Energy Efficient Infrastructure for More Resilient Local Economies:

The Role of District Energy/CHP & Microgrids

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Advancing Innovative Solutions Since 1984

EESI

EESI Briefing

562 Dirksen Senate Office Building

Washington, DC

May 8, 2013

Agenda

- **Introductions –** ***Carol Werner, EESI***
- **Industry Overview –** ***Rob Thornton, IDEA***
- **Case Study, Resilient Institution: Princeton University –** ***Ted Borer, Princeton University***
- **Case Study, Urban Efficiency & Reliability –** ***Bill DiCroce, Veolia Energy NA***
- **The Case for Cutting Waste –** ***Ken Smith, Ever-Green Energy***
- **Policy/Legislative Options-** ***Mark Spurr, IDEA***
- **Q&A**

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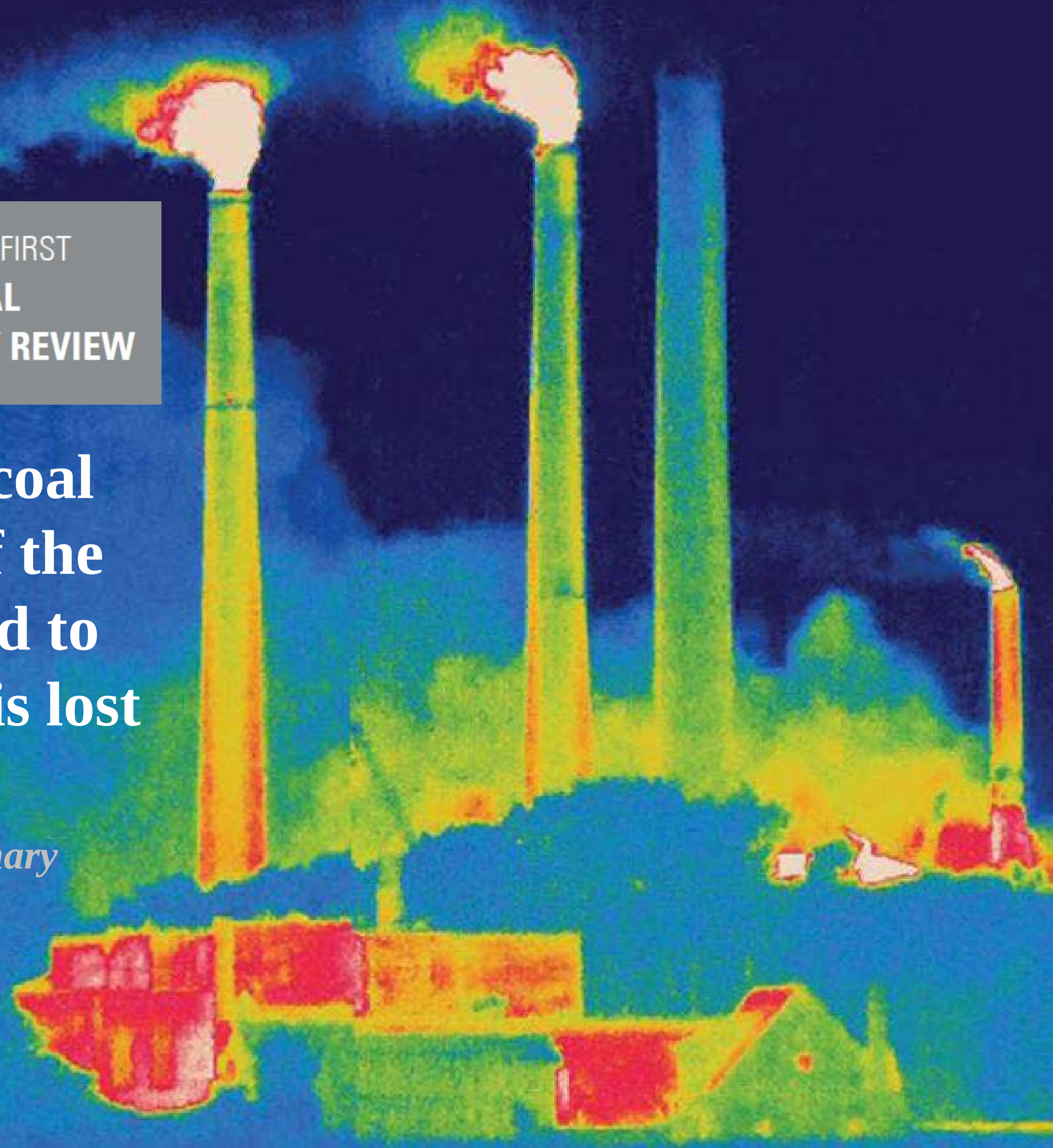
U.S. DEPARTMENT OF ENERGY

QTR | REPORT ON THE FIRST **QUADRENNIAL TECHNOLOGY REVIEW**



“For the average coal plant, only 32% of the energy is converted to electricity; the rest is lost as heat.”

