FROM STEAM TO 4GDH IN DK AND US

EXPERIENCE IN DK AND US

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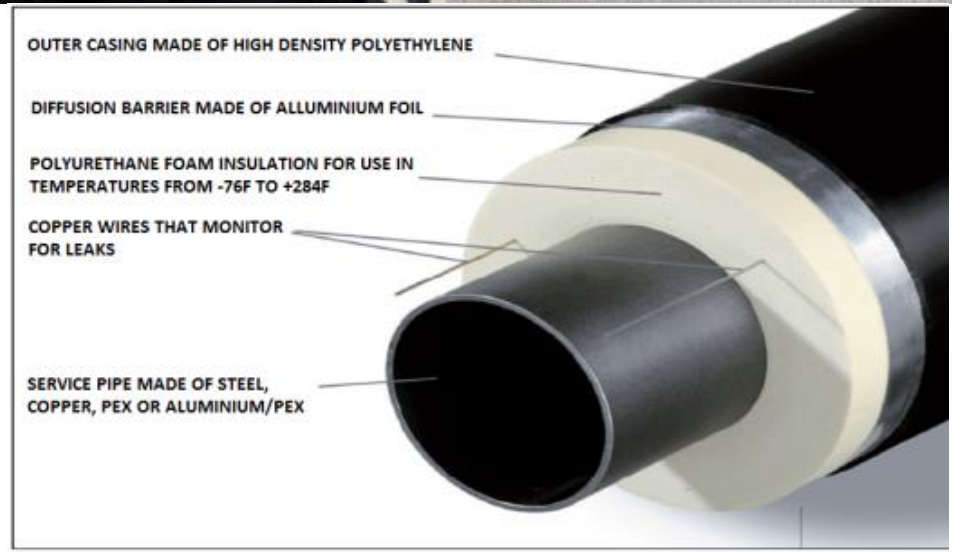
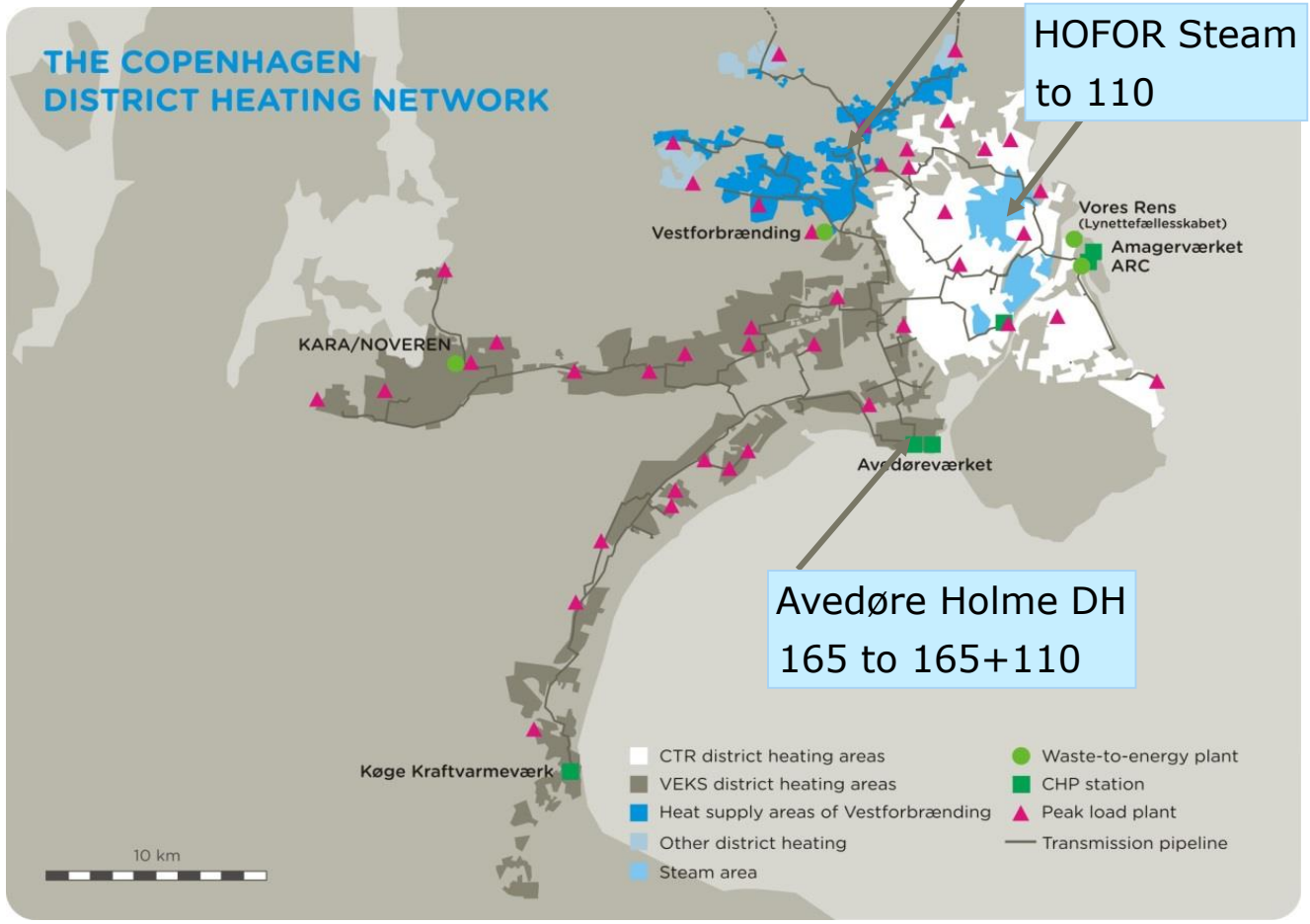
BENEFITS: HOT WATER VS. STEAM SYSTEM

