

Part 2 - More Energy from WTE: District Heating in Denmark & Potential for the U.S.

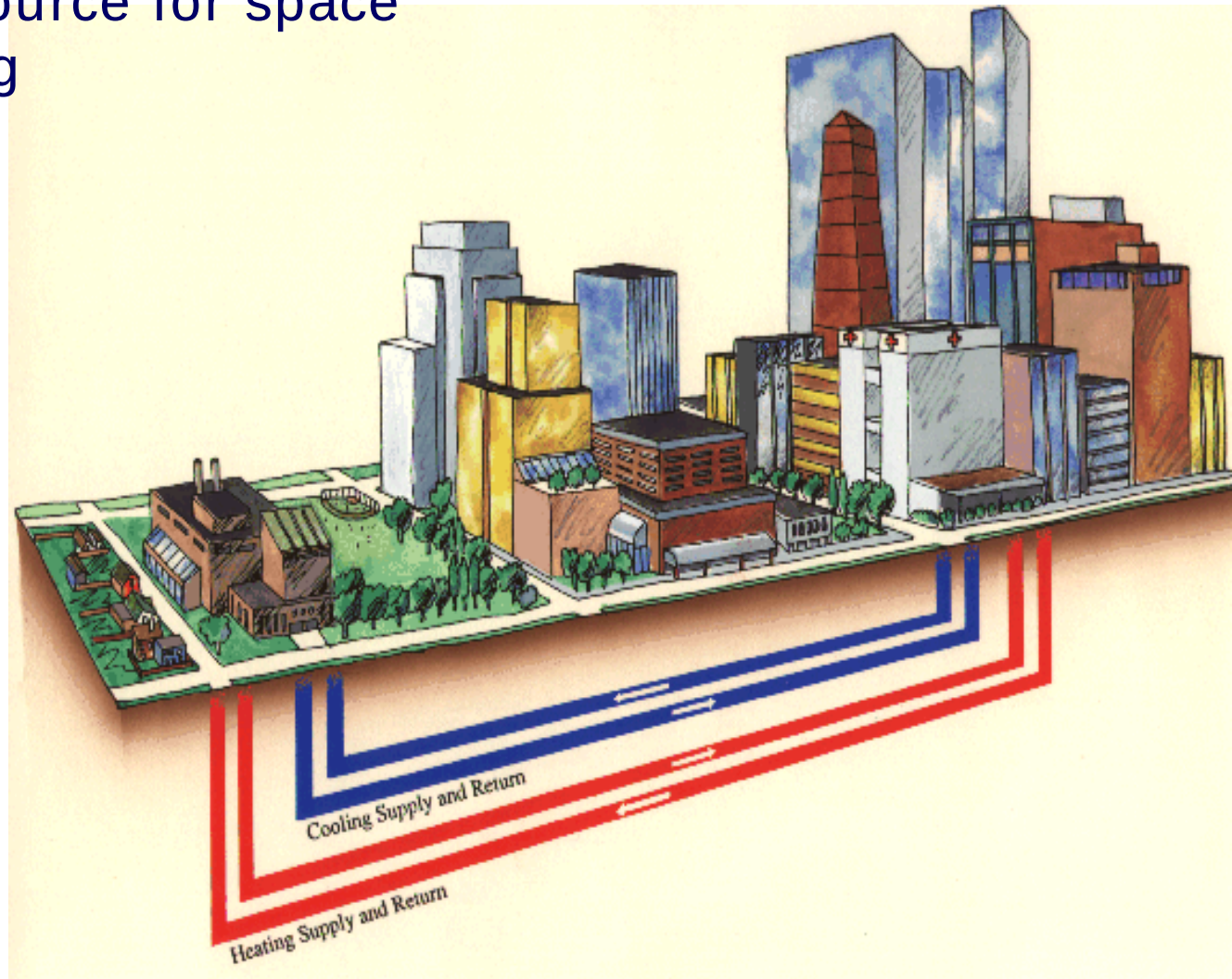


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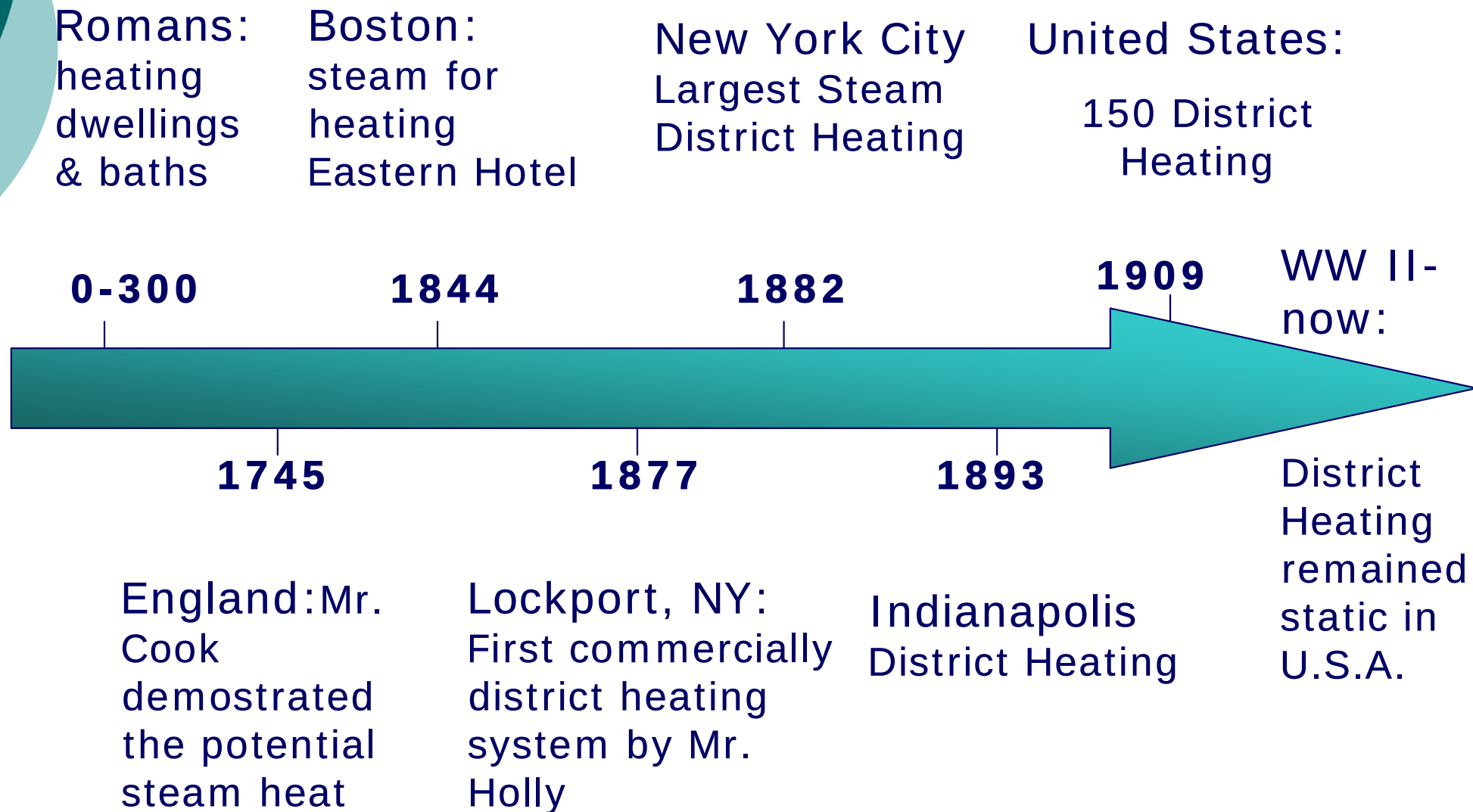
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District Heating & Cooling

- Distribution of thermal energy from a central source for space heating & cooling
- Source:
 - Boiler
 - Cogeneration (or CHP)