-Page VI, Executive Summary

Efficiency of US Power Generation

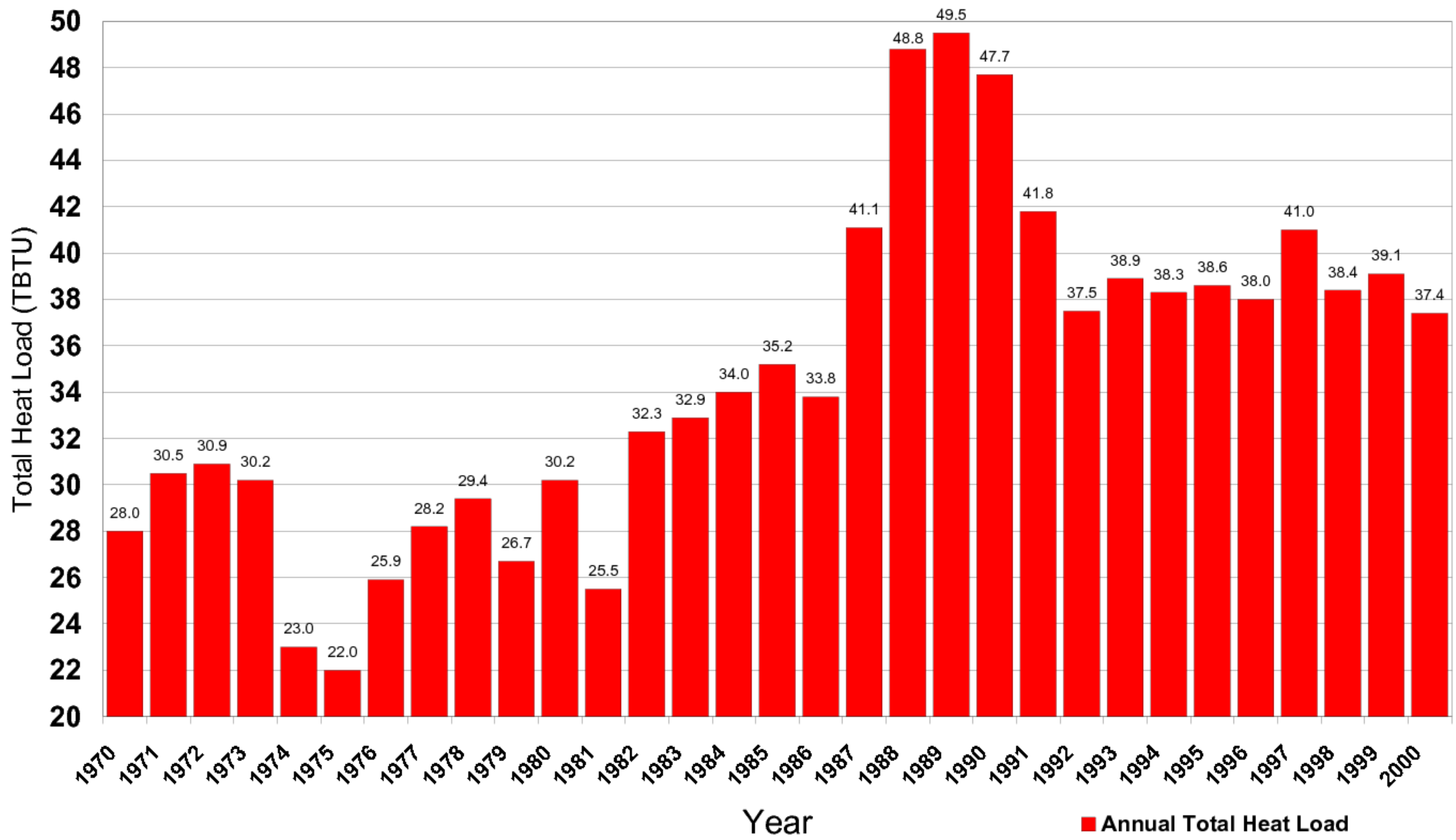
U.S. COAL-FIRED POWER PLANTS RANKED BY EFFICIENCY

Decile	No of units	Net nameplate capacity (GW)	Capacity factor	2007 total generation (BkWh)	2007 generation-weighted efficiency (HHV)
1	181	30	67%	177	26.5%
2	108	30	70%	180	30.0%
3	90	30	73%	189	31.0%
4	73	30	73%	189	31.7%
5	84	30	75%	194	32.4%
6	75	30	69%	181	33.2%
7	79	29	71%	182	34.0%
8	70	30	70%	186	34.9%
9	57	29	72%	184	35.9%
10	46	30	74%	192	37.9%
Overall	863	297	71%	1,856	32.5%

Power Engineering Magazine, November 2009

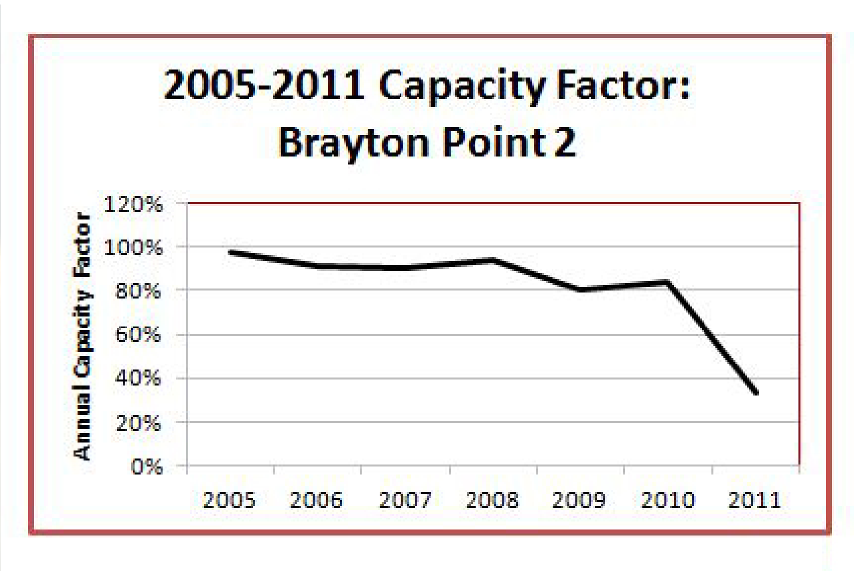
Brayton Point Power Station, Somerset, MA – 1,537 MW
Pre-2011: Once-through cooling – Taunton River:Mount Hope Bay

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.



