4th Generation District Energy

4GDE

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Outline

Evolution of District Energy

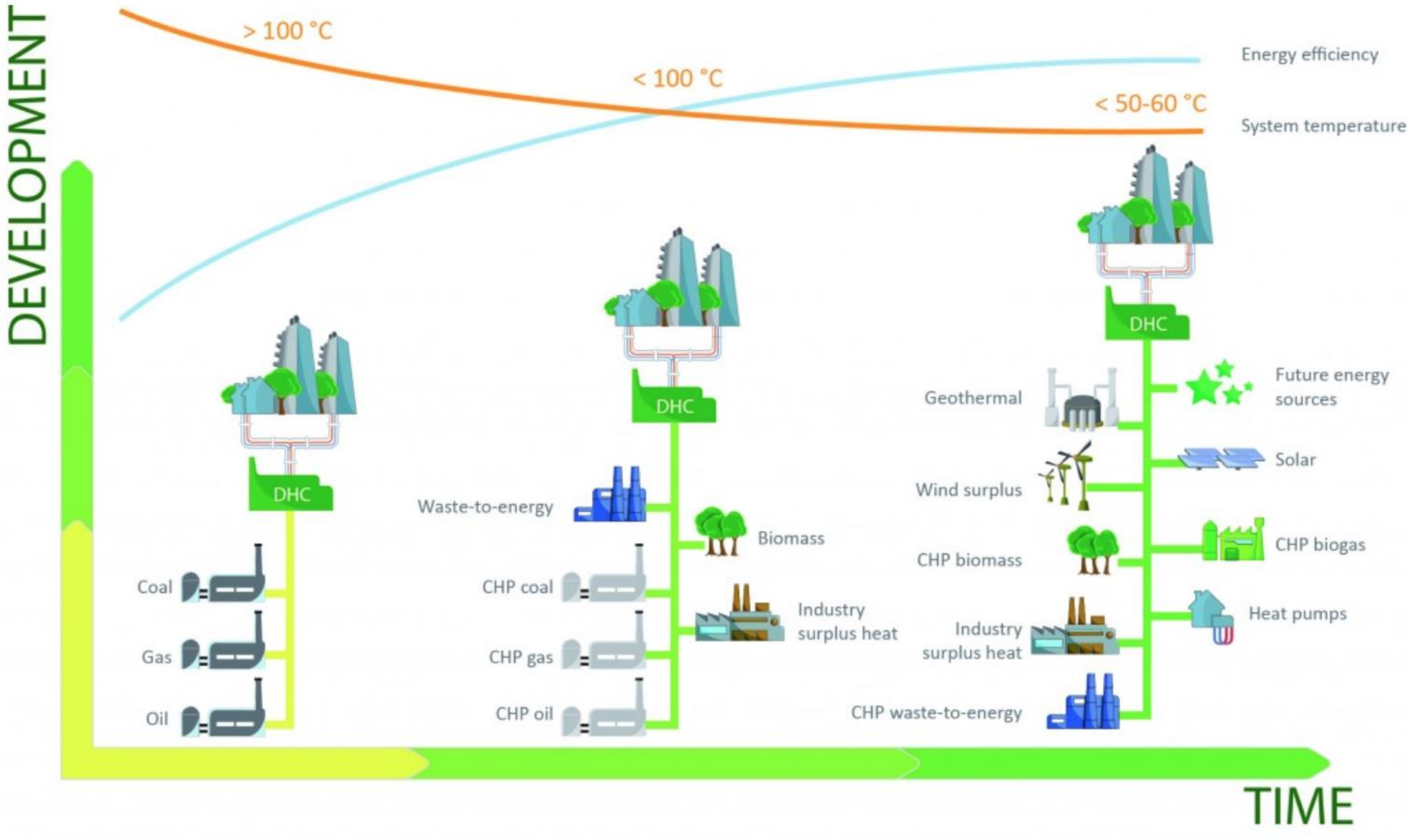
Case Studies

Energy Storage – thermal and electric

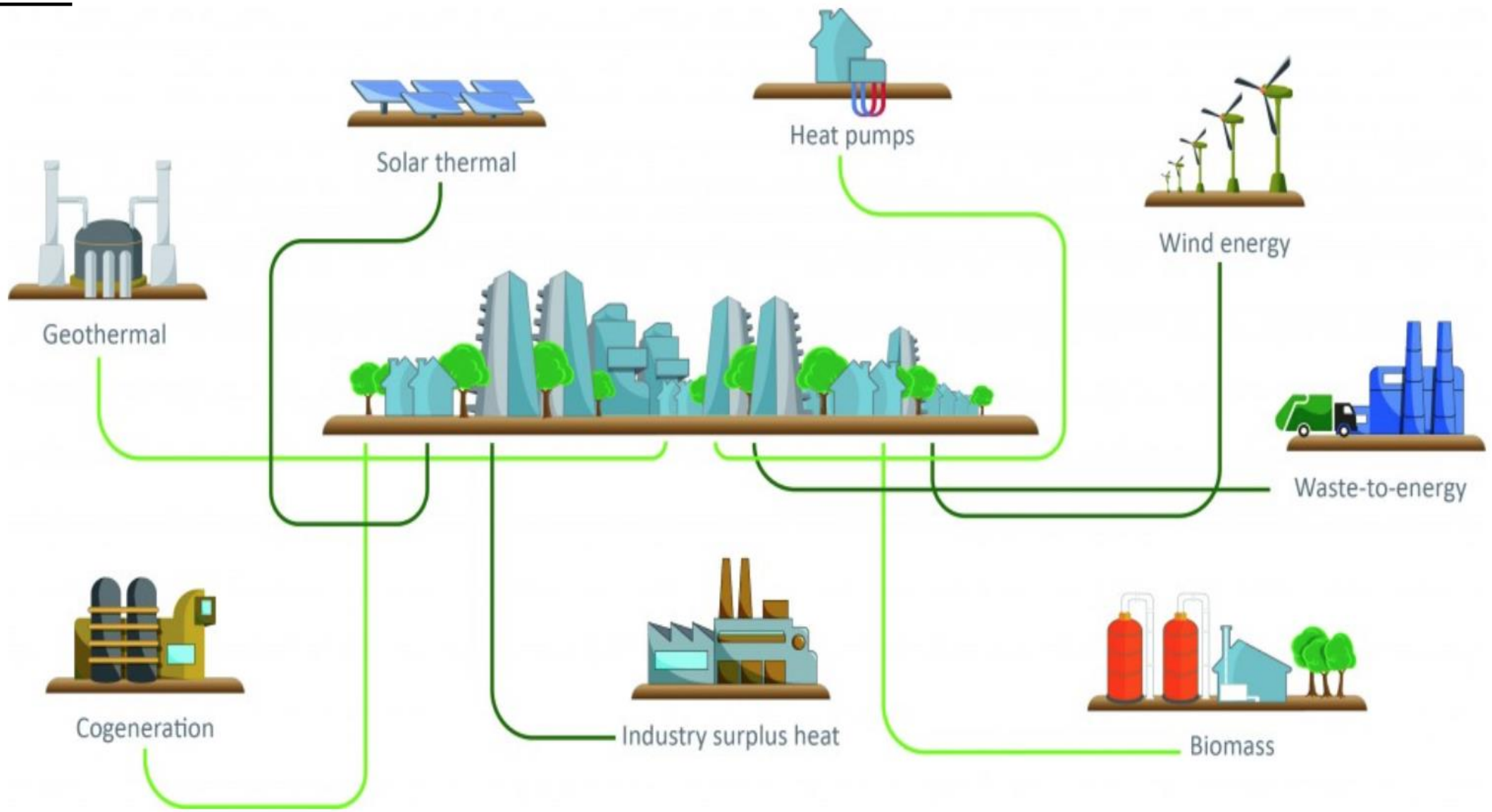
Woodstock Renewable Heat

Impediments

Key Benefits of 4GDE


DEVELOPMENT
> 100 °C
< 100 °C
< 50-60 °C
Energy efficiency
System temperature
DHC
Coal
Gas
Oil
DHC
Waste-to-energy
Biomass
CHP coal
Industry surplus heat
CHP gas
CHP oil
DHC
Geothermal
Future energy sources
Solar
Wind surplus
CHP biogas
CHP biomass
Heat pumps
Industry surplus heat
CHP waste-to-energy
TIME

