Buildings of the Future: Commercial Partner Strategies for Building Resilience

Thursday, July 11th, 2019

11:00am—12:30pm

Session Panel

Rielle Green
CBRE

Zachary Brown
CBRE

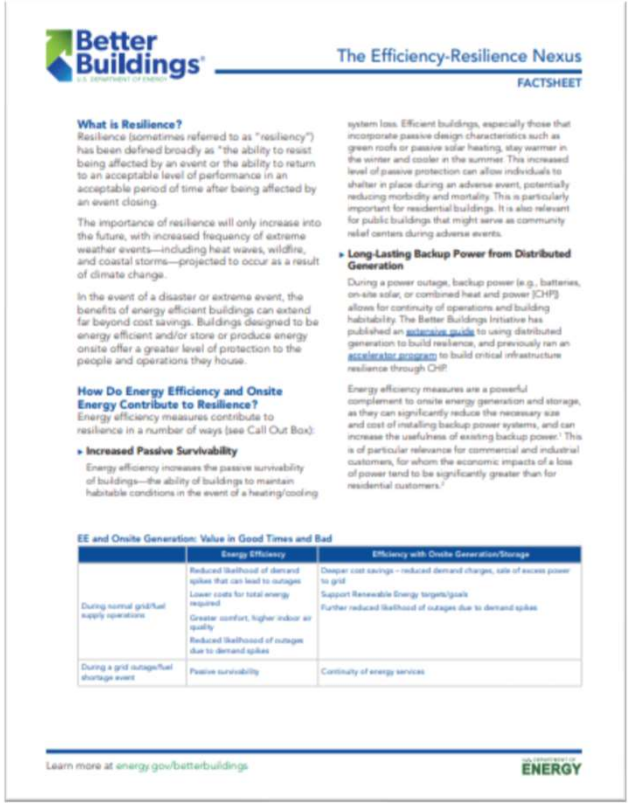
Aaron Daly
Whole Foods

Jim Freihaut
DOE Mid-Atlantic CHP TAP Ctr.

Moderator: Sarah Zaleski, *DOE*

Better Buildings Solution Center – Resilience Page

- https://betterbuildingsinitiative.energy.gov/resilience
- Landing page for partner & industry resources focused on resilience strategies, organized to help you find information most relevant to your resilience goals
- Includes "**Energy Efficiency – Resilience Nexus" Factsheet**
- Contact your DOE lead to contribute a resource or case study!



Better Buildings

The Efficiency-Resilience Nexus

FACTSHEET

What is Resilience?

Resilience (sometimes referred to as "resiliency") has been defined broadly as "the ability to resist being affected by an event or the ability to return to an acceptable level of performance in an acceptable period of time after being affected by an event closing.

The importance of resilience will only increase into the future, with increased frequency of extreme weather events—including heat waves, wildfire, and coastal storms—projected to occur as a result of climate change.

In the event of a disaster or extreme event, the benefits of energy efficient buildings can extend far beyond cost savings. Buildings designed to be energy efficient and/or store or produce energy onsite offer a greater level of protection to the people and operations they house.

How Do Energy Efficiency and Onsite Energy Contribute to Resilience?

Energy efficiency measures contribute to resilience in a number of ways (see Call Out Box):

- **Increased Passive Survivability**

  Energy efficiency increases the passive survivability of buildings—the ability of buildings to maintain habitable conditions in the event of a heating/cooling system loss. Efficient buildings, especially those that incorporate passive design characteristics such as green roofs or passive solar heating, stay warmer in the winter and cooler in the summer. This increased level of passive protection can allow individuals to shelter in place during an adverse event, potentially reducing morbidity and mortality. This is particularly important for residential buildings. It is also relevant for public buildings that might serve as community relief centers during adverse events.

- **Long-Lasting Backup Power from Distributed Generation**

  During a power outage, backup power (e.g., batteries, on-site solar, or combined heat and power [CHP]) allows for continuity of operations and building habitability. The Better Buildings Initiative has published an extensive guide to using distributed generation to build resilience, and previously ran an accelerator program to build critical infrastructure resilience through CHP.

  Energy efficiency measures are a powerful complement to onsite energy generation and storage, as they can significantly reduce the necessary size and cost of installing backup power systems, and can increase the usefulness of existing backup power.[1] This is of particular relevance for commercial and industrial customers, for whom the economic impacts of a loss of power tend to be significantly greater than for residential customers.[2]

EE and Onsite Generation: Value in Good Times and Bad

	Energy Efficiency	Efficiency with Onsite Generation/Storage
During normal grid/fuel supply operations	Reduced likelihood of demand spikes that can lead to outages Lower costs for total energy required Greater comfort, higher indoor air quality Reduced likelihood of outages due to demand spikes	Deeper cost savings – reduced demand charges, sale of excess power to grid Support Renewable Energy targets/goals Further reduced likelihood of outages due to demand spikes
During a grid outage/fuel shortage event	Passive survivability	Continuity of energy services

Learn more at energy.gov/betterbuildings

ENERGY

Rielle Green & Zachary Brown

CBRE

U.S. DEPARTMENT OF ENERGY

CBRE

RESILIENCE AT AN INVESTMENT PORTFOLIO LEVEL

JULY 11TH, 2019

INTRODUCTIONS

RIELLE GREEN
Assistant Manager, Energy & Sustainability
CBRE

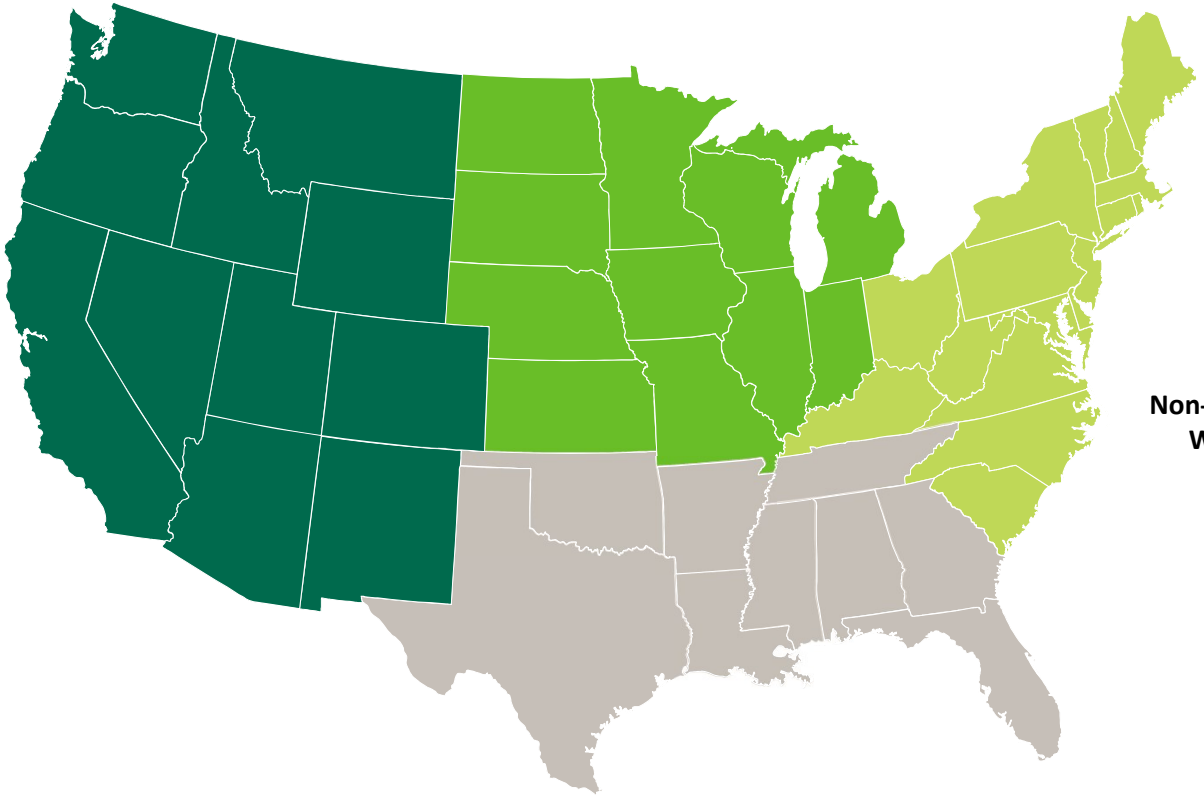
ZACHARY BROWN
Director, Energy & Sustainability
CBRE

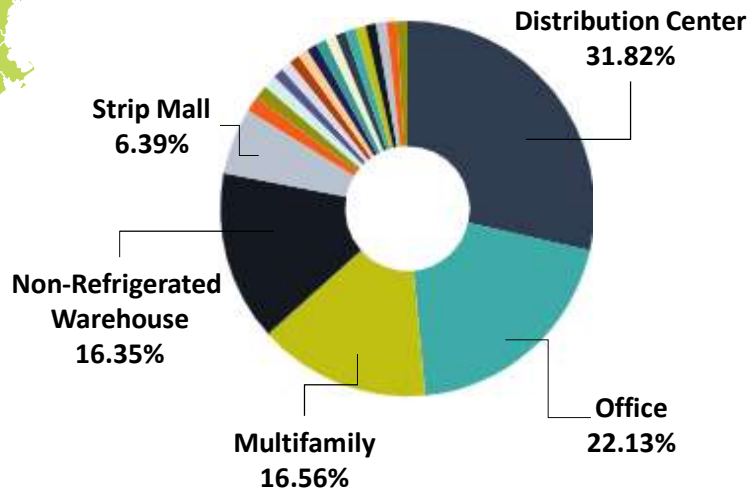
DEFINING RESILIENCE
How is climate change impacting real estate?

