ENGINEERING TOMORROW

# THE ROLE OF DISTRICT COOLING IN THE FUTURE SMART ENERGY SYSTEMS

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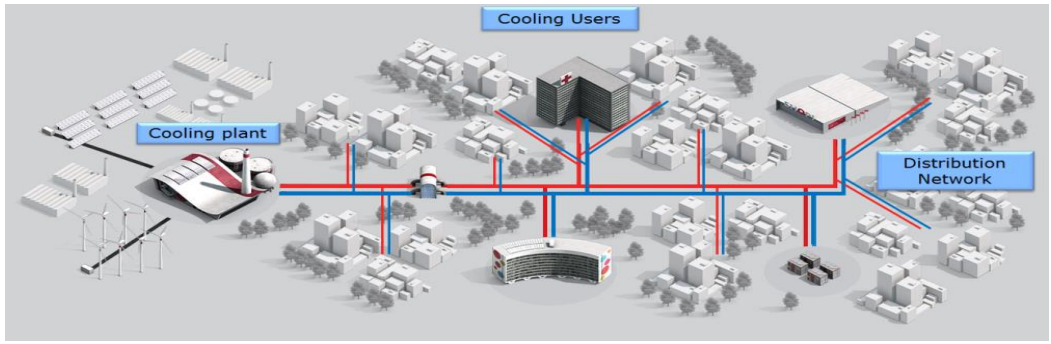
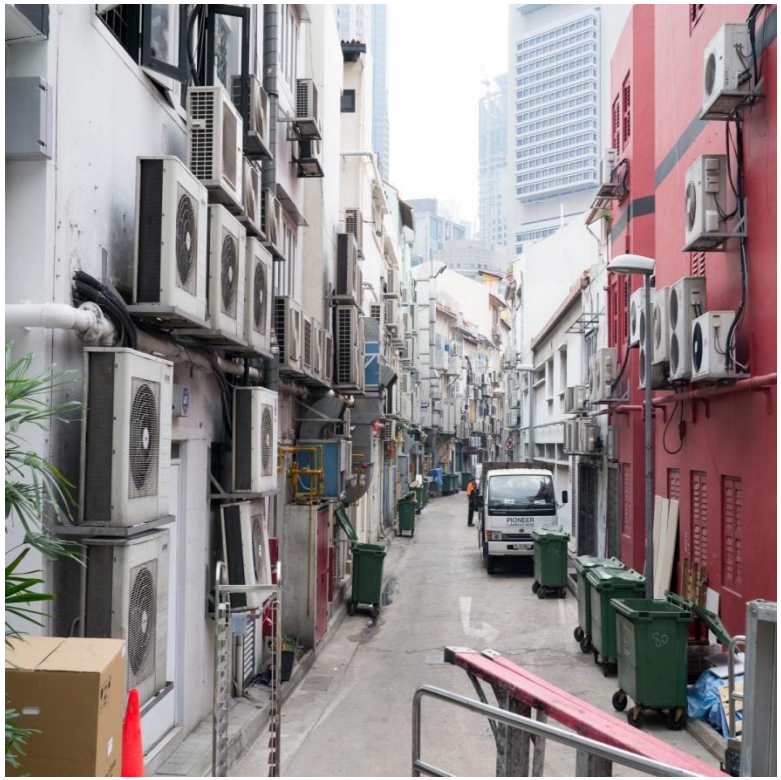
# District cooling

- Along with economic growth people are putting more focus on fulfilling their comfort needs
- Cooling demand in Europe is growing
  - Commercial cooling demand is estimated to be only 27% saturated
  - Residential cooling demand is estimated to be only 5% saturated
- In USA and Japan the saturation is 80%/65% and 100%/85% respectively
- Europe is in unique position to achieve cooling in a smart, energy efficient and environmental friendly way by introducing district cooling from the beginning of the cooling trend