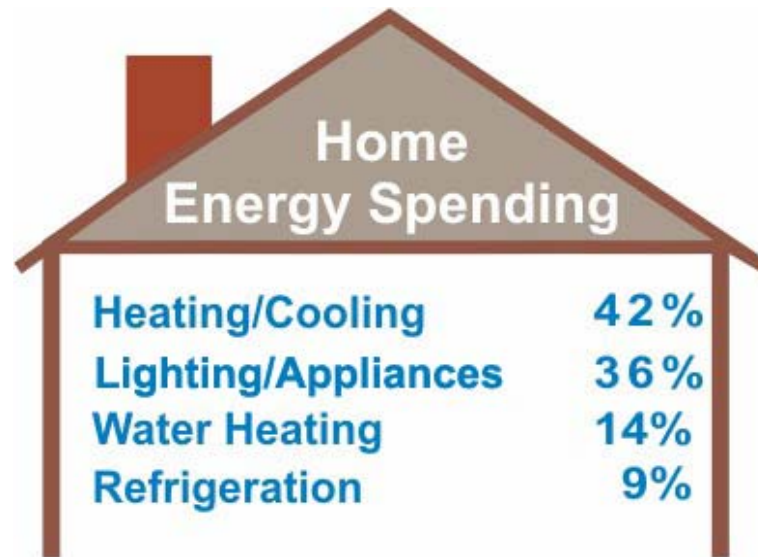


History of District Heating

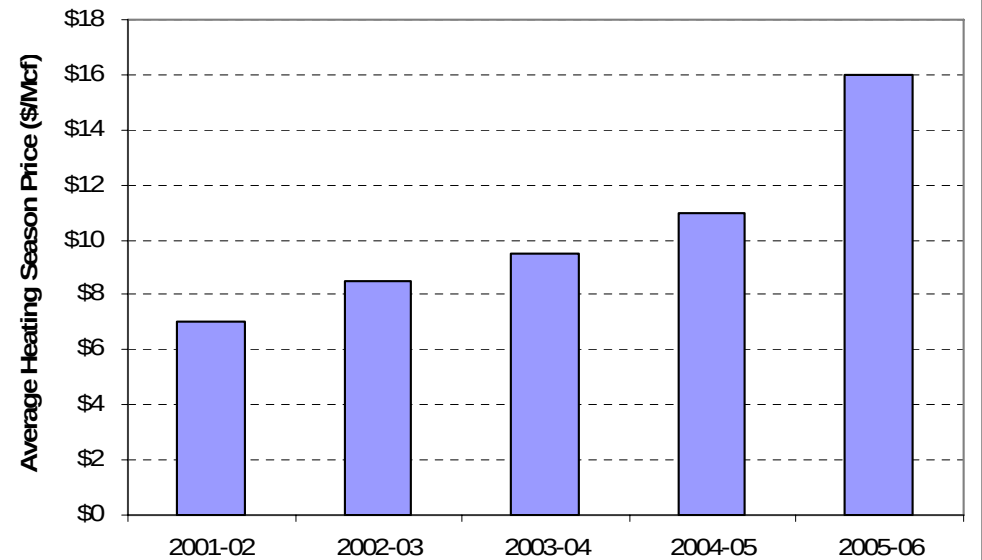
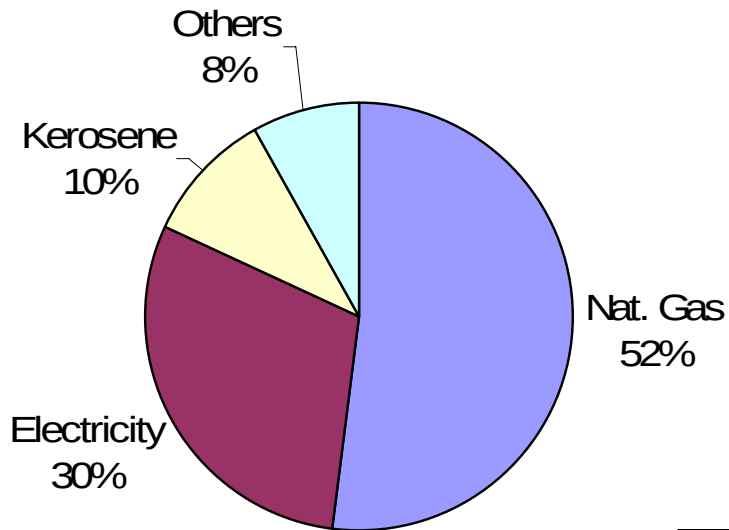


Current Situation U.S. District Heating

- 5,800 district heating/cooling systems, mostly steam
 - 1.1 quadrillion Btu (320 million MWh)
 - >2,000 institutional facilities
- < 5% nation's heating and cooling
- ~ 50% energy bills(\$800) for heating/cooling



Heating Fuel in the U.S.



