A Warming Climate for District Energy/CHP in the USA

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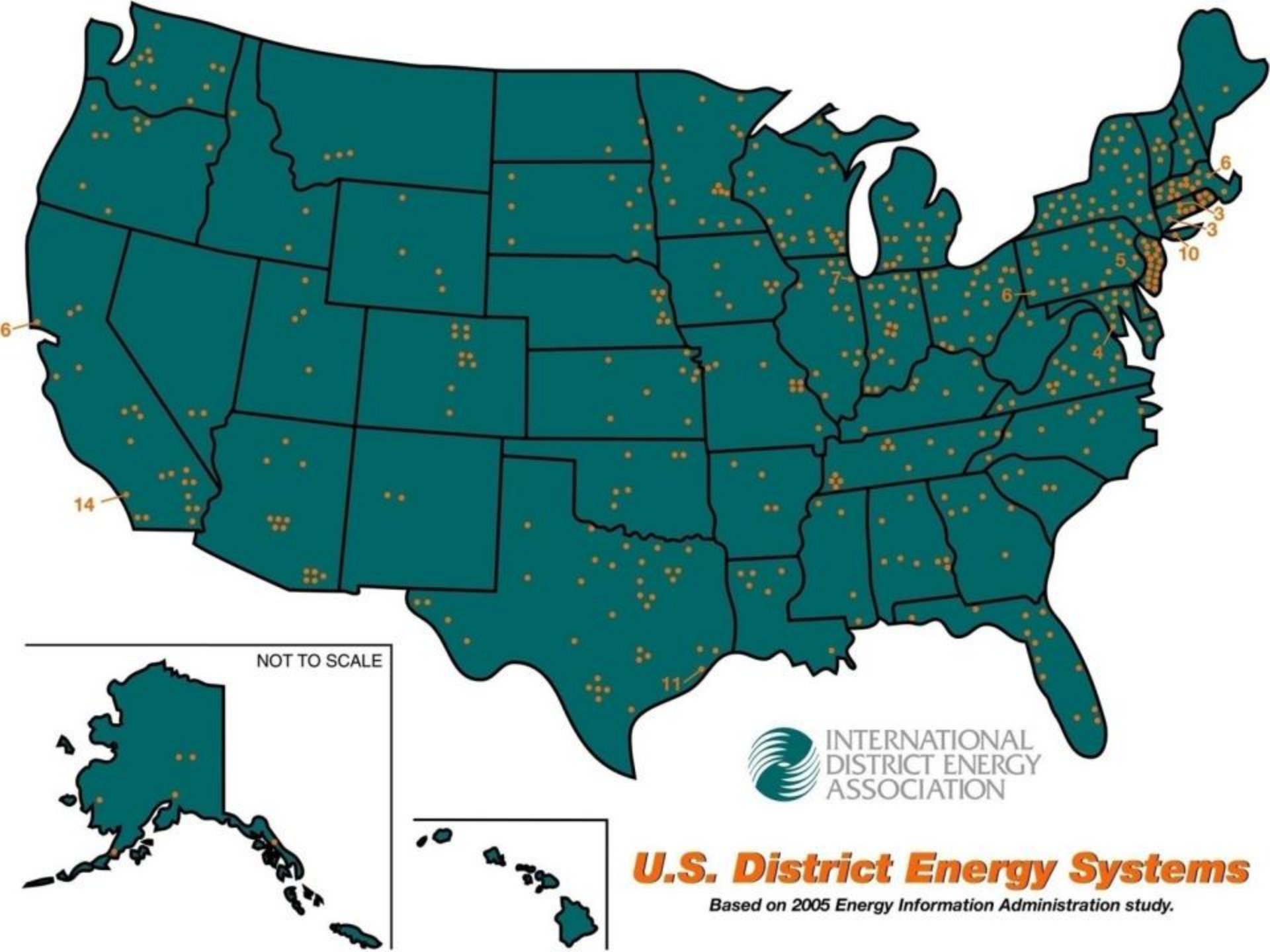
US Department of Energy

IEA District Heating Futures Workshop

Gustavelund, Tuusula, Finland

31 August, 2009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NOT TO SCALE
INTERNATIONAL
DISTRICT ENERGY
ASSOCIATION
U.S. District Energy Systems
Based on 2005 Energy Information Administration study.

