U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

U.S. Department of Energy Financing Mechanisms and Resilience Tools

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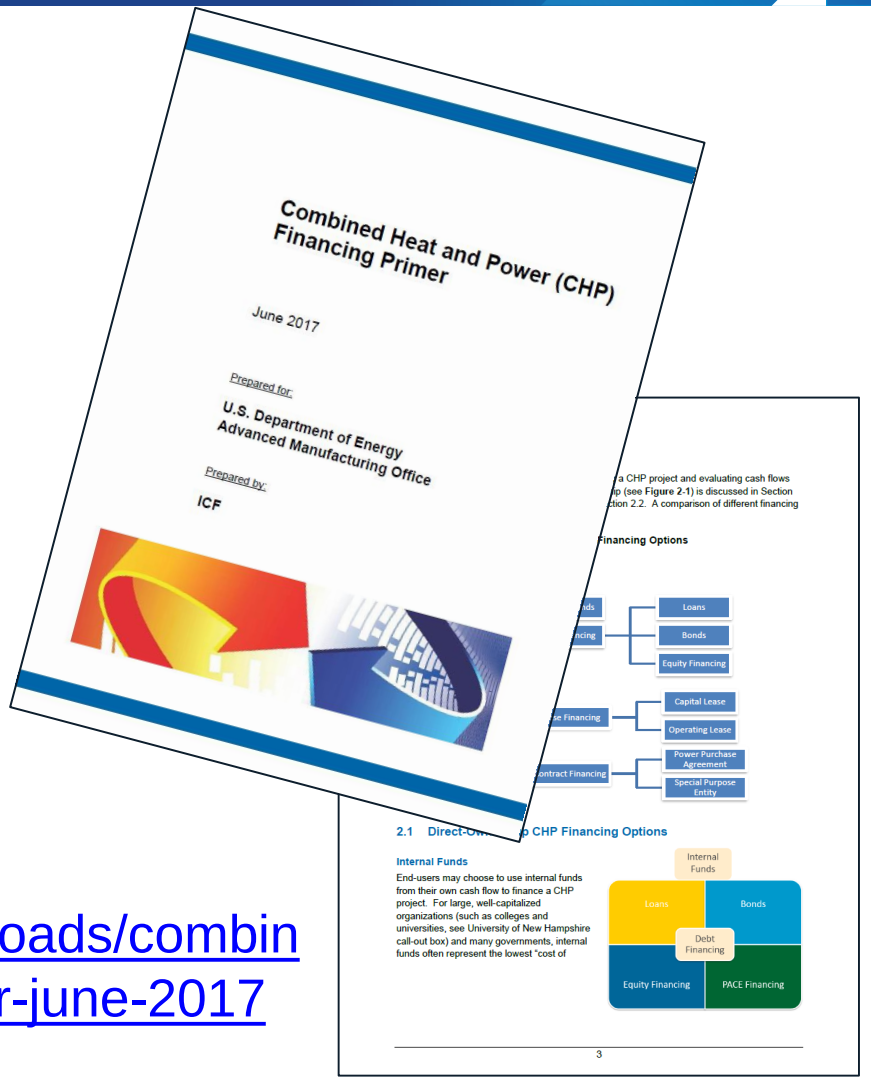
ICF

CHP Financing Primer

- Summary of financing options
- Considerations for what financing option is right for your project
- Case study examples for each option

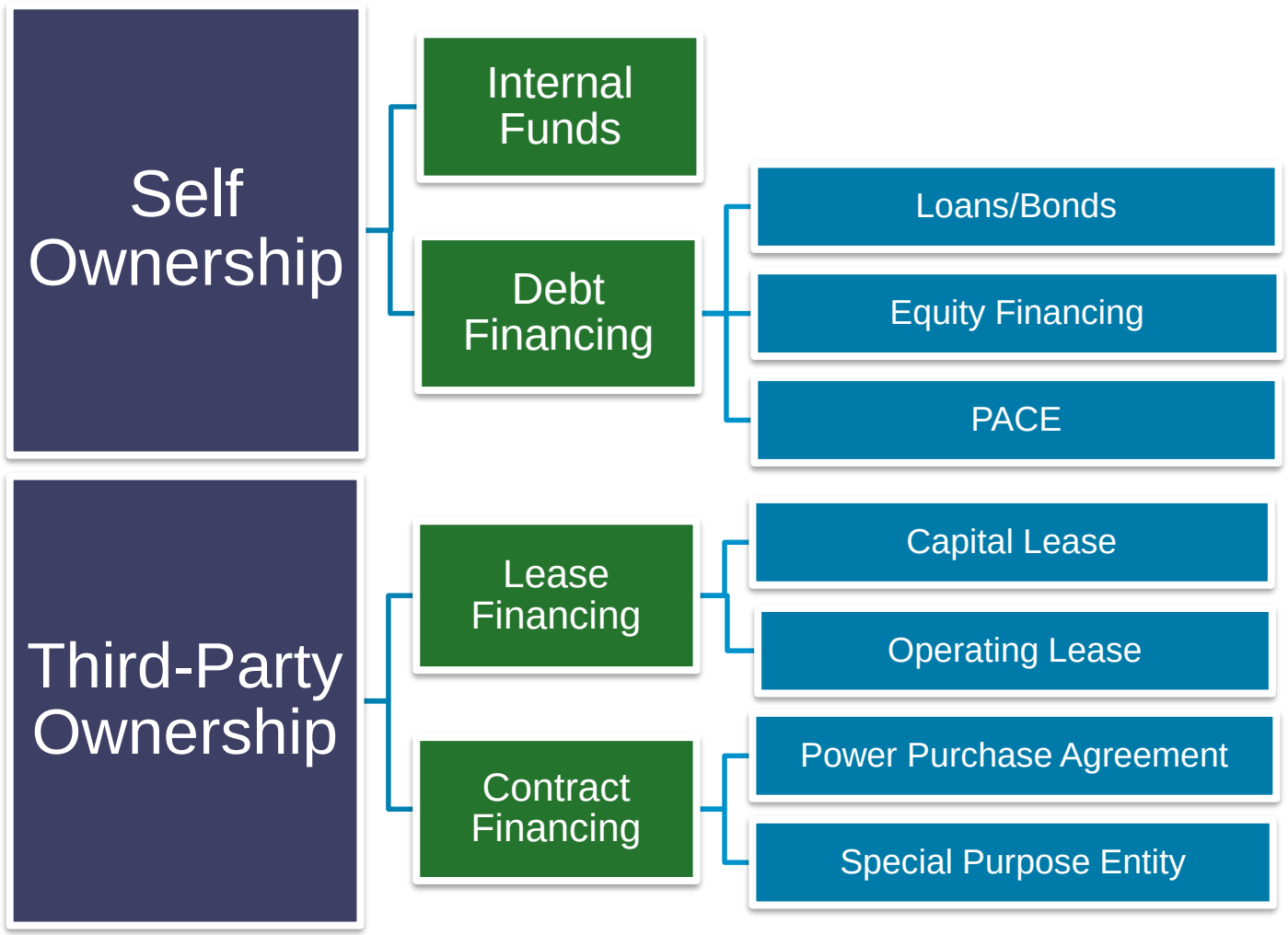


Available at:
https://www.energy.gov/eere/amo/downloads/combined-heat-and-power-chp-financing-primer-june-2017