New York City: Largest Steam District Heating



New York City Steam District Heating

- Steam system opened in 1882
 - 105 miles pipe
- Delivers 27 billion lbs steam annually
- 1,800 customers
 - 69% large commercial
- Capacity: 12.5 million lbs/hr
- Winter peak load: 10.6 million lbs/hr
- Pipe cost:
 - Distribution \$2,000/ft
 - Transmission \$4,000/ft



Advantages: Hot Water vs Steam District Heating

Hot Water

- Piping can range to 15-70 miles
- Less cogenerator electricity is sacrificed
- Closed loop
- Heat loss is low: 5% - 15%
- Installation, operation, retrofit to buildings is easy
- Metering energy use is easy
- Easy to operate under conditions of varying thermal load
- Hot water can be stored
- Less expensive pipes
- Hot water piping installed 3 feet

Steam

- Pumps are not required
- Can be a one-pipe system with no return
- Retrofit of old urban steam buildings may be easy



Co-Op City, Bronx, NY

Hot Water District Heating/Cooling



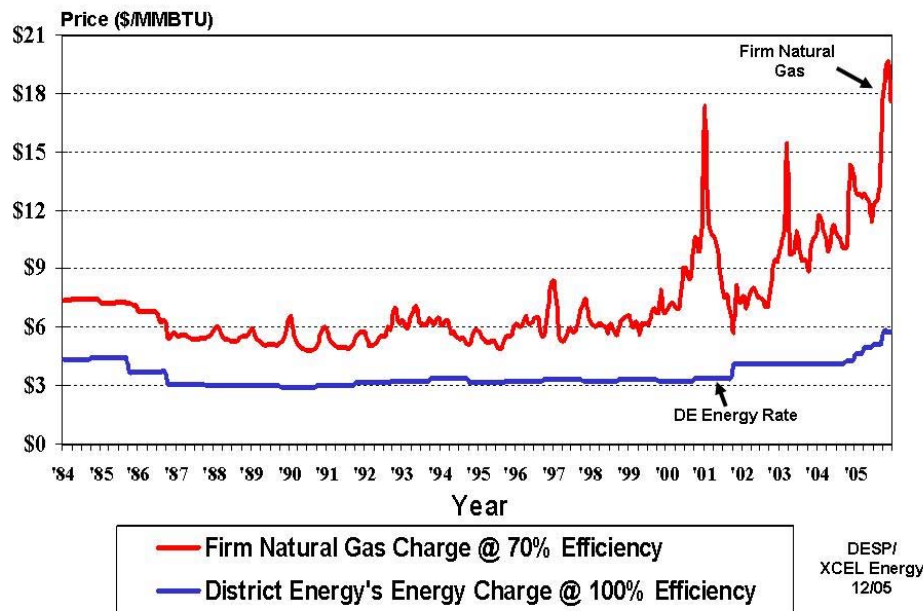
- Largest single residential U.S.
 - 35 high-rise buildings
- Combined Heat & Power plant
 - Natural Gas
 - 2x 13 MW gas turbines
- Pre-insulated hot-water pipes 27 mi
- Using 50% less energy



St. Paul, MN

Hot Water District Heating/Cooling

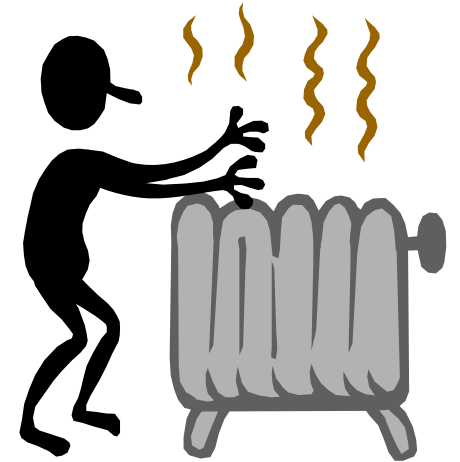
Energy Charges: District Energy vs. On-Site