ASSESSING VULNERABILITY TO RISK
Developing a checklist

IMPLEMENTATION & MEASURING SUCCESS
Protecting our assets & investor perspective

SCOPE OF WORK
70,135,959 TOTAL SQ FT





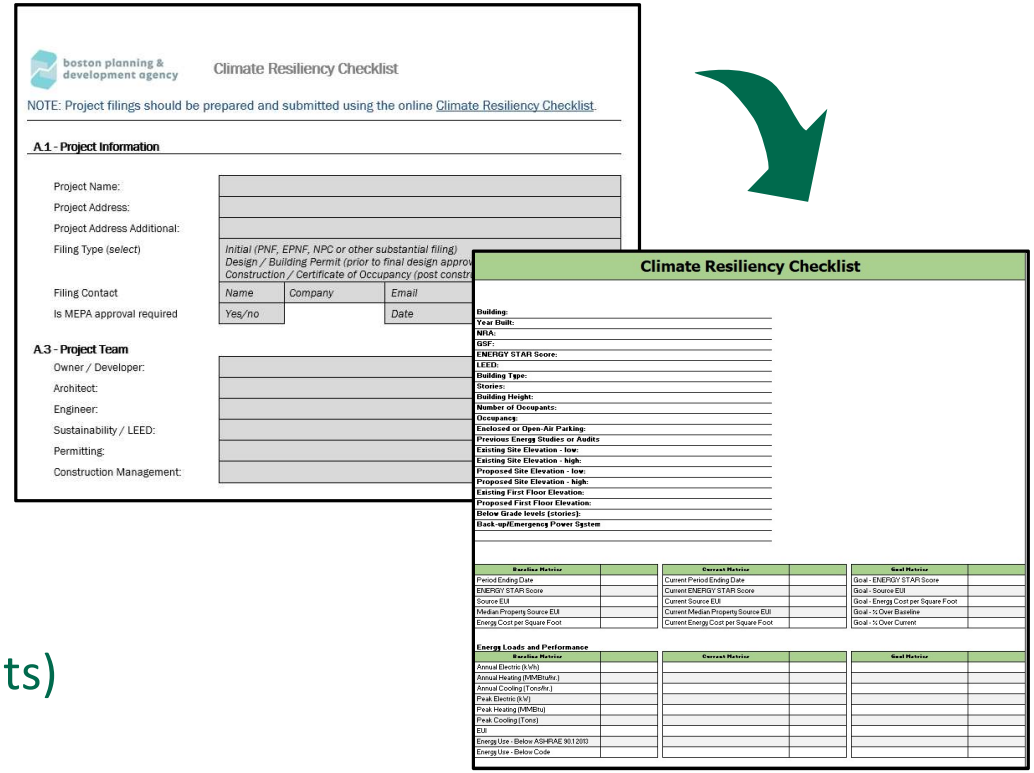
DEFINING RESILIENCE

Source: CBRE Research, 2019.

HOW DO YOU ASSESS VULNERABILITY TO RISK?
PILOTING AT A BUILDING LEVEL

CHECKLIST DEVELOPMENT

- Utilize available resources
- Test for success
- Learn along the way



boston planning & development agency

Climate Resiliency Checklist

NOTE: Project filings should be prepared and submitted using the online Climate Resiliency Checklist.

A.1 - Project Information

Project Name:	
Project Address:	
Project Address Additional:	
Filing Type (select)	*Initial (PNF, EPNF, NPC or other substantial filing)* *Design / Building Permit (prior to final design approv* *Construction / Certificate of Occupancy (post constr*
Filing Contact	*Name* / *Company* / *Email*
Is MEPA approval required	*Yes/no* / *Date*

A.3 - Project Team

Owner / Developer:	
Architect:	
Engineer:	
Sustainability / LEED:	
Permitting:	
Construction Management:	

Climate Resiliency Checklist

Building:	
Year Built:	
NRA:	
GSF:	
ENERGY STAR Score:	
LEED:	
Building Type:	
Stories:	
Building Height:	
Number of Occupants:	
Occupancy:	
Enclosed or Open-Air Parking:	
Previous Energy Studies or Audits	
Existing Site Elevation - low:	
Existing Site Elevation - high:	
Proposed Site Elevation - low:	
Proposed Site Elevation - high:	
Existing First Floor Elevation:	
Proposed First Floor Elevation:	
Below Grade levels (stories):	
Back-up/Emergency Power System	

Baseline Metrics		**Current Metrics**		**Goal Metrics**	
Period Ending Date		Current Period Ending Date		Goal - ENERGY STAR Score	
ENERGY STAR Score		Current ENERGY STAR Score		Goal - Source EUI	
Source EUI		Current Source EUI		Goal - Energy Cost per Square Foot	
Median Property Source EUI		Current Median Property Source EUI		Goal - % Over Baseline	
Energy Cost per Square Foot		Current Energy Cost per Square Foot		Goal - % Over Current	

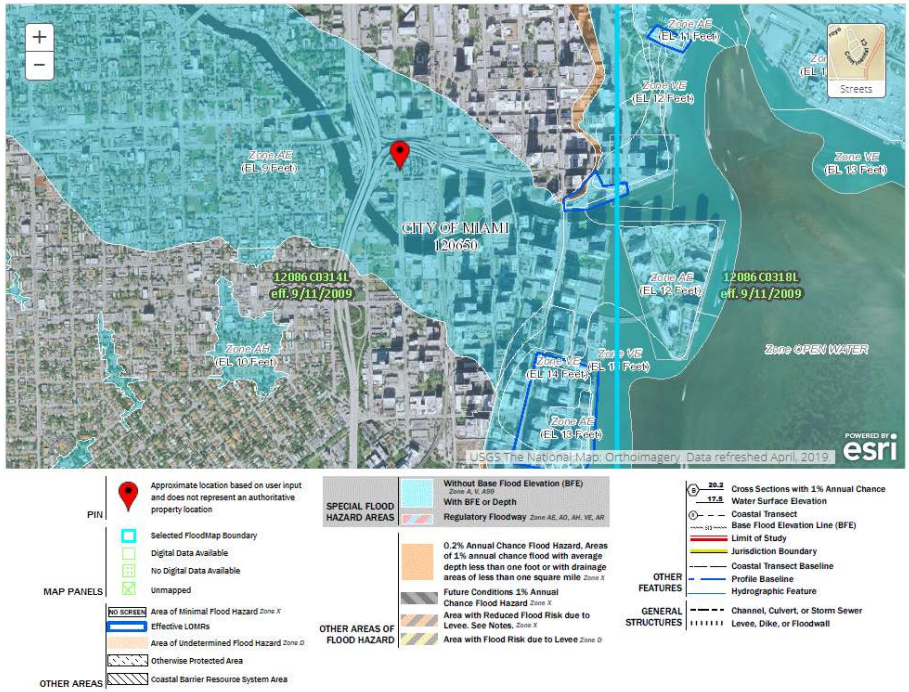
Energy Loads and Performance

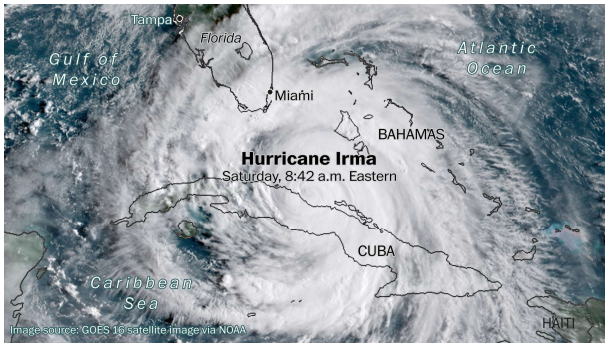
Baseline Metrics		**Current Metrics**		**Goal Metrics**	
Annual Electric (kWh)					
Annual Heating (MMBtu/hr.)					
Annual Cooling (Tons/hr.)					
Peak Electric (kW)					
Peak Heating (MMBtu)					
Peak Cooling (Tons)					
EUI					
Energy Use - Below ASHRAE 90.1 2010					
Energy Use - Below Code					

CHECKLIST COMPONENTS

- Protect the asset (property)
- Protect the people (tenants/residents)
- Climate disaster scenarios