4G-DE

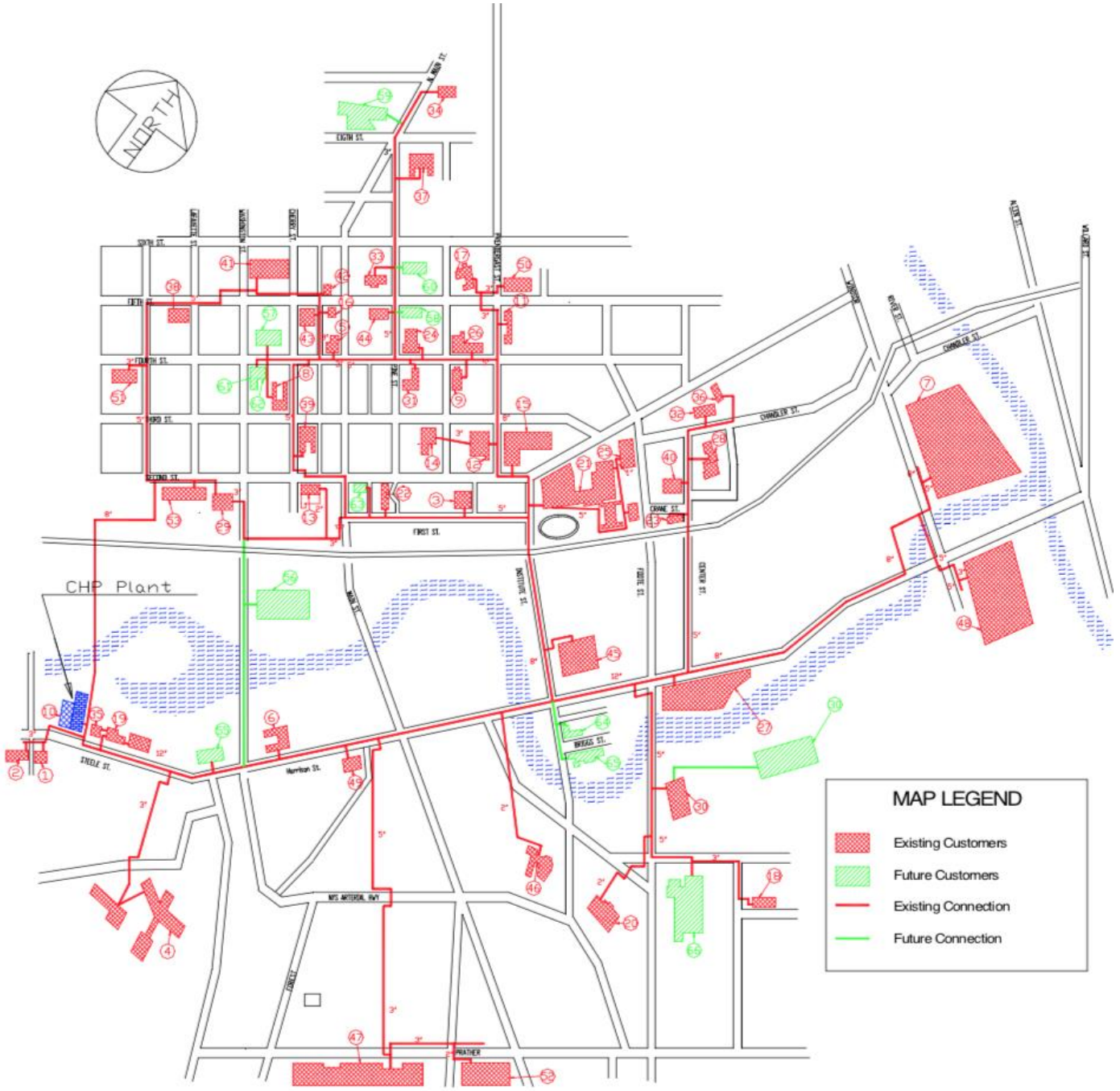


Euroheat and Power www.euroheat.org

Jamestown, NY, District Heat System - DCHP

- By-product from power plant
- 80 Customers, 250 apartments
- Hot water system, 250°F
- Municipal ownership
- $14 million saved in 1st 20 years