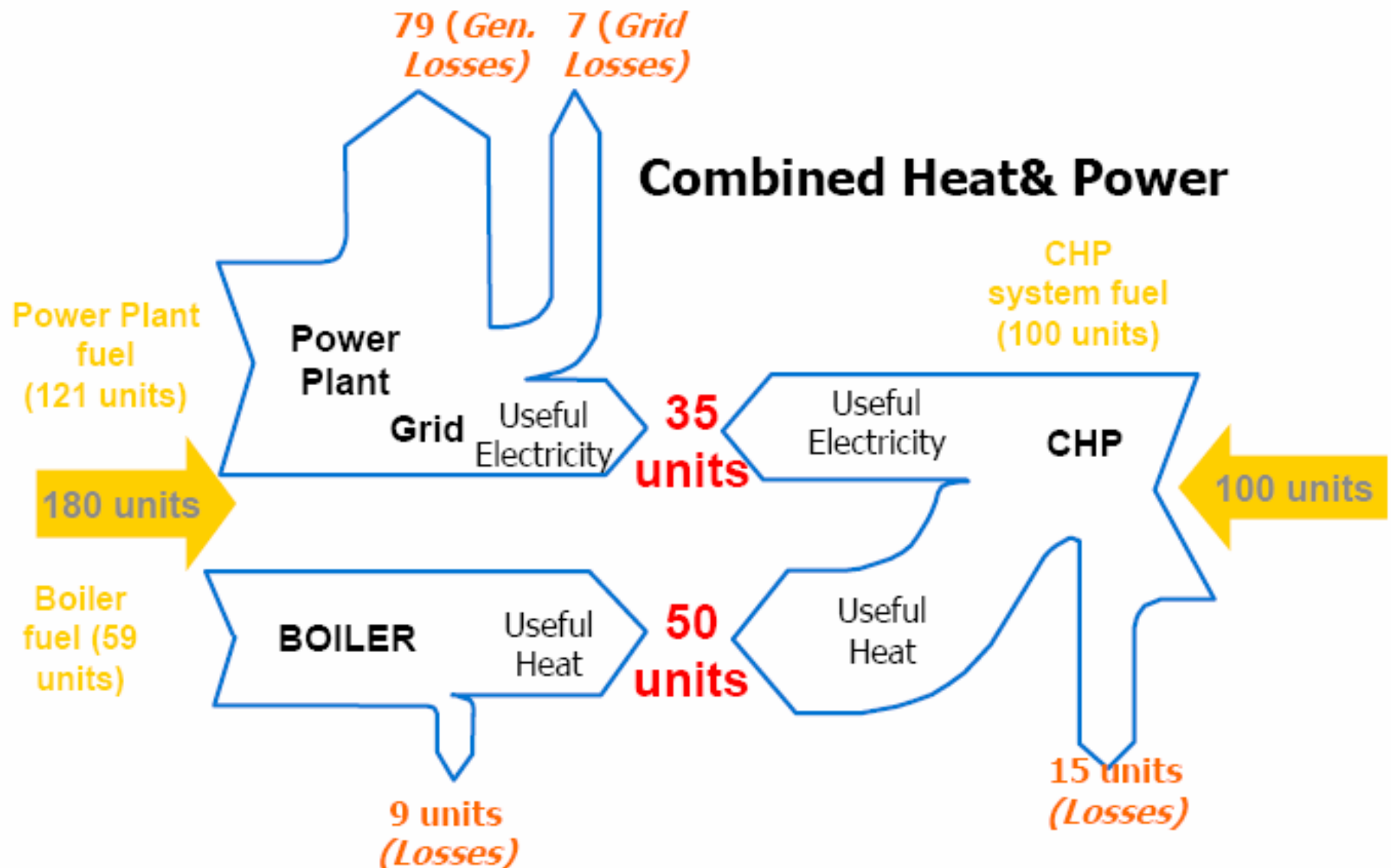
- Hot water district heating system
 - 18.5 mi –hot water
 - 6.2 mi – chilled water
- Combined Heat & Power
 - 65 MW(t) & 25 MW (e)
- Waste wood, coal, oil, natural gas
 - 280,000 tons waste wood/yr
- Reduce pollution
 - 600 tons SO₂; 280,000 tons CO₂
- Rates have been stable