ASSESSING VULNERABLE ASSETS
CASE STUDY: FLORIDA





BUILDING LEVEL CHECKLIST

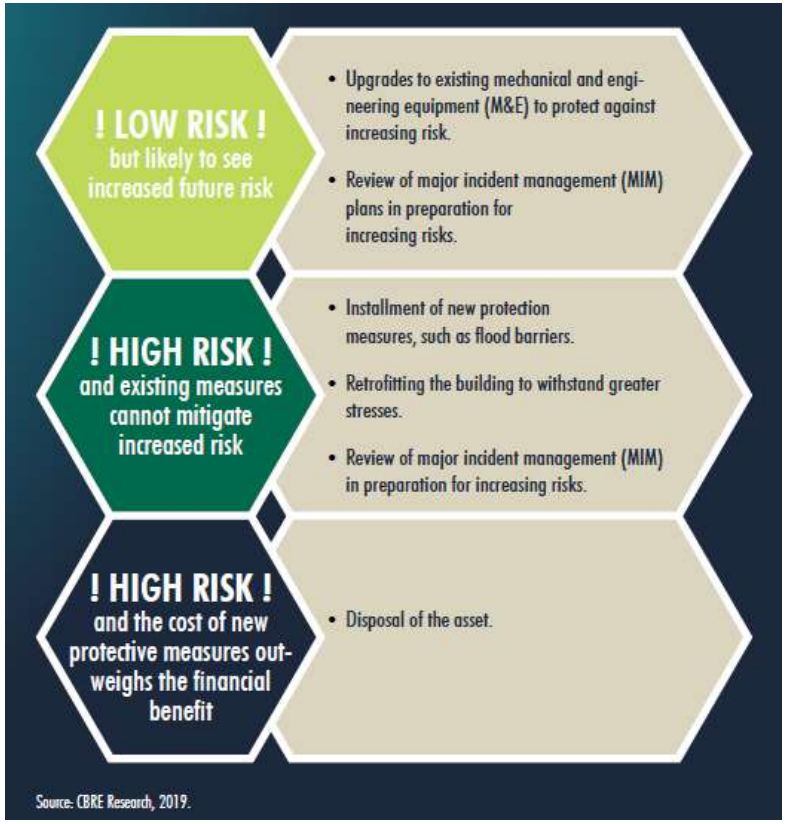
KEY TAKE-AWAYS

- Check if building is in a flood zone
- Create a list of critical systems
- Create emergency procedures for applicable climate disasters (near & mid-term)
- Educate tenants/residents on types of emergencies and evacuation plans

Rooftop AC condenser damaged by impact

Elevator bank flooded

HOW DO YOU SUCCESSFULLY PLAN AND RESPOND TO RISK?
DIVING DEEPER AT A BUILDING LEVEL



What comes after risk is identified?

Flood Resilience Report

Consultant

IMPLEMENTATION
CASE STUDY: BOSTON, MASSACHUSETTS

Boston's Fan Pier

Flood Map

Flood Wall

INVESTOR PERSPECTIVE

INVESTORS ARE DEMANDING MORE TRANSPARENCY, BUT HAVE YET TO FULLY UNDERSTAND THE FINANCIAL IMPACTS OF CLIMATE CHANGE

INVESTOR PERSPECTIVE

RISKS

OPPORTUNITIES

INVESTOR PERSPECTIVE

PRE-ACQUISITION & DUE DILIGENCE

- ESG Acquisitions Checklist
    - Resilience Appendix

REPORTING & DISCLOSURE

- GRESB (Global Real Estate Sustainability Benchmark)
    - Resilience Module

INVESTOR PERSPECTIVE

GRESB®

The ESG Benchmark
for Real Assets

CBRE

THANK YOU

JULY 11TH, 2019

Aaron Daly

Whole Foods

U.S. DEPARTMENT OF ENERGY

Resilient Buildings
In Practice

WHOLE FOODS MARKET

WFM Snapshot

Founded: **1980**
Store Count: **c500**

Our purpose is to Nourish People and the Planet

We Sell the Highest Quality Natural & Organic Foods

We Satisfy and Delight our Customers

We Promote Team member Growth and Happiness

We Practice Win-Win Partnerships with our Suppliers

We Create Profits and Prosperity

We Care About our Communities and the Environment

Whole Foods, Whole People, Whole Planet

Whole Foods

Valuing Resilience

Whole Foods

Threats to **Grid Reliability**

'I'm not going to shop in the dark': Grocers, shoppers cope with power outages

Maria Halkias and Orla McCaffrey

Power outages reported across Central Florida as storms roll through

Soggy weather causes crashes, delays

By Adrienne Cutway - Web Editor

Posted: 3:37 PM, June 12, 2019
Updated: 3:37 PM, June 12, 2019

Lightning strikes, causes power outage in northeast Brainerd

By Brainerd Dispatch Today at 3:00 a.m.

Dallas Business Looted As Storm Power Outage Continues

Program: CBS 11 News Morning **Categories:** News, Crime, General, Local News, KTVTTV, Top Story