Financing Goals

- CHP ownership and financing strategy is all about allocating project risks and responsibilities
- A thorough understanding of the goals of your project and the risks you are willing to take on will determine your best financing option
- Ownership strategies have changed over time and will continue to evolve

CHP Financing Options

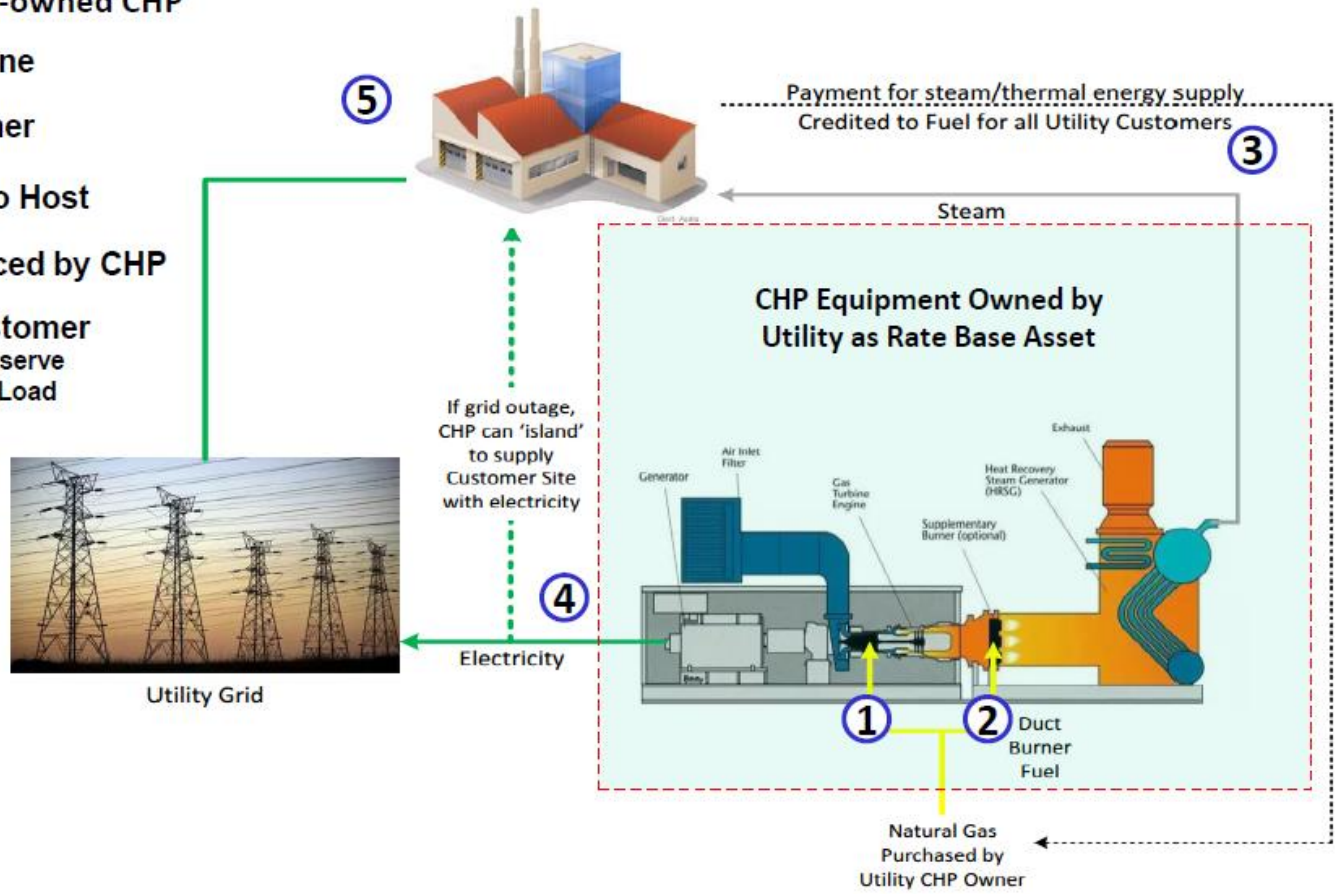


Utility-Owned CHP Structure

Simplified Structure for Utility-Owned CHP

