Community Energy Systems: Strategies & Tools for Efficiency, Resiliency and Renewal

IDEA Community Energy Workshop
Miami, FL
June 2, 2013
Microgrids/District Energy: What is Driving the Discussion?

• Frequency and severity of extreme weather events causing economic disruption
• Growing recognition of need for local plan & response
• Desire for community-based infrastructure as economic and environmental engine
• Importance of safe, secure and reliable energy to attract industry; development
• Clean energy as climate adaptation
Super Storm Sandy: By the Numbers

• 820 miles in diameter on 10/29/12
  • Double the landfall size Isaac & Irene combined

• Caused 106 fatalities

• Total estimated cost to date - $71 billion+ (dni lost business)
  • New York - $42
  • New Jersey - $29

• Affected 21 states (as far west as Michigan)

• 8,100,000 homes lost power

• 57,000 utility workers from 30 states & Canada assisted Con Ed in restoring power
NYC Co-Op City
Bronx, New York

• “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 cogeneration plant maintained power before, during and after the storm (heat & power)

Mission-Critical Operations

• **Danbury Hospital** (Danbury, CT) – 4.5 MW CHP
  - supplies 371 bed hospital with power and steam to heat buildings, sterilize hospital instruments & produce chilled water for AC
  - $17.5 million investment, 3-4 year payback, cut AC costs 30%

• **Nassau Energy Corp.** (Long Island, NY) – 57 MW CHP
  - Supplies thermal energy to 530 bed Nassau University Medical Center, Nassau Community College, evacuation center for County
  - No services lost to any major customers during Sandy

• **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 (Process sewage for 47 communities)
Resilient University Microgrids

• The College of New Jersey (NJ) – 5.2 MW CHP
  - “Combined heat and power allowed our central plant to operate in island mode without compromising our power supply.” - Lori Winyard, Director, Energy and Central Facilities at TCNJ

• Fairfield, University (CT) – 4.6 MW CHP
  - 98% of the Town of Fairfield lost power, university only lost power for a brief period at the storm’s peak
  - University buildings served as area of refuge for off-campus students

• Stony Brook University (LI, NY) – 45 MW CHP
  - < 1 hour power interruption to campus of 24,000 students (7,000 residents)

• NYU Washington Square Campus (NY, NY) – 13.4 MW CHP

• Princeton University (NJ) – 15 MW CHP
  - CHP/district energy plant supplies all heat and hot water and half of the electricity to campus of 12,000 students/faculty
  - "We designed it so the electrical system for the campus could become its own island in an emergency. It cost more to do that. But I'm sure glad we did." – Ted Borer, Energy Manager at Princeton University
Paradigm Shift

- In U.S., during the first half of 2012,
  - 165 new electric power generators installed
  - Totaling 8,100 megawatts (MW) new capacity
  - Of 165, 105 of those units under 25 MW and;
  - Mostly renewable - solar, wind or landfill gas

- Environmental compliance and lower cost natural gas impacting coal plants
Brayton Point Power Station, Somerset, MA – 1,537 MW
Pre-2011: Once-through cooling – Taunton River:Mount Hope Bay
Figure 12: Brayton Point Station Heat Rejection versus Time (1970 - 2000)
Brayton Point Cooling Towers – $570 Million in 2011

Total environmental compliance $1.1 billion since 2005.
Somerset power plant put up for sale

Dominion Loss on Write-Downs; Core Improves… *WSJ*, Jan 31, 2013

Energy company Dominion Resources posts 4Q loss – *The Virginian Pilot*, Jan 31, 2013
Heat Transmission Systems
The Greater Copenhagen DH System

- 18 municipalities
- 4 integrated DH systems
- 500,000 end-users
- 34,500 TJ (9,600 GWh, 32,700 GBTu)
- Approx 20% heat demand in Denmark
World Class CHP – 90%+ Efficiency
Avedore 1&2, Copenhagen

Unit 1 (810MW) – Coal; Unit 2 (900 MW) – Multi-Fuel (straw; biomass, etc)
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
District Energy/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, technologies not feasible on single-building basis
- Fuel flexibility improves energy security, local economy
Thermal-only District Energy: Opportunity for Microgrid/CHP Renewal

- Approx. 56,000,000 lbs per hr aggregated heating demand in 300 known US DE thermal-only sites:
  - Cities/Communities
  - Campuses
  - Airports
  - Military bases

- Represents between 5 and 11 GW near term CHP potential

- Aggregated thermal load facilitates efficient, competitive CHP
Federal CHP Policy

White House Executive Order, Aug 30, 2012

“Accelerating Investment in Industrial Energy Efficiency”

- Increase CHP capacity by 40 GW (50%) by 2020

- Convene federal and regional stakeholders to address barriers – policy, financial, regulatory

- Accounting for potential emission reduction benefits of CHP in State Implementation Plans (SIPs); employ output-based emissions approaches

- Providing incentives for CHP deployment of CHP: emissions allowance trading program, state implementation plans, grants, and loans

- Expand participation and tools of Clean Energy Application Centers and support DOE Better Buildings, Better Plants to reduce energy intensity
State Policy Landscape