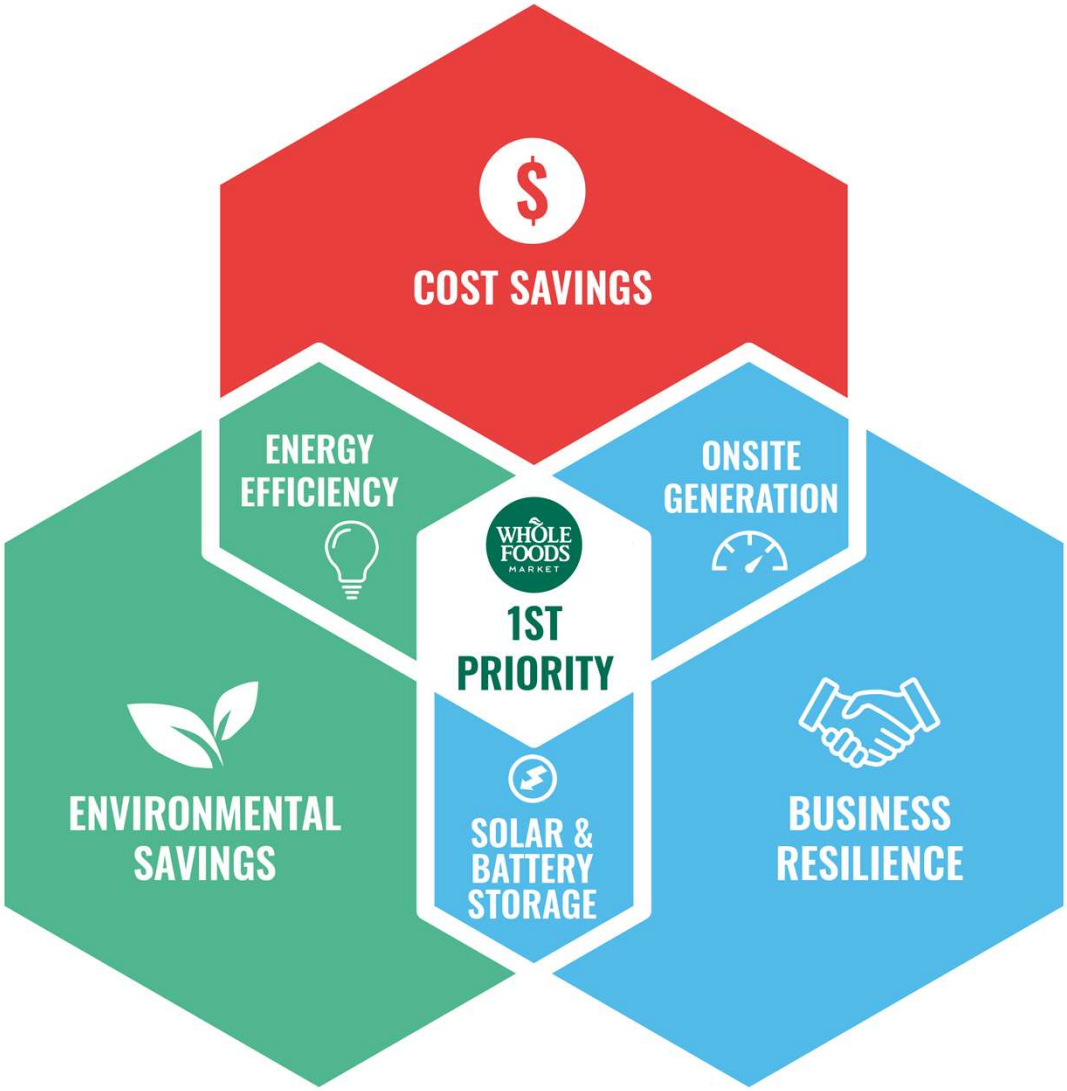
Whole Foods

Costs to
Grocery Business

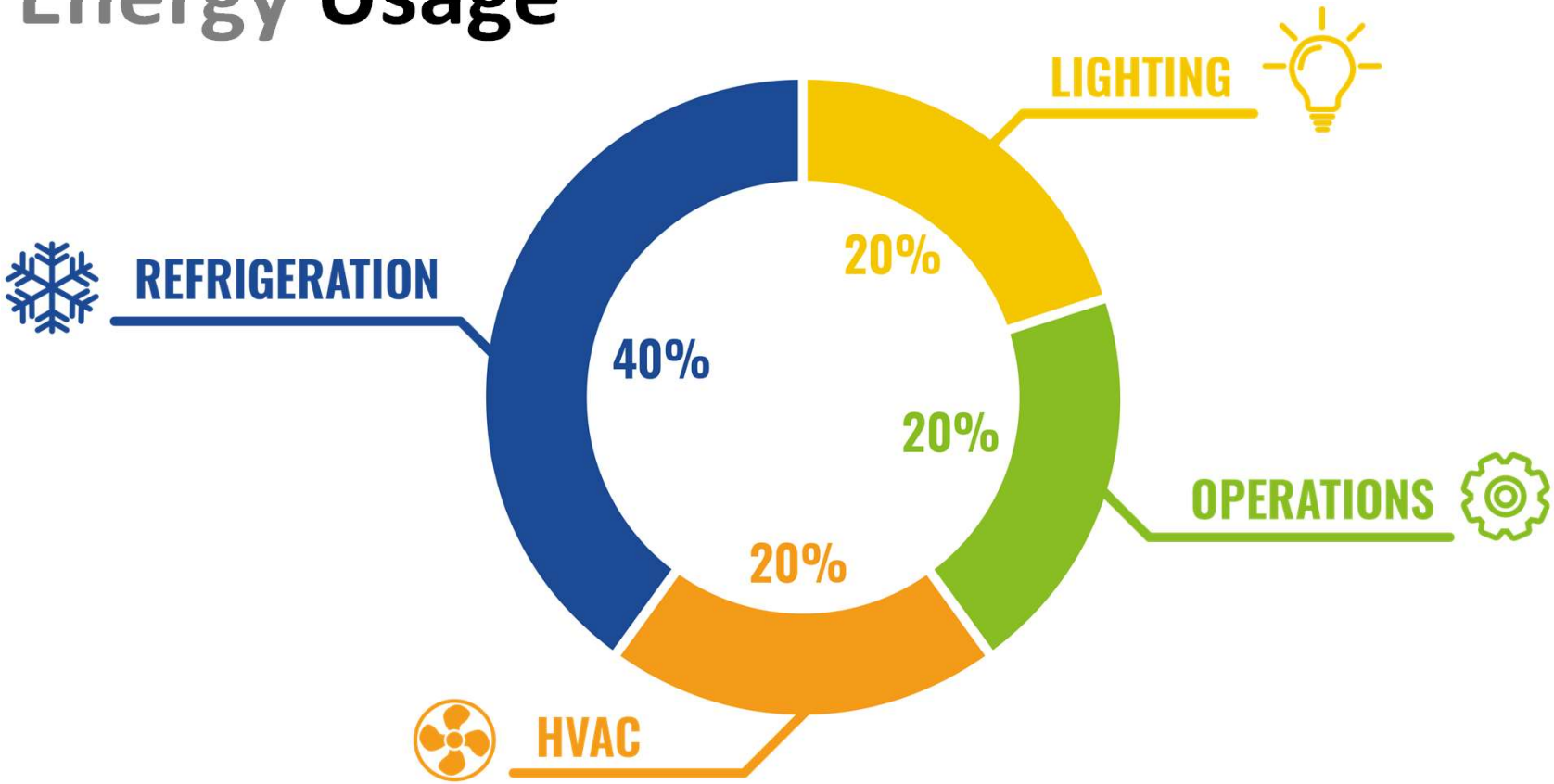
- Lost Sales
- Lost Product
- Added Labor
- Equipment Failure

Energy

Program Goals



Energy Usage



Whole Foods

Energy Reduction
From 2008 Baseline:

-20.6%

kWh Electricity per Sqft

Across 12MM+ sqft area

Whole Foods

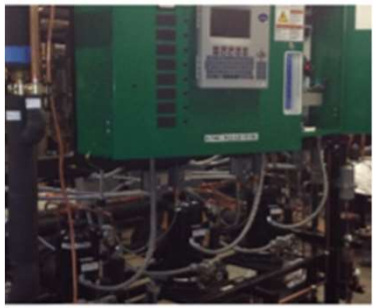
Energy **Infrastructure**

Refrigeration Systems

Cases

HVAC

Lighting



Controls

Walk-ins

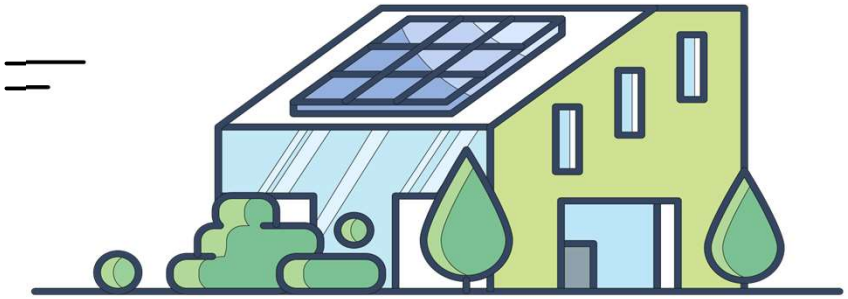
Cash Registers

Kitchen Equipment

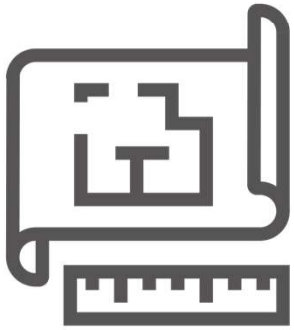
Energy Conservation Measures (ECM's)

Whole Foods

OER Solar Photovoltaic (PV)



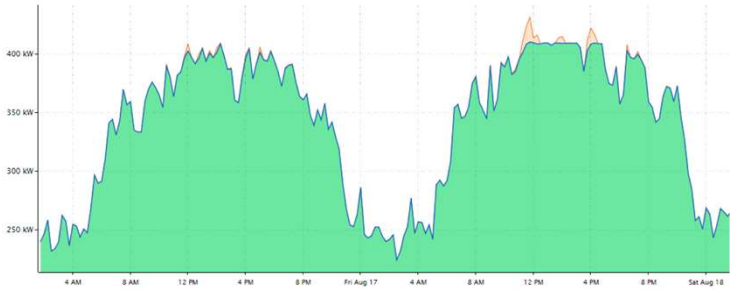
10 MEGAWATTS OF ROOFTOP SOLAR ON 60 STORES & DISTRIBUTION CENTERS



4.3MW UNDER CONSTRUCTION

Whole Foods

OER
Electrochemical Battery Storage



8 Operational Systems; 14 more under construction

Whole Foods

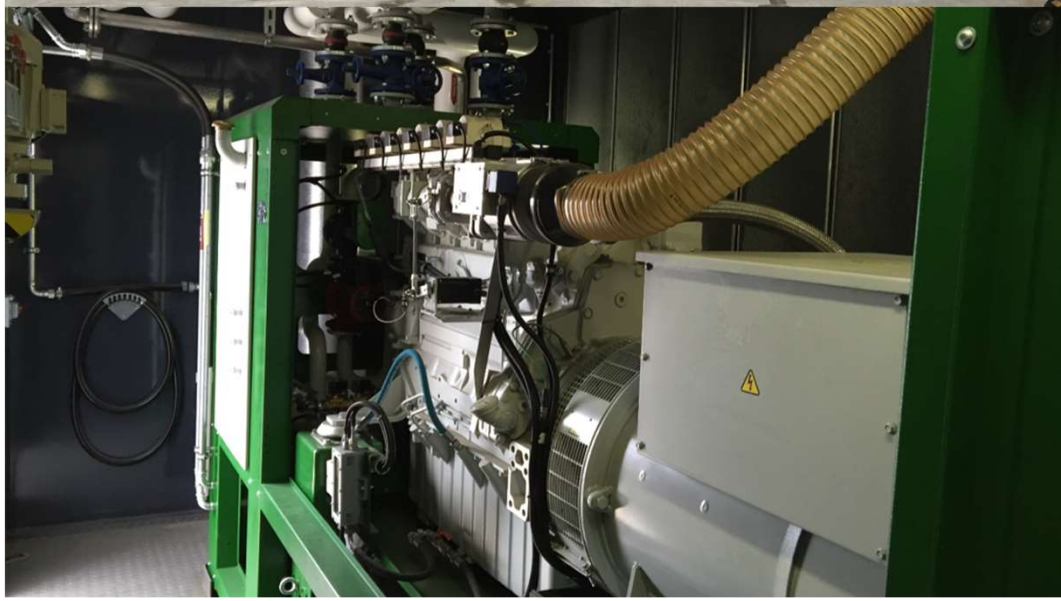
OER
Refrigeration Thermal Storage

Whole Foods

Onsite Energy Resources (OER): Fuel Cells

Whole Foods

OER
Gas Fired Engine Combined Heat & Power (CHP) Plants



Case Study: Zero Net Energy (ZNE) Buildings

Whole Foods Market to Transform San Francisco Store to Zero Net Energy

by Pamela Crouch | Apr 13, 2016 | News & Events | 0 comments

Project funded by $3M California Energy Commission grant will convert an existing grocery store to scalable near-zero net energy – serving as a model for stores throughout the state

