ability to repair and rebuild infrastructure following a major event.
- ☐ **Shutdown Procedures:** Develop remote or manual shutdown procedures to increase operational flexibility while also enabling preventative shutdowns to protect infrastructure.
- ☐ **Stockpile Inventory:** Develop and maintain a current inventory of stockpiled equipment, and consider strategically distributing stockpiles across the utility's service territory to facilitate better response following a major disruption.

Resilience at Work

Eugene Water & Electric Board Earthquake Warning System

EWEB installed two seismometers in its territory, at the Leaburg and Carmen-Smith hydroelectric facilities. The seismometers are tied in to the larger Pacific Northwest Seismic Network, the group of monitoring sites that provide input to the ShakeAlert system.

EWEB spent about $25,000 to install the two seismometers. In an earthquake, “P” waves arrive ahead of “S” waves, which are typically more damaging to structures. If the seismometers pick up P waves, it could provide valuable seconds or minutes to implement automatic preparedness procedures, such as closing headgates and opening breakers to minimize damage.

Learn more about the types of actions that specific utilities are taking to improve the resilience of their electric infrastructure.

Communications

The fourth category of actions that utilities can take to improve resilience is in the area of communications. Following a major disruption, it is possible that normal modes of communication may become inoperable and alternative methods will be required.

Take Action

The following are some of the actions that COUs can take to improve the resilience of utility communication systems:

- ☐ **Contact Information:** Develop a comprehensive communication list to enable utility staff from multiple locations to have contact information for other staff members and state or local government partners via cell phone, landline, satellite phone, or alternative communication method. Ensure that staff are familiar with key contacts and maintain digital and hard copies of this list.

Take Action

The following are some of the actions that COUs can take to improve the resilience of utility communication systems (continued):

- ☐ **Crisis Communications Plan:** Develop a plan of action for communicating with utility management, staff, customers, local government, and the public following a major disaster.
- ☐ **Redundant Communication Infrastructure:** Deploy robust fiber communication networks with redundant routes to increase the resilience of that communication system.
- ☐ **Designate Out-of-Region Partner:** Identify an out-of-region partner utility and establish a system for utility employees to remotely check in with their status following a major emergency.
- ☐ **Satellite Phones:** Equip key utility staff and/or key utility facilities with satellite phones that can establish a communication link to state and local governments, other utilities, or utility staff if normal cellular networks are down.
- ☐ **Alternative Communication Systems:** Deploy HAM radios or battery-powered walkie-talkies to enable staff-to-staff communication through alternative systems.
- ☐ **Dispatch-to-Truck:** Deploy portable radio repeater towers that can provide communication links between utility facilities and trucks in the field, and train staff on their operations.

Resilience at Work

McMinnville Water & Light Communications

Three satellite phones are dispersed among McMinnville's on-call staff, with one permanently located at the utility's treatment plant. The City also built a portable communications center. It purchased a trailer, and fitted it with a HAM radio and portable generator.

Learn more about the types of actions that specific utilities are taking to improve the resilience of their communication systems.

V. Utility Actions: Distributed Energy Resources

This section is focused on the deployment of distributed energy resources (DERs). In some instances, the utility can deploy DERs to make its own infrastructure and operations more resilient. While in other instances, utilities can coordinate with local government and critical service providers to identify the optimal deployment of DERs to improve community energy resilience. When deployed strategically, DERs have the potential to provide meaningful value for regular utility operations while also providing an important resource to assist in broader community recovery efforts following a major emergency.

Key Term

Distributed Energy Resources is an umbrella term used to refer to any resource interconnected to the distribution grid of a local utility. While definitions vary on the range of resources included, the Oregon Department of Energy considers DERs to be inclusive of the following:

- Generation sources (e.g., rooftop solar or diesel generators)
- Technologies that modify demand on the distribution system (e.g., energy efficiency and demand response)
- Electric vehicles and associated charging infrastructure

While there have been significant advancements in DER technologies in recent years, it is the intentional design and deployment of one or more types of these DERs into a cohesive microgrid that does the most to improve local energy resilience. The key distinguishing characteristic of a microgrid is its ability to disconnect, or island, from the traditional grid while continuing to deliver power to local loads.[21] Microgrid systems are often designed to provide this functionality primarily during times when there is an outage on the traditional grid.

Deep Dive

Advancements in DER Technologies

Rapid advancements in distributed generation technologies, software and hardware control systems, connected and automated loads, battery storage, and electric vehicles are creating new opportunities for the cost-effective deployment of innovative DER solutions.

Learn more about the recent trends and advancements in DER technologies.

Key Term

A microgrid is "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode."[22]

- **Size and Location.** A microgrid can range in size from a single home or building to an entire campus or even a city. The larger the size, the more complicated and expensive it is to design, build, and control.
- **Energy Efficiency.** The first step in designing a microgrid is to evaluate ways to reduce energy demand for the microgrid by improving energy efficiency.
- **Isolate Critical Loads.** All system loads should be evaluated to identify and isolate only those that are critical. For example, providing power from a microgrid to a building's heating system may be considered critical, while powering the cooling system may not be.
- **Technology Selection.** A microgrid can include virtually any type of energy technology. Additional efficiencies and environmental and health benefits can be achieved through combining technologies. This might include, for example, supplementing an existing diesel generator with a solar plus storage system that can enable the microgrid to utilize its on-site liquid fuel supplies for a longer period of time, and to operate during some hours without the generator at all.
- **Control Equipment.** The key distinguishing characteristic of any microgrid involves its ability to disconnect or "island" itself from the larger electric grid. Advanced control equipment can automatically island the system from the grid and optimize the use of DERs within the microgrid.