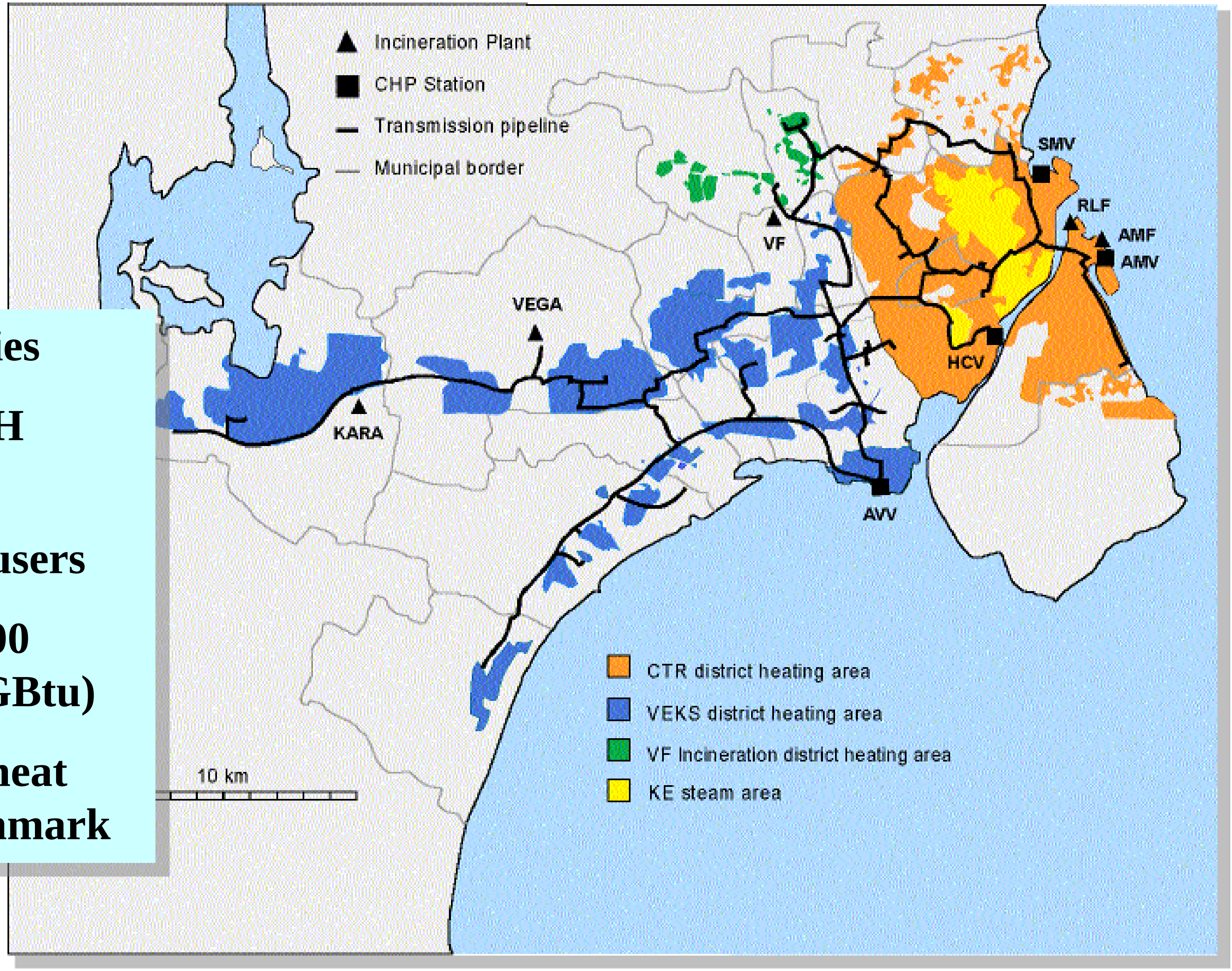
Somerset power plant put up for sale
Boston Globe, Sept 7, 2012