- ✓ Lower investment costs
- ✓ Lower operating costs due to lower temperatures
  - ✓ higher efficiency for the entire system
  - ✓ lower heat loss 5-10 % vs. 30-50% for steam
- ✓ Significantly lower maintenance costs
  - ✓ no steam traps, condensate return etc.
  - ✓ Minimum of start-up costs
- ✓ High resilience
- ✓ Lower temperatures enable access to a broad range of renewable sources
- ✓ Enables thermal storage to be utilised



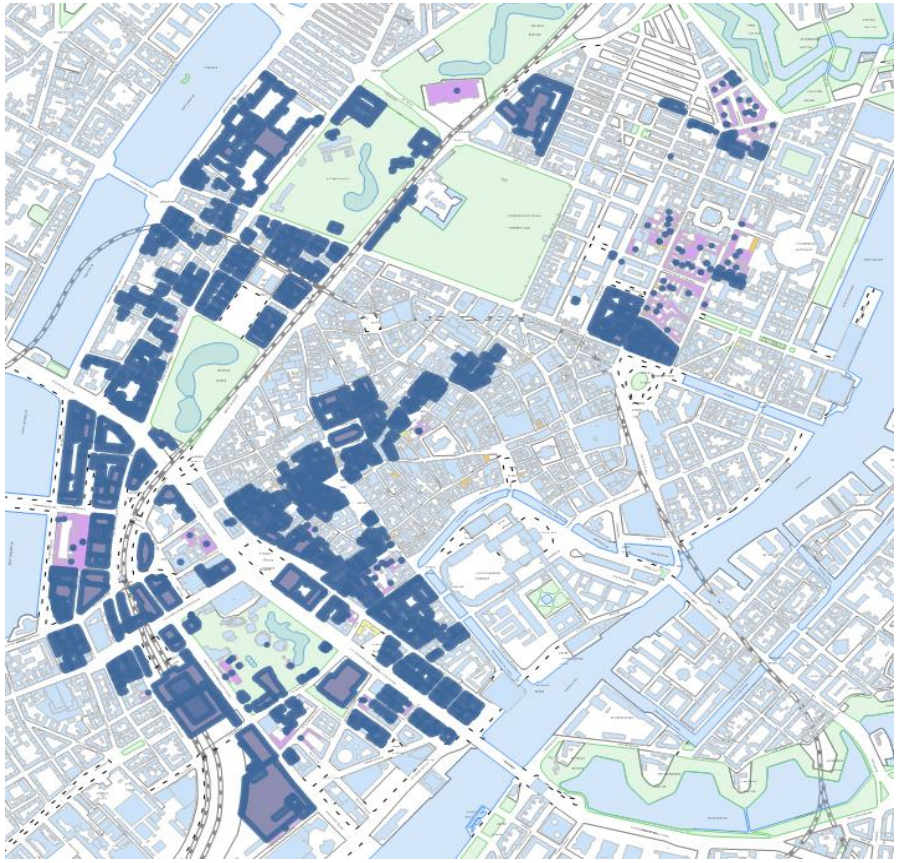
TRANSITION TO 4GDH IN GREATER COPENHAGEN
4 TRANSMISSION AND 20 DISTRIBUTION COMPANIES