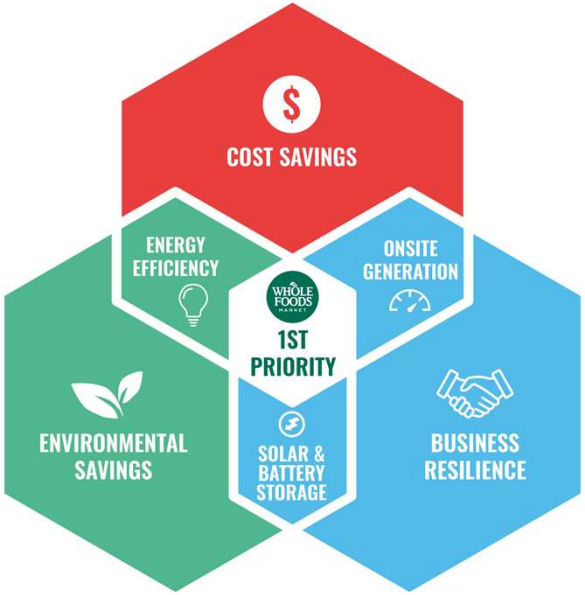
Whole Foods

Waste to Energy: Used Cooking Oil Recycling

Whole Foods

Waste to Energy: **Biodigester Technologies**

Building
Micro-Grids



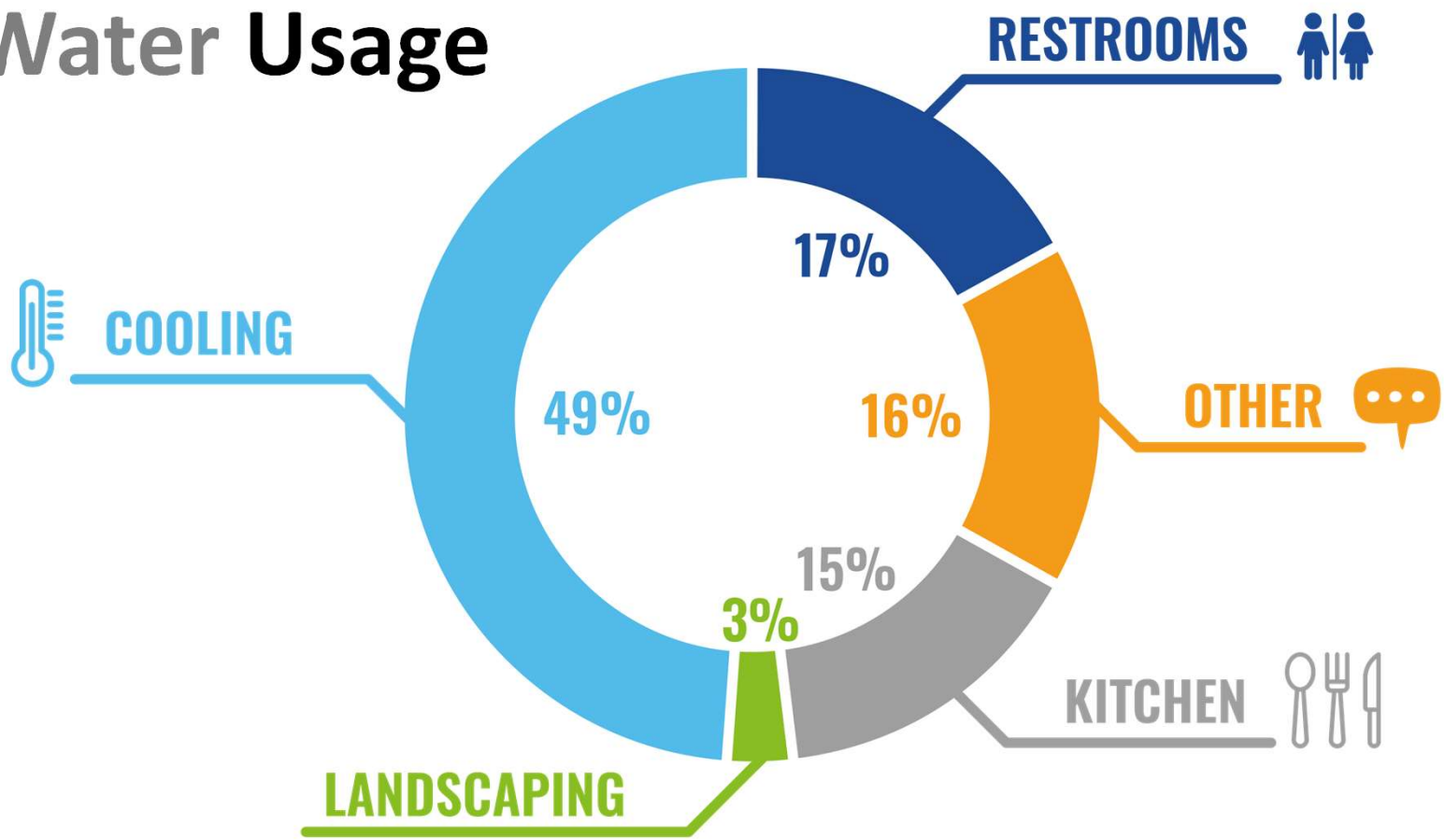
Solar

Battery

Genset

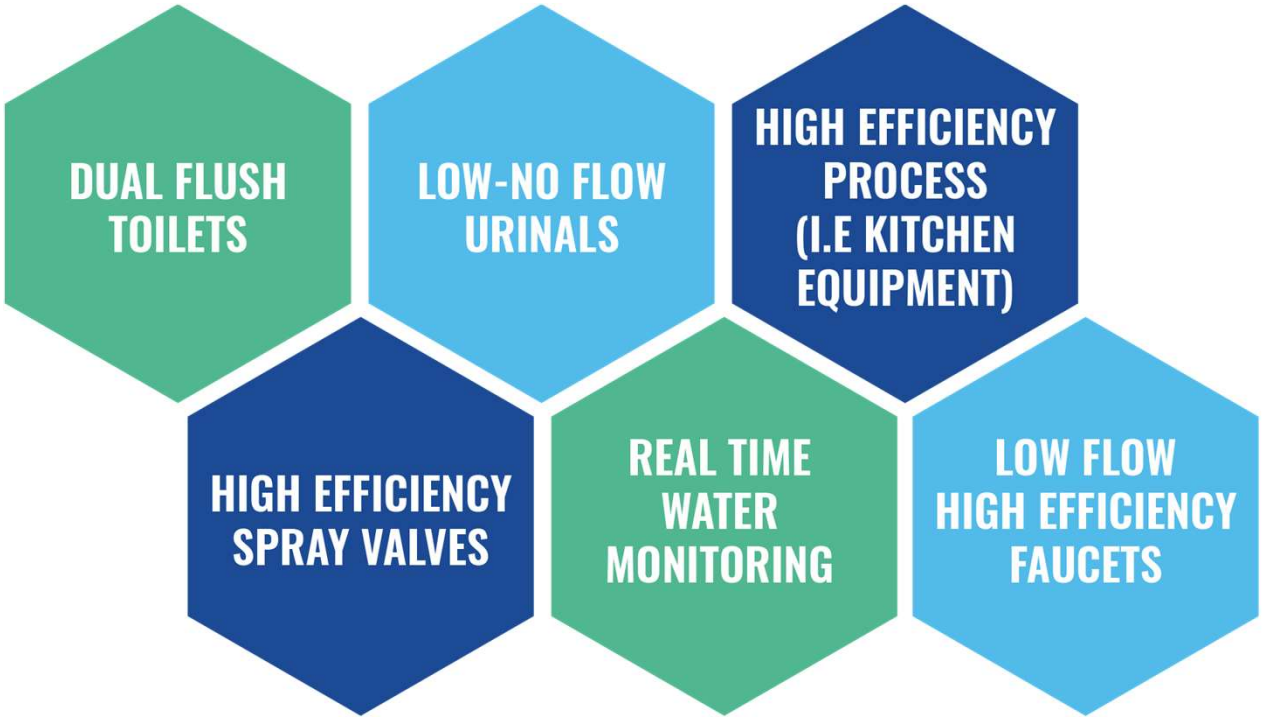
Water

Water Usage



Whole Foods

Water Efficiency Measures



Whole Foods

Waste Conservation Measures: **Stormwater Catchment**

Whole Foods

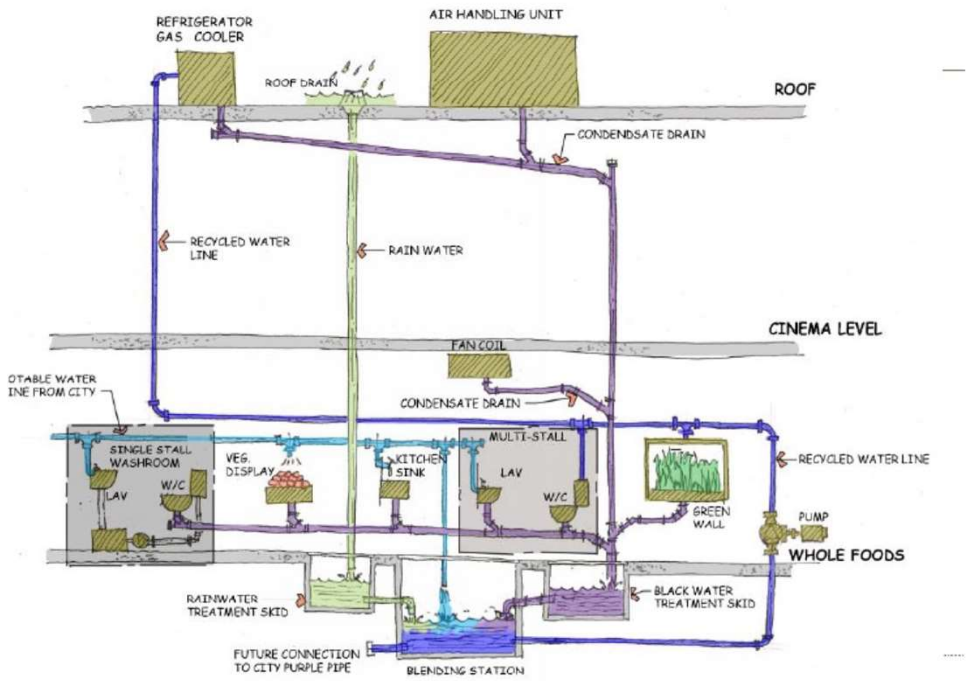
Waste Conservation Measures: **Hybrid Condensers**

Whole Foods

Waste Conservation Measures:
Ecological Wastewater & Stormwater Treatment

Whole Foods

Waste Conservation Measures:
Onsite Wastewater Treatment



Presentation complied with the assistance of our sustainability consultants AB Group:

abgroup.com

Jim Freihaut

DOE Mid-Atlantic CHP TAP Center