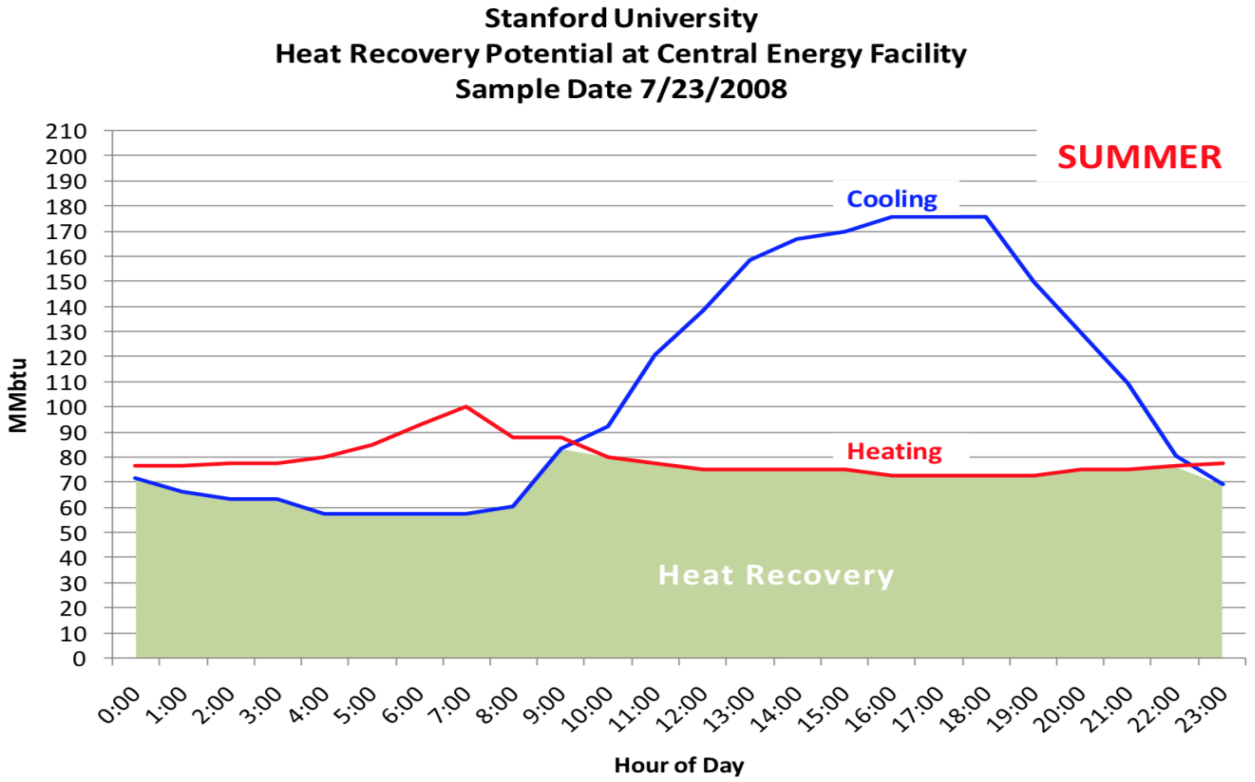
"130 individual boilers shut down by customers connected to the District Heat system."
Dr. I. Oliker, P.E.

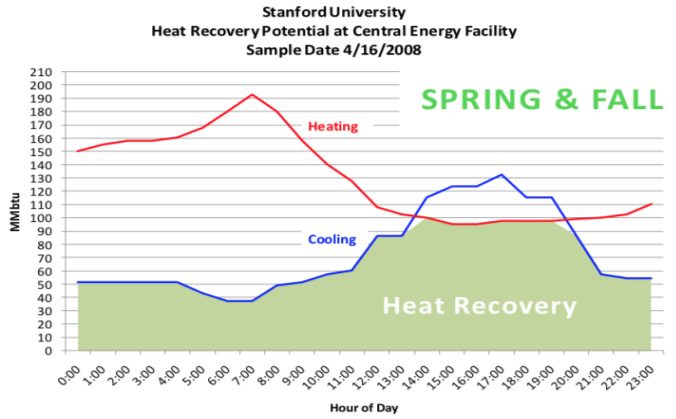


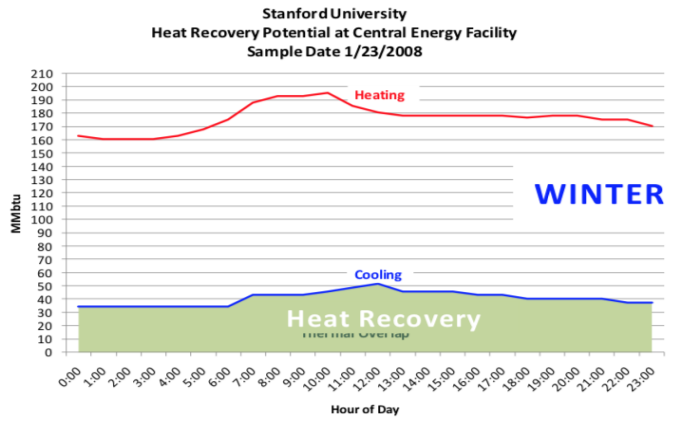
Stanford University – 4GDE:

CHC – Combined Heating and Cooling

Optimum renewable system temperature



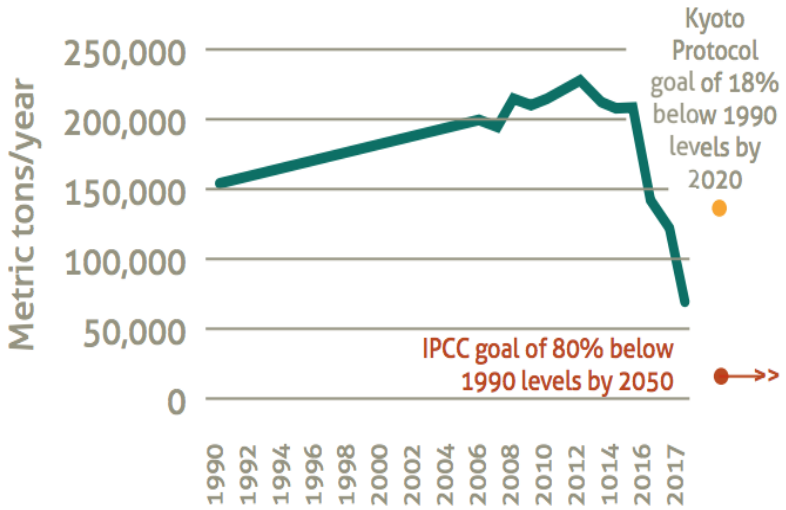




Source: Stanford University, Draft Energy & Climate Plan (April 2009)

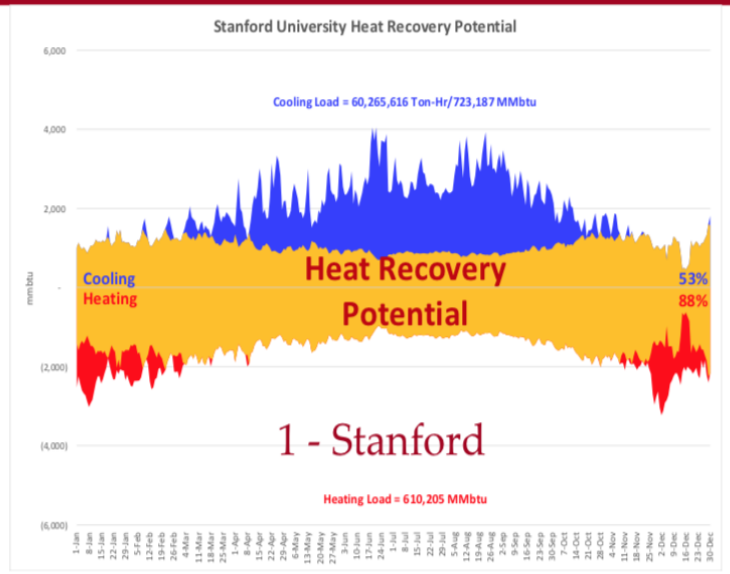
Stanford University. **CHC** – Combined Heating and Cooling

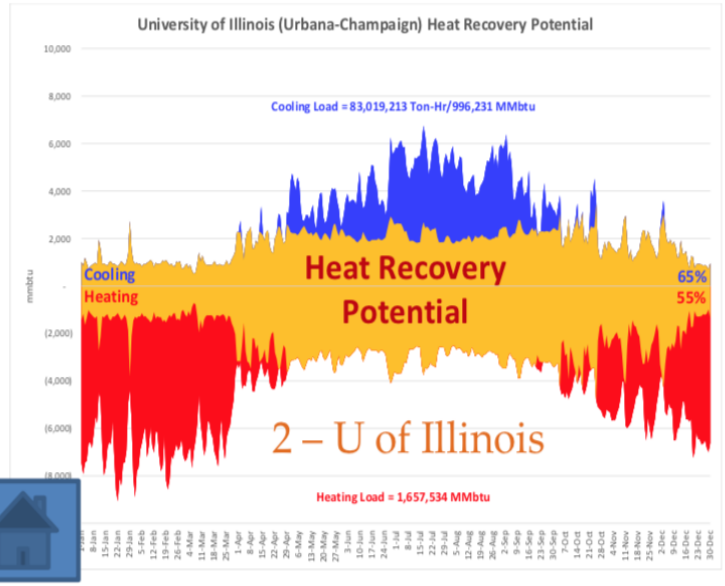
Figure 4. Greenhouse gas emissions trend, Stanford University, 1990-2017. (Graph reflects actual emissions through 2014 and estimated for 2015-2017.)

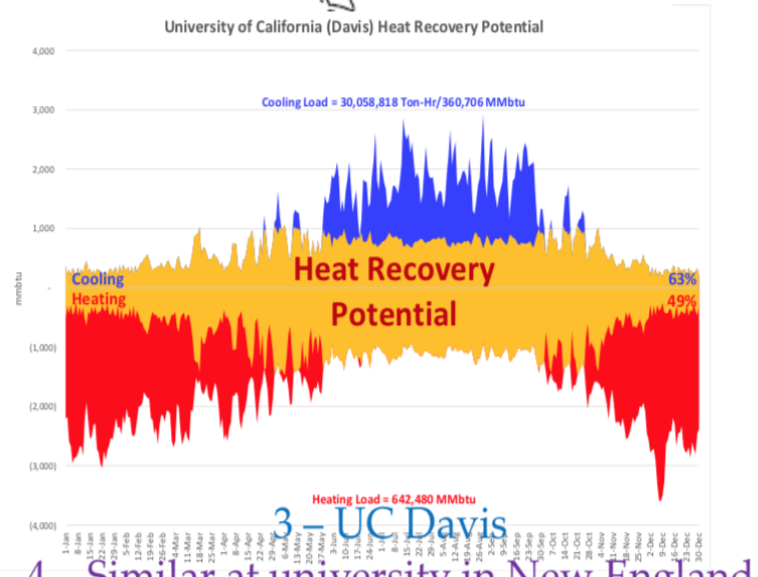


Source: Stanford University.