- HOFOR steam in the city center:
  - No new steam pipes since 1980
  - Local steam heat exchangers basis for supply of new hot water networks
  - Replacement project from 2009 to 2022
- Vestforbrænding, northern suburbs
  - 165 dgr.C super heated water in 1975
  - Only hot water pipes since 1980
  - Max supply from 165 °C to 130 °C in 2000
  - Further to max 110 °C in 2030 ?
- All distribution companies go for
  - max <95 °C on the coldest day
  - Normal operation 60-80 °C



STEAM TO HOT WATER
THE OVERALL PLANNING

- Planning 2-5 years ahead, heat supply planning
- Internal coordination (joint work between utilities..)
- Dialogue with the authorities (municipal approval)
- Contact to customers and stakeholders (building owners)
- Overall district heat network design – hydraulics
  Working package – Summary of all collected information
- Detailed district heat network design – Pipe dimensions
  Project planning (municipal permits, traffic planning)
- Customers heat exchanger system design
- Establishing the district heating network, Archaeology, traffic, parking, polluted ground, shielding for safety, shops, traders, working progress, etc.
- Restoration of the streets – dialogue with road authority



Source: Rene Thiemke HOFOR

STEAM TO HOT WATER IMPORTANT STEPS

- Establish local District Heating Pipelines
- Rebuild Customer Facilities (steam to water)
- Install a temporary Steam/Water Heat Exchanger
- Switch Customers Supply from Steam to Water
- Expand the main District Heating System and connect to the Local supply Pipelines
- Disconnect Steam Supply Pipelines
- Reuse large double steam pipes to hot water S/R
- Reuse pipes or trench whenever feasible
- Co-ordinate with the district cooling
  - marketing as early as possible
  - construction work in same trench