U.S. DEPARTMENT OF ENERGY

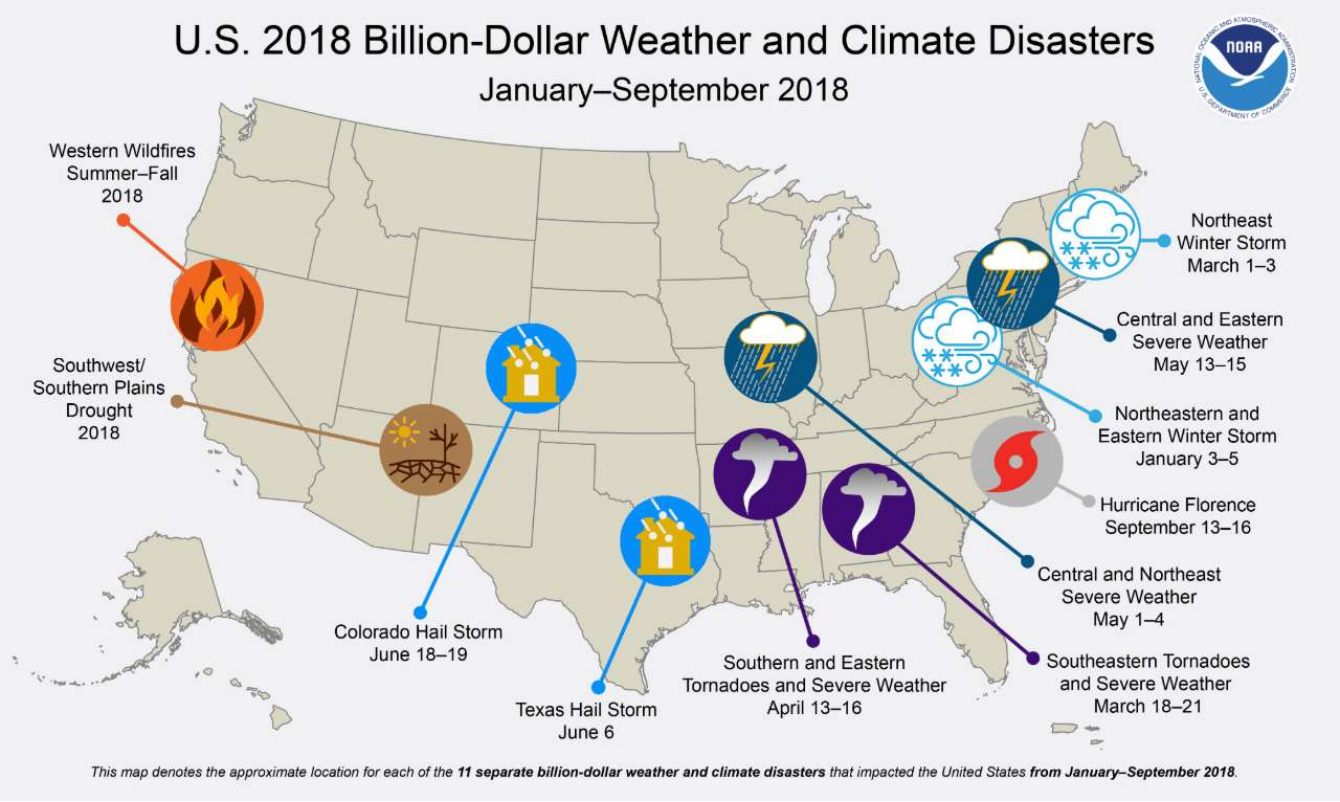
Resilience and Reliability with CHP

J. Freihaut
Pennsylvania State University
Department of Architectural Engineering
Director DOE Mid-Atlantic CHP TAP Ctr.

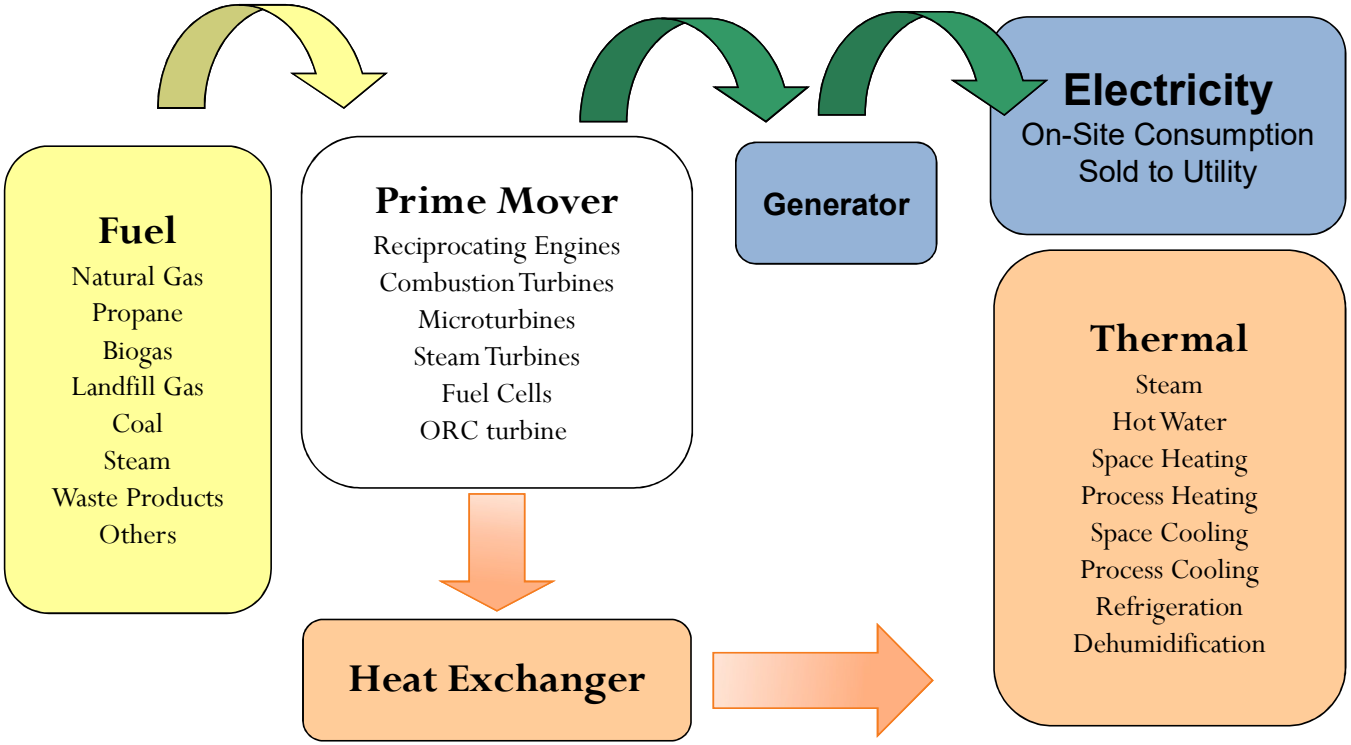
U.S. DOE CHP Deployment Program
CHP Technical Assistance Partnerships

CHP Technical Assistance Partnerships

Power Outages are Costly



CHP System Schematic



CHP: A Key Part of Our Energy Future

- Form of Distributed Generation (DG)
- An integrated system
- Located at or near a building / facility
- Provides at least a portion of the electrical load and
- Uses thermal energy for:
  - Space Heating / Cooling
  - Process Heating / Cooling
  - Dehumidification

CHP provides efficient, clean, reliable, affordable energy – today and for the future.

