District Energy/CHP/Microgrids: Resilient, Efficient Energy Infrastructure

IDEA EESI Senate Briefing
Dirksen Senate Office Building
December 6, 2016
AGENDA

- Introductions/Q&A - Carol Werner, EESI (Moderator)
- Industry Overview – Rob Thornton, IDEA
- Princeton CHP/Microgrid – Ted Borer, Princeton University
- City of Pittsburgh District Energy Initiative – Michael Rooney, Univ of Pittsburgh Center for Energy
- NRG Energy National Perspective – Jim Lodge, NRG Energy
“For the average coal plant, only 32% of the energy is converted to electricity; the rest is lost as heat.”

-Page VI, Executive Summary
Current U.S. Electricity System

Energy Consumed To Generate Electricity: 100% 33.6 Quads*

Opportunity — Useful heat rejected/dumped to the environment

Electric Utilities

Conversion Losses: 66% 22.1 Quads

Resource Utilization: 33% 11.5 Quads

Resource Utilization:
- Residential: 3.8 Quads
- Commercial: 3.2 Quads
- Industrial: 3.6 Quads
- Other: 0.3 Quads

Centralized generation drawbacks:
- No opportunity to recover heat generated when converting fuel to electricity
- Substantial losses in transmission/distribution of electricity — particularly during peak
- Large plants and the grid are vulnerable to disruption

*Quads — Quadrillion Btu's

Source: NREL http://www.nrel.gov/dtet/about.html
36% of U.S. Energy Becomes Waste Heat

U.S. Energy Consumption

- 36% Waste heat, mostly from power plants
- 28% Useful industrial & building energy
- 36% Total transportation energy

International District Energy Association
Figure 3. Comparison of U.S. Power Plant Waste Heat to Total Energy Use in Other Countries.

The U.S. Energy System Remains Inefficient

Source: Recycled Energy Development, data from US Energy Information Agency
Opportunity: Locally Generate Heat and Power

Combined heat and power solution to recycling waste heat: Distribute electricity generation to where waste heat can be recovered and put to use.

Benefits:
- More efficient use of our natural resources
- More secure against natural and man-made disasters
- Reduced pollution
- Enhanced indoor air quality and comfort

Source: NREL [http://www.nrel.gov/dtet/about.html](http://www.nrel.gov/dtet/about.html)
District Energy/CHP/Microgrid – Community Scale Energy Solution

- Underground network of pipes “combines” heating and cooling requirements of multiple buildings
- Creates a “market” for valuable thermal energy
- Aggregated thermal loads creates scale to apply fuels and technologies not feasible on single-building basis
- Fuel flexibility & distributed generation improves energy security, strengthens local economy
Energy-Efficiency Comparisons

**Standard Power Plant**
- 100% Fuel Input
- 60% "Waste" heat rejected to environment
- 40% Useful energy produced for electricity

**District Energy/Combined Heat and Power Plant**
- 100% Fuel Input
- 20% "Waste" heat rejected to environment
- 40% Useful energy produced for heating and/or cooling via district energy system
- 40% Useful energy produced for electricity
Future Proofing A More Resilient City

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DISTRICT ENERGY/CHP MICROGRID DRIVERS
Figure 1. Number of Devastating Natural Disasters (Category 5), 1980-2008
Polar Vortex Extreme Cold
Pacific Air Cut Off
Late-Month Pattern
AccuWeather.com
BILLION DOLLAR DISASTER EVENTS

Billion Dollar Disaster Events by Year: QER 2015
SUPERSTORM SANDY:
BY THE NUMBERS

820 mi diameter – 10/29/12

Double the landfall size of Isaac + Irene combined

Affected 21 states
(as far west as Michigan)

126 fatalities in U.S.
8,100,000 homes lost power
57,000 utility workers from 30 states & Canada assisted Con Edison in restoring power
Total estimated losses $71 billion+ (dni lost business)
District Energy/CHP/Microgrids Maintained Operations During Sandy:

Nassau Energy Corp. District Energy (Long Island, NY) – 57 MW CHP

South Oaks Hospital (Long Island, NY) – 1.3 MW CHP

Hartford Hospital/Hartford Steam (CT) – 14.9 MW CHP

Bergen County Utilities Wastewater (Little Ferry, NJ) - 2.8 MW CHP

Fairfield University (Fairfield, CT) – 4.6 MW CHP Campus
CO-OP CITY
THE BRONX
NEW YORK CITY
40 MW DE/CHP
“City within a city”

60,000 residents, 330 acres, 14,000+ apartments, 35 high rise buildings

One of the largest housing cooperatives in the world; 10th largest “city” in New York State

40 MW Cogen plant maintained heat and power throughout Sandy – back fed Con Edison grid
PRINCETON UNIVERSITY
15 MW District Energy
CHP
STORM-TESTED + PROVEN ANNUALLY
October 2011
Hurricane Irene

October 2012
Hurricane Sandy

CITY OBJECTIVES

• Increase energy efficiency and improve grid reliability/resiliency – extreme weather

• Integrate intermittent renewables, expand local tax base, replace remote coal/nuclear generation

• Tap local energy supplies - improve trade balance & drive economic multipliers

• Deploy cleaner energy sources to compete for high quality employers, factories, tenants

• Cut GHG emissions & address climate adaptation
Kendall Station

- Peaking plant reconfigured for base load
- Thermal heat discharge into Charles River
  - No CHP, wasted thermal heat resource
  - Lawsuit from environmental groups
- Previous owner IPP focus
- Not long-term district energy/CHP
Boston Green Steam Project: $112 million

Kendall Station:
- Acquisition: $50 million
- Reconfiguration: $35 million

Charles River Transmission Pipeline:
- $27 million

Local Job Creation:
- $21 million in labor costs
- 147,500 man hours – welders, pipe fitters, electricians, insulators
Green Steam Project Reducing Boston’s Carbon Footprint
Cuts carbon emissions by 475,000 tons/year, equivalent to:
• Removing 80,000 cars from the streets annually
• Installing 600 football fields of solar PV
Integrated Thermal Smart Grid
STATE POLICY TRENDS

Since 2012, $400 Million to Microgrids in Northeast (Sandy States)

- New York
  - $40 M Microgrid grant program (NY Prize)
  - Reforming Energy Vision (REV) creates new utility platform for DER
- Connecticut - 1st phase $18M; 2nd phase $20 M
- New Jersey
  - $30 M Microgrid deployment grants
  - $200 M Energy Resilience Bank
- Massachusetts - $32 M financing
  - Cities acting on resilient strategies
  - City of Boston Microgrid Regulatory Strategy
Cities, communities, campuses need financial support for energy infrastructure renewal.

290+ District Energy Systems hold CHP potential.

District Energy/CHP/Microgrids:
- support quality renewal jobs
- enhance energy resiliency
- strengthen aging grid
- optimize local resources & fuel flexibility
- reduce emissions
THANK YOU

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