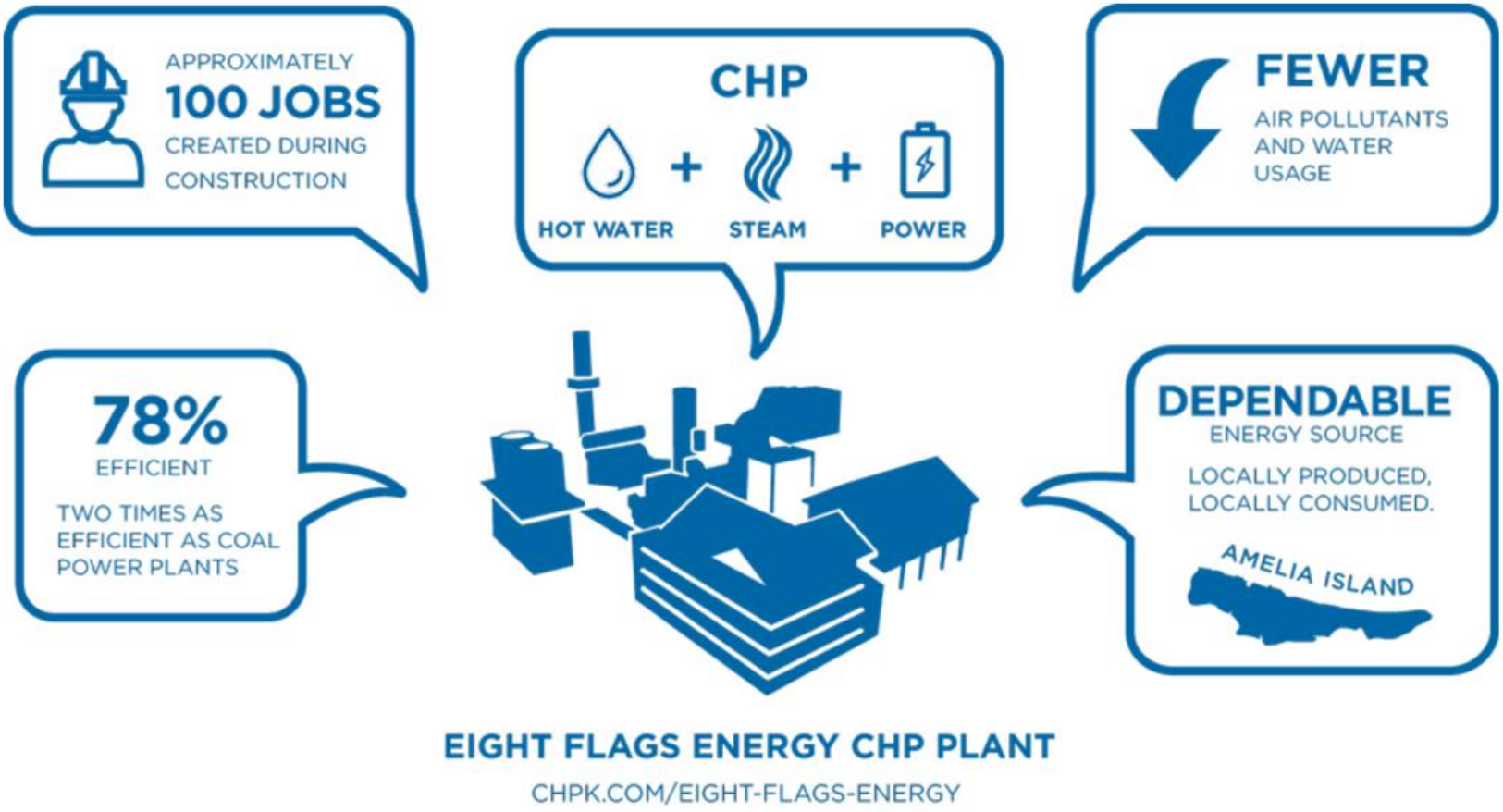
Meter Points for Utility-owned CHP

1. Fuel to Gas Turbine
2. Fuel to Duct Burner
3. Steam/Thermal to Host
4. Electricity Produced by CHP
5. Electricity to Customer
   Utility continues to serve Customer Electric Load



Source: Sterling Energy Group, LLC

Florida Public Utilities / Rayonier 21 MW CHP Overview – Eight Flags CHP



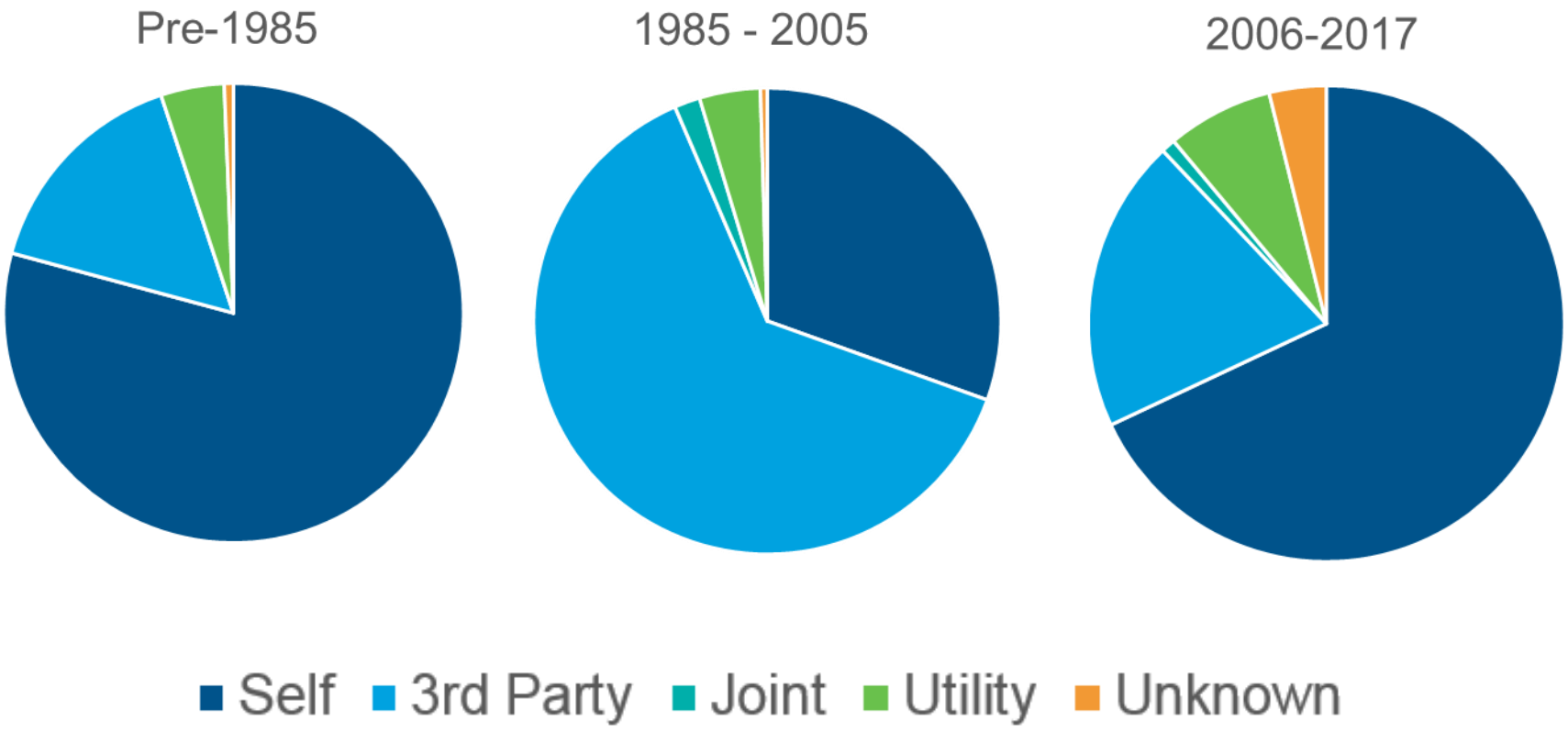
Source: Chesapeake Utilities, http://www.chpk.com/eight-flags-energy/