Resilience at Work

Oregon Examples
Using DERs to Improve Local Energy Resilience

The following is a high-level summary of several innovative utility projects in Oregon that utilize DER deployments to enhance local energy resilience.

Learn more about each of these projects and other DER examples.

EWEB: Grid Edge Demonstration Project

The Eugene Water and Electric Board has completed a project incorporating solar plus storage and a microgrid at the Howard Elementary School in Eugene. The system provides resilient back-up power to critical loads in the school and is co-located with a domestic water well to provide emergency water pumping.

PGE: Dispatchable Standby Generation

Portland General Electric has partnered with a number of large customers across its territory to leverage their existing diesel generators as an emergency utility resource, while improving the resilience capabilities of these generators for the customer.

PGE: Portland Fire Station No. 1

The City of Portland partnered with PGE to deploy a solar plus storage system at the city's Fire Station No. 1. The solar plus storage system will be paired with the existing on-site generator to provide resilient on-site back-up power for the fire station during an outage and provide benefits to the utility during normal grid operation.

Resilience at Work

Oregon Examples Leveraging DERs

Other utilities in the state are evaluating innovative energy resilience projects that would leverage DERs.

Learn more about each of these projects and other DER examples.

Tillamook PUD: Dairy Waste Microgrid Planning

As part of its three-year strategic plan, Tillamook People's Utility District is assessing how three local dairy waste digesters could be developed into a microgrid to provide power, especially following an emergency.

EWEB: Blackstarting Generation to Power Critical Loads

The Eugene Water and Electric Board is actively deploying smart meters that it anticipates will allow it to better respond following an emergency by remotely isolating critical loads on its distribution system. At the same time, EWEB is evaluating the potential to black start its utility-owned generation facilities (i.e., the capability to restore power to a portion of the electric grid without relying on the transmission system) so that they can deliver power only to these critical loads on its distribution network following a major outage on the transmission system.

Central Lincoln PUD: Using AMI to Integrate DERs

Central Lincoln PUD has deployed advanced metering infrastructure (AMI, or smart meters) that enable two-way communications between customer meters and the utility grid, in addition to providing the utility with more granular data analytics. Central Lincoln PUD anticipates utilizing these systems to help it better integrate DERs like solar, wind, biomass, battery storage, and wave energy.

Deep Dive

Deploying Resilient Microgrid Solutions

Utilities across the country are looking to deploy DER solutions to improve energy resilience. In many cases, these projects are developed in coordination with local governments and provide community energy resilience and other co-benefits.

Learn more about these projects.

Tools & Tips

Many open source tools are available to help inform the design of DER and microgrid projects:

GridLAB-D (Pacific Northwest National Laboratory)

Developed by Pacific Northwest National Laboratory, GridLAB-D is a free, open-source distribution system simulation and analysis tool that allows utilities to perform time-series simulations (from millisecond time intervals to seasonal effects over a period of years) and model control system interactions. The tool is designed to enable utilities to optimize the deployment of the latest energy technologies on their distribution systems, including distributed generation, storage, demand response, volt-VAr and conservation voltage reduction, and microgrids.

GridLAB-D was designed as a flexible simulation environment to model not only the power system, but the overlying systems that affect the power system. It allows utilities to evaluate the interplay between all elements of the distribution system, from the substation to end-use loads. The following is a list of the types of projects that utilities have used GridLAB-D to deploy:

(i) Distribution automation design and evaluation
(ii) Peak load management
(iii) Distributed solar, CHP, and storage
(iv) Rate structure analysis

Tools & Tips

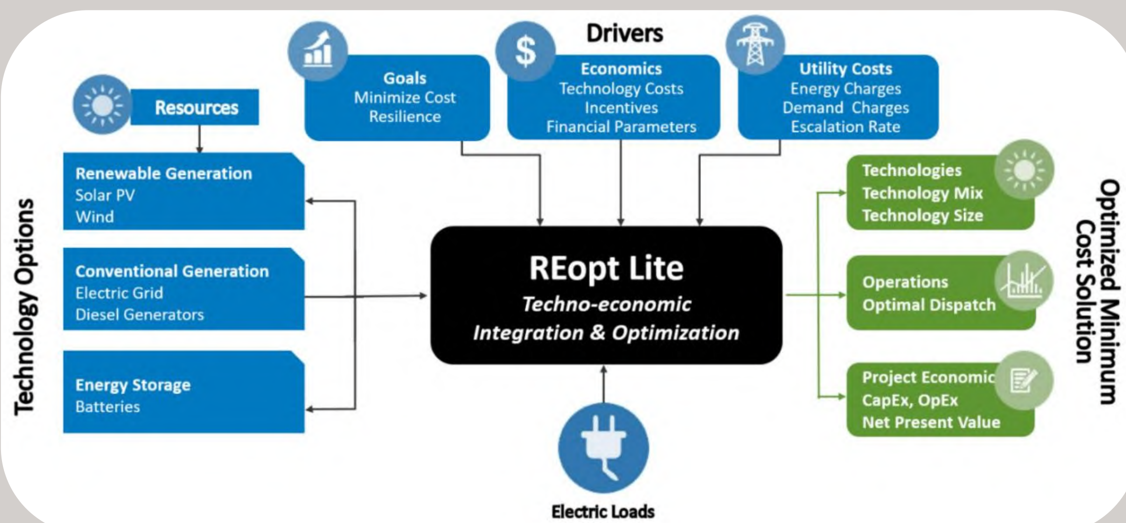
Many open source tools are available to help inform the design of DER and microgrid projects:

Renewable Energy Integration & Optimization Tool (NREL)

The National Renewable Energy Laboratory (NREL) has developed the Renewable Energy Integration & Optimization Tool (REopt) specifically for commercial building managers. According to NREL, the tool has been developed to:

(i) Evaluate the economic viability of grid-connected PV, wind, and battery storage;
(ii) Identify optimal system sizes and battery dispatch strategies to minimize energy costs; and;
(iii) Estimate how long a system can sustain critical loads during a grid outage.

Figure 3: Renewable Energy Integration & Optimization Tool (REopt)



Tools & Tips

Many open source tools are available to help inform the design of DER and microgrid projects:

Microgrid Design Toolkit (Sandia)

Sandia National Laboratories has developed a Microgrid Design Toolkit (MDT) that is available for download on its website. The MDT has been developed as a decision support tool for microgrid designers to help them identify and characterize various microgrid design decisions. According to Sandia, the MDT can be used to:

(i) Search effectively through large design spaces for efficient alternatives;
(ii) Investigate the simultaneous impacts of several design decisions;
(iii) Derive defensible, quantitative evidence for decisions; and
(iv) Gain a quantitative understanding of the relationships between design objectives and the trade-offs associated with alternate technological design decisions.

Grid Modernization Laboratory Consortium (USDOE)

The U.S. Department of Energy and the national laboratories have formed a strategic partnership called the Grid Modernization Laboratory Consortium with the goal of modernizing the electric grid. While the consortium works on a broad range of grid modernization topics, much of their work is of relevance to the topics of DER deployments, microgrids, and improving local energy resilience. The GMLC maintains a list of publicly available resources that are developed as part of the project on its website.

Considerations for DER Investments to Improve Energy Resilience	
Risk Assessment: Identify resilience threats, the likelihood of occurrence, and the expected duration of resulting disruptions.	**Critical Infrastructure & Siting:** Identify critical utility infrastructure and coordinate with local governments to identify critical energy-dependent community infrastructure.
Prioritization: Engage community stakeholders to develop a process for prioritizing which critical infrastructure assets should be targeted for DER deployments to improve community energy resilience and to capitalize on potential health and environmental co-benefits.	**Power Needs:** Evaluate how a site will be used by the community during a disaster to determine the critical loads. Calculate the amount of on-site power needed to sustain critical loads at critical infrastructure and consider ways to reduce those needs through investments in energy efficiency.
DER Solutions: Consider location-specific opportunities to deploy DER solutions that can meet on-site critical power needs, including distributed solar, diesel generators, bioenergy sources, storage, CHP, and other technologies.	**Financing:** Identify available technical assistance and appropriate mechanisms to finance DER deployments in priority locations, including: monetization of utility or grid benefits, grant funding, tax incentives, public-private partnerships, co-funding with local governments, and ratepayer investments.

VI. Federal, State, and Local Emergency Management Planning

Federal, state, and local governments invest significant time and resources on emergency management planning. Generally, federal and state plans expect that local governments will lead the response in communities following an emergency or major event. In most cases, consumer-owned utilities are likely to play a critical role in local response efforts, so it is important for utilities to understand general roles of the federal, state, and local governments as they relate to emergency management and energy resilience:

Federal Government

- Establish a national emergency management framework
- Provide funding for mitigation projects and recovery efforts
- Develop standardized communication protocols to be used in coordinated responses to major events

State of Oregon

- Develop, through the Oregon Office of Emergency Management, the state's emergency management framework and communicate with localities through county emergency managers
- Coordinate the restoration and recovery of electricity, natural gas, and liquid fuels deliveries across the state following a major event
- Conduct statewide energy resilience planning efforts focused on vulnerabilities to bulk energy systems (e.g., transmission network, liquid fuels hub, etc.)

Local Governments

- Conduct community-specific evaluations to better understand specific threats and identify mitigation investments that can improve energy resilience
- Provide coordination between local governments and energy providers to identify opportunities that enhance community energy resilience
- Develop local energy resilience strategies that complement broader state and federal emergency management and preparedness efforts

Federal Government: FEMA

FEMA Region X Headquarters

Federal Regional Center
130 – 228th Street, Southwest
Bothell, WA 9021-8627
425-487-4600

fema.gov/region-x-ak-id-or-wa

The Federal Emergency Management Agency coordinates the federal government's role in preparing for, preventing, mitigating the effects of, responding to, and recovering from all domestic disasters, whether natural or man-made.[23] To carry out its mission, FEMA relies heavily on regional field offices that coordinate with state and local emergency managers. Oregon (along with Washington, Idaho, and Alaska) is located within FEMA Region X, headquartered in Bothell, WA.

FEMA's work is guided by five separate frameworks, collectively referred to as the National Planning Frameworks.[24] The National Planning Frameworks are intended to describe how entire communities and the nation work together to achieve the country's National Preparedness Goal:

> "A secure and resilient nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from threats and hazards that pose the greatest risk."

FEMA's five national planning frameworks show how state and local emergency planning efforts are aligned.

