Combined Heat and Power (CHP) Update on Security and Resiliency

Presentation to:

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Presentation Outline

- Critical Infrastructure and CHP
- Update on State Activities
- CHP Case Studies

Critical Infrastructure

"Critical infrastructure" refers to those assets, systems, and networks that, if incapacitated, would have a substantial negative impact on national security, national economic security, or national public health and safety."

Patriot Act of 2001 Section 1016 (e)

Applications:

- Hospitals and healthcare centers
- Water / wastewater treatment plants
- Police, fire, and public safety
- Centers of refuge (often schools or universities)
- Military/National Security
- Food distribution facilities
- Telecom and data centers

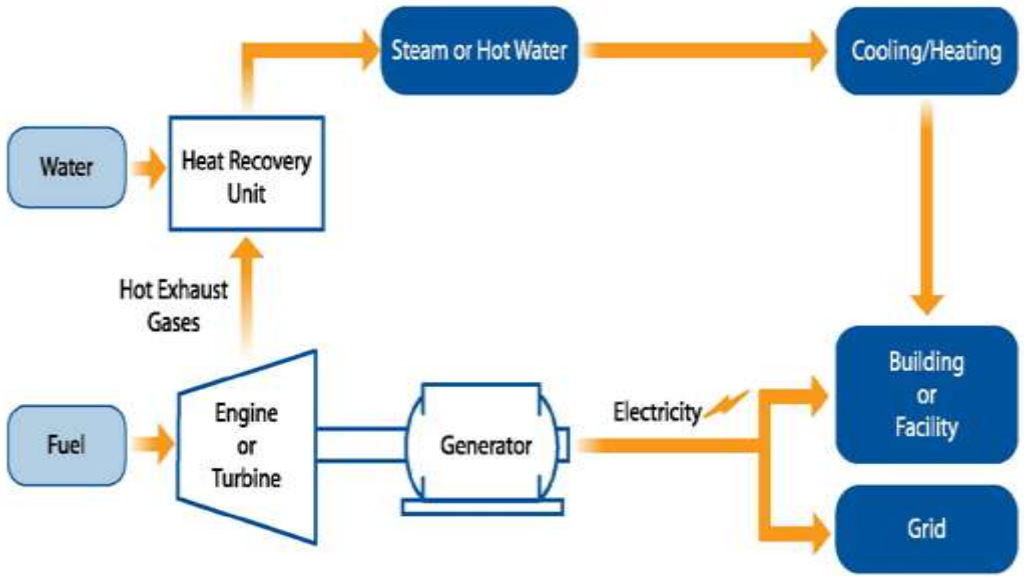
Infrastructure Resiliency

- A key principle of disaster preparedness
- Ability to maintain operation despite a devastating event
- CHP (if properly configured):
  - Offers the opportunity to improve CI resiliency
  - Can continue to operate, providing uninterrupted supply of electricity and heating/cooling to the host facility

What Is Combined Heat and Power?

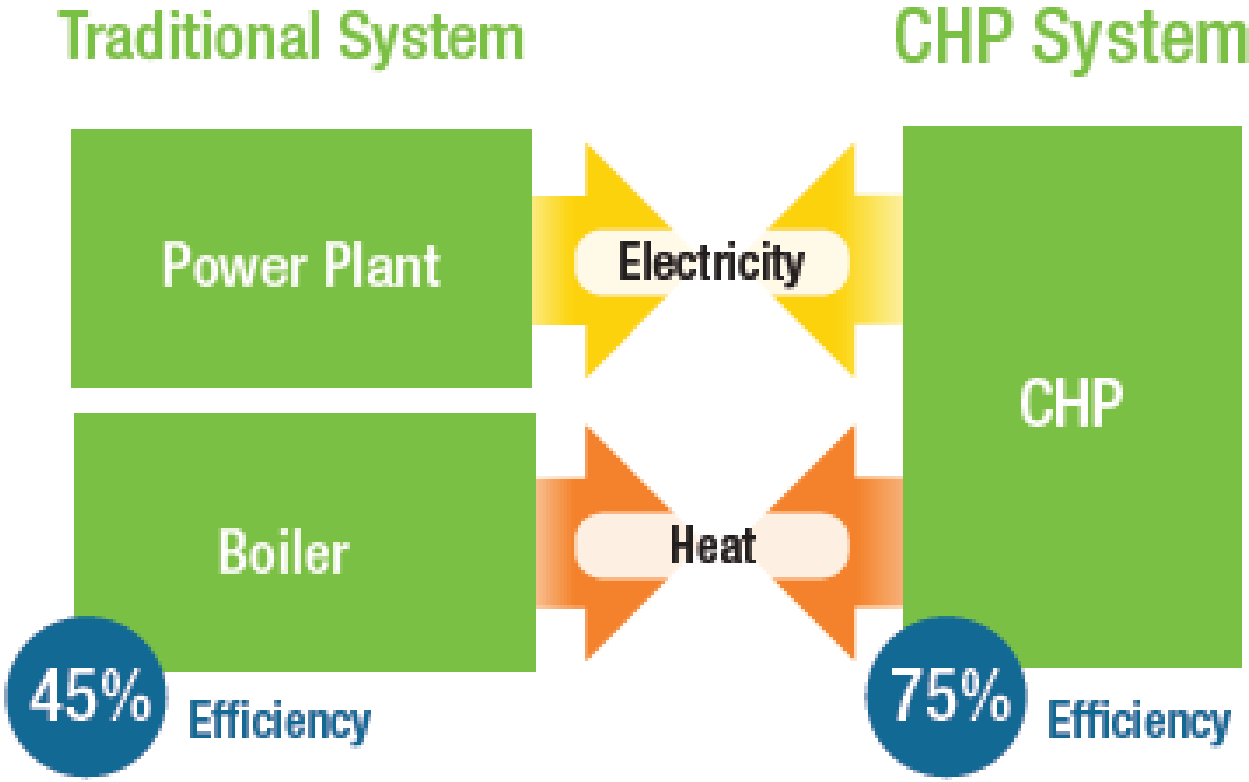
CHP is an *integrated energy system* that:

- Is located at or near a factory or building
- Generates electrical power
- Recovers waste heat for:
  - heating,
  - cooling or
  - dehumidification
- Can utilize a variety of technologies and fuels



Defining Combined Heat & Power (CHP)

The on-site simultaneous generation of two forms of energy (heat and electricity) from a single fuel/energy source



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

CHP versus Backup Generation

	Backup Generator	CHP
System Performance	• Only used during emergencies	• Designed and maintained to run continuously • Improved performance reliability
Fuel Supply	• Limited by on-site storage	• Natural gas infrastructure typically not impacted by severe weather
Transition from Grid Power	• Lag time may impact critical system performance	• May be configured for “flicker-free” transfer from grid connection to “island mode”
Energy Supply	• Electricity	• Electricity • Thermal (heating, cooling, hot/chilled water)
Emissions	• Commonly burn diesel fuel	• Typically natural gas fueled • Achieve greater system efficiencies (80%) • Lower emissions

Power Outage Cost Estimates

Superstorm Sandy

- Nearly $20 billion in losses from suspended business activity
- Total losses estimated between $30 to $50 billion
- Two-day shutdown of the NY Stock Exchange, costing an estimated $7 billion from halted trading
- Rutgers estimates economic losses of $11.7 billion for New Jersey GDP

SOURCE: http://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_enabling_resilient_energy_infrastructure.pdf

CHP Design for Reliability

- One estimate states that over $150 billion per year is lost by U.S. industries due to electric network reliability problems

Source: https://www1.eere.energy.gov/manufacturing/distributedenergy/pdfs/chp_critical_facilities.pdf

- CHP systems designed for reliability will incur additional costs ($45 - $170/kW depending on complexity of system)

- These additional costs however provide important reliability benefits to the site, and to the community at large

Uninterrupted Operation Requirements

- **Black start capability**
  - allows the system to start up independently from the grid
- **Generators capable of independent operation**
  - the system must be able to operate without the grid power signal
- **Ample carrying capacity**
  - system size must match critical loads
- **Parallel utility interconnection and switchgear controls**
  - the system must be able to disconnect from the grid, support critical loads, and reconnect after an event

Update – Ongoing State Efforts

- New York State:
  - Gov. Cuomo announced $20M investment (2013) with intent to invest up to $75M over next few years in clean energy projects (including CHP) aimed at providing continuous power & heat during grid outages.
  - Programs being implemented through NYSERDA – rolling applications through Dec, 2016.

- Connecticut:
  - Microgrid Pilot Program (includes CHP) with $15M in 2013 and $30M in 2014. Funds not to cover basic equipment costs, but to provide funds for required assessments, studies, interconnection, black start and other upgrades to ensure inclusion of grid resiliency support.
  - 4 or 5 of the first 8 projects selected for funding included CHP.

Update – Ongoing State Efforts

- New Jersey:
  - Improving energy resilience through the NJ Energy Master Plan which calls for 1.500 MW of CHP by 2020
  - N.J. Economic Development Authority and Board of Public Utilities, under Gov. Christie, has issued funding to assist in improving grid reliability in the state through CHP.

- Texas & Louisiana:
  - Bills passed requiring all government entities to identify which government buildings and facilities are critical in an emergency situation
  - Prior to constructing or making extensive renovations to any government owned critical structures, a CHP feasibility assessment must be performed.

- Many states are including CHP in their NASEO/DOE State Energy Assurance Plans.