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

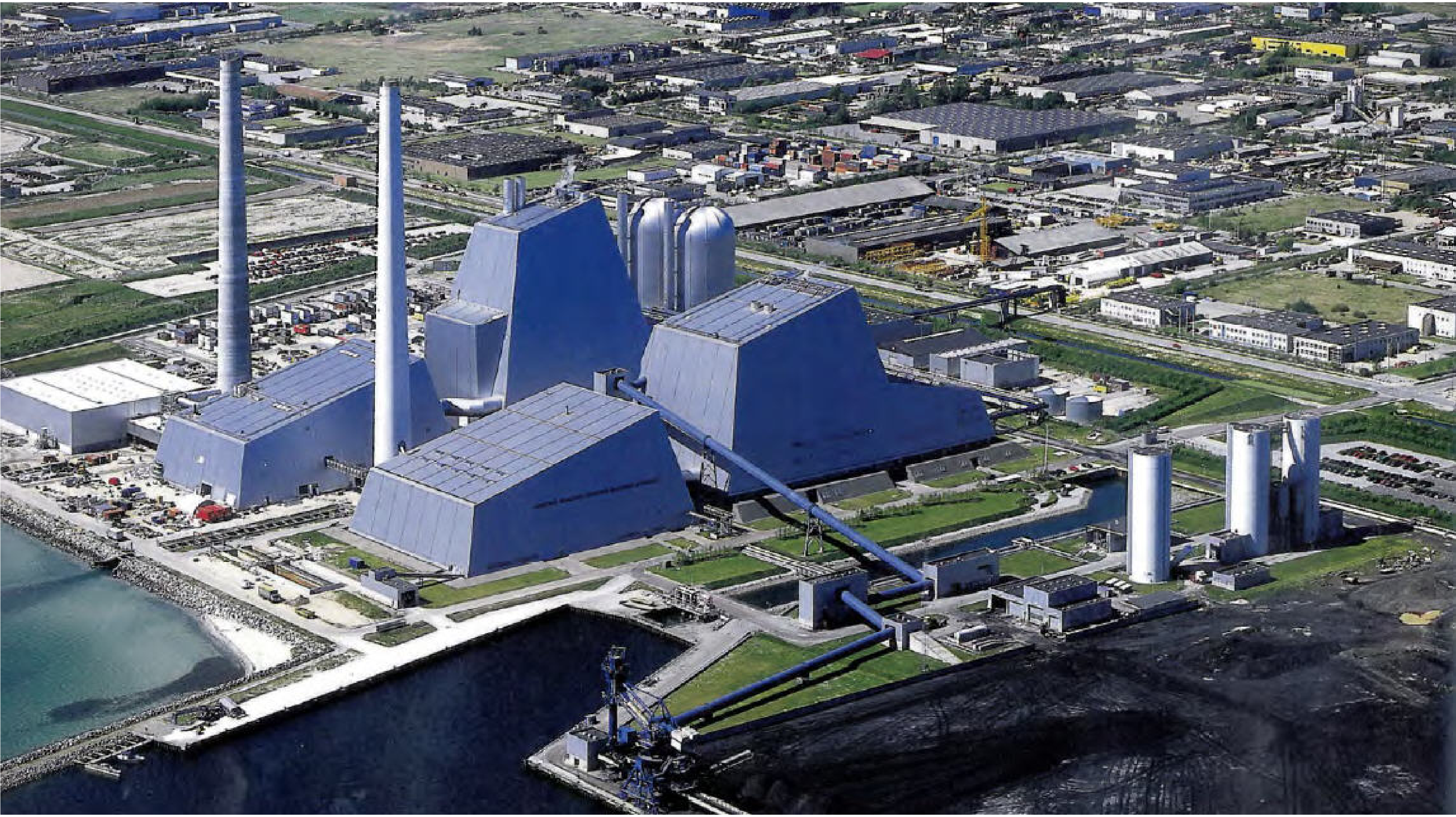
4 integrated DH systems

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)