Benefits District Heating

- High efficiency: waste heat
- Reduction of pollution
- Local resources
- Stabilization of energy costs and supplies
- Reduced capital, operating and maintenance costs for building owners
- Increase space in buildings



Efficiency Combined Heat & Power



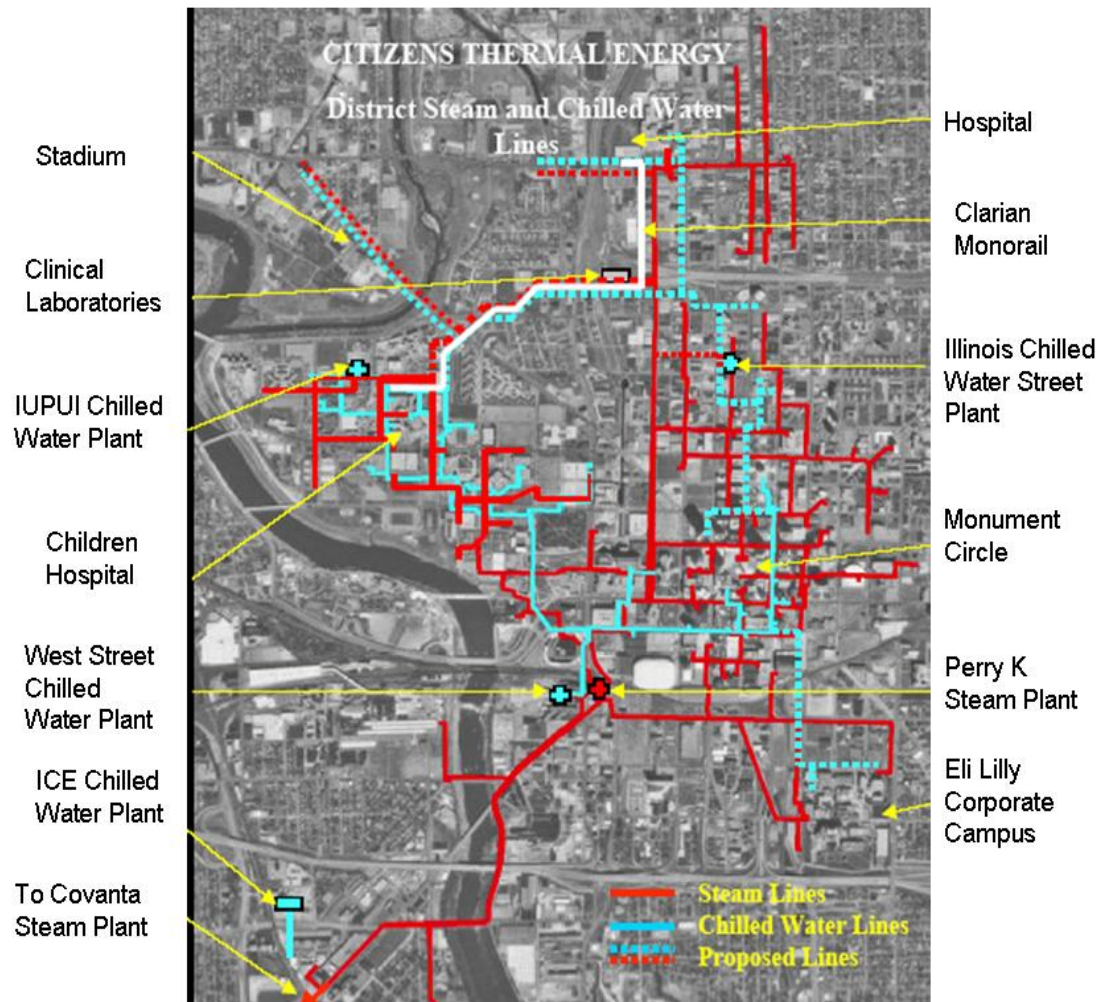


Waste-to-Energy & District Heating in the U.S.