Source: Rene Thiemke HOFOR

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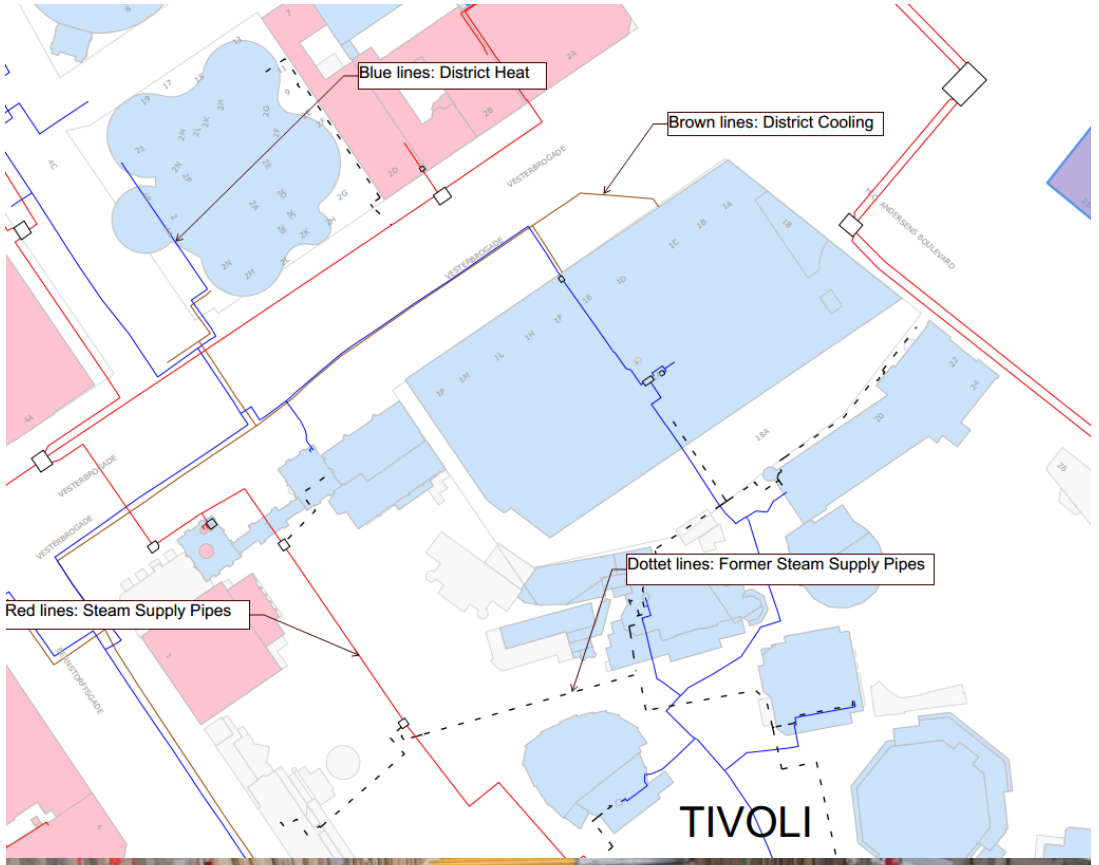
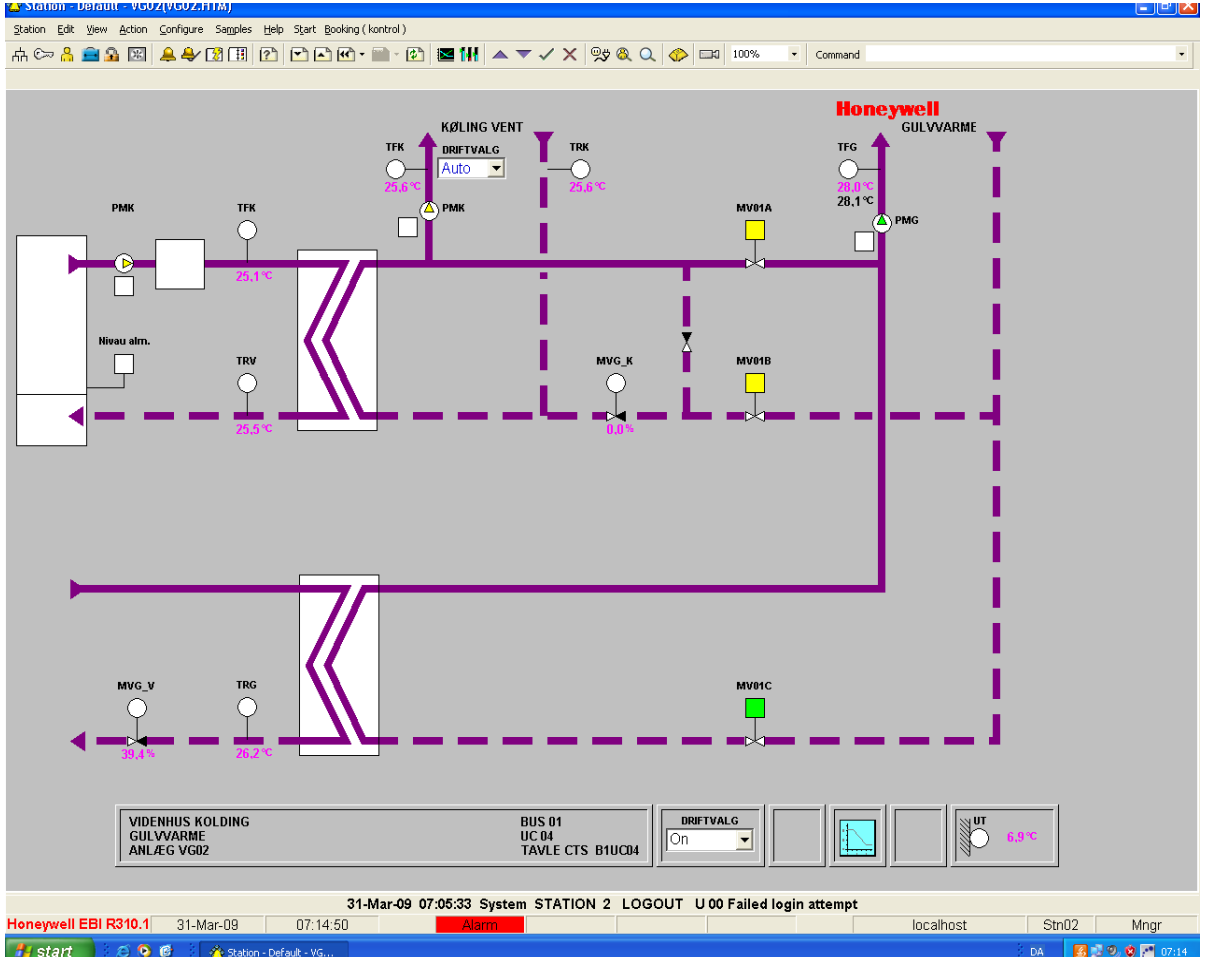