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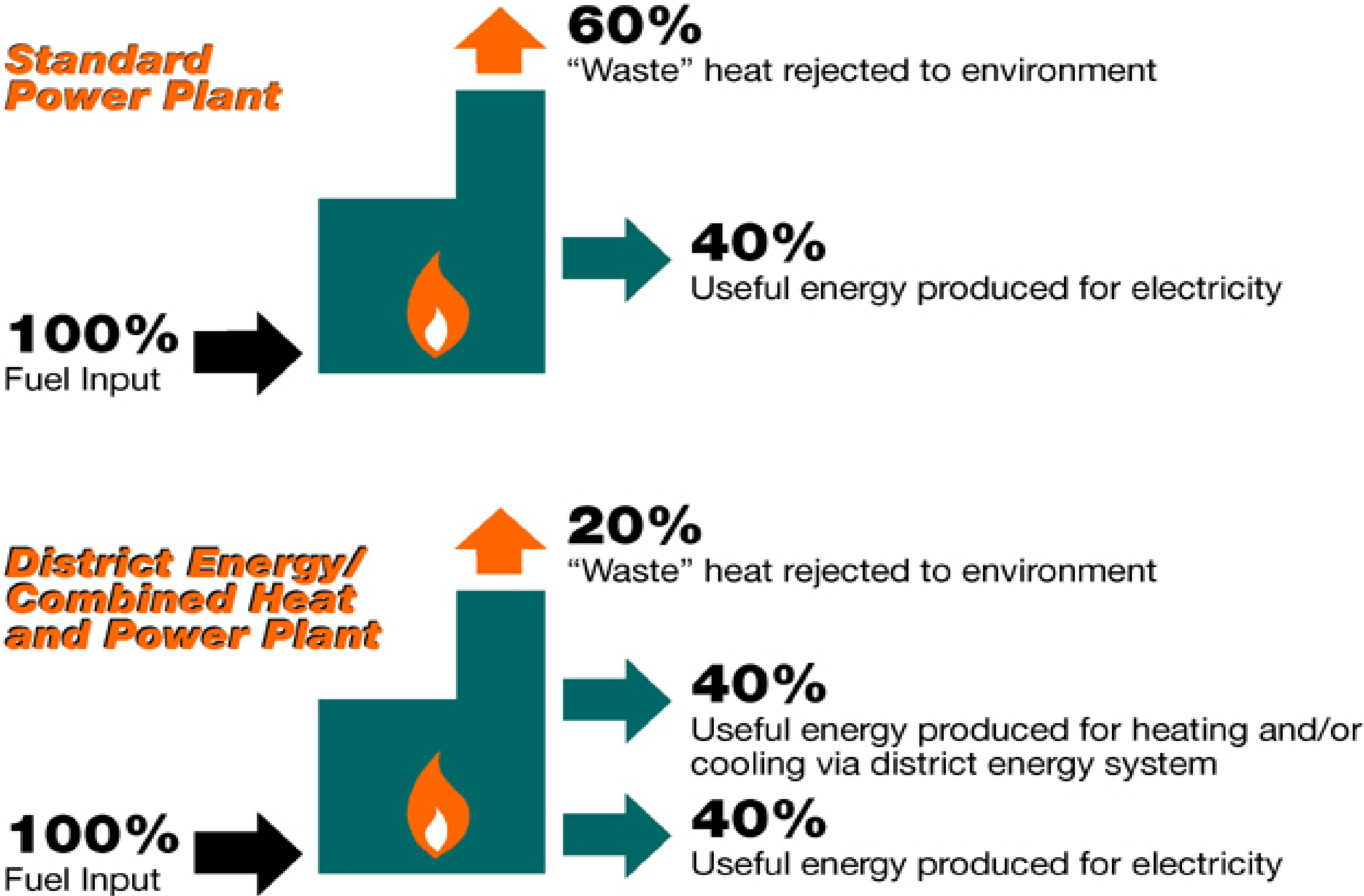
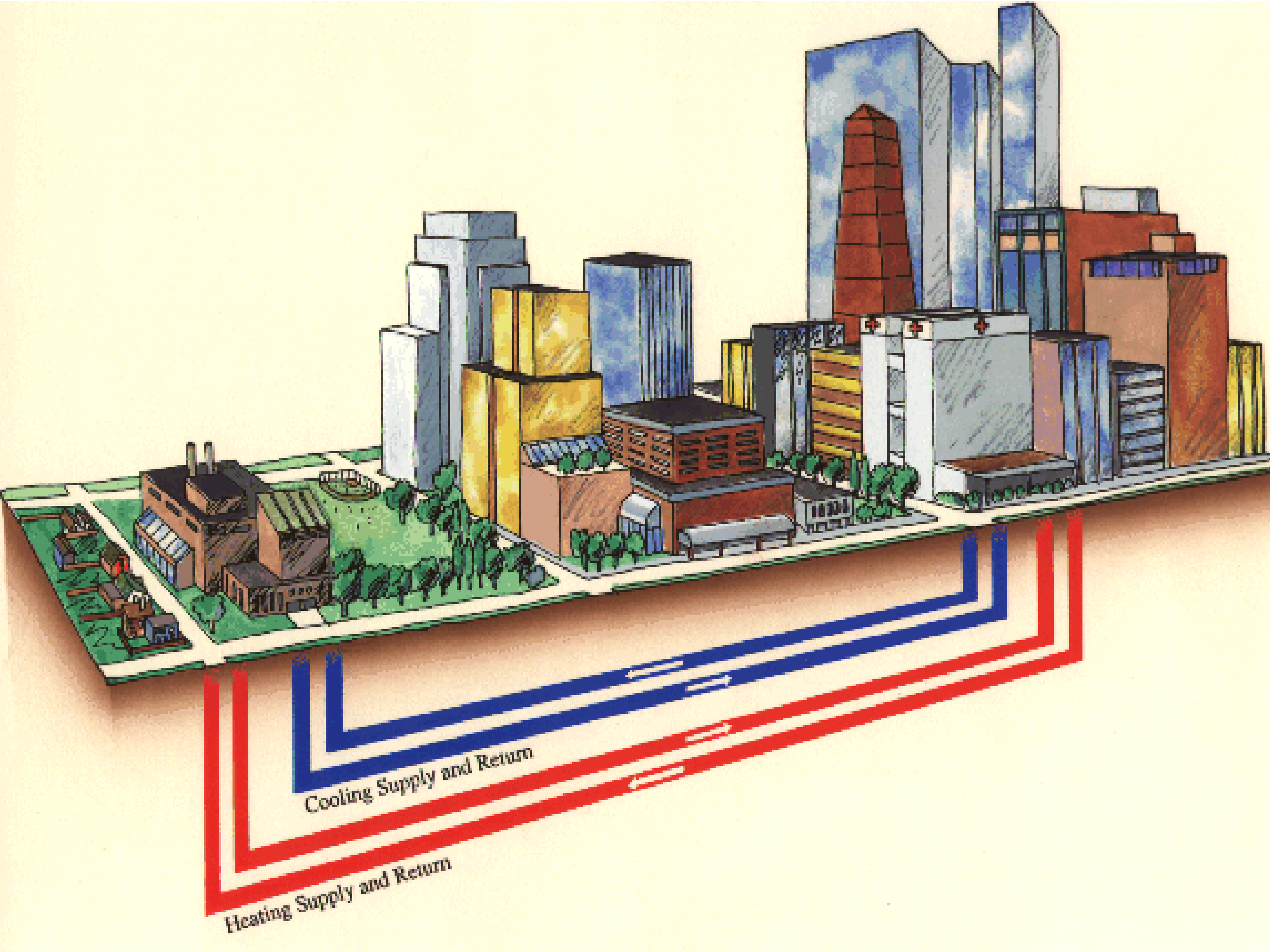
Energy-Efficiency Comparisons




Cooling Supply and Return
Heating Supply and Return

What is a District Energy/Microgrid?

- **Local “distributed” generation**

- **Robust, economic assets 24/7/365**

- **Generation located near load centers & customer density; often mission-critical**