- 1970s, energy recovery from MSW began to develop
- 1974, Nashville, TN, first WTE to provide steam district heating & cooling in the world
 - 2004 modify to use Natural Gas
- 1986, the Baltimore Southwest was largest cogeneration WTE plant
- Today, 28 WTE plants sell steam
 - 21 cogenerate 1.6 million lbs steam/hr and 272 MW (e)
 - 7 generate 929,000 lbs steam/hr

Indianapolis WTE, IN

- Indianapolis WTE, Indiana
 - Started in 1988
 - 2,150 TPD of waste
 - Half of the steam for Indianapolis DH
 - 10 million lbs/day



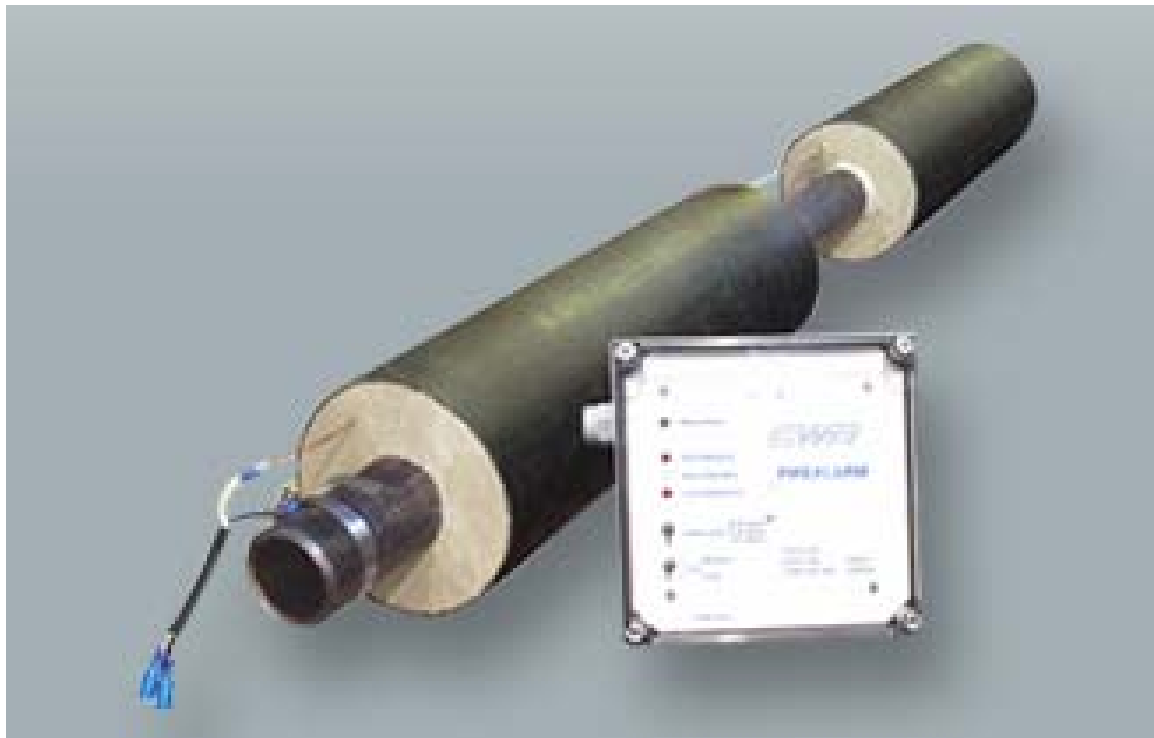
Huntsville WTE, AL



- Started in 1990
- 690 TPD of waste
- All steam for U.S. Army's Redstone Arsenal
- 180,000 lbs steam/hr
- Repair steam traps and vault piping
- Income: 52% steam, and 48% tipping fee
- Tipping fee: \$39.90/ton