Typical Financing Timeframe

Start-to-finish: 3 – 6 months

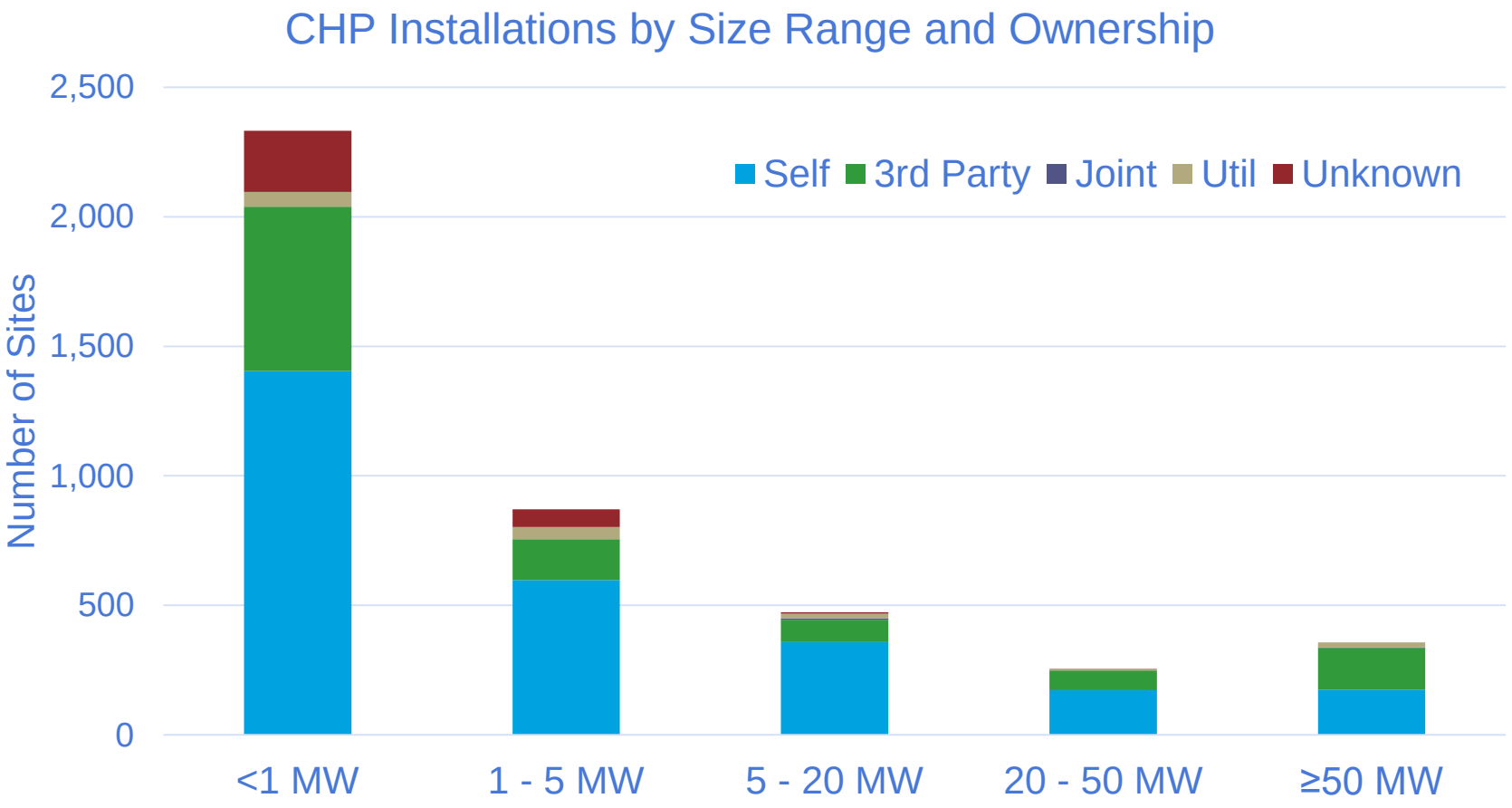
½ – 1 ½ months	½ – 1 ½ months	1 – 2 months	1 – 2 months
Identify lender to provide financing	Draft term sheet	Negotiate contract terms and conditions	Finalize contract language and obtain financing

CHP Capacity by Ownership



Source: DOE/ICF CHP Installation Database (U.S. installations as of Dec. 31, 2017)

CHP System Size Impact on Ownership

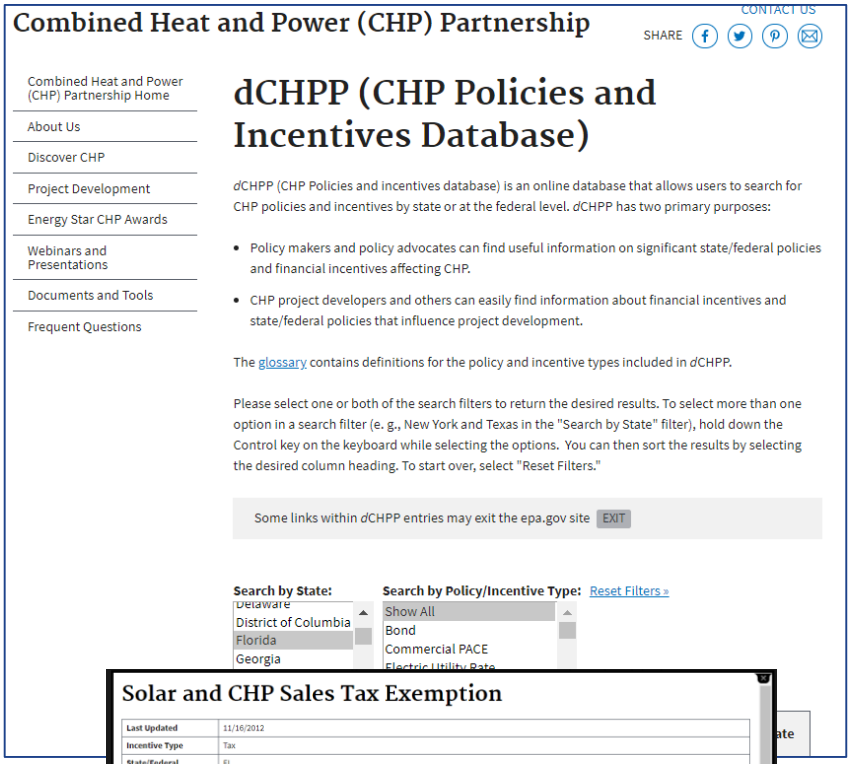


Source: DOE/ICF CHP Installation Database (U.S. installations as of Dec. 31, 2015)