Figure 4: FEMA's Five National Planning Frameworks

Framework I: Prevention	Identify and coordinate prevention capabilities and mechanisms	Planning; public information and warnings; operational coordination
Framework II: Protection	Identify protection capabilities; align key roles and responsibilities	Physical protective measures; risk management; supply chain integrity and security
Framework III: Mitigation	Raise community awareness of risks and mitigation strategies	Community resilience; long-term vulnerability reduction; identify risks and hazards
Framework IV: Response	Roles, responsibilities, structure for responding to threats, hazards, and events	Critical transportation; search and rescue; fatality response; communications
Framework V: Recovery	Roles, responsibilities, structure for response; pre- and post-disaster planning	Economic recovery; health and social services; infrastructure; natural/cultural resources

FEMA Funding

Another important role of the federal government in this space concerns funding for mitigation projects and recovery efforts. In many cases, such as with FEMA's Pre-Disaster Mitigation funding program, an electric utility may need to develop a FEMA-approved Hazard Mitigation Plan before applying for federal funding.

Key Term

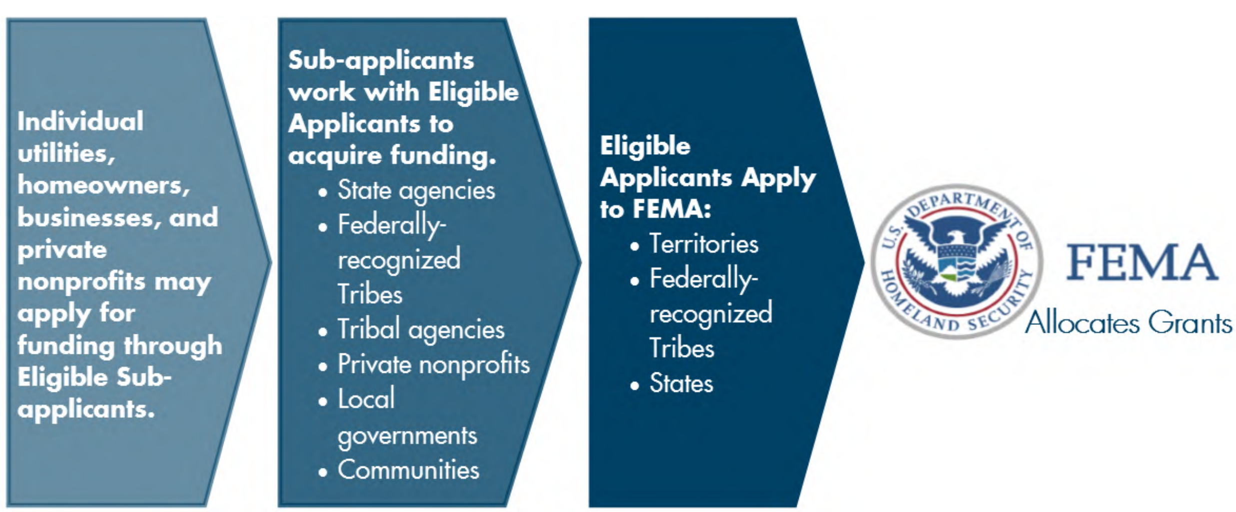
A local **Natural Hazard Mitigation Plan** (NHMP) identifies and examines the hazards, vulnerabilities, and risks facing a city, county, or special district. The NHMP also identifies a mitigation strategy to reduce expected impacts on people, property, and the environment.

For more information about the development of NHMPs, check out the Oregon Office of Emergency Management's background page on Natural Hazards Mitigation Planning and FEMA's Local Mitigation Plan Handbook.

When applying to FEMA for pre-disaster funding, the Oregon Office of Emergency Management will be the sole applicant for all statewide applications for funding from FEMA. In order for COUs to participate, they will need to either qualify as a "sub-applicant" directly or work with another eligible sub-applicant (such as a city or county government).

Applications for funding must be consistent with the goals and objectives identified in both (1) the state's NHMP, and (2) the NHMP of the local jurisdiction in which the project would be located. Eligible sub-applicants are then required to submit completed applications to OEM at least 30 days prior to FEMA's deadline.

Figure 5: Flowchart for Eligible Applicants for FEMA Funding



Deep Dive

FEMA's Role in Emergency Management

Learn more about FEMA's role in emergency management planning, including information about potential funding opportunities for utilities.

Federal Government: USDOE

In 2013, the U.S. Department of Homeland Security published an updated *National Infrastructure Protection Plan*.[25] The NIPP outlines how government and private sector entities in the critical infrastructure community work together to manage risks and achieve desired outcomes for security and resilience. The U.S. Department of Energy was designated by Presidential Policy Directive 21 (PPD-21) as the sector-specific agency tasked with carrying out the federal government's mission to prepare for, prevent, mitigate the effects of, respond to, and recover from major events in the energy sector.[26] In particular, the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) leads the Department's emergency preparedness and coordinated response to disruptions in the energy sector, including physical and cyber-attacks, natural disasters, and man-made events.

CESER was formed in 2018 as a new office within USDOE and is comprised of two divisions: Cybersecurity for Energy Delivery Systems (CEDS) and Infrastructure Security and Energy Restoration (ISER). CEDS focuses on the cyber threat, vulnerability sharing, supply chain risks, and component vulnerabilities. ISER focuses on working with state and local governments to secure energy infrastructure against all hazards, reduce impacts from disruptive events, and recover from disruptions.