Characteristics of US District Energy Industry

1. Downtown steam systems serving central business districts, many have chilled water service too
    - Commercial office space is principal end-user
    - Hotels, arenas, event space
    - Residential segment growing (but competitive)
2. Large university campuses/institutions with heating (steam) and cooling systems, many adding CHP
3. New community energy systems emerging in smaller towns to utilize local fuel supplies
4. Movement toward lower carbon solutions

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

IDEA 100 years
INFORMING CONNECTING ADVANCING
since 1909

US District Energy Industry Capacity

- Total industry base is approximately 2,500 systems
- Heating systems principally steam distribution
- Hot water for new expansions, renewals

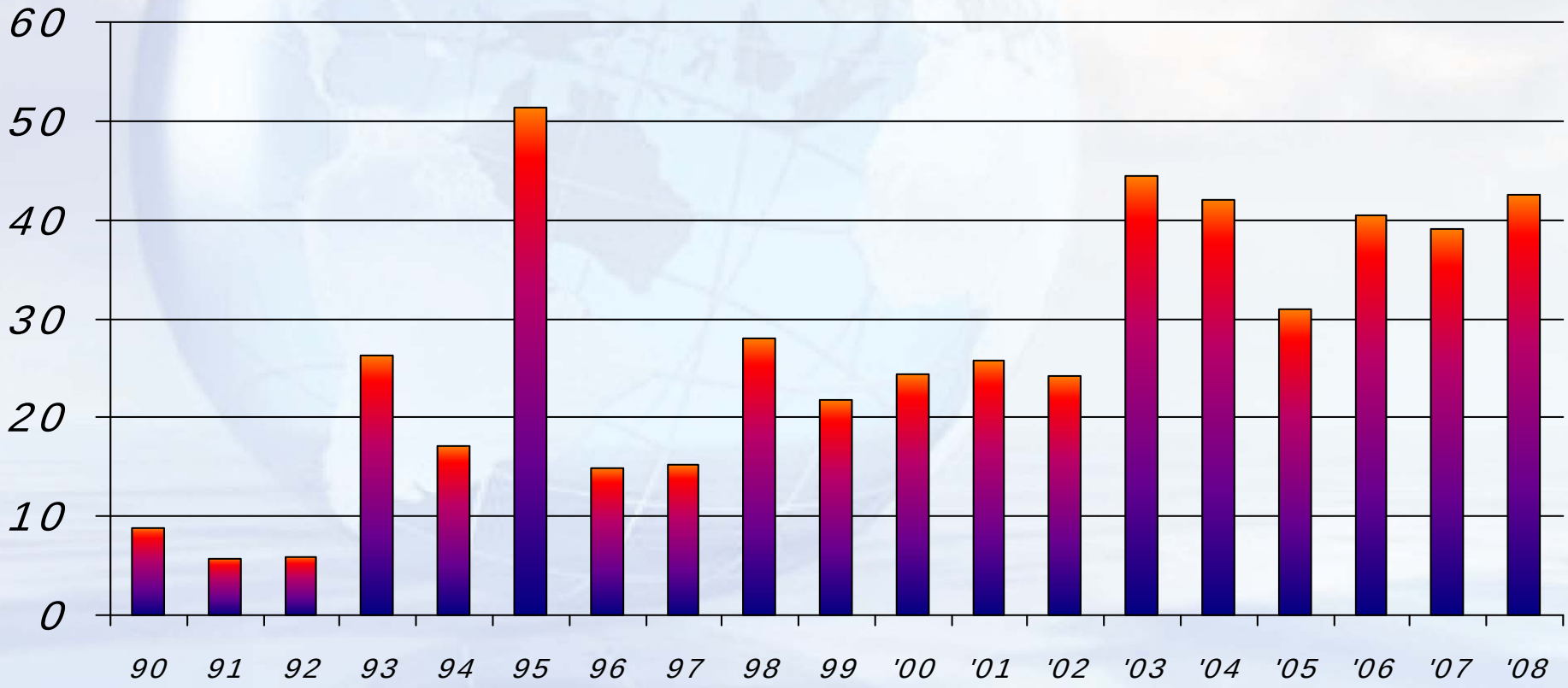
	# Systems Reporting	Gross SF Customer Building Space Served	Heating Capacity (MMBtu/Hr)	Cooling Capacity (Tons)	Electricity Generation (CHP Mwe)
Downtown Utilities	85	1,898,037,560	49,239,000	1,082,355	950
Campus Energy Systems	330	2,489,216,071	82,107,191	1,855,546	2,197

* Based on systems reporting 2005 data to EIA Survey

North American Industry Growth

(Million sq ft customer bldg space connected/committed)