EPA dCHPP Database

- The CHP policies and incentives database is an online U.S. CHP policy database hosted by the Environmental Protection Agency
- dCHPP allows users to search for CHP policies and incentives at federal, state, and local levels
- Policy/incentive results include information such as:
  - Summary info
  - CHP eligibility requirements
- Information is updated annually

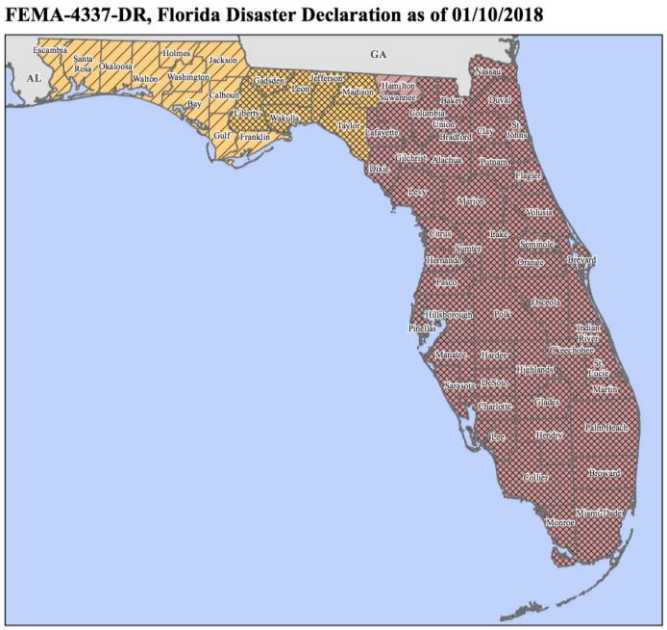
Available at: https://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database



Timely Resiliency Incentives/Financing Programs

U.S. Economic Development Administration

2018 Disaster Supplemental



Facts:

- Congress approved $600 in FY2018 funding for economic recovery in disaster areas.
- Atlanta office $147 million allocation
- EAA funds can be awarded to assist a wide variety of activities related to disaster recovery focused on economic development, including economic recovery strategic planning grants and construction assistance.
- Includes **"Resiliency projects to increase the ability of a community or region to anticipate, withstand, and bounce back from future economic injuries and disasters."**
- More info: https://www.eda.gov/programs/disaster-recovery/2018-supplemental/

Timely Resiliency Incentives/Financing Programs

FEMA

2018 Pre-Disaster Mitigation Grant

Facts:

- Congress approved $235 million in FY2018 funding for economic recovery in disaster areas
- States receive $575K allocation and remaining funds are awarded competitively
- Local governments are eligible subapplicants
- After natural hazard mitigation projects, FEMA will select projects to fund **"Generators for critical facilities identified in a FEMA-approved mitigation plan and meet the standards set by local building codes."**
- Application period is Oct 1-Jan 31, 2019
- More info:
- https://www.fema.gov/pre-disaster-mitigation-grant-program

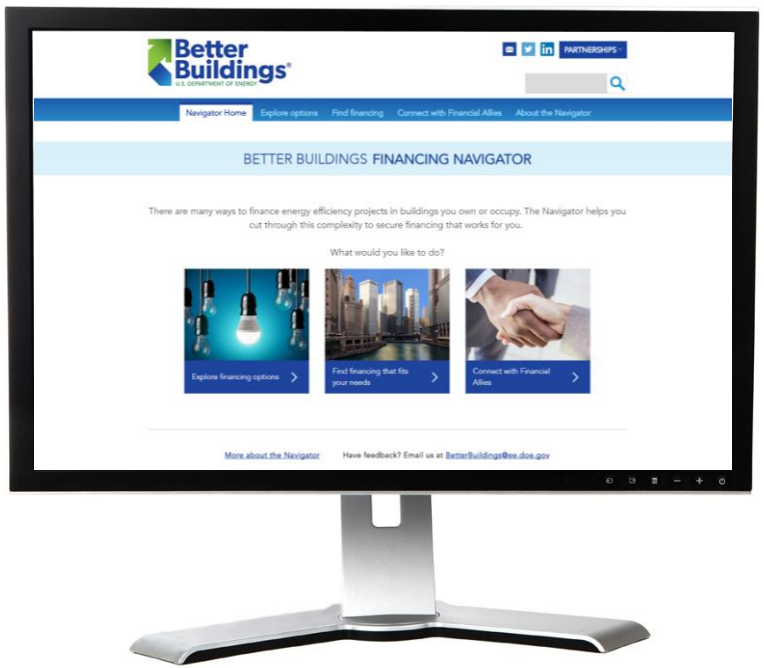
Timely Resiliency Incentives/Financing Programs

Funding Opportunities:

- Building U.S. Communities' and Businesses' Resilience to Extreme Events – NOAA Climate Program Office
- EPA Smart Growth Grants and Other Funding
- FEMA Preparedness Grants
- FEMA Hazard Mitigation Assistance
- USDA Natural Resources Conservation Service
- More info: https://toolkit.climate.gov/content/funding-opportunities

The Better Buildings Financing Navigator

The Navigator is an online tool that helps public and private organizations find financing solutions for energy efficiency projects.



With the Navigator, you can…

1. **Explore:** Learn the basics of the efficiency financing market
2. **Find:** Answer a few simple questions to see which financing options might be a fit for your project
3. **Connect:** Speak to Better Buildings Financial Allies who may be able to finance your project

Available at: https://betterbuildingssolutioncenter.energy.gov/financing-navigator

Who are the Better Buildings Financial Allies?