Example CHP Installations (serving critical loads)

Case Studies (Project Profiles) located at
http://www1.eere.energy.gov/manufacturing/distributedenergy/chp_database/Default.aspx

CHP Applications:

Disaster Relief, Hurricane Sandy

New York Presbyterian Hospital

Manhattan, NY

Capacity: **7.5 MW**
Fuel: **Natural Gas**
Prime Mover: **Combustion Turbines**
Installed: **2009**

New York City's first hospital with grid-independent operating capability

Maintained full service while the surrounding grid was shut down

Due to its CHP system, New York Presbyterian not only cared for its own patients during the Hurricane Sandy blackout, but was able to admit patients from nearby hospitals that had lost power during the storm.

Source: http://cdhnrgy1.user.openhosting.com/Fact%20Sheets/New%20York%20Presbyterian%20Hospital%20Fact%20Sheet.pdf

CHP Applications:

Disaster Relief, Hurricane Katrina

Mississippi Baptist Medical Center

Jackson, MS

Capacity: **4.2 MW**
Fuel: **Natural Gas**
Prime Mover: **Combustion Turbines**
Installed: **1991**

The independence provided by the CHP system allowed MBMC to continue operation relatively unaffected during Hurricane Katrina in 2005. As soon as power reliability became a factor MBMC performed a load shed, switched off of the power grid, and continued operation in turbine-only mode. MBMC was the only hospital in the Jackson metro area to remain nearly 100% operational. After approximately 50 hours, the power reliability issue was addressed and MBMC connected to the power grid and returned to normal operation.

Source: ***http://www.southeastcleanenergy.org/resources/reports/CHP-MBMC.pdf***

CHP Applications:

Mission Critical Power System

University of Toledo Data Center

Toledo, OH

Capacity: **260 kW**
Fuel: **Natural Gas**
Prime Mover: **Microturbine**
Installed: **2012**

Microturbine CHP system installed in University of Toledo's Green Data Center. The system will be capable of providing 100 percent of the data center's critical electric and cooling needs.

Source: http://www.capstoneturbine.com/_docs/CS_CAP345_University_Toledo_lowres.pdf

CHP Applications:

Addressing Extended Power Outages

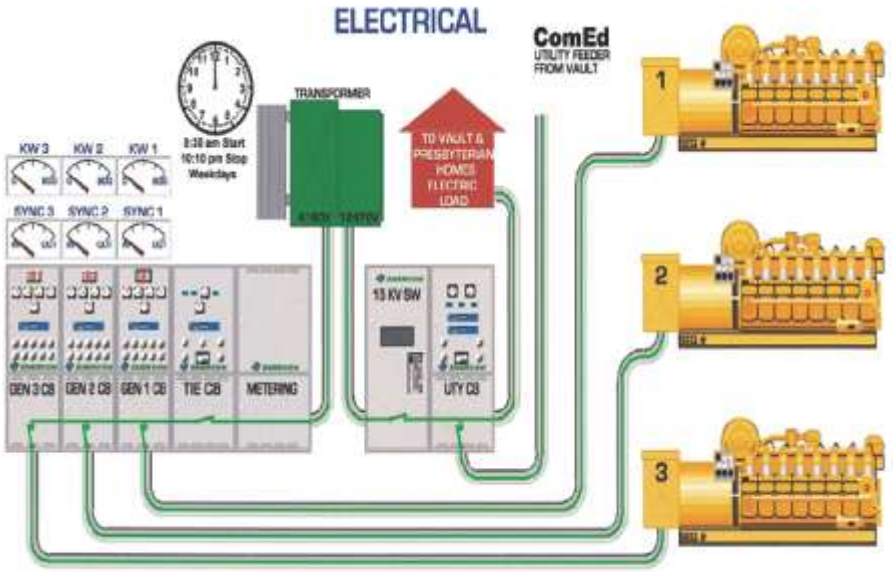
Presbyterian Homes

Evanston, IL

Capacity: **2.4 MW**
Fuel: **Natural Gas**
Prime Mover: **Recip. Engines**
Installed: **2001**

Ice storm in winter of 1998 knocked out power for 9 hours.

- *600 senior residents were transferred to safety*
- *CHP installed to avoid future outages*



"The environment we provide to elderly adults had everything to do with our decision to pursue power generation. Loss of power isn't an option. Lives depend on it."

- Keith Stohlgren, V/P Operations

"We had no power for nine hours one cold, winter day during an ice storm. The loss of power forced us to take immediate, aggressive measures to ensure the comfort and safety of our residents."

– Nancy Heald Tolan, Director of Facilities Management

US DOE Regional Clean Energy Application Centers (CEACs)

- **U.S. DOE Midwest Clean Application Center** originally established in 2001 by U.S. DOE and ORNL to support DOE CHP Challenge
- Today the **8 Centers** promote the use of **CHP, District Energy, and Waste Heat-to-Power** Technologies
- Strategy: provide a technology outreach program to end users, policy, utility, and industry stakeholders focused on:
  - **Market analysis & evaluation**
  - **Education & outreach**
  - **Technical assistance**
- Midwest Website: www.midwestcleanenergy.org

Questions?

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