Deep Dive

Federal Cybersecurity Resources

Learn more about available federal government tools and resources designed specifically for addressing cybersecurity risks in the electric sector.

Tools & Tips

CESER has several resources available online that may be of interest to utilities and the communities that they serve:

Cybersecurity

CESER plays an important role in coordinating cybersecurity initiatives within the energy sector in cooperation with other government partners and private industry.

Situation Reports

SitReps provide details on the impact of major events (both current and archived) and the energy industry's recovery and restoration activities. Details include an evaluation of recovery compared to pre-event conditions for electricity, natural gas, and liquid fuel deliveries. They also identify any energy-related waivers from federal agencies necessary for recovery operations.

Community Guidelines for Energy Emergencies

A resource developed for homeowners, local businesses, and governments intended to help them prepare for and respond to energy emergencies. It is intended to complement the energy restoration activities of utilities and other energy providers that will likely be focused on critical public services.

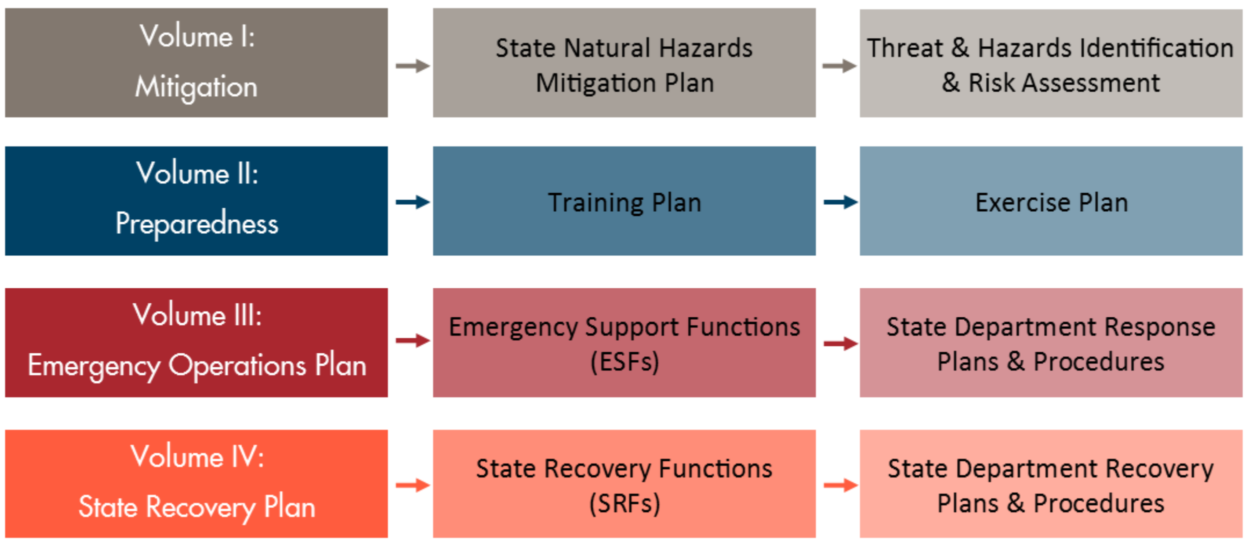
USDOE Funding

The U.S. Department of Energy also has funding opportunities that may support local energy resilience activities by utilities. Several different offices within USDOE hold competitive solicitations on a regular basis to award funding and can be found on the Department's Funding & Financing webpage. These opportunities are frequently changing, however, so utilities are encouraged to sign up for email alerts from USDOE or periodically check for new funding opportunities that may align with the utility's local energy resilience objectives.

State of Oregon

The Oregon Office of Emergency Management develops and maintains the State of Oregon Comprehensive Emergency Management Plan. The CEMP is broken into volumes that correspond to the four following core functions of emergency management at the state level: Mitigation, Preparedness, Response, and Recovery.

Figure 6: Oregon's Four Core Functions from the Comprehensive Emergency Management Plan



Note that these four core functions parallel the five core mission areas of FEMA (Prevention, Protection, Mitigation, Response, and Recovery) as reflected in the National Planning Frameworks.

An important component of the CEMP for consumer-owned utilities is the Emergency Operations Plan, which identifies, consistent with FEMA's guidance, primary state agency leads for each of 18 Emergency Support Functions (ESFs). ESF 12 relates to energy matters with the Oregon Department of Energy and the Oregon Public Utility Commission identified as primary lead agencies.

Deep Dive

State Emergency Management Planning

Learn more about Oregon's CEMP, including an identification of all the ESFs. You'll also find a snapshot from the *Cascadia Playbook* of what to expect for ESF 12 following a Cascadia earthquake.

Energy Assurance Plan

In their lead roles for ESF 12, the Oregon Department of Energy and the Oregon Public Utility Commission developed an Energy Assurance Plan (EAP).[27] The plan provides:

- (i) An overview of the state's energy infrastructure and overall energy profile.
- (ii) A high-level evaluation of the role of renewables and smart grid technologies in energy assurance planning.
- (iii) A description of different types of energy emergencies that could occur in Oregon.
- (iv) An explanation of how the state would respond to energy emergencies.

ODOE and OPUC are designated as the primary state agencies for planning, preparedness, response, and recovery to energy emergencies with potential impacts to Oregonians. OPUC is responsible for developing and maintaining emergency response plans for electricity and natural gas emergencies, while ODOE is responsible for developing and maintaining an emergency response plan for the liquid fuels sector.