- 30+ leading financing companies that have committed to funding efficiency, renewables, and generation projects
- Primarily project financing companies
- Some institutional investors (e.g. Citi) and specialty providers (e.g. Energi)
- Active in all sectors including government, C&I, MUSH, multifamily, and residential across the U.S.
- Represent large, medium, and start-up companies
- They are available to help you!

Better Buildings® CHALLENGE
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CHP for Resiliency Accelerator

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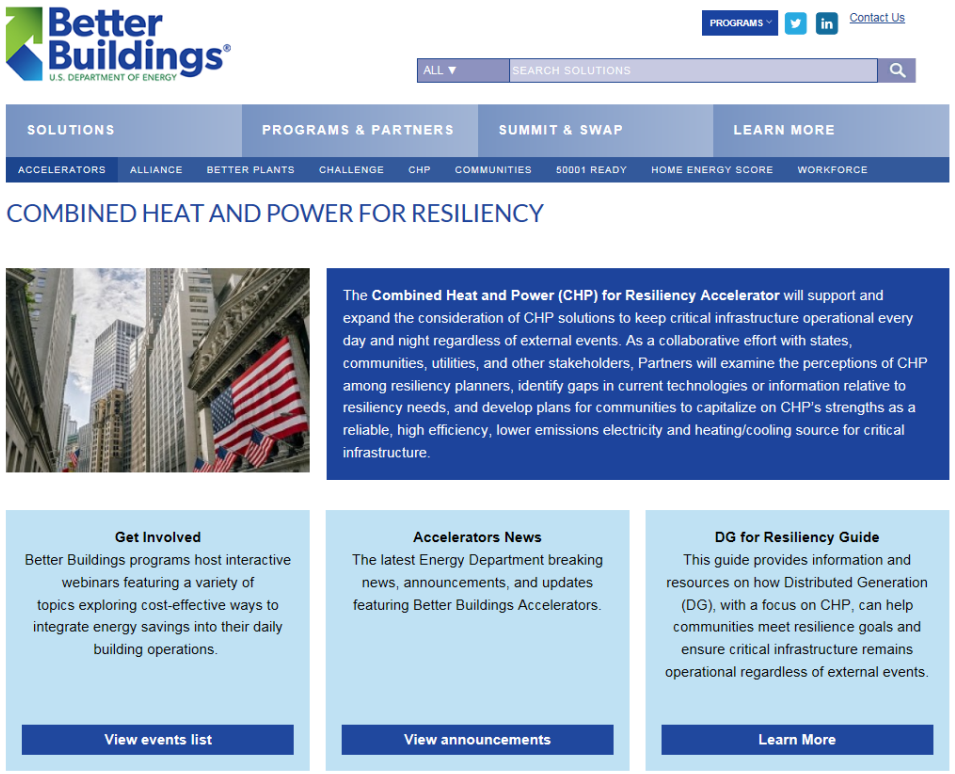
CHP for Resiliency Accelerator

- Purpose:
  - Incorporate consideration of CHP into resiliency planning efforts at the city, state, and utility levels
- Collaborate with Partners to:
  - Assess opportunities for CHP to maintain critical operations
  - Document Partner process for replicability
- Key Materials Developed:

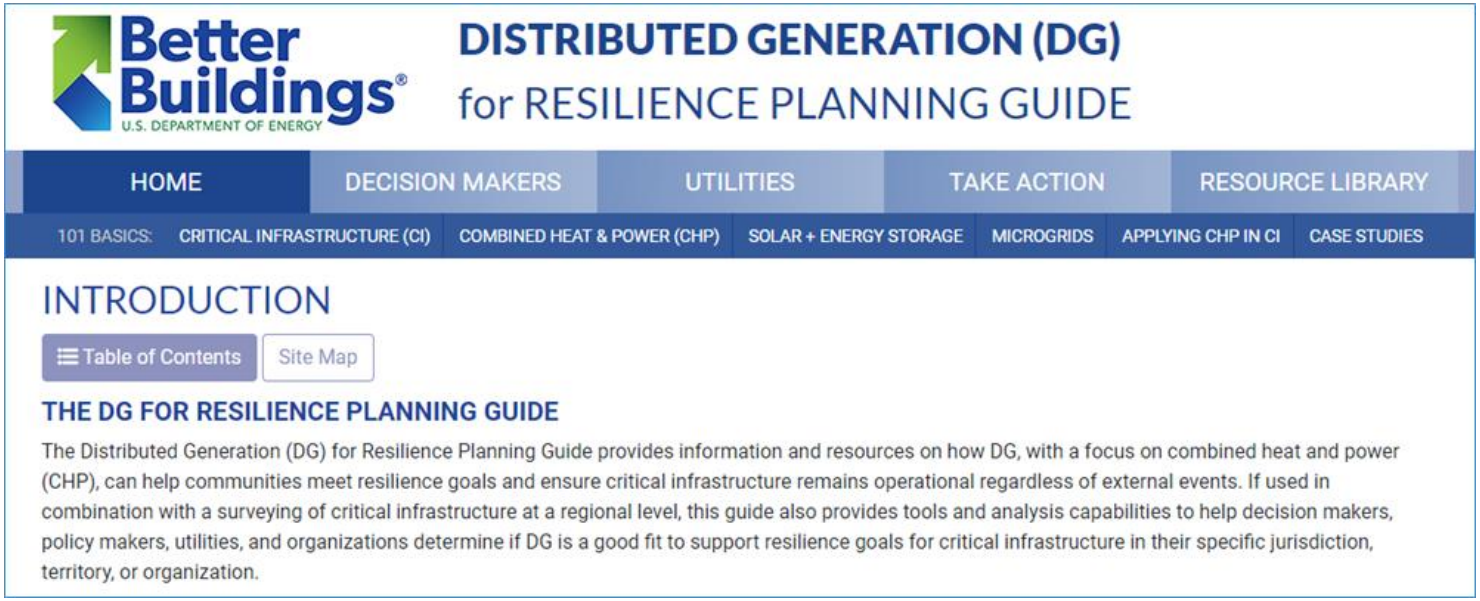
1. DG for Resiliency Planning Guide
2. CHP for Resiliency Screening Tool
3. DER Matrix – Issue Brief
4. Partner Profiles



https://betterbuildingsinitiative.energy.gov/accelerators/combined-heat-and-power-resiliency

The Distributed Generation (DG) for Resilience Planning Guide

- Web-based guide that provides information and resources on how distributed generation (w/a focus on CHP), can help communities meet resilience goals and ensure critical infrastructure remains operational regardless of external events.