Pre-Insulated & Pre-fabricated Pipes

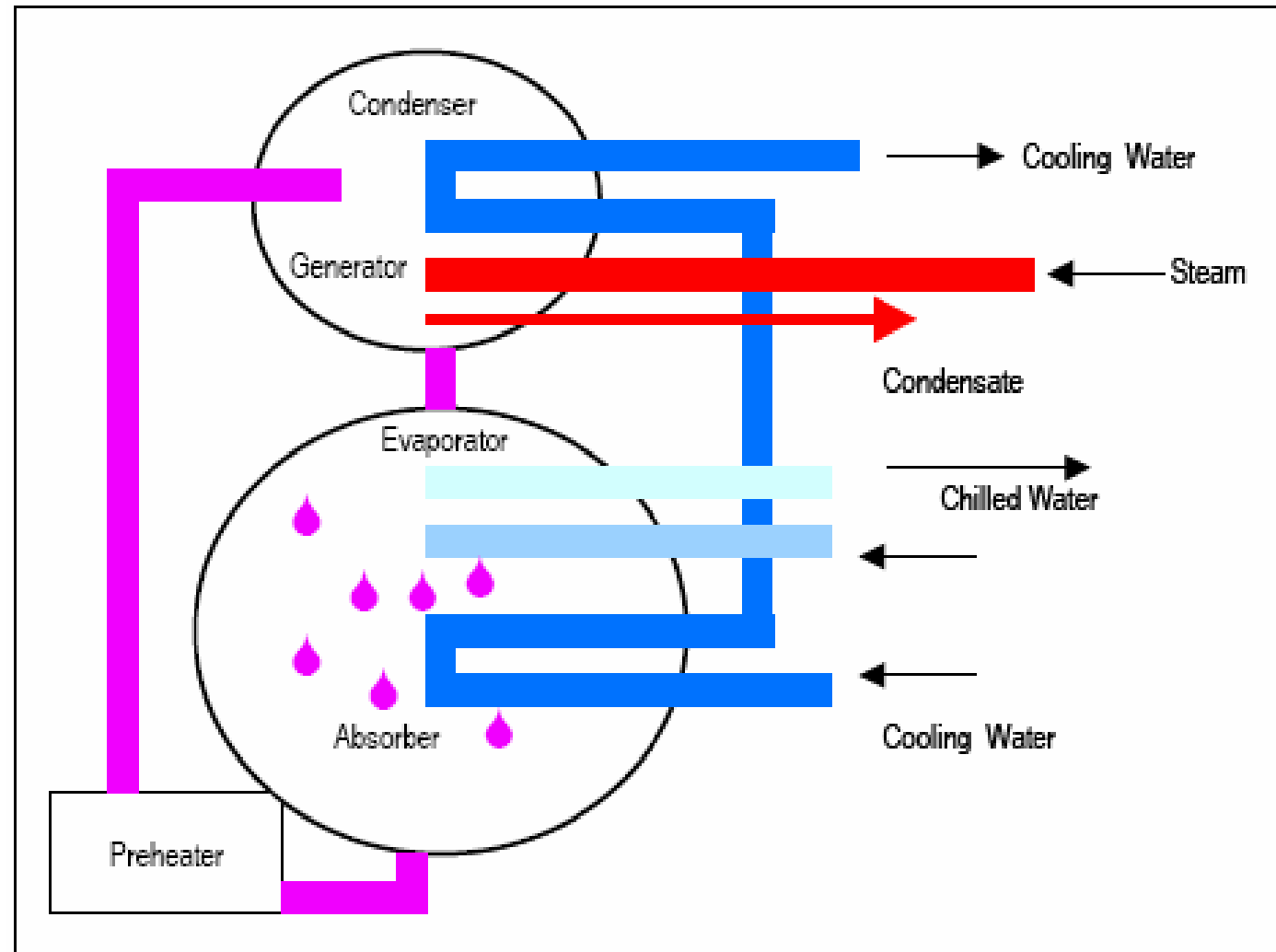
- Pre-insulated Pipes available in the U.S.:
 - Leak Detection
 - Monitor System



District Cooling- Chiller Technology

- Centrifugal Chillers
 - Electricity
- Absorption Chillers
 - Hot water & steam
 - Absorber: lithium bromide

Absorption Chiller Circuit



Why WTE plants for district heating?

- Some cities are densely populated and have long, cold winters, e.g. northeastern cities
- U.S. technology for cogeneration exists
- Available municipal solid waste as fuel



Establish a district heating in an existing WTE plant in a northeastern city

Thank You!



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