Aggregate "reported" since 1990 - 467,686,922 sq ft



Residential, Hotel, Hospitals

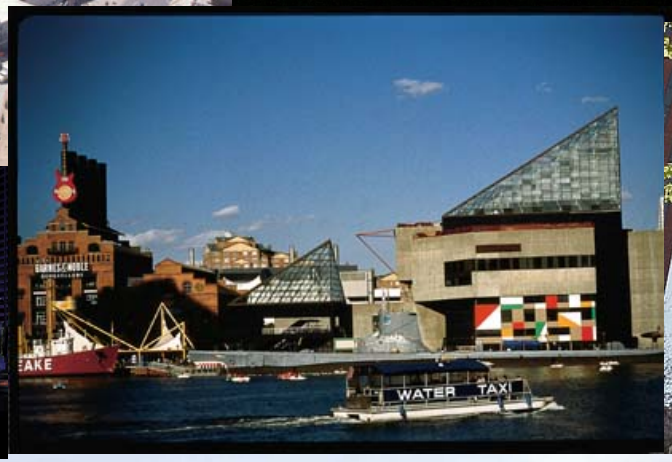
Commercial, Government, Arena











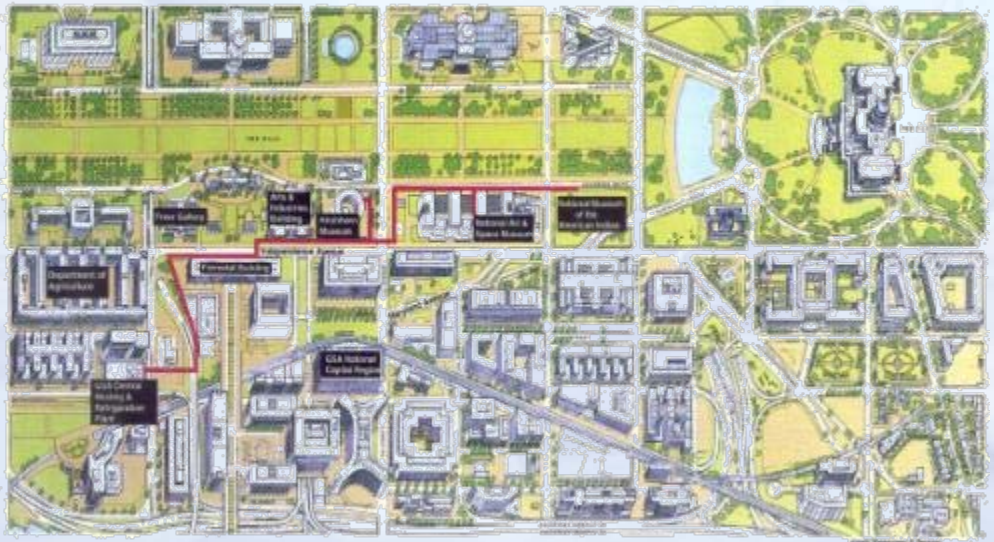
Downtown District Energy Systems
New York City – Con Edison Steam System

- World's largest steam system – 1850+ customers
- Seven (7) generating facilities supply over 102 miles of underground piping
- Customers use approx. 500,000 tons of steam-driven chillers, displacing 350 MW peak electric demand on grid
- Combined heat and power provides 60% of total annual steam