HOW TO LOWER TEMPERATURES IN DH SYSTEMS

- Co-operate with building owners on how to improve HVAC installations
  - Two string systems with thermostats
  - Under floor heating, larger radiators, etc.
- Discount for lower return temperature
- Lower operation temperature, identify critical consumers and find solutions
  - Temperature boost with a boiler
  - 3-pipe connection of critical consumers
- Develop low-temperature zones
  - Supply with low temperature production
  - 3-pipe connection of low-temp. Consumer
- Optimize the supply temperature



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THREE NORTH AMERICAN CASES

GENERAL PROBLEMS TO BE SOLVED

SHERITON COLLEGE IN CANADA

From steam to
Hot water district heating

- Preinsulated pipes
- Twin pipes
- Fixed without expansion joints


CASE


Sheridan

DARTMOUTH COLLEGE, HANOVER NH

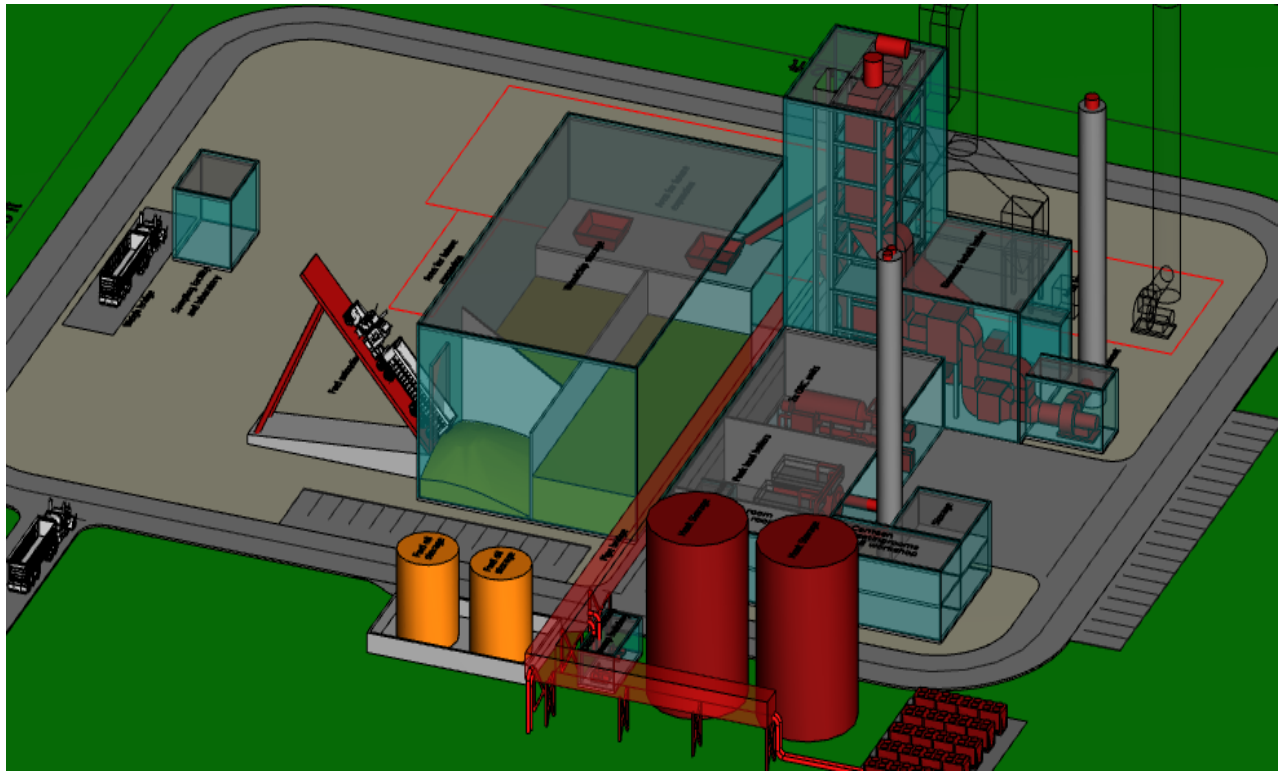
What we did

- Feasibility Studies with variety of production options incl. combined heating / cooling / seasonal storage
- Conversion of steam based DH System. Layout of district heating piping network
- Hydraulic calculations (heating and cooling)
- Energy Plant lay-out and 3D
- Fuel and fuel supply systems
- Detailed strategy for district cooling and chillers