Heat Recovery in Other US Regions



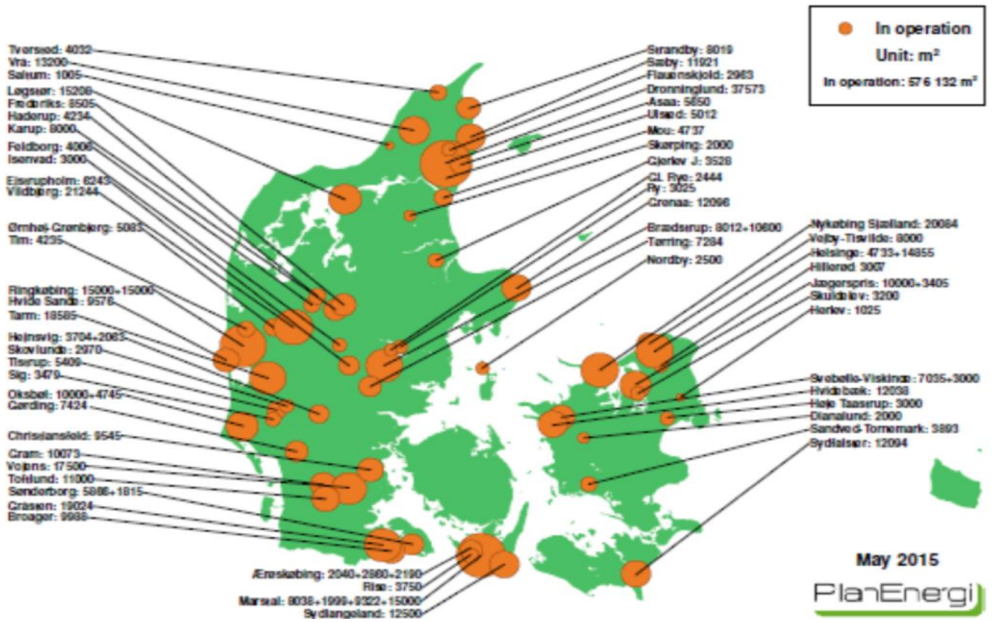




3 – UC Davis

4 – Similar at university in New England (62% Cooling, 43% Heating)

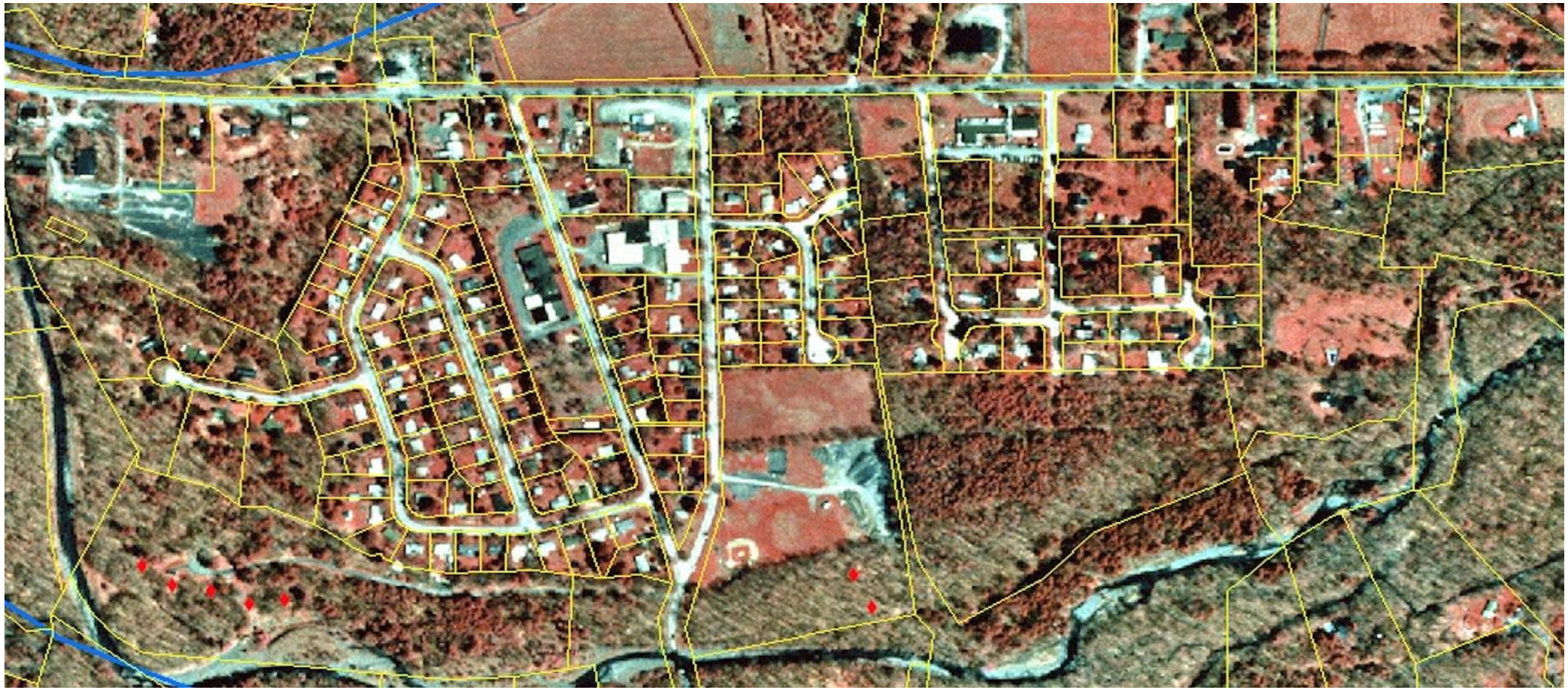
Danish solar district heating map



Dronninglund seasonal solar heat storage, 45 acre feet.