Con Edison, NYC – 660 MW CHP
East River Re-powering Project

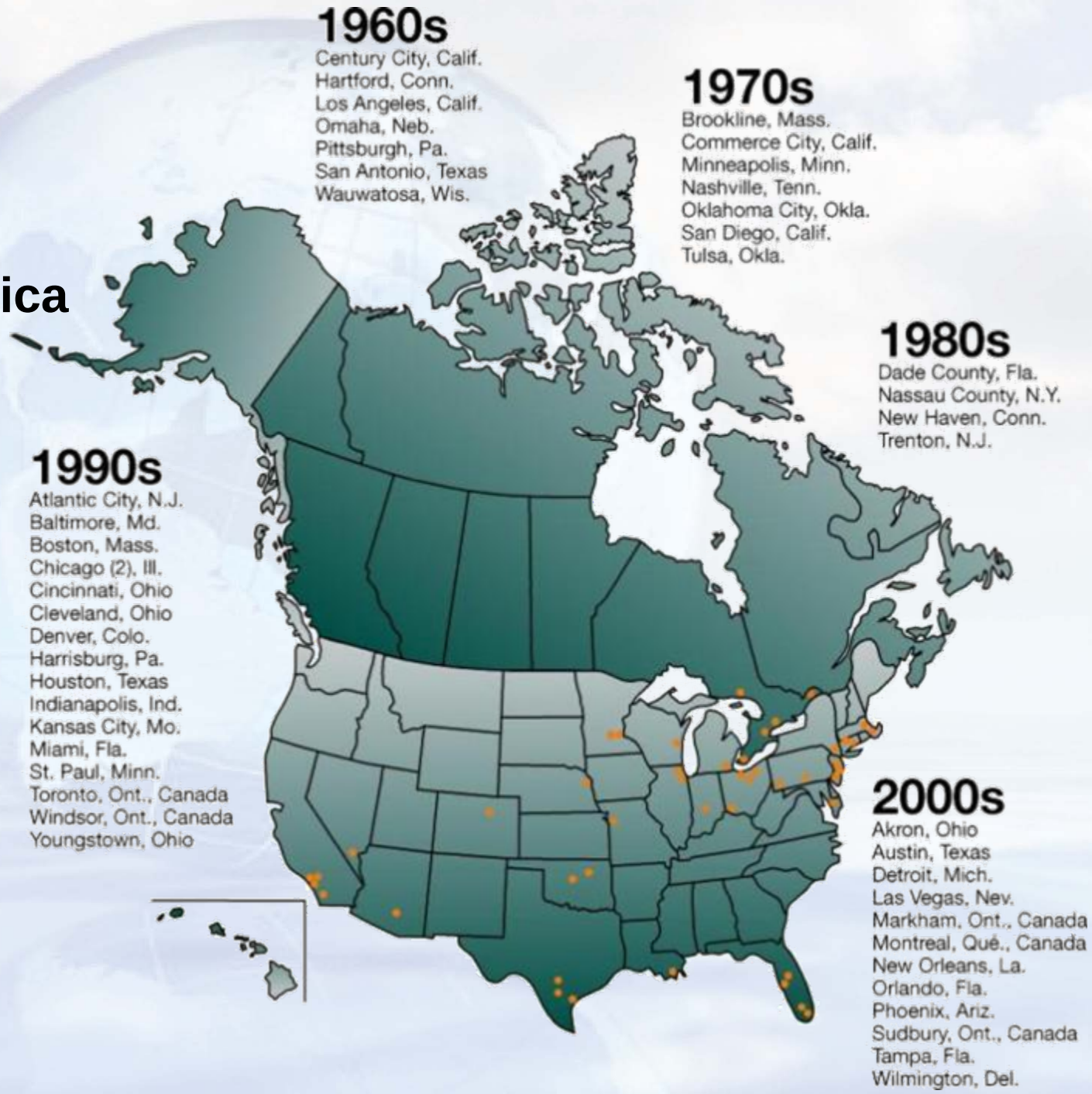
Downtown System – Washington DC

- Chilled water & steam service
- Very high reliability (99.9998)
- Critical loads (Federal Govt)
- Recently added 17,000 tons and 10 MW CHP



Chilled Water Distribution System
GSA Cogeneration and Chiller Plant Expansion Project

Downtown District Cooling Systems in North America



Downtown District Cooling Systems

- Scale up with highly efficient equipment
- Cut peak demand on electric grid
- Deploy ice and thermal storage

- Reduce owning/operating costs
- Free up valuable leasable space
- Simplify building operations

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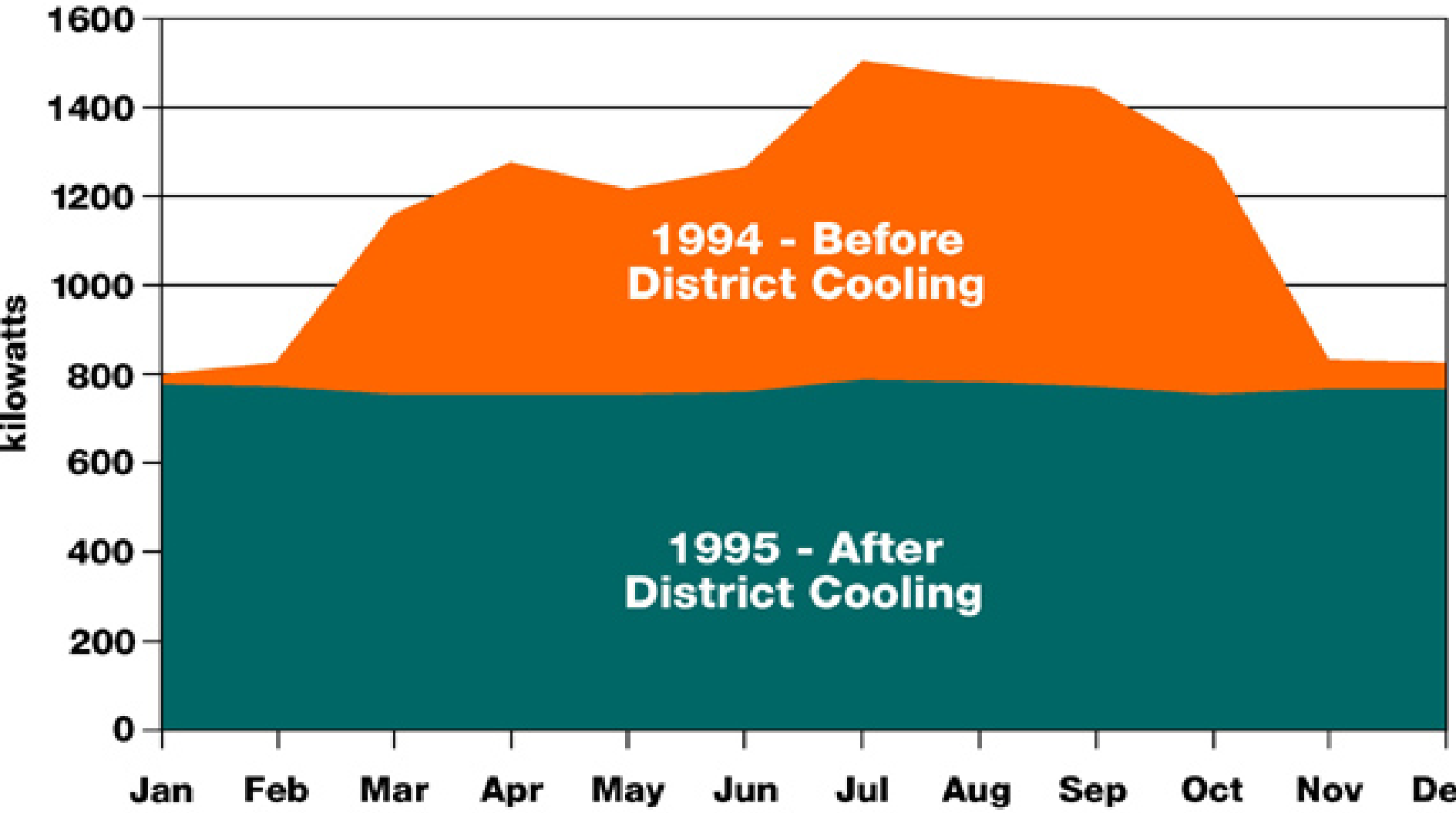
District Cooling Customer Electric Demand Profile