• Massachusetts
  – Green Communities Act 2009 – Alternative Energy Portfolio

• Minnesota
  – Waste Heat Recovery qualifies under Utility Efficiency program

• Maine
  – BTU Act - Biomass Thermal Utilization Act provides tax parity

• New Hampshire
  – SB 218: adds renewable thermal energy to state RPS

• Washington State
  – SB 6012: renewable thermal energy eligible for State RECs

• Ohio
  – SB 242: renewable energy resources do not need to produce electricity to qualify for RECs

• Connecticut:
  – $20 M Microgrid Grant & Loan Pilot Program - Public Act 12- 48
Community Energy/Microgrid
Local Drivers

- Growing demand for greater reliability and resiliency
- Gain control over infrastructure
- Desire to expand local tax base and replace remote coal generation
- More sustainable resources to help compete for higher quality employers, factories, tenants
- Tapping local energy supplies to improve trade balance & drive economic multiplier
- Cutting GHG emissions and addressing climate adaptation
Future Proofing A More Resilient City

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IDEA Planning Guide for Community Energy

- Consider energy in comprehensive planning, brownfield/revitalization projects, Climate Action Plans
- Project champions: Mayors, economic development, sustainability staff, elected officials, planners; SEO’s
- Variety of project developers: opportunities for collaboration and public/private partnerships
  - Local governments
  - Communities
  - Private property developers
  - Other public sector developers
  - Institutions/Bases/Pharma Research
  - Corporations and industrial parks
  - Landowners and building operators

Click here: www.districtenergy.org/community-energy-planning-development-and-delivery

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Stages of Development

Stage 1: Objectives setting
Stage 2: Data gathering
Stage 3: Project definition
Stage 4: Options appraisal
Stage 5: Feasibility study
Stage 6: Financial modeling
Stage 7: Business modeling
Stage 8: Marketing & business development
Stage 9: Project procurement
Stage 10: Delivery
Financial Modeling

• Reconsider project objectives:
  – Financial viability
  – Competitive pricing to attract customers
  – State grants or program funding options
    • AEPS; EERS; REC’s, etc
  – Reduce emissions: market mechanisms
  – Supply security: highly valuable to mission-critical customers, i.e. hospitals
  – Sustainability and benefits to local economy
Typical Business Models for North American District Energy Systems

• Privately-owned energy provider (urban utility)
  – Competitive market; tariff service or long term contract; non-exclusive city franchise; no obligation to serve
  – May be publicly-traded company; subsidiary of IOU
  – Veolia Energy; NRG Thermal; Energy Systems Co, ConEd, etc

• Public or Municipal Utility
  – OU Cooling (Orlando); Duluth Steam; Markham District Energy

• Cooperative or Private, Non-profit
  – District Energy St. Paul; TECO (Houston); Franklin Heating Station (Mayo Clinic); RDC, Rochester, NY; Medical Center Co.

• Hybrid or Public/Private Partnership
  – Assets owned by municipality or agency, managed by third party
  – Enwave Energy (Toronto)
Project Financing

- District Energy operating assets generate revenue
  - Customer contract revenue can serve as collateral
- Projects qualify for municipal bonds
- Early stage matching funds – LESRA 2013
- Potential sources of capital
  - Clean Energy Development Bonds
  - Develop, Finance, Operate: i.e. DBOOM
  - Commercial PACE for energy efficiency:
    Ygrene Partners (CA, FL, GA, LA, MN, MA & CT)
  - Traditional debt; pension funds
  - Master Limited Partnerships (pending)
Master Limited Partnership Parity Act

In 2013 - Senate Bill S.795 / House Bill HR. 1696

MLPs are comprised of a number of investors (“limited partners”) and several managers (“general partners”).

The MLP Parity Act expands the eligibility for MLP financing from just fossil-fuel projects to include renewable-energy projects.
District Energy St. Paul, MN

- District hot water service to 29 million sq ft buildings (90% market)
- District cooling service to over 17 million sq ft
- Combined heat & power: 25 Mwe (electric); 65 MWt (thermal)
- Double the efficiency of conventional power plants
- Fuel flexible: waste wood, natural gas, coal, oil – stable energy prices
- Municipal wood waste displaces 275,000 tons coal/yr; cuts landfill; reduces CO2 emissions 280,000 tons/yr
- Over $12 million in fuel purchases re-circulates in local economy
Markham District Energy, Inc.

- Owned, Developed and Operated by the City of Markham, Ontario
- Planned 30M sq ft Downtown Markham Centre - Greenfield with district energy infrastructure to attract “blue chip” companies
- First customer connection in 2000 - IBM Canada Labs
- Now over 6M sq. ft served from three (3) interconnected plants - Tridel; Markham Civic Center, YMCA, Honeywell, Motorola, Bill Crothers and Unionville High Schools, all new condominium buildings
- District Heating, District Cooling, Thermal Energy Storage, 11MW CHP
- Electricity use reduced by up to 90%
- 61MW demand & 85M kWh consumption reduced each year
- CO₂ emissions reduced by 79,000 Tonnes / Year
- Eliminates ozone depleting refrigerants
- Reduces harmful NOₓ and SOₓ
'Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has.'

Margaret Mead