Oregon Resilience Plan

The Oregon Resilience Plan was developed in 2013 by the Oregon Seismic Safety Policy Advisory Commission at the direction of the Oregon Legislature. The ORP evaluates the expected effects of a CSZ earthquake and tsunami to different sectors and regions of Oregon, with recommendations to reduce risk and improve recovery. These recommendations were formulated with the intention that, if implemented over the next 50 years, the state could achieve resilience targets as identified by the ORP to reduce timelines for the restoration of certain services following a CSZ earthquake. Chapter 6 of the ORP is focused on the state's energy sector, and identifies 10 recommendations for the state to improve its resiliency.

Deep Dive

State Energy Resilience Planning

Learn more about Oregon's Energy Assurance Plan and the Oregon Resilience Plan, including details on the Oregon Fuel Action Plan.

Local Governments

As noted throughout the guidebook, local governments play a critical role in preparing for and responding to emergencies. The guidebook does not dedicate much space to discussing the specific activities being undertaken by local governments because there is significant variety among them; the most important action is to connect with the particular local governments in your service territory to understand what they are doing and how the utility can collaborate. To find contact information for local emergency managers in your county, refer to the Local and Tribal Emergency Managers List maintained and updated by the Oregon Office of Emergency Management.

Utility Checklists: Local Energy Resilience Planning

These checklists can be used as quick reference guides for consumer-owned utility staff who are developing local energy resilience plans. As noted in the introduction to this guidebook, these are only recommendations and suggestions to help utilities improve local energy resilience.

Take Action

Preparation

Assessment of Resilience Threats

- ☐ Identify specific resilience threats in the utility's service territory
- ☐ Evaluate the likelihood of occurrence of potential resilience threats
- ☐ Identify impacts expected to the utility and local communities, including severity and duration
- ☐ Assess dependency of the utility and local communities on the state's bulk energy systems and how impacts could have local effects

Evaluate Local Resources

- ☐ Identify utility-owned local generation sources and whether those sources can "blackstart"
- ☐ Identify which of the utility's customers already have on-site generation capabilities
- ☐ Develop a technical assessment of the potential for new distributed generation resources
- ☐ Identify existing energy storage capabilities within the utility's service territory and the potential to develop more
- ☐ Conduct technical assessment to identify necessary investments required to segment or island portions of the distribution system

Coordination

- ☐ Connect with local governments to identify what types of emergency planning they have done and the extent to which those plans consider the resilience of local energy systems
- ☐ Identify the interdependencies of the delivery of critical public services with the resilience of the energy sector
- ☐ Identify whether critical public service providers have on-site back-up generation capabilities, or if not, whether they have alternative energy contingency plans
- ☐ Evaluate whether there are opportunities to make strategic investments in coordination with local governments to maximize community energy resilience benefits

Business Continuity Planning: People

- ☐ Develop a culture of preparedness
- ☐ Integrate regular safety trainings
- ☐ Train staff in FEMA's Incident Command System
- ☐ Develop succession and devolution plans
- ☐ Encourage staff participation in resilience planning at state and local level
- ☐ Establish mutual aid agreements and utilize them to ensure staff readiness
- ☐ Equip utility vehicles with Go Bags
- ☐ Share resilience information with staff on an ongoing basis

Business Continuity Planning: Facilities

- ☐ Conduct facilities assessment
- ☐ Complete a comprehensive vulnerability and risk assessment that includes the scope of expected impacts and mitigation costs
- ☐ Prioritize investments in facilities to address resilience threats
- ☐ Evaluate need for alternate facility sites
- ☐ Plan to remodel, retrofit, or relocate key facilities based on threat assessment
- ☐ Expand on-site power capabilities
- ☐ Expand capabilities to house staff on site

Business Continuity Planning: Infrastructure

- ☐ Complete a comprehensive vulnerability and risk assessment that includes the scope of expected impacts and mitigation costs
- ☐ Prioritize investments in infrastructure to address resilience threats
- ☐ Plan to retrofit or rebuild key infrastructure to meet seismic code
- ☐ Evaluate the ability of transmission and distribution towers to withstand threats
- ☐ Relocate infrastructure from inundation, tsunami, and liquefaction zones
- ☐ Deploy remote sensing capabilities
- ☐ Digitize critical engineering records
- ☐ Develop emergency infrastructure shutdown procedures

Business Continuity Planning: Communications

- ☐ Develop distributed communication lists
- ☐ Deploy redundant communication infrastructure
- ☐ Equip key staff and facilities with satellite phones
- ☐ Deploy radios or walkie-talkies to enable back-up staff-to-staff communication
- ☐ Deploy portable radio repeaters for back-up communication with utility truck fleet

Distributed Energy Resources

- ☐ Identify critical utility infrastructure and critical energy-dependent community infrastructure
- ☐ Assess how much on-site power is needed to sustain critical loads at critical infrastructure after considering investments in energy efficiency
- ☐ Identify opportunities for deploying DERs that maximize value to the utility and to communities
- ☐ Engage community stakeholders to identify priority locations for improving community energy resilience
- ☐ Identify mechanisms to finance DER resilience solutions

Online Resources: Local Energy Resilience Planning

Business Continuity Plan Resources

Continuity Guidance Circular (FEMA)
Continuity Resource Toolkit (FEMA)
Every Business Should Have a Plan (FEMA)
Developing and Maintaining Emergency Operations Plans (FEMA)
Build-a-Kit (Go Bag) (U.S. Department of Homeland Security)
IEEE 693-2018: Recommended Practice for Seismic Design of Substations (IEEE)