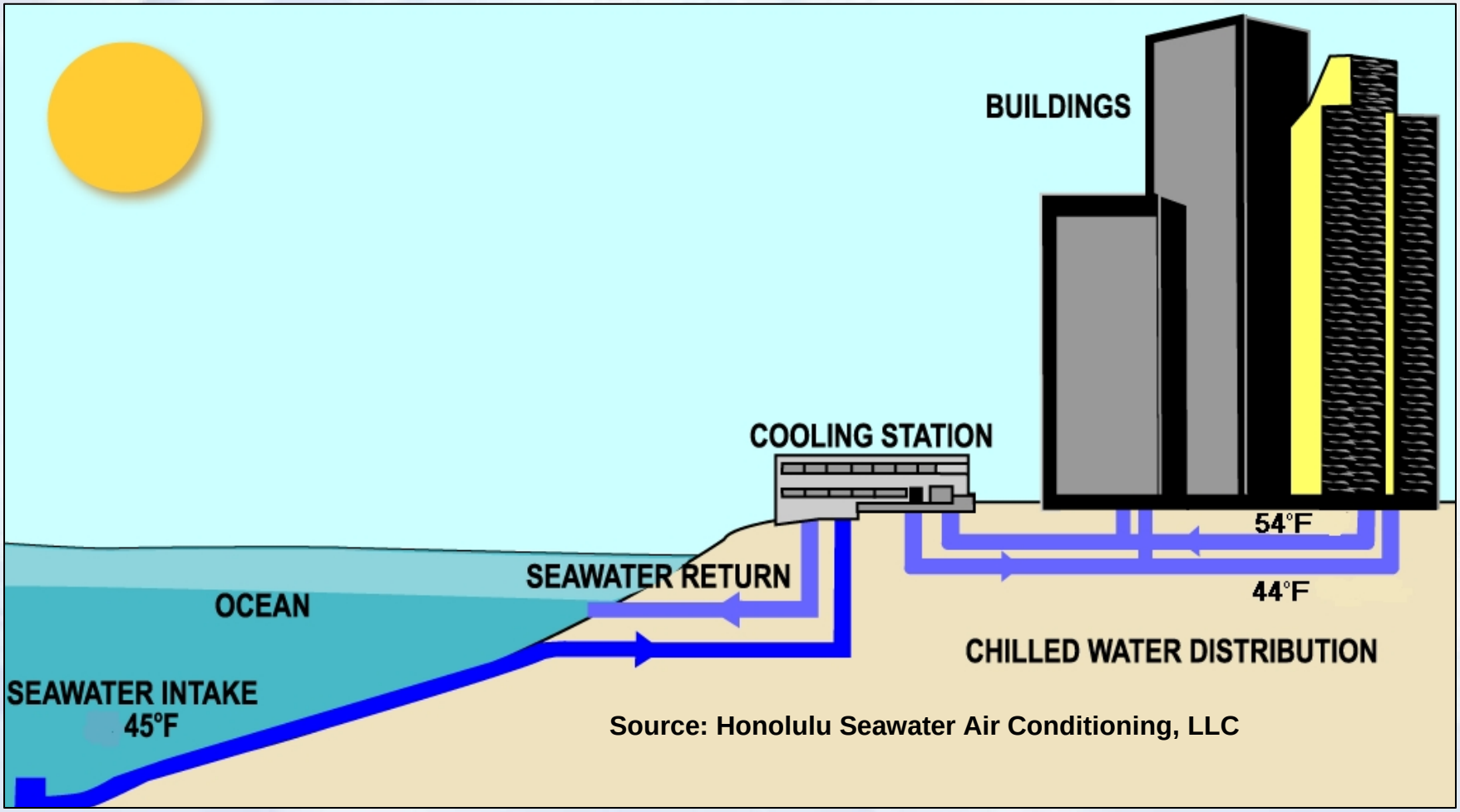
350,000 sf commercial office building built in 1965. Located in Cleveland. Two electric chillers displaced. Actual peak meter readings varied just 2% Jan-July