Available at: **https://resilienceguide.dg.industrialenergytools.com/**

Two Main Sections to the Guide

- Stakeholder Action Pages
  - Decision Makers
  - Utilities
  - Take Action
  - Resource Library
- Information and resources for resiliency planners to actively use to incorporate CHP in their planning process.

- 101 Pages: Background Information
  - Critical Infrastructure
  - Combined Heat and Power
  - Solar + Energy Storage
  - Microgrids
  - Applying CHP in Critical Infrastructure
  - Case Studies

Take Action Page

- Provide user with an efficient approach to quickly assess a critical infrastructure portfolio for potential DG deployment, and/or;
- Provide a framework for reviewing existing resiliency strategies and policies, and developing new programs.

- **Steps 1 & 2: Identify and Rank CI Sectors and Subsectors Conducive to DG Technologies**
  - Provides users with criteria for identifying and prioritizing CI sectors conducive to DG technologies
- **Step 3: Individual Site Assessments and Next Steps**
  - Individual Site Assessments: Tools that can be used to perform individual site assessment of DG technologies are provided for users:
    - CHP Site Screening Tool
    - Solar + Storage Screening Tool
    - Microgrid Modeling Tools

Table 2. Critical Infrastructure Sub-Sectors Conducive to CHP

CI Sector	Sub-sector Conducive to CHP
Transportation	Airports
Information Technology	Data Centers
Government Facilities	College/Universities Schools Prisons Military Bases
Emergency Services	Police Stations Fire Stations
Water and Wastewater Systems	Waste Water Treatment Plants
Food and Agriculture	Food Processing Food Distribution Centers Supermarkets
Commercial Facilities	Lodging Multi-Family Buildings
Healthcare and Public Health	Hospitals Nursing Homes
Healthcare and Public Health	Chemicals / Pharmaceuticals Food Processing

CHP for Resilience Screening Tool

- Live Demo

Issue Brief – Examining the Performance of Different DERs in Disaster Events

- Explores how different DERs are impacted by various types of natural disasters (flooding, high winds, extreme temperature, etc.)
- Goal: To assist stakeholders in evaluating the technology options best able to meet their resilience priorities

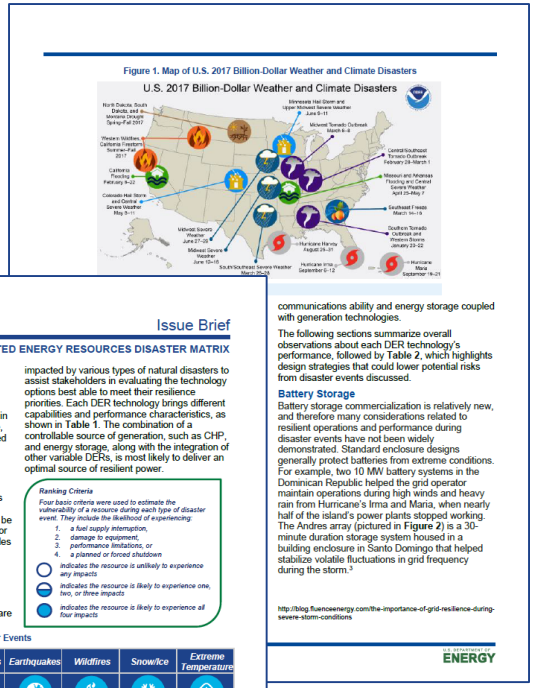


Figure 1. Map of U.S. 2017 Billion-Dollar Weather and Climate Disasters

U.S. 2017 Billion-Dollar Weather and Climate Disasters

Better Buildings U.S. DEPARTMENT OF ENERGY

Issue Brief

DISTRIBUTED ENERGY RESOURCES DISASTER MATRIX

How Do Natural Disasters Impact DER Performance?

Widespread electrical outages are becoming more prevalent in the United States, typically caused by weather-related events. As shown in Figure 1 on the following page, in 2017 alone, communities across the country were impacted by 16 separate billion-dollar weather-related disaster events, leading to a growing need to protect against the risks of these disruptions.[1]

To address the increased risk of electricity system outages, communities and businesses are increasingly exploring options to invest in distributed energy resources (DERs) that can be strategically deployed to continue operations or restore power quickly in critical areas. Examples of different types of DERs include solar photovoltaic (PV), wind, combined heat and power (CHP), energy storage, demand response, electric vehicles, microgrids, and energy efficiency.[2]

This issue brief explores how different DERs are impacted by various types of natural disasters to assist stakeholders in evaluating the technology options best able to meet their resilience priorities. Each DER technology brings different capabilities and performance characteristics, as shown in Table 1. The combination of a controllable source of generation, such as CHP, and energy storage, along with the integration of other variable DERs, is most likely to deliver an optimal source of resilient power.

Ranking Criteria

Four basic criteria were used to estimate the vulnerability of a resource during each type of disaster event. They include the likelihood of experiencing:

1. *a fuel supply interruption,*
2. *damage to equipment,*
3. *performance limitations, or*
4. *a planned or forced shutdown*

○ *indicates the resource is unlikely to experience any impacts*

◒ *indicates the resource is likely to experience one, two, or three impacts*

● *indicates the resource is likely to experience all four impacts*

Table 1. Matrix of DER Vulnerability to Weather Events

Natural Disaster or Storm Events	Flooding	High Winds	Earthquakes	Wildfires	Snow/Ice	Extreme Temperature
Battery Storage	◒	○	◒	●	○	◒
Biomass/Biogas CHP	◒	◒	◒	●	○	○
Distributed Solar	○	◒	◒	●	◒	◒
Distributed Wind	○	◒	◒	◒	◒	◒
Natural Gas CHP	○	○	◒	◒	○	○
Standby Generators	◒	○	◒	●	◒	○

[1] National Oceanic and Atmospheric Administration, Climate. January 8, 2018. "2017 U.S. billion-dollar weather and climate disasters: a historic year in context." Available at https://www.climate.gov/news-features/blogs/beyond-data/2017-us-billion-dollar-weather-and-climate-disasters-historic-year

[2] The National Association of Regulatory Utility Commissioners (NARUC). *Distributed Energy Resources and Rate Design and Compensation*. Available at https://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0

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communications ability and energy storage coupled with generation technologies.

The following sections summarize overall observations about each DER technology's performance, followed by Table 2, which highlights design strategies that could lower potential risks from disaster events discussed.