Source: *www.energy.gov / chp*

How Does CHP Increase Resilience?

- For end users:
  - Provides continuous supply of electricity and thermal energy for critical loads
  - Can be configured to automatically switch to “island mode” during a utility outage, and to “black start” without grid power
  - Ability to withstand long, multiday outages
- For utilities:
  - Enhances grid stability and relieves grid congestion
  - Enables microgrid deployment for balancing renewable power and providing a diverse generation mix
- For communities:
  - Keeps critical facilities like hospitals and emergency services operating and responsive to community needs

Critical Infrastructure Sectors Conducive to CHP

- Host facilities must have a consistent electric and thermal demand, and a reliable source of fuel (pipeline natural gas, anaerobic digester gas, etc.)

Who Can Use CHP?				
Airports	Chemicals & Pharmaceuticals	Colleges & Universities	Critical Manufacturing	Datacenters
Distribution Centers	Fire Stations	Food Processing	Food Sales & Supermarkets	Government Facilities
Hospitals & Healthcare	Hotels & Lodging	Laundries	Military Bases	Multifamily
Nursing Homes	Police Stations	Prisons	Schools	Wastewater Treatment Plants

CHP: Proven to be Resilient

Hurricane Harvey

- University of Texas Medical Branch (UTMB)
- Texas Medical Center (TMC)
- Southwest Energy Data Center
- Lake Charles Manuf. Complex
- DeBakey VA Medical Center

Hurricane Irma & Maria

- Hospital De La Concepcion PR
- Wyndham Hotel St. Thomas
- Univ. of Florida Shands Medical Center
- Matosantos Commercial Corp
- Captain Morgan Diageo Rum Distillery
- Plaza Extra East Supermarket St. Croix

CHP Systems Kept Facilities Operational Through Hurricanes

Superstorm Sandy

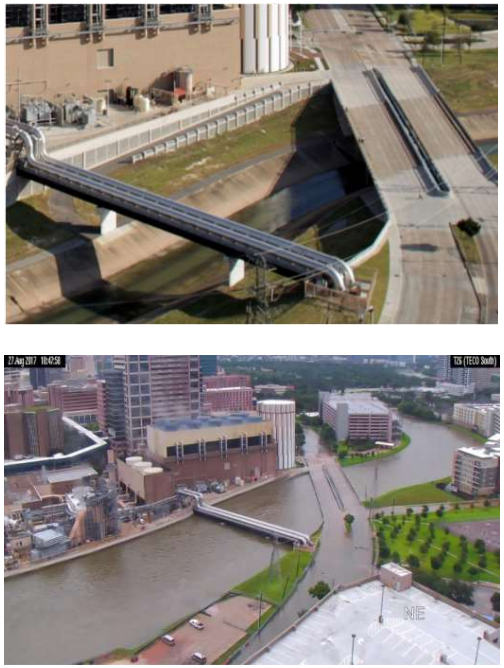
- South Oaks Hospital
- Princeton University
- Salem Community College
- Public Interest Data Center
- Bergen Counties WWTP
- Sikorsky Aircraft Corp.

Hurricane Ike & Katrina

- Mississippi Baptist Medical Center
- Louisiana State University
- University of Texas Medical Branch (UTMB)

Project Snapshot: Texas Medical Center

- **Location:** Houston, TX
- **Application/Industry:** Hospital
- **Capacity:** 48 MW
- **Prime Mover:** Combustion turbine
- **Fuel Type:** Natural gas
- **Thermal Use:** Steam for heating and chilled water
- **Installation Year:** 2010
- **Resilience Benefits**
  - Provided critical services to hospital patients and staff throughout Hurricane Harvey
  - Elevated CHP system design was able to withstand flooding given significant storm surge in the area
  - Also provides $6-12 million in energy cost savings per year



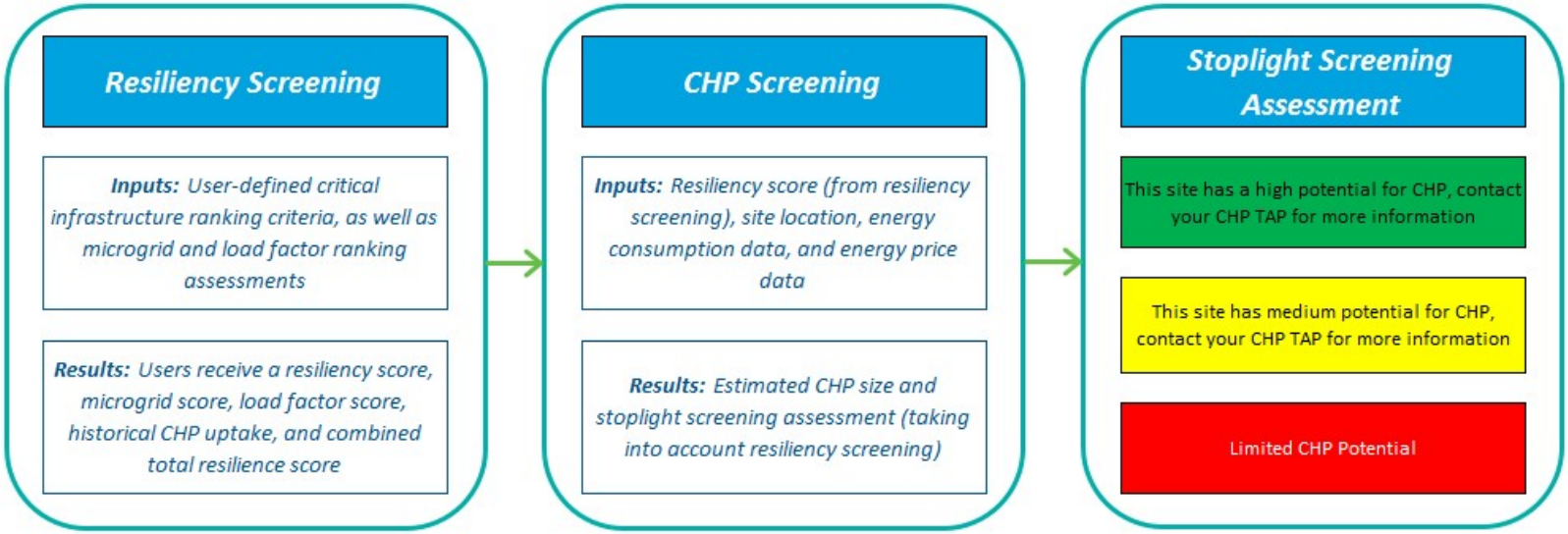
Brays Bayou before and after flooding from Hurricane Harvey, photos courtesy of the Thermal Energy Corporation (TECO)

Resilience Planning with DOE CHP for Resiliency Accelerator

- The DOE CHP for Resiliency Accelerator includes resources and tools designed to assist with resilience planning efforts
  - Distributed Generation for Resiliency Planning Guide
  - CHP for Resilience Screening Tool
  - Issue Brief on Performance of DERs in Disaster Events
  - Partner Profiles

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

The CHP for Resilience Screening Tool



Resiliency Screening Factors: Government Continuity, Locational Ranking, Leverage/Scalability, Life Safety, Economic Impact, Microgrid, and Load Factor

Access the tool at the accelerator website under "Featured Resources":
https://betterbuildingsinitiative.energy.gov/accelerators/combined-heat-and-power-resiliency