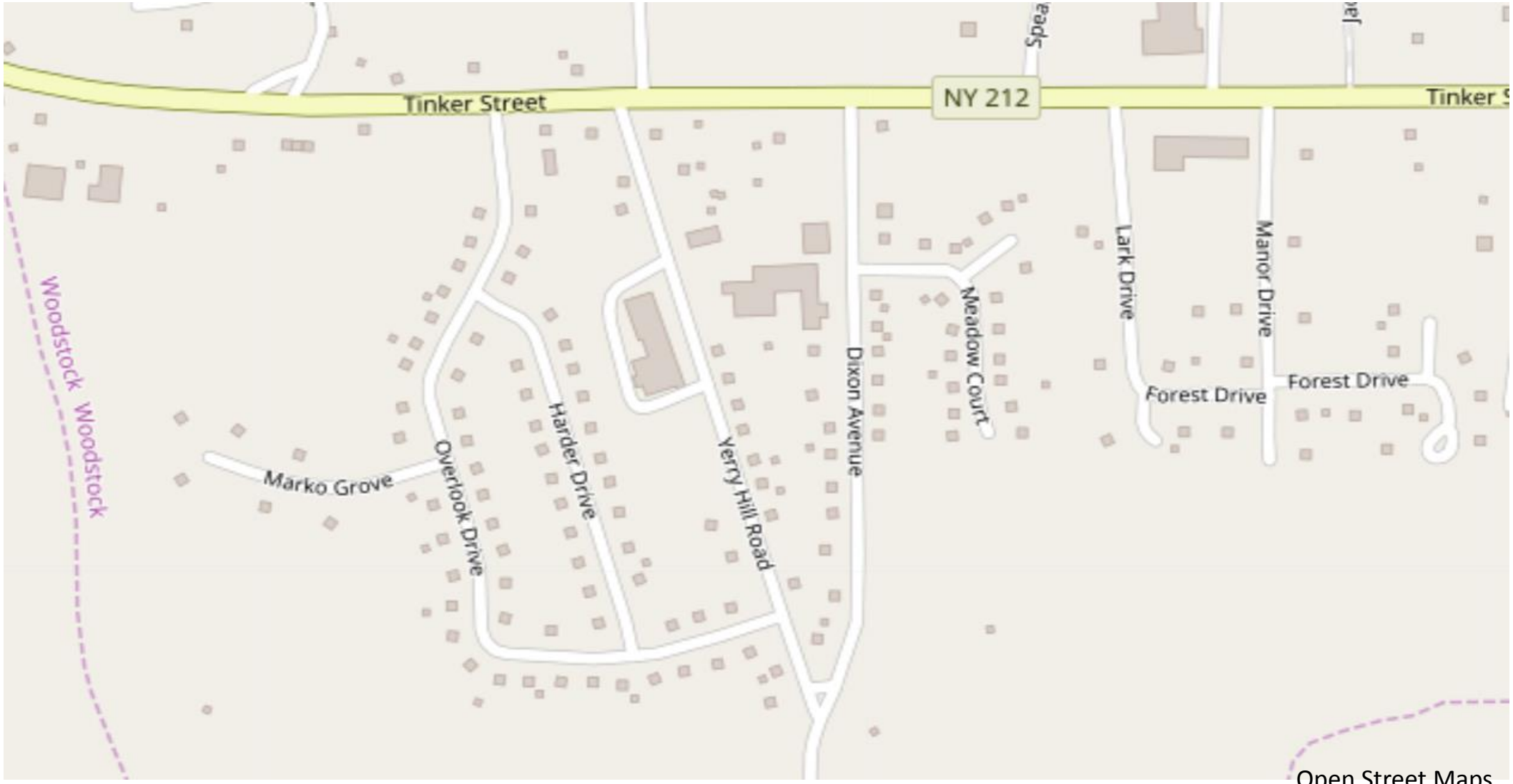
Dronninglund solar hot water panels, 9 acre surface

Proposed Woodstock Renewable Heat Project site.