Battery Storage

Battery storage commercialization is relatively new, and therefore many considerations related to resilient operations and performance during disaster events have not been widely demonstrated. Standard enclosure designs generally protect batteries from extreme conditions. For example, two 10 MW battery systems in the Dominican Republic helped the grid operator maintain operations during high winds and heavy rain from Hurricane's Irma and Maria, when nearly half of the island's power plants stopped working. The Andres array (pictured in Figure 2) is a 30-minute duration storage system housed in a building enclosure in Santo Domingo that helped stabilize volatile fluctuations in grid frequency during the storm.[3]

http://blog.fluenceenergy.com/the-importance-of-grid-resilience-during-severe-storm-conditions

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Matrix of DER vulnerability to weather events

Natural Disaster or Storm Events	Flooding	High Winds	Earthquakes	Wildfires	Snow/Ice	Extreme Temperature
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Distributed Solar	○	◒	◒	●	◒	◒
Distributed Wind	○	◒	◒	◒	◒	◒
Natural Gas CHP	○	○	◒	◒	○	○
Standby Generators	◒	○	◒	●	◒	○

Design considerations and other strategies to increase resilience of DERs

Natural Disaster or Storm Event / Resource	Flooding	High Winds	Earthquakes	Wildfires	Snow/Ice	Extreme Temperature
Battery Storage	• Elevate equipment above flood and storm surge levels • Use NEMA-rated enclosures that protect against water damage • Factor equipment repair or replacement in O&M plans	• Use NEMA-rated enclosures to minimize exposure to debris • Design EMS or protection systems to shut down at harmful wind speeds or conditions.	• Utilize shock-mount system enclosures to maintain integrity of individual system components	• Use built-in fire suppression system	• Design enclosures to withstand snow/ice loads • Design with sealings and venting to address moisture • Use NEMA-rated enclosures to minimize exposure to moisture	• Design protection or EMS to withstand extreme temperatures • Design system to shut down to protect component integrity
Biogas/Biomass CHP	• Elevate equipment and biomass stockpiles above flood levels • For biogas, coordinate with the wastewater treatment on potential planned shutdowns	• For biogas, use rigid covers to protect digester tanks • For biomass, cover or protect onsite fuel supply stockpiles	• Maintain industry standards for facilities sited near seismic activity	• For biomass, use enclosures, fire protection, or containment strategies for fuel supply.	• Design with proper freeze protection • Protect biomass stockpiles from excess snow and ice	• Use heating jackets designed for optimal temperatures and adequate thermal management systems • Ensure systems are designed for regional temperature ranges
Distributed Solar	• Design systems and framing for easy runoff and drainage, especially for commercial rooftop systems with flat roofs • For ground mount, avoid siting in flood zones	• Use secure, flush-mounted systems for rooftop solar • Use flexible racking and anchoring systems • Maintain ASCE standards for rooftop systems based on expected wind loads	• Ensure roof mount design meets ASCE building code for seismic areas	• If ground-mount, site in open areas away from flammable material (trees, shrubs, etc.)	• Manually remove snow/ice to clear panels • Autonomous mechanical cleaning (tiled removal) • Install bifacial systems capable of absorbing irradiance on the back or front of panels	• Site systems in applicable weather conditions • Enhance design to maximize cooling and airflow in order to ensure optimal temperature conditions for modules and electrical components (inverters)
Distributed Wind	• Design foundation for conditions in high water table • Elevate controls and electronics above flood and storm surge levels • Use site drainage strategy	• Include design features and braking procedures to withstand hurricane force winds (feather blades, lock rotors, change orientation, etc.)	• Design systems for ground acceleration rating based on typical seismic activity	• Extend gravel apron around base of turbine	• Install electro-thermal ice protection systems • Use ice-resistant coating on blades	• Design uninterruptible power supply to operate within adequate temperature range • Add on "cold weather packages"
Natural Gas CHP	• Elevate equipment above flood and storm surge levels	• Locate systems indoors or protect with containers designed to withstand high wind and debris	• Shock-mount system enclosures • Maintain industry standards for pipelines sited near seismic activity	• Use fire protection systems for above-ground facilities associated with gas delivery networks	• No additional design consideration needed	• To ensure fuel availability, purchase "firm supply" to avoid curtailment
Standby Generators	• Elevate equipment above flood and storm surge levels • Store enough fuel onsite to avoid delivery issues	• Locate systems indoors or protect with containers designed to withstand high wind and debris	• Purchase an earthquake-resistant model (IBC certified; subject to shake table testing)	• Avoid siting in areas prone to wildfire • Store enough fuel onsite to avoid delivery issues	• Store enough fuel onsite to avoid delivery issues	• Check generator batteries during cold weather • Enclose the system to protect from temperatures. • Store "winter diesel" fuel in cold climates with additives to prevent gelling

Other Resources: Packaged CHP Accelerator

- **Goals**
  - Research and validate that total project costs and installation times for packaged CHP systems can be reduced by 20% or more
  - Evaluate the integration of new technologies with packaged CHP systems and identify R&D challenges and opportunities around packaged CHP and related technologies

- **Partners**

CHP Supplier Partners – CHP system packagers and solution providers participating in the national eCatalog of packaged CHP systems

CHP Engagement Partners – Utilities, federal agencies, states, cities or other market entities committed to promoting packaged CHP (via the eCatalog)

Visit the Packaged CHP Accelerator Website:
https://betterbuildingsinitiative.energy.gov/accelerators/packaged-chp

Other Resources: Sustainable Water Infrastructure of the Future (SWIFt) Accelerator

- **Goals**
  - Catalyze the adoption of innovative and best-practice approaches in data management, technologies, and financing for infrastructure improvement
  - Improve the energy efficiency of the partners' participating water resource recovery facilities by at least 30% and integrate at least one resource recovery measure
- **Accelerator Partners**
  - State, regional, and local agencies engaging with water resource recovery facilities in their jurisdiction to accelerate a pathway toward a sustainable infrastructure
- **Energy Data Management Manual for the Wastewater Treatment Sector**
  - Step-by-step guide for wastewater treatment plants on how to appropriately track energy performance
  - Describes the benefits of energy data management, and how it can help drive savings when linked to a strong energy management program

Visit the Sustainable Water Infrastructure of the Future (SWIFt) Accelerator Website: https://betterbuildingsinitiative.energy.gov/accelerators/packaged-chp

Questions?

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