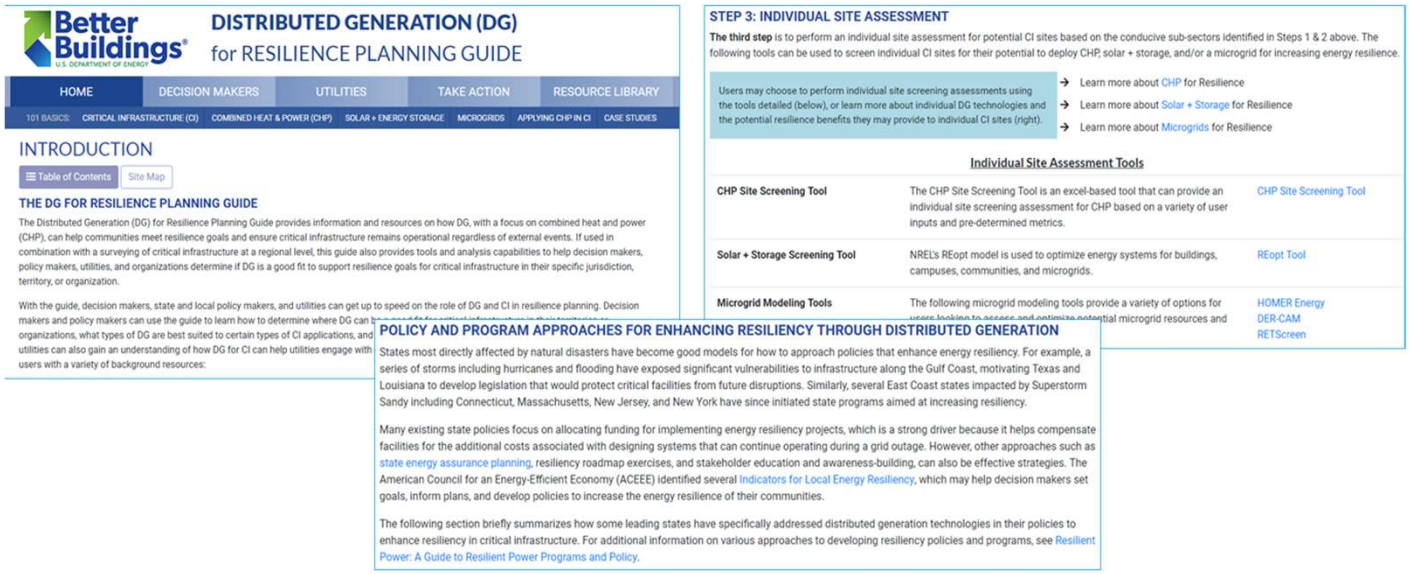
Issue Brief – Examining the Performance of Different DERs in Disaster Events

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	◒	○	◒	●	◒	○

https://betterbuildingsinitiative.energy.gov/sites/default/files/attachments/DER_Disaster_Impacts_Issue%20Brief.pdf

Distributed Generation (DG) for Resilience Planning Guide

- **Provides information and resources on how DG (w/a focus on CHP), can help communities meet resilience goals and ensure critical infrastructure remains operational regardless of external events**



Better Buildings U.S. DEPARTMENT OF ENERGY

DISTRIBUTED GENERATION (DG) for RESILIENCE PLANNING GUIDE

HOME | DECISION MAKERS | UTILITIES | TAKE ACTION | RESOURCE LIBRARY

101 BASICS: CRITICAL INFRASTRUCTURE (CI) | COMBINED HEAT & POWER (CHP) | SOLAR + ENERGY STORAGE | MICROGRIDS | APPLYING CHP IN CI | CASE STUDIES

INTRODUCTION

Table of Contents | Site Map

THE DG FOR RESILIENCE PLANNING GUIDE

The Distributed Generation (DG) for Resilience Planning Guide provides information and resources on how DG, with a focus on combined heat and power (CHP), can help communities meet resilience goals and ensure critical infrastructure remains operational regardless of external events. If used in combination with a surveying of critical infrastructure at a regional level, this guide also provides tools and analysis capabilities to help decision makers, policy makers, utilities, and organizations determine if DG is a good fit to support resilience goals for critical infrastructure in their specific jurisdiction, territory, or organization.

With the guide, decision makers, state and local policy makers, and utilities can get up to speed on the role of DG and CI in resilience planning. Decision makers and policy makers can use the guide to learn how to determine where DG can h organizations, what types of DG are best suited to certain types of CI applications, and utilities can also gain an understanding of how DG for CI can help utilities engage with users with a variety of background resources:

STEP 3: INDIVIDUAL SITE ASSESSMENT

The third step is to perform an individual site assessment for potential CI sites based on the conducive sub-sectors identified in Steps 1 & 2 above. The following tools can be used to screen individual CI sites for their potential to deploy CHP, solar + storage, and/or a microgrid for increasing energy resilience.

Users may choose to perform individual site screening assessments using the tools detailed (below), or learn more about individual DG technologies and the potential resilience benefits they may provide to individual CI sites (right).

→ Learn more about CHP for Resilience
→ Learn more about Solar + Storage for Resilience
→ Learn more about Microgrids for Resilience

Individual Site Assessment Tools

CHP Site Screening Tool	The CHP Site Screening Tool is an excel-based tool that can provide an individual site screening assessment for CHP based on a variety of user inputs and pre-determined metrics.	CHP Site Screening Tool
Solar + Storage Screening Tool	NREL's REopt model is used to optimize energy systems for buildings, campuses, communities, and microgrids.	REopt Tool
Microgrid Modeling Tools	The following microgrid modeling tools provide a variety of options for users looking to assess and optimize potential microgrid resources and	HOMER Energy DER-CAM RETScreen

POLICY AND PROGRAM APPROACHES FOR ENHANCING RESILIENCY THROUGH DISTRIBUTED GENERATION

States most directly affected by natural disasters have become good models for how to approach policies that enhance energy resiliency. For example, a series of storms including hurricanes and flooding have exposed significant vulnerabilities to infrastructure along the Gulf Coast, motivating Texas and Louisiana to develop legislation that would protect critical facilities from future disruptions. Similarly, several East Coast states impacted by Superstorm Sandy including Connecticut, Massachusetts, New Jersey, and New York have since initiated state programs aimed at increasing resiliency.

Many existing state policies focus on allocating funding for implementing energy resiliency projects, which is a strong driver because it helps compensate facilities for the additional costs associated with designing systems that can continue operating during a grid outage. However, other approaches such as state energy assurance planning, resiliency roadmap exercises, and stakeholder education and awareness-building, can also be effective strategies. The American Council for an Energy-Efficient Economy (ACEEE) identified several Indicators for Local Energy Resiliency, which may help decision makers set goals, inform plans, and develop policies to increase the energy resilience of their communities.

The following section briefly summarizes how some leading states have specifically addressed distributed generation technologies in their policies to enhance resiliency in critical infrastructure. For additional information on various approaches to developing resiliency policies and programs, see Resilient Power: A Guide to Resilient Power Programs and Policy.

https://resilienceguide.dg.industrialenergytools.com/

Policies and Programs for Resilient CHP

Resilience and Reliability with CHP

NJ Energy Resilience Bank

- Funded with $200MM from US HUD CDBG disaster recovery funds awarded to NJ as a result of Superstorm Sandy and operated by the NJ Economic Development Authority with support from the NJ Board of Public Utilities and NJ Dept. of Treasury.
- Eligible applicants included public and/or not-for profit WWTPs and Hospitals which were impacted by Sandy or other eligible storms
- Eligible systems included CHP meeting 65% LHV efficiency and capable of operating in grid island mode. The CHP plant, in conjunction with existing emergency generators must be capable of operating the facility's designated critical loads for 7 days without delivery of fuel to emergency generators

NJ Energy Resilience Bank

- ERB Funding Mechanism
  - The NJ ERB Program provides a financing product that covers 100% of the cost of implementing resilient CHP
  - The financing product is made up of:
    - Grant/forgivable loan for 100% of eligible resilience costs
    - Grant/forgivable loan for 40% of remaining eligible costs (i.e. CHP)
    - Loan at 2% with 20-year term for the balance of ERB project funds
  - Typically the program provided approx. 60% of total project costs in the form of a grant and 40% as a loan resulting in positive cash flow throughout the life of the project.
- ERB requirements include implementation of a comprehensive 10-year service contract on major equipment at the owner's expense.

Gov Christie and PSE&G President David Daly at opening of first ERB CHP project to begin operation. (Photo: ~Courtesy of Gov. Chris Christie's Office)

NJ Energy Resilience Bank

- All the funding has been allocated to projects either upgrading existing CHP facilities or implementing new CHP facilities with the majority of the funding being allocated to hospitals implementing new resilient CHP projects. Eight hospitals were approved by the ERB to move forward with new resilient CHP projects

Hospital	Location	Gen Set Size	Gen Set Type
St Peter's UH	New Brunswick	2 MW	Recip Engine
Cooper UH	Camden	4.5 MW	Combustion Turbine
Hunterdon MC	Flemington	1.5 MW	Recip Engine
St Barnabas MC	Livingston	2.5 MW	Recip Engine
Jersey City MC	Jersey City	1.5 MW	Recip Engine
Newark Beth Israel	Newark	2 MW	Recip Engine
UH Somerset	Sommerville	1.5 MW	Recip Engine
Trinitas Regional MC	Elizabeth	2 MW	Recip Engine

Thank You!

Pleas provide feedback on this session
in the Summit App

Download the app to your mobile device or go to
event.crowdcompass.com/bbsummit19

Contact Us

- Speakers
  - Rielle Green, CBRE — rielle.green@cbre.com
  - Zachary Brown, *CBRE* — zachary.brown@cbre.com
  - Aaron Daly, *Whole Foods* — aaron.daly@wholefoods.com
  - Jim Freihaut, *Mid-Atlantic CHP TAP* — Jdf11@psu.edu

- Moderator
  - Sarah Zaleski, *DOE* — Sarah.Zaleski@EE.Doe.Gov