Mutual Aid Resources

Western Regional Mutual Assistance Group (WRMAG)
American Public Power Association – Mutual Aid Program (American Public Power Association)
IS-706: NIMS Intrastate Mutual Aid – An Introduction (FEMA)

Natural Hazard Mitigation Planning Resources

Natural Hazards Mitigation Planning (Oregon Dept. of Land Conservation and Development)
Local Mitigation Planning Handbook (FEMA)
Example: Hazard Mitigation Plan Annex to Land County HMP (Emerald PUD)

Other State Resources

Comprehensive Emergency Management Plan (Oregon Office of Emergency Management)
Cascadia Playbook v.3 (Oregon Office of Emergency Management)
Local and Tribal Emergency Managers List (Oregon Office of Emergency Management)
Oregon Resilience Plan (Oregon Seismic Safety Policy Advisory Commission)
Oregon Fuel Action Plan (Oregon Department of Energy)
Oregon HazVu: Statewide Geohazards Viewer
Advanced Oregon Wildfire Risk Explorer

Other Federal Resources

Electric Power System Resiliency: Challenges and Opportunities (EPRI)
Utility Investments in Resilience of Electricity Systems (Lawrence Berkeley National Lab)
National Infrastructure Protection Plan: Energy Sector-Specific Plan (U.S. Dept. of Energy)
Clear Path IV: Energy-Focused Disaster Response Exercise (U.S. Dept. of Energy)
FEMA Region X Power Grid Risk Profile (FEMA)

Severe Contingency Solver for Electric Power Transmission Systems (Los Alamos National Lab)

Emergency Power Resources for Critical Facilities

Emergency Power Systems for Critical Facilities (FEMA)
Emergency Power Facility Assessment Tool (U.S. Army Corps of Engineers)

FEMA's Ready Business Toolkits

Business Emergency Preparedness Social Media Toolkit (FEMA)
Earthquake "QuakeSmart" Toolkit (FEMA)
Inland Flooding Toolkit (FEMA)
Power Outage Toolkit (FEMA)
Severe Wind/Tornado Toolkit (FEMA)

Microgrid and DER Resources

National Laboratory Microgrid Planning Tools

GridLAB-D (Pacific Northwest National Laboratory)
Re-Opt: Renewable Energy Integration & Optimization Tool (NREL)
Microgrid Design Toolkit (Sandia National Laboratory)
Additional Microgrid Resources (Grid Modernization Laboratory Consortium)

IEEE Standards

IEEE 1547-2018 Standard for Interconnection and Interoperability of DERs (IEEE)
IEEE 2030.7-2017 Standard for the Specification of Microgrid Controllers (IEEE)

Other

The Value of Resilience for DERs: An Overview of Current Analytical Practices (NARUC)
Stochastic Optimization of Microgrids with Renewable and Storage Energy Systems (IEEE)

Cybersecurity Resources

Cybersecurity Tools and Information Sharing

National Cyber Alert System (U.S. Department of Homeland Security)
Electricity-Information Sharing and Analysis Center (NERC)
Cybersecurity Capability Maturity Model (U.S. Department of Energy)
Cyber Resilience Review (U.S. Department of Homeland Security)
Cyber Security Evaluation Tool (U.S. Department of Homeland Security)

Cybersecurity Standards and Guidelines

Critical Infrastructure Protection Standards (NERC)
Risk Management Process Guidelines (U.S. Department of Energy)
Energy Sector Cybersecurity: Framework Implementation Guidance (U.S. Dept. of Energy)
Guidelines for Smart Grid Cybersecurity (National Institute of Standards and Technology)

Federal Funding Resources

U.S. Department of Energy

Funding & Financing

Federal Emergency Management Administration

Disaster Recovery Reform Act of 2018 (DRRA)

Pre-Disaster
Pre-Disaster Mitigation (PDM)
Flood Mitigation Assistance (FMA)
Regional Catastrophic Preparedness Grant Program (RCPGP)
National Earthquake Hazard Reduction Program (NEHRP)
National Tsunami Hazard Mitigation Program (NTHMP)
NIMS and ICS All-Hazard Training Program

Post-Disaster
Hazard Mitigation Grant Program (HMGP)
Public Assistance Grant Program (PAGP)
Fire Management Assistance Grant Program (FMAGP)

Other Federal Agencies

Coastal Resilience Grants Program (National Oceanic and Atmospheric Administration)
Planning Program and Local Technical Assistance Program (Department of Commerce)
Investments for Public Works and Economic Development Facilities (Department of Commerce)
Economic Adjustment Assistance Program (Department of Commerce)
Electric Infrastructure Loan & Loan Guarantee Program (USDA)
Energy Efficiency and Conservation Loan Program (USDA)
Energy Resource Conservation (USDA)
Distributed Generation Energy Project Financing (USDA)

References

[1] Federal Energy Regulatory Commission (FERC), *Reliability Primer*, p. 74. Available online: https://www.ferc.gov/legal/staff-reports/2016/reliability-primer.pdf

[2] Oregon Department of Energy, *Biennial Energy Report – Chapter 5: Resilience* (2018), see p. 3. Available online: https://www.oregon.gov/energy/Data-and-Reports/Documents/BER-Chapter-5-Resilience.pdf

[3] Electric Power Research Institute (EPRI), *Power System Transformation: Flexibility, Connectivity, Resiliency*. 2016. Available online: https://www.epri.com/#/pages/product/000000003002007377/

[4] Electric Power Research Institute (EPRI), *Electric Power System Resiliency: Challenges and Opportunities*. 2016. Figure 1, p. 3. Available online: https://www.epri.com/#/pages/product/3002007376/

[5] Oregon Seismic Safety Policy Advisory Commission (OSSPAC), *The Oregon Resilience Plan: Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami.* Report to the 77th Legislative Assembly. February 2013.