Woodstock Western Hamlet region. Woodstock Transition & Town of Woodstock

Woodstock Site



Open Street Maps

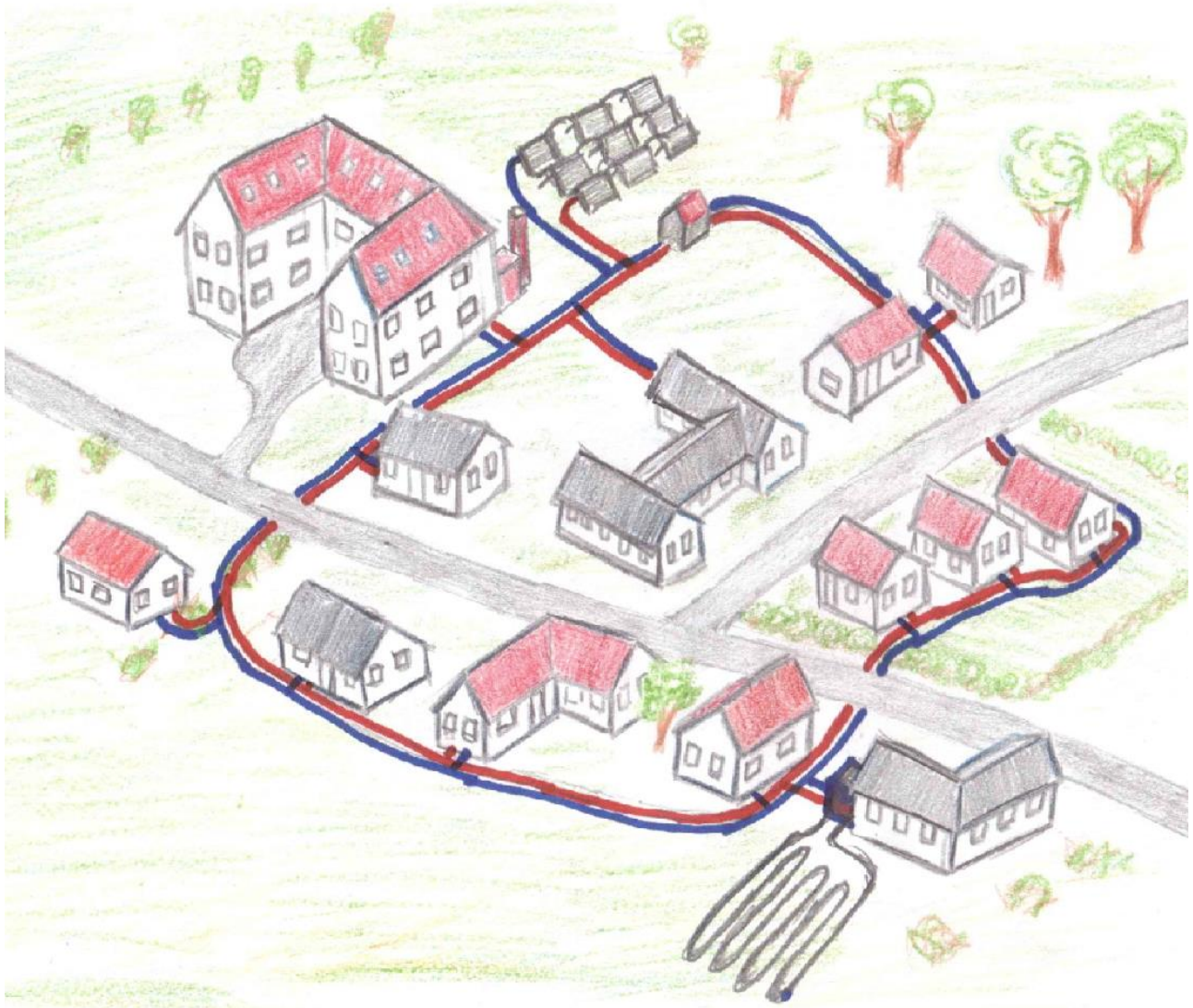
Proposed Woodstock Renewable Heat Project

- 108 homes, 1,000 sq. ft. av.
- 300 seat theater
- Three restaurants
- Record Studio & radio station
- Fire Dept. building
- Offices and light commercial
- 40 room hotel, planed.

Goal:

Assess and promote municipal 4GDH:

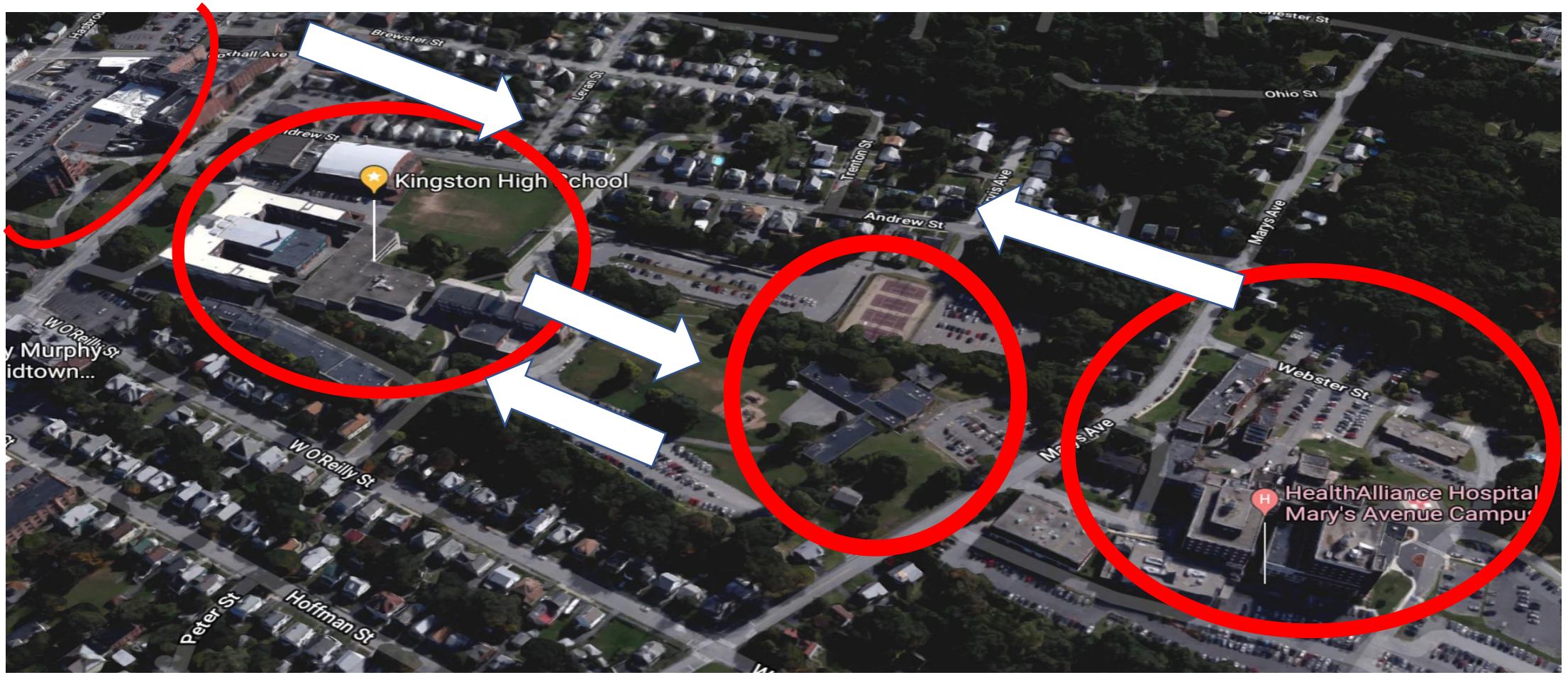
- Heat Pumps: air and ground source
- Solar thermal
- Thermal storage
- Recycled heat



Landsby Naervarme, Denmark

Kingston, NY

- Locking in long-term fossil fuel, $ millions of taxpayer money.
- 1991 District Energy study, two hospitals and two educational facilities.