DARTMOUTH COLLEGE, HANOVER NH

What we did

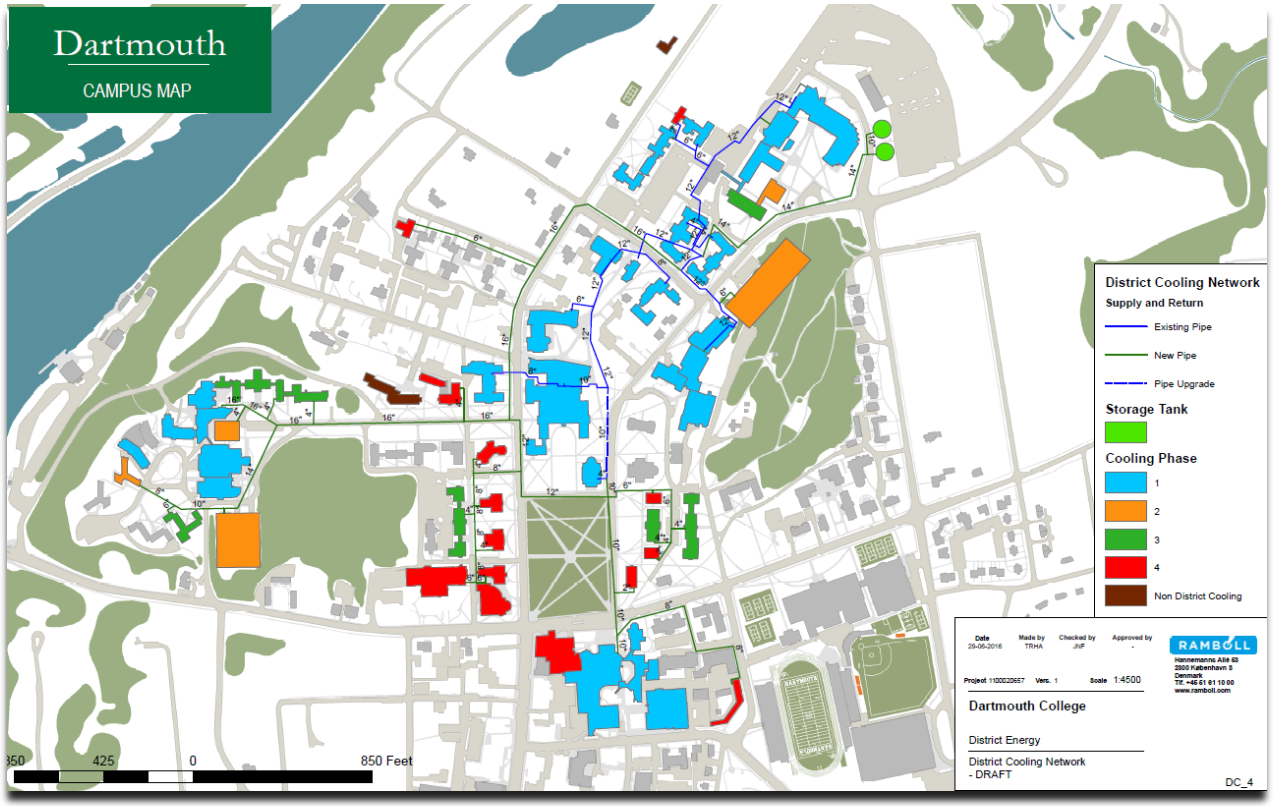
- Utilization of excess energy from cooling production
- Different storage options (PTES, BTES, ATES)
- Boiler sizing strategy
- Close contact with potential vendors (boiler and Organic Rankine Cycle units)
- Electric / SCADA
- Procurement strategy