Higher Value Buildings

Without District Energy

With District Energy

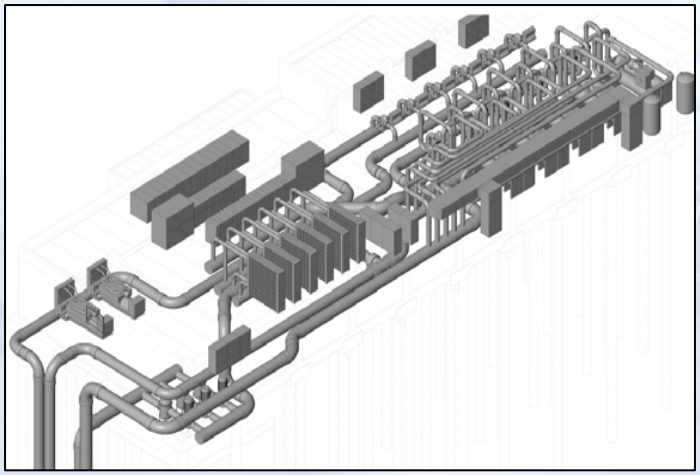
Honolulu Seawater Air Conditioning



Source: Honolulu Seawater Air Conditioning, LLC

Why Seawater Air Conditioning in Hawaii?

Hawaii's electricity is generated primarily from oil



Pumping Station Engineering

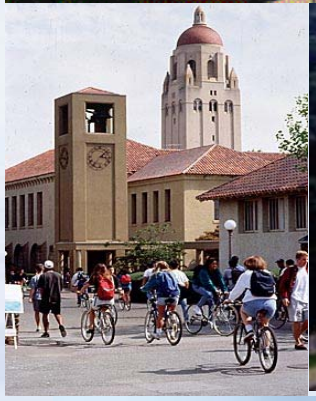
- **Available Renewable Ocean Resource – Cold Water**
- **24/7/365 need for Air Conditioning**
- **Expensive Electricity**
- **60% of Building Electricity is used for Cooling**
- **Vulnerable to Oil Price Fluctuations**
- **Isolated Island Grid**

Grid and Environmental Offsets

HSWAC Significantly Reduces Electricity Usage

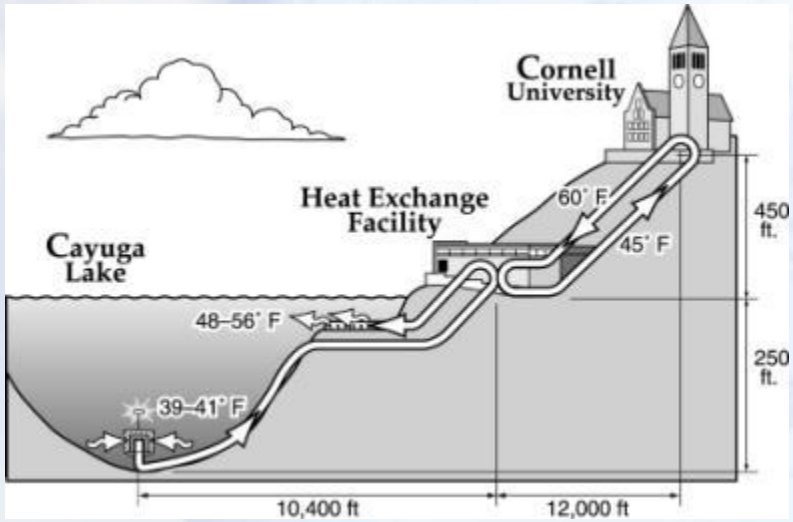
- Offsets 14 MW of HECO Capacity
- Saves 77 Million kWh per Year
- Equals One Year of HECO Projected Load Growth
- Saves 174,000 Barrels of Oil per Year
- Eliminates 83,000 Tons of Carbon Dioxide per Year
- Reduces the Use of Ozone Depleting Refrigerants
- Reduces Sewage by 114 Million Gallons per Year
- Reduces Water Usage by 265 Million Gallons per Year