# What is the risk if we do not consider district cooling?

- Not so favorable building add-ons



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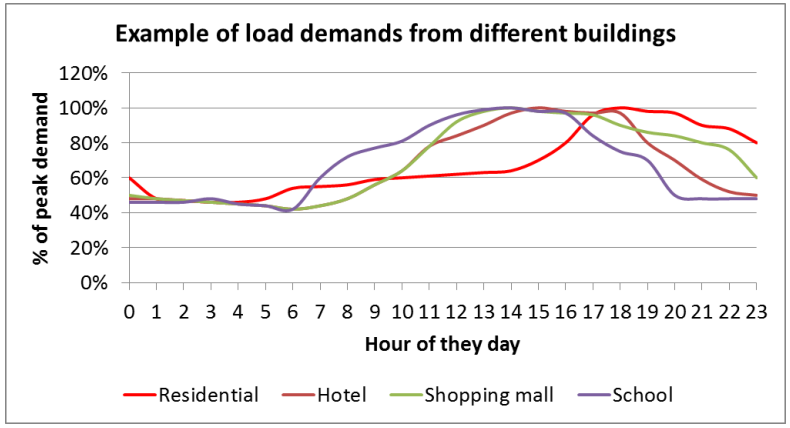
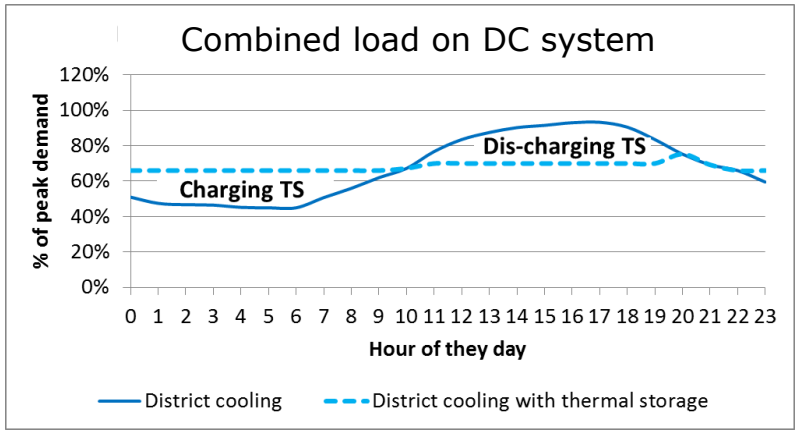
# What is the risk if we do not consider district cooling?

- General oversizing of equipment
  - Building level cooling units will be designed for peak load + reserve
- District cooling benefits
  - As demand varies between users the district cooling system can take advantage of it when it comes to investing in cooling capacities
  - Large thermal storages can be used to:
    - Optimize the cooling production
    - Reduce capacity investment
    - Smooth electrical load due to cooling