Energy Storage Comparison
Unit Investment Costs

Electricity

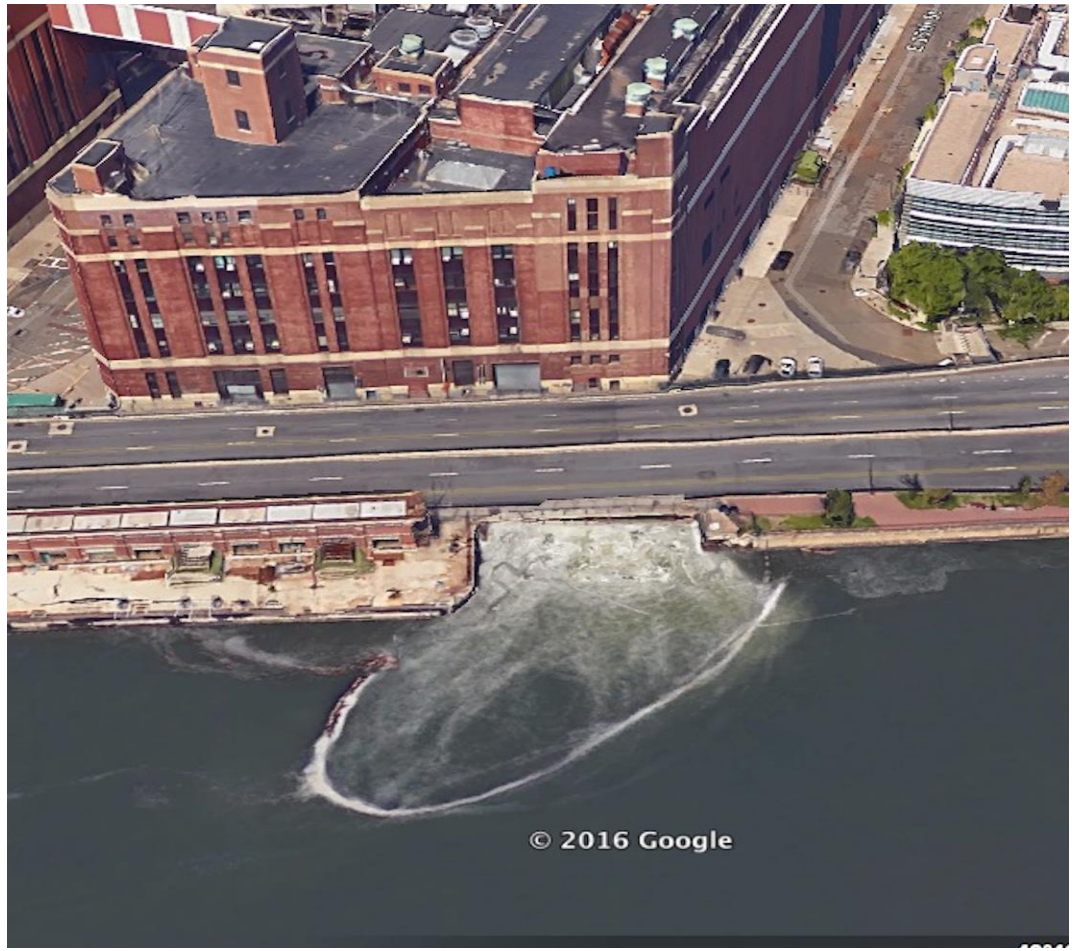
Thermal

Central

Decentral

Credit – David Connelly

Rensselaer, NY. Empire Generating,



14th Street, NY, NY (partial cogeneration to DH)

Random Timeline

- **National Action Plan for DHC/C**: US DOE & NYSERDA (keynote by Eugene McGrath, president of ConEd) – Two day workshop in 1991
- **3rd Global District Energy Awards** in NYC. HELEN – 2013
- **1st Conference** on Smart Energy Systems and 4G-District Heating (4GDH) - 2015, Aalborg, Denmark.
- **Campus Energy 2018**, key shift from steam to hot water

Accelerants needed:

- Clear policy to include 4GDE
- Create utility incentives, IOU's Coop's and Muni's
- Supportive legislative/regulatory framework/tracks (PSC's).
- Question regulatory silos separating electric, thermal and gas
- Explore 4GDE as a key to decarbonization
- Exergy – as a planning tool
- RGGI – expand reach and add "negatherm" credit

Key Attributes of 4GDE

- Higher adoption/participation rates
- Easier consumer choice
- Lower cost: (density cost curves - Sven Werner, etc.)
- Electric load shedding – with cold storage
- Gas grid load shedding – with heat storage.
- Dynamic capability: harness by-product and ambient heat.
- Medium and low temperature allows combustion free systems
- Integration with “Smart Energy Systems” (electric, thermal and trans.)

4GDE can be an effective key to achieving deep decarbonization over the long term.

Resources

- www.4dh.eu. Aalborg University
- www.districtenergy.org International District Energy Association
- www.euroheat.org DHC+ Technology Platform
- http://www.iea-dhc.org IEA DHC Program

Thank you.

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