DARTMOUTH COLLEGE, HANOVER NH

Benefits for the client

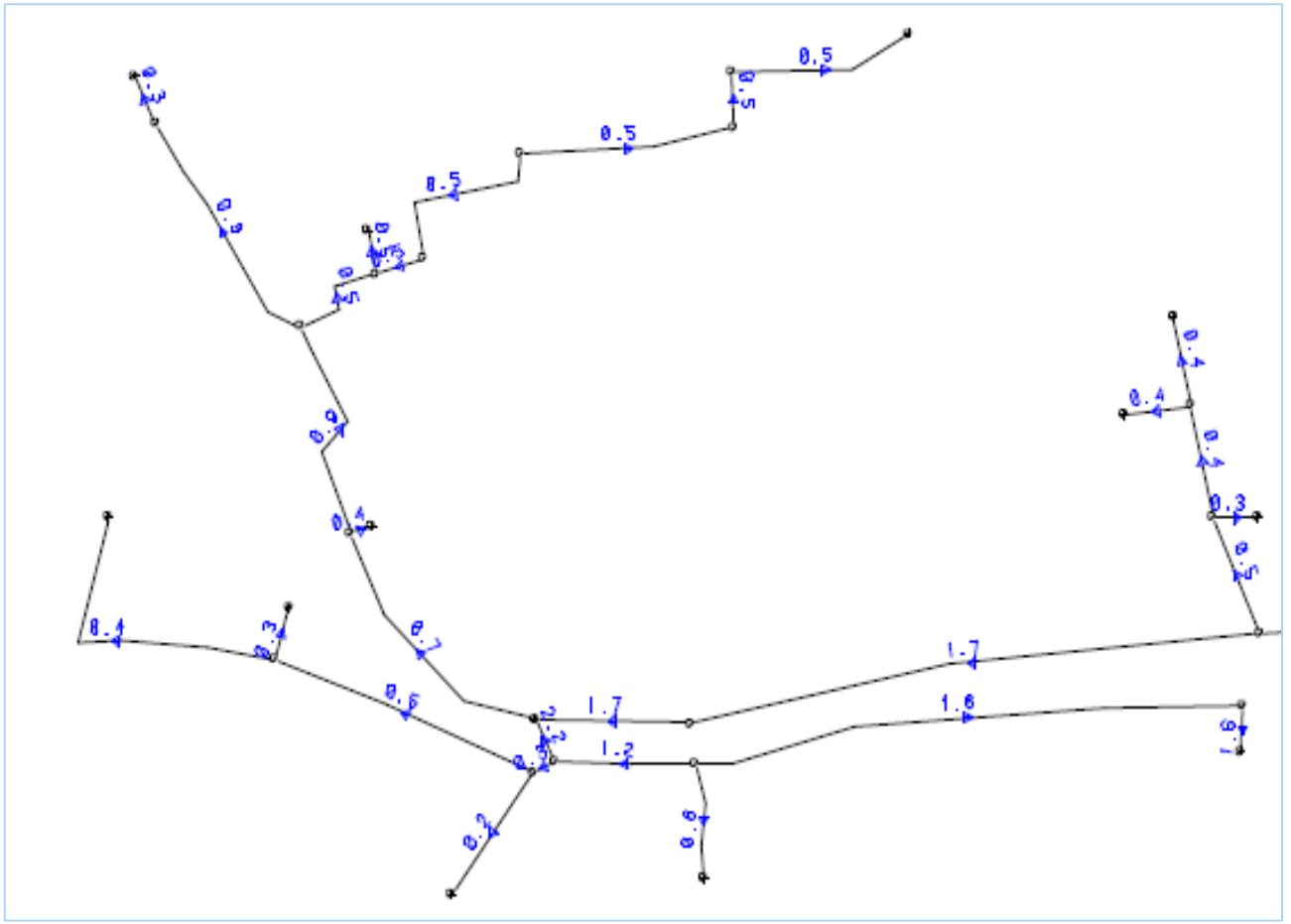
- Reduced dependency on fossil fuels
- A flexible and resilient energy system
- A system prepared for future recovering waste heat from cooling production
- Significantly efficiency increase
- Technical and economic overview of wide range of sustainable options
- Long term planning of district cooling expansion on the campus area



WESLEYAN UNIVERSITY, MIDDLETOWN CT

Conclusion

- Payback time for implementing a hot water loop less than 10 years
- Reduced fuel consumption/carbon emissions due to reduced energy looses
- Great potential for utilizing waste heat from a nearby power plant w. up to 300 MW available waste heat



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NORTH AMERICAN PROJECT EXPERIENCE IN GENERAL

- North American contractors tend to price the implementation of new hot water systems way too high
  - Limited experience and thereby high contingencies
- Project risk and contingencies should not be on the contractor only
- By a close dialog with the contractors and sharing the experiences from Europe the prices can be reduced 30 -50%
- Challenge that firms with European knowledge and experience is not approved for working for government sites like defense facilities

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THANK YOU FOR YOUR ATTENTION
QUESTIONS & ANSWERS

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