U.S. Campus Energy Systems



- Load growth driven by building construction
- Critical care research facilities - reliability is paramount
- Common ownership between plant/buildings
- Able to retain 100% energy savings
- Longer investment horizon
- History of success with combined heat & power (CHP)

Cornell Univ. Lake Water Cooling



16,000 Tons Capacity - $58,000,000

Lake source water: 39-41º F

Lake return water : 48-56º F

Campus loop supply/return : 45º - 60º F

Lake source intake pipe: 10,400 ft long, 250 ft deep

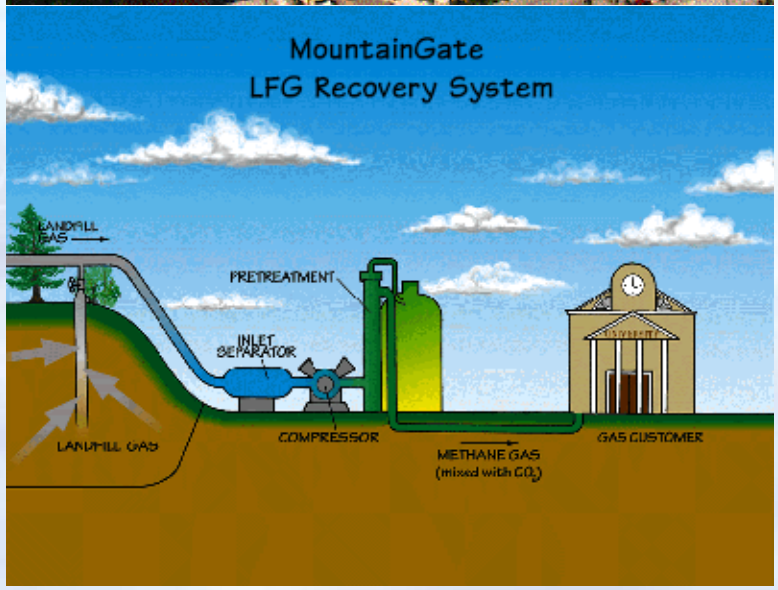
Campus S/R loop pipe: 12,000 ft

Benefits:

- **CO2 emissions cut 56 million #'s/yr**
- **Reduced cooling electricity by 87% - cutting 20 million kwh/yr**
- **Sulfur oxides cut 654,000 lbs/yr**
- **Nox reduced 55,000 lbs/yr**
- **40,000 lbs CFC eliminated**

UCLA – Landfill Gas for CHP

- 43 MW Combined Cycle CHP Facility
- 21,900 ton Cooling Plant
- Landfill gas for 30% of annual plant fuel – 4.5 mile pipeline
- Reduced emissions 34% and cut water use 70 million gal/year
- Eliminated 4,000,000 ft3 flareoff of LFG/day



University of Iowa – Biomass

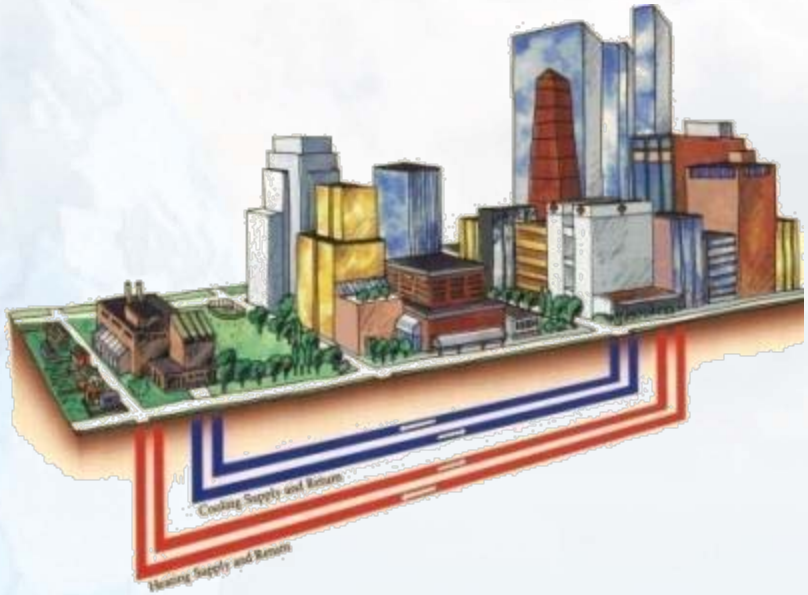
- Oat hulls - byproduct of breakfast cereal
- Displace 60,000 tons coal annually
- Reduce emissions by nearly 50%