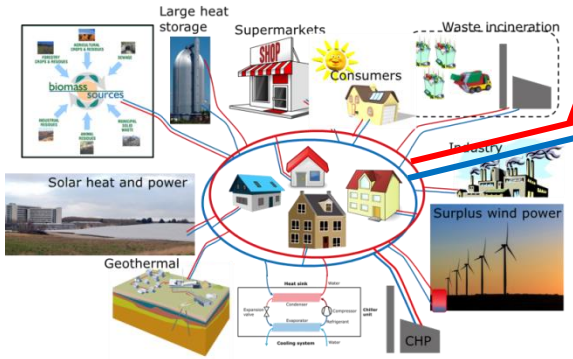



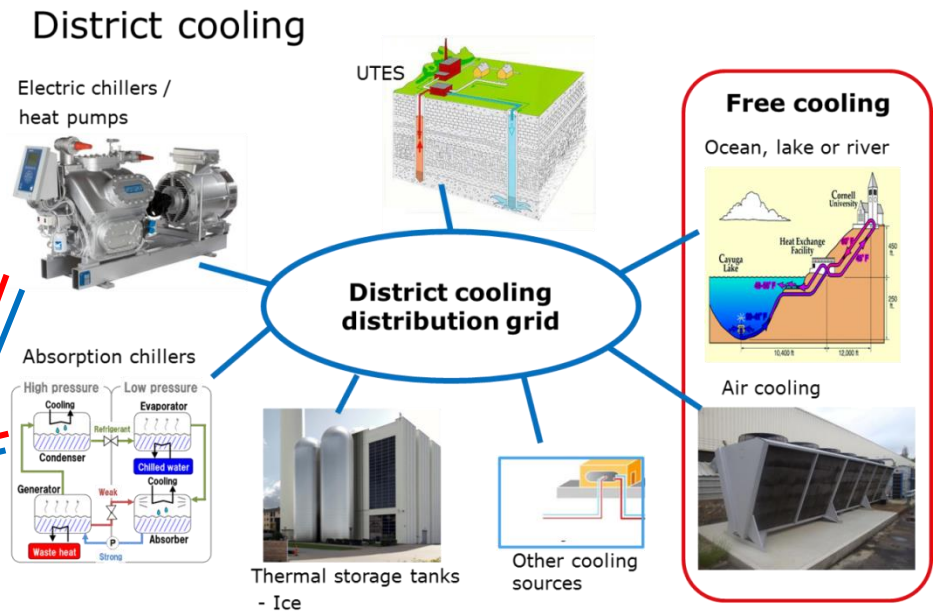
# What is the risk if we do not consider district cooling?

- <u>Unnecessary energy waste</u>
  - Building level cooling units will generally be oversized to the demand at hand
    - Units will be designed for peak load
    - Vast majority of the unit lifetime it will be operated at part load
  - Most cooling users will not have expertise to ensure optimum operation of their cooling units
    - Experience in the U.S. shows that the average fouling in water-cooled chillers results in 17% increase in energy consumption
- Cooling is the core business of **D**istrict **C**ooling **C**ompanies
  - The DCC will ensure optimum operation of their cooling units!
  - The surplus heat from the cooling units could further be used in the district heating system!

# What is the risk if we do not consider district cooling?

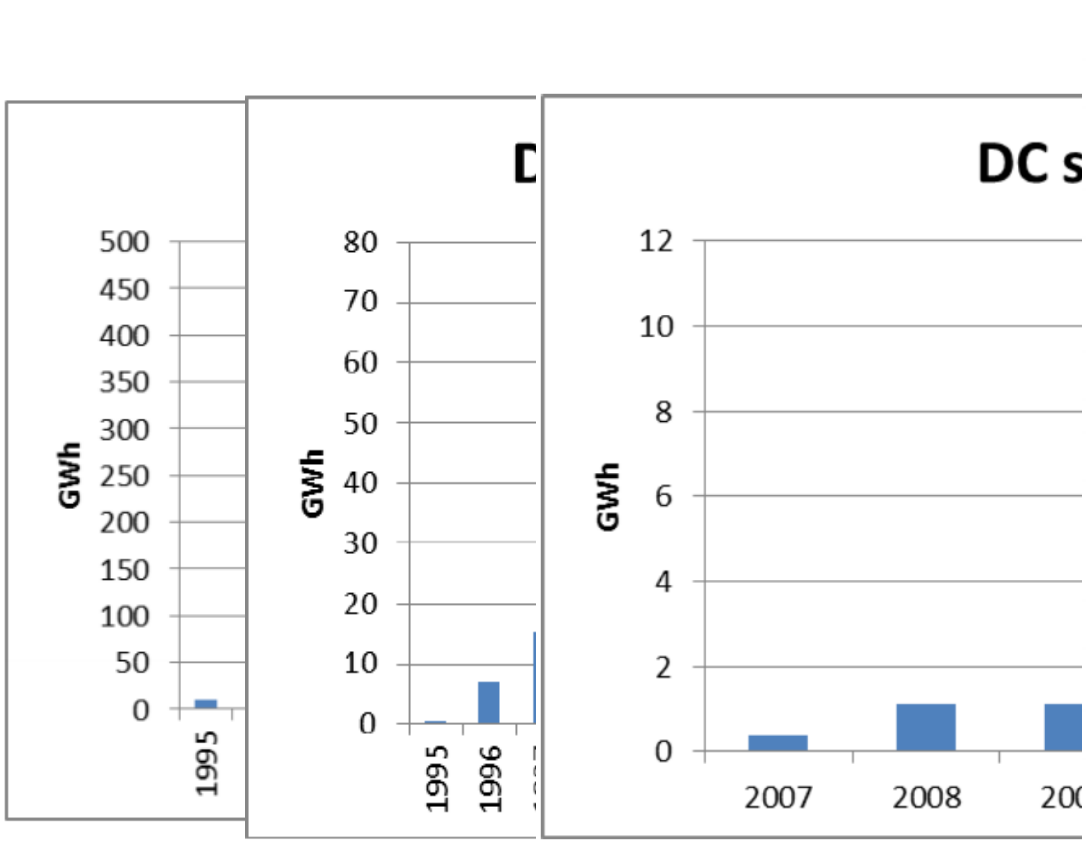
- <u>Fuel lock in</u>
  - Decentralized solutions are typically electrically driven
- District cooling is fuel independent
  - It can use any free cooling sources available
  - Heat from power generation
  - Heat from/to the district heating system
  - etc.