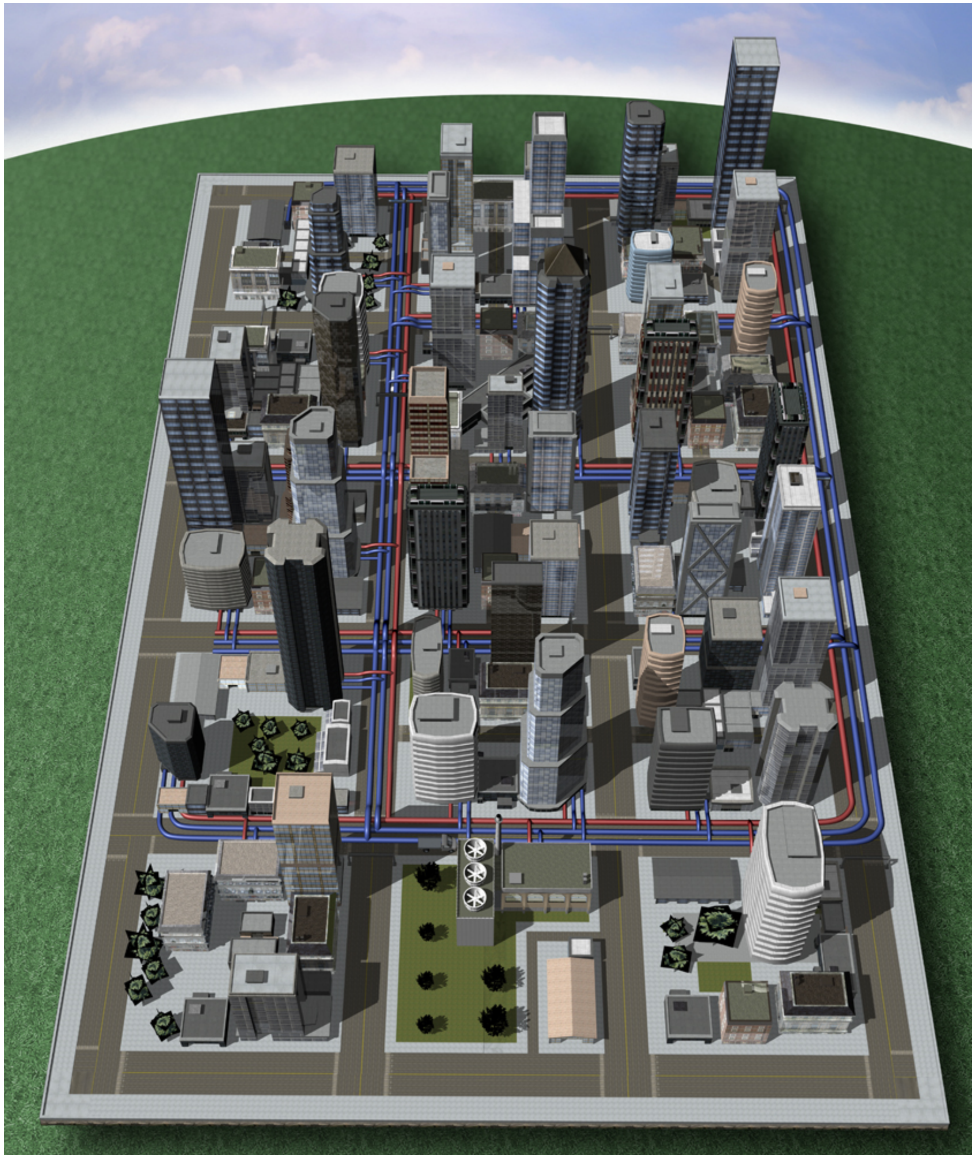
- **Integrating CHP; thermal energy; electricity generation; thermal storage and renewables**

- **CHP generation interconnected with regional & local electricity grid**

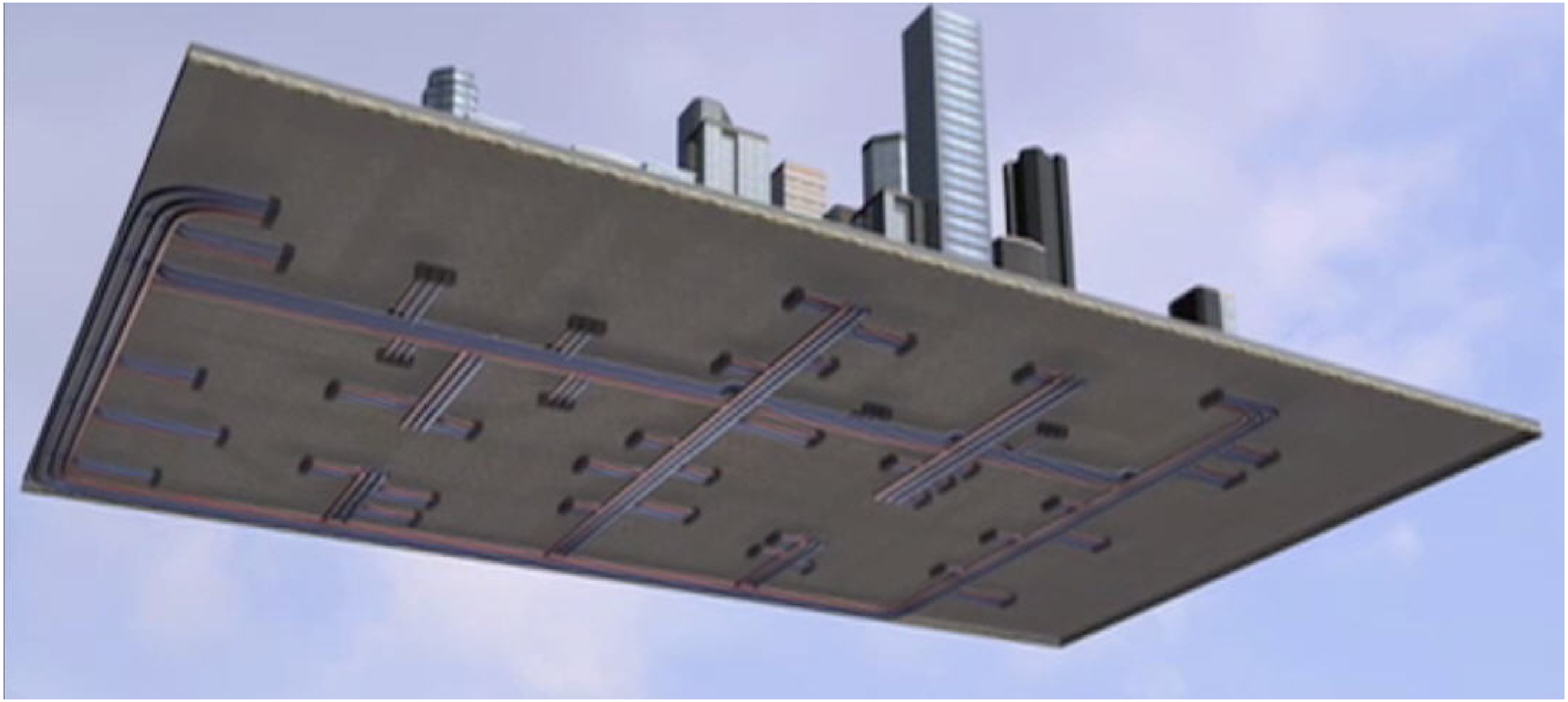
- **Able to “island” in the event of grid failure**