U.S. Industry Trends

- Evaluation & implementation of fuel flexible solutions
  - Biomass, Co-firing, Waste Wood
  - Bio-fuels for CHP (gas turbines)
  - Local fuels (oat hulls; corn stover; chipped tires, etc)
- Developing renewable sources (lake & ocean cooling)
- Integrating power generation (CHP) with cooling
- Supporting end-user energy efficiency (Energy Star Buildings)
- Waste energy recovery (surplus industrial heat sources)
- Institutions increasing overall system efficiency to decrease carbon footprint

Policy Framework for District Energy

- 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 technologies not feasible on single-building basis



- District energy uses industrial grade equipment:
  - greater fuel flexibility
  - increased efficiency
  - reduced emissions
  - higher reliability
  - renewable/recycling energy (surplus heat)

Legislation vs Regulation

- April 18, EPA issued “endangerment ruling” on CO2 to regulate as hazardous material
- Supreme Court ruled 2 years ago to allow EPA to regulate CO2
- “Game-changer” to backstop Congress and force action
- Legislation is “preferable” to regulation

Federal Stimulus - ARRA

- **IDEA had secured $1.6 Billion line item in both Senate & House bills to Conference Committee**
  - **Deleted during late hour negotiations**

- **DOE - $156 Million Grants for District Energy/ CHP/ Waste Energy /Industrial Efficiency**
  - **“Shovel Ready” Projects: Institutional, Public**
  - **Solicitation closed July 14, 2009**
  - **359 Proposals – Total value $9.2 Billion**
  - **Federal share - $3.4 Billion (25:1 Ratio Need/Grant)**

Waxman-Markey Climate Bill

American Climate and Energy Security

- On June 26, US House of Representatives passed the American Clean Energy and Security Act of 2009 (H.R. 2454 – ACES)
- Four titles:
  - New Energy technologies (RPS, CCS, Fuel Standard)
  - Energy Efficiency Standard (EERS; fuel economy,etc)
  - Cap and trade program
  - Consumer worker/industry assistance & adaptation
- Cap and trade provisions influenced by Dingell-Boucher draft; USCAP blueprint

Waxman-Markey Climate Bill

American Climate and Energy Security

- **Covers 85% of US GHG emissions**
- **Cap & trade target levels**
  - **3% below 2005 levels by 2012**
  - **17% below 2005 levels by 2020**
  - **83% below 2005 levels by 2050**
- **Allocation of free allowances (initial)**
    - **35% to electricity LDC's (regulated)**
    - **12% to "trade sensitive" industries (steel, aluminum, etc)**
    - **1 to 4% to refineries**
  - **Quantitative limits on offsets/"discount" of offsets**
  - **Preemption of state caps from 2012 to 2017**

Impacts on District Energy

- **Currently cap & trade program only requires "covered entities" to hold allowances/offset credits**
  - **electric generators/large industrials emitting more than 25,000 metric tons /year – "downstream"**
- **District energy facilities not "covered entities" under current version**
  - **Electricity sources are defined to exclude cogeneration of steam & electricity, unless cogenerator sells minimum quantity of electricity (1/3 of capacity and >25 MW)**
  - **Industrials sources include only manufacturing sector and natural gas processing/transportation**

Impacts on District Energy

- Exception for district energy may not persist
  - IDEA pro-active assuming coverage
- If district energy facilities become covered entities:
  - Will need to hold allowances/offset credits each year
  - Use of fossil fuels (inc. generation) will generally become more costly
  - More efficient systems will have competitive advantage (because quantity of allowances needed per unit of energy will be lower)
- Upstream natural gas regulation is key

Senate Climate /Energy Bill

- Senate Energy & Natural Resources (ENR) Committee passed American Clean Energy Leadership Act (ACELA) in June
  - Federal Renewable/Energy Efficiency Standard
- Senate Environment and Public Works (EPW) Climate/Energy bill forming right now
- Likely to go to Conference after August recess
  - Senate Conferees named; House TBD after August
- Thermal Energy Efficiency Act – Senate Bill S.1621
  - Co-sponsors Senators Sanders (I-VT) & Merkley (D-OR)
  - Recognizes value of thermal energy
  - Provides up to 2% annual carbon emissions auction revenue to design, develop district energy systems (public and private)
  - 2% emissions allowance value - $1.5 billion per year

Renewable electricity and energy efficiency standard

- Electric utilities selling > 4,000,000 MWhrs
- Required to supply 20% of demand from combination of renewable and energy efficiency
  - 15% renewable; 5% efficiency
  - If State determines can't meet renewable, lower to 12% and efficiency increase to 8%
- Important lever for district energy/CHP

District Energy Summit:
Leading the way to Copenhagen COP 15
Copenhagen, Denmark
November 3, 2009

Thank you

Doug Kaempf, Industrial Technologies Program

US Department of Energy

www.doe.gov/itp

International District Energy Association (IDEA)

www.districtenergy.org