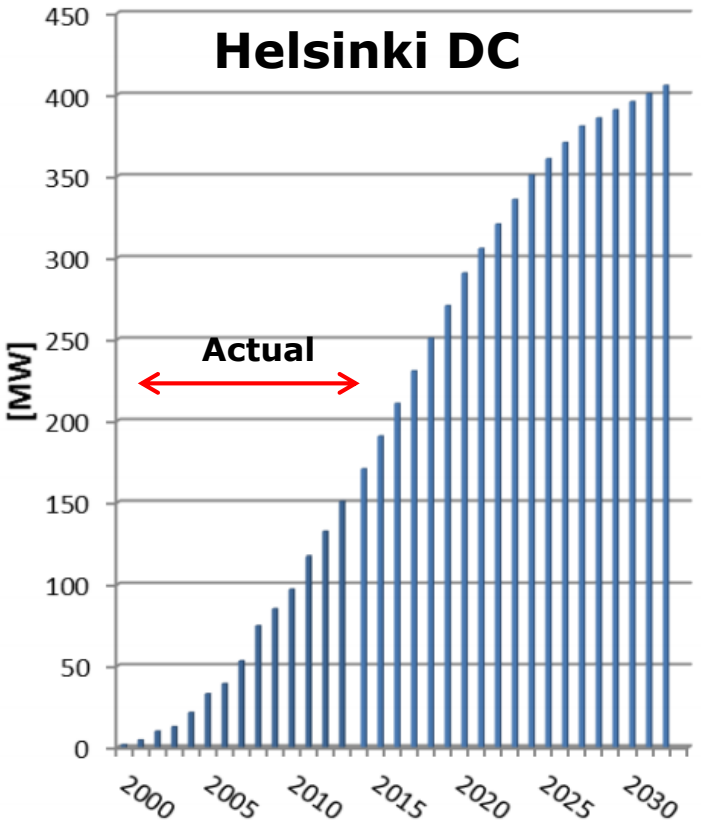


# Typical growth of district cooling systems

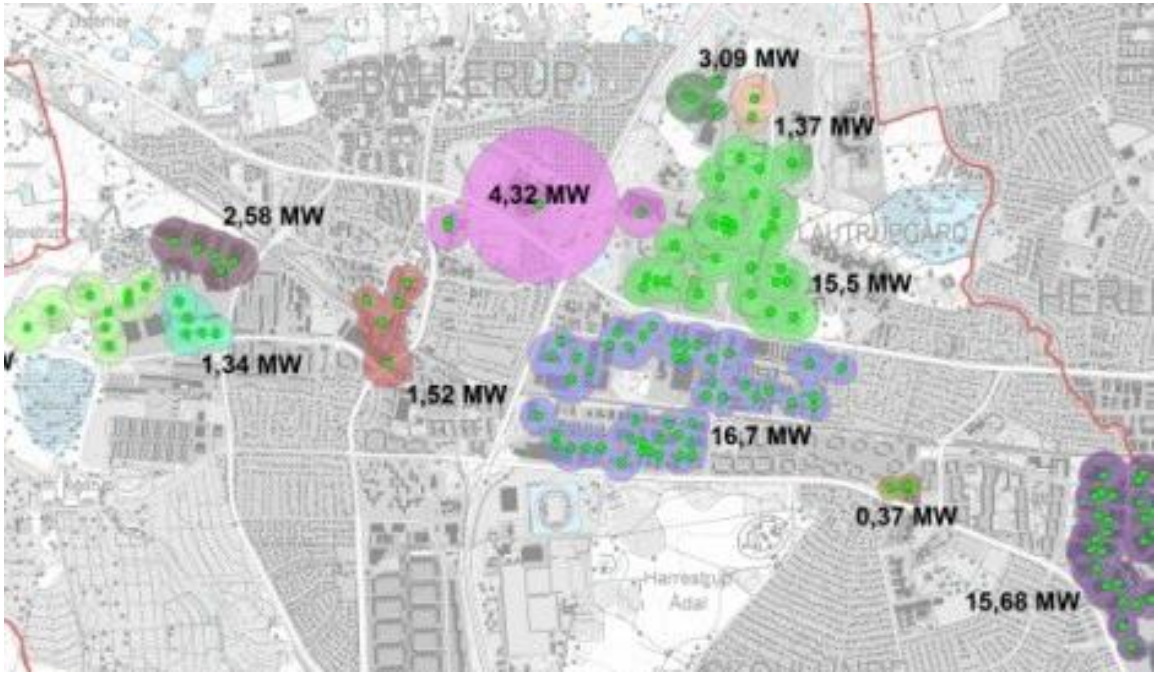
- Real cases show that once district cooling system are built they tend to grow very fast, until the market is saturated



# How to map district cooling potentials?

- Ramboll consultants have developed a simple and effective way to quickly estimate the potentials for district cooling




- When the circle intersect each other they indicate the district cooling system could be economical

# District cooling substations

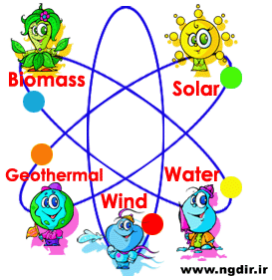
- District cooling substations are build on decades of experience with district heating, while specially optimized for the low dT and the low temperatures

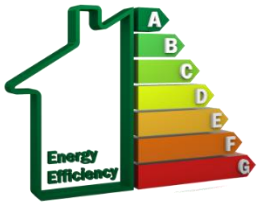
# Common challenges with district cooling

- Large upfront investments
- Finding space for the district cooling facilities:
  - Technical components (in a building),
  - Thermal storage
  - Pipe network installation (large dimensions), especially in city centre areas
- Minimizing noise pollution of very large chillers / heat pumps
- Low temperature difference between the supply and return (low dT syndrome)
- Faster then expected system growth once initiated
- All of those challenges can be solved with good preparation work, high quality solution and focused operation

# Drivers for district cooling


- Power drivers:
  - Economy of scale
  - Environmental friendly
  - Fuel/source independent
  - Higher energy efficiency




- Example of general drivers
  - Space saving at buildings
  - Flexibility for optimizing cooling production over time and cooling sources.
  - Reduces and optimizes electrical consumption
  - Reduced HFC handling
  - Silent operation at connected buildings
  - Maximum energy security

# Conclusions

- Everywhere district cooling systems are installed they experience rapid growth
- District cooling can lead the way to reduce environmental impact from cooling of buildings through its
  - Source independent nature
  - High energy efficiency - Large scale advantages
  - Utilization of simultaneity in the cooling demand
  - Implementation of renewable energy
  - Absorption cooling if high temperature waste heat is available
    - From existing district heating sources or power generation
- Economic optimization with thermal energy storages
  - Large accumulator tanks
  - UTES (underground thermal energy storage)
  - Pit storage
  - ATES systems

# Conclusions

- District cooling can deliver the heat from the buildings to the district heating system – lowering the price of district heating


- District cooling adds to the energy security through it multi source nature


- District cooling can act as a load shifting technology for the electrical grid (Electrical grids get more fluctuating in the future)


- <u>District cooling is the smart solution for the smart energy system of the future</u>

# Thank you for your attention

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