[6] *Oregon Resilience Plan* at p. 43.

[7] *Oregon Resilience Plan* at p. 5.

[8] Petersen, M. D., Cramer, C. H., and Frankel, A. D., 2002, Simulations of seismic hazard for the Pacific Northwest of the United States from earthquakes associated with the Cascadia subduction zone: Pure and Applied Geophysics, v. 159, no. 9, 2147–2168. https://doi.org/10.1007/s00024-002-8728-5

[9] Goldfinger, C., Nelson, C. H., Morey, A. E., Johnson, J. E., Patton, J. R., Karabanov, E., Gutiérrez-Pastor, J., Eriksson, A. T., Gràcia, E., Dunhill, G., Enkin, R. J., Dallimore, A., and Vallier, T., 2012, Turbidite event history — Methods and implications for Holocene paleoseismicity of the Cascadia subduction zone: U.S. Geological Survey Professional Paper 1661–F, 170 p. https://pubs.usgs.gov/pp/pp1661f/

[10] Goldfinger, C., Galer, S., Beeson, J., Hamilton, T., Black, B., Romos, C., Patton, J., Elson, H. C., Hausmann, R., and Morey, A., 2017, The importance of site selection, sediment supply, and hydrodynamics: a case study of submarine paeloseismology on the northern Cascadia margin, Washington, USA: Marine Geology, v. 384, p. 4–16, 17, 24–46. https://doi.org/10.1016/j.margeo.2016.06.008

[11] Dalton, M.M., P.W. Mote, and A.K. Snover [Eds.]. 2013. Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities. Washington, DC: Island Press. http://cses.washington.edu/db/pdf/daltonetal678.pdf

[12] Dalton, M.M., K.D. Dello, L. Hawkins, P.W. Mote, and D.E. Rupp (2017) The Third Oregon Climate Assessment Report, Oregon Climate Change Research Institute, College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR. http://www.occri.net/media/1042/ocar3_final_125_web.pdf

[13] IPCC, 2014a: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.

[14] USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S.

Global Change Research Program, Washington, DC, USA, 470 pp, doi: 10.7930/J0J964J6. https://science2017.globalchange.gov/

[15] U.S. Departments of Energy and Homeland Security. National Infrastructure Protection Plan: Energy Sector-Specific Plan. 2015. Washington, D.C. p. 14-16. Available online: https://www.dhs.gov/sites/default/files/publications/nipp-ssp-energy-2015-508.pdf

[16] Emerald People's Utility District (EPUD), "Hazard Mitigation Plan Annex to the Lane County Hazard Mitigation Plan." September 13, 2016. https://www.epud.org/wp-content/uploads/epud_hazard_mitigation_plan_8-9-16-Board-Meeting.pdf

[17] *Oregon Resilience Plan* at p. 13.

[18] Federal Emergency Management Administration (FEMA), "Continuity Guidance Circular." February 2018. https://www.fema.gov/media-library-data/1520878493235-1b9685b2d01d811abfd23da960d45e4f/ContinuityGuidanceCircularMarch2018.pdf

[19] Federal Emergency Management Agency (FEMA), "Every Business Should Have a Plan." https://www.fema.gov/media-library-data/1389022685845-7cdf7d7dad7638a19477d01fdbfa820f/Business_booklet_12pg_2014.pdf

[20] EPRI, *Electric Power System Resiliency* at Figure 3, p. 14.

[21] For more information on the technical standards required for the operation of a microgrid, see IEEE 2030.70-2017 – IEEE Standard for the Specification of Microgrid Controllers. https://standards.ieee.org/standard/2030_7-2017.html

[22] U.S. Department of Energy Microgrid Exchange Group. Microgrid Definitions. 2018. https://building-microgrid.lbl.gov/microgrid-definitions

[23] https://www.fema.gov/about-agency

[24] https://www.fema.gov/media-library-data/1466016288879-63f68f6dced909f08cf8687deaa8e718/Overview_of_National_Planning_Frameworks.pdf

[25] U.S. Department of Homeland Security, *NIPP 2013: Partnering for Critical Infrastructure Security and Resilience*. https://www.dhs.gov/cisa/national-infrastructure-protection-plan

[26] U.S. Department of Homeland Security, *Energy Sector*. https://www.dhs.gov/cisa/energy-sector

[27] Oregon Department of Energy and Oregon Public Utility Commission. Oregon State Energy Assurance Plan. 2012. Salem, OR. https://www.oregon.gov/energy/Data-and-Reports/Documents/2012%20Oregon%20State%20Energy%20Assurance%20Plan.pdf

This material is based upon work supported by the Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), under the State Energy Program Award Number DE-EE0008292.

OREGON DEPARTMENT OF ENERGY

550 Capitol St. NE
Salem OR 97301
800-735-8055
www.oregon.gov/energy
askenergy@oregon.gov