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**

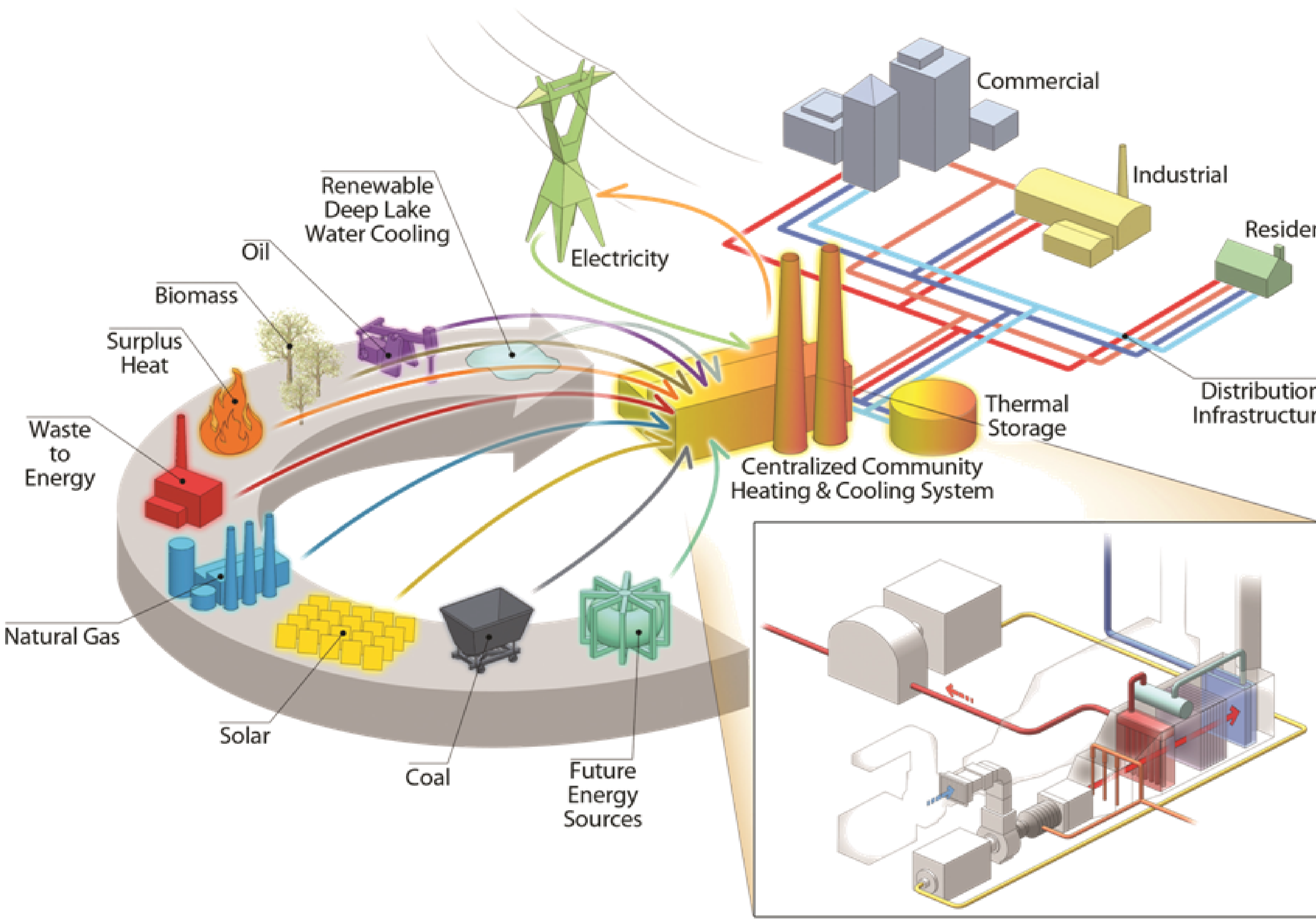


Infrastructure for Local Clean Energy Economy

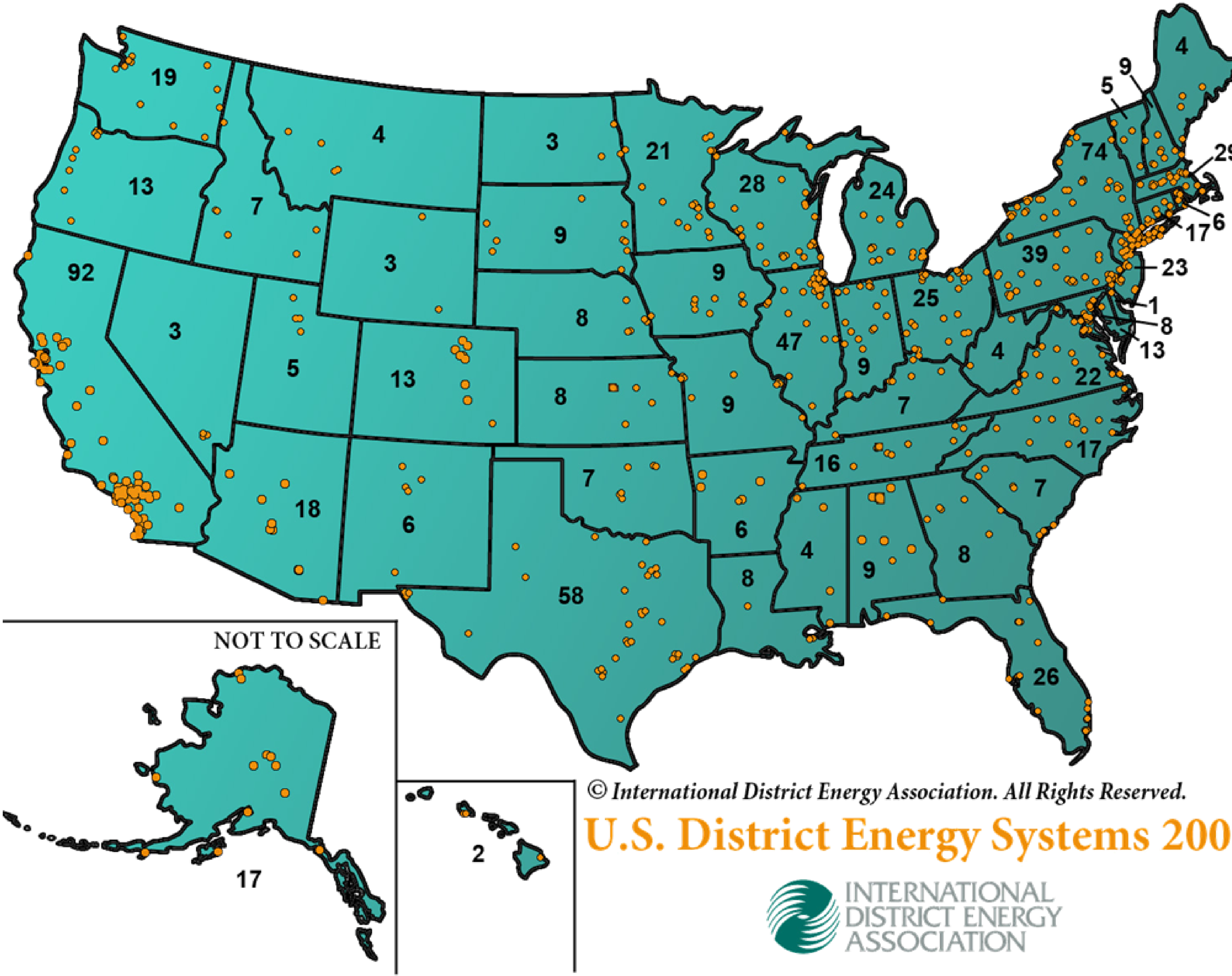


- Connects thermal energy sources with users
- Urban infrastructure – hidden community asset
- Robust and reliable utility services
- Energy dollars re-circulate in local economy

Future Proofing A More Resilient City



- CHP turbine
- Generator
- Gas peaking boilers
- Emission controls
- Compressors
- Chillers
- Pumps
- Plate heat exchangers



U.S. District Energy Systems 2009

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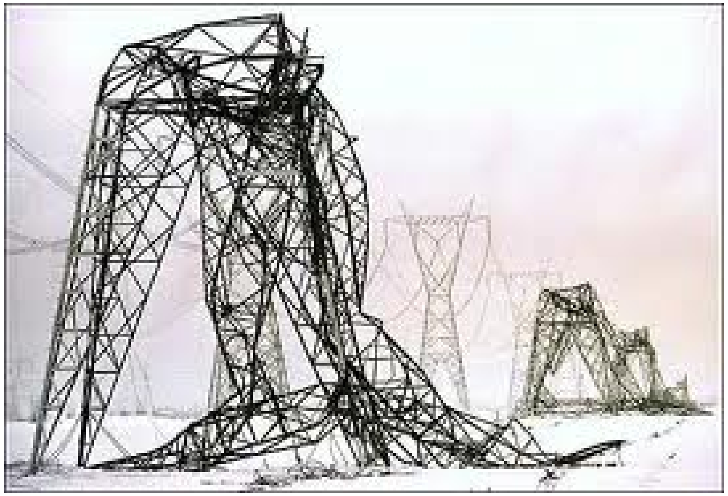
District Energy Thermal Only: Excellent Near Term Opportunities for Microgrid/CHP Integration

- **300 District Heating systems; 56,000,000 MMBtu/Hr heat demand in:**
  - **Cities/Communities**
  - **Campuses**
  - **Airports**
  - **Military bases**
- **Represents approx. 11 GW near term CHP potential**
- **Aggregated customer thermal loads facilitates efficient, competitive CHP generation**

District Energy/CHP/Microgrid Local Opportunity Drivers



- Growing demand for greater grid reliability and resiliency
- Desire to expand local tax base & replace remote coal generation
- Tapping local energy supplies to improve trade balance & drive economic multiplier
- More sustainable energy sources to help compete for high quality employers, factories, tenants
- Cutting GHG emissions and addressing climate adaptation
- Local infrastructure advantages in extreme weather events

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


Danbury , CT


Long Island, NY


Garden City, NY


Garden City, NY

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)**

http://www.forbes.com/sites/williampentland/2012/10/31/where-the-lights-stayed-on-during-hurricane-sandy/

Mission-Critical Operations

- **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
- **Marina Thermal** (Atlantic City) – 25,000 Tons; 335,000 #/hr, 8 MW
- **Danbury Hospital** (Danbury, CT) –
  - 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%
- **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)


Princeton University, NJ
Stony Brook Univ, NY
Fairfield, CT
Ewing, NJ

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 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 (NYC) – 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***

Thank you for your attention.

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

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