The potential of district heating

Refurbishing urban heating systems and integrating excess and renewable heat

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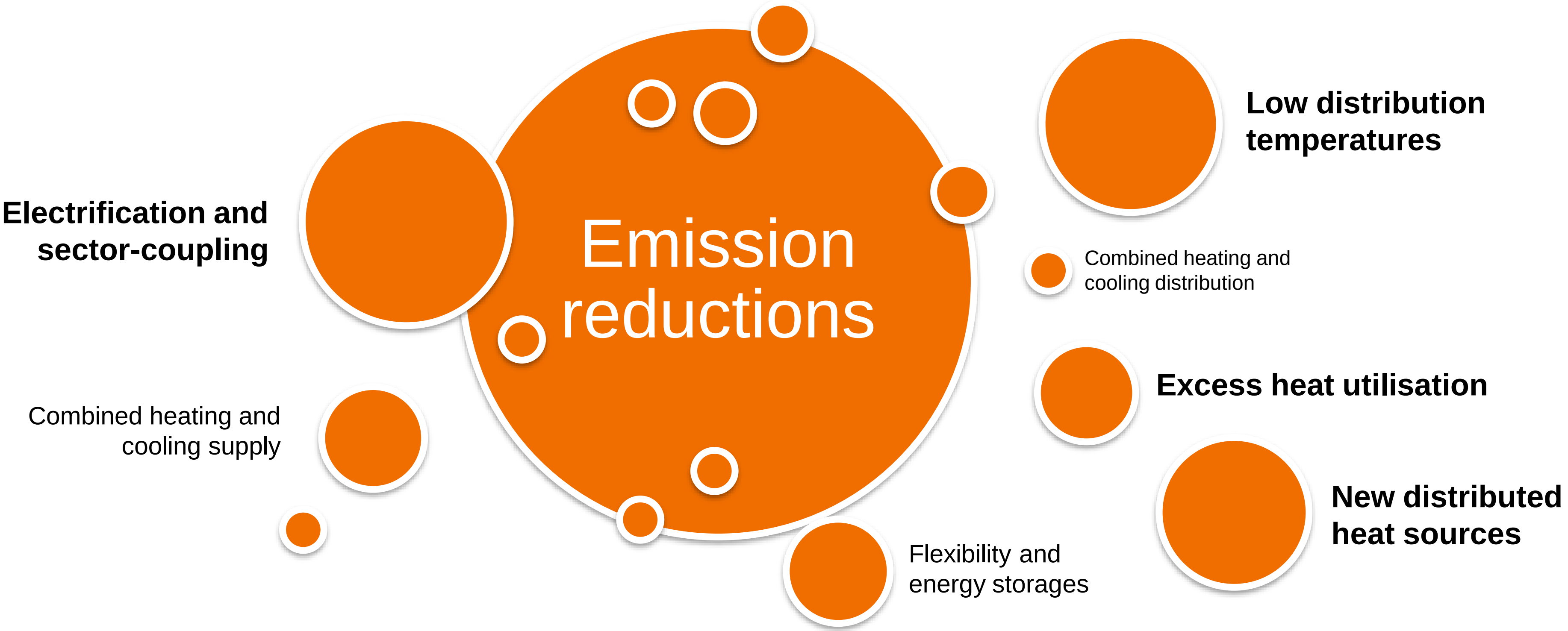
Introduction to district heating

- A **technology for distributing heat** through a network of pipes, taking advantage of the most efficient local heat supply options
- **Suited for densely populated urban areas** where the efficiency of the costly distribution network is the highest (not the entire heating sector)

- A city-wide network represents an **essential infrastructure for integrating renewable and excess heat** sources
- Large connected heat load enables utilisation of **large industrial excess heat sources** and represents **high potential for flexibility measures**, and enables **heat storages as a cheap energy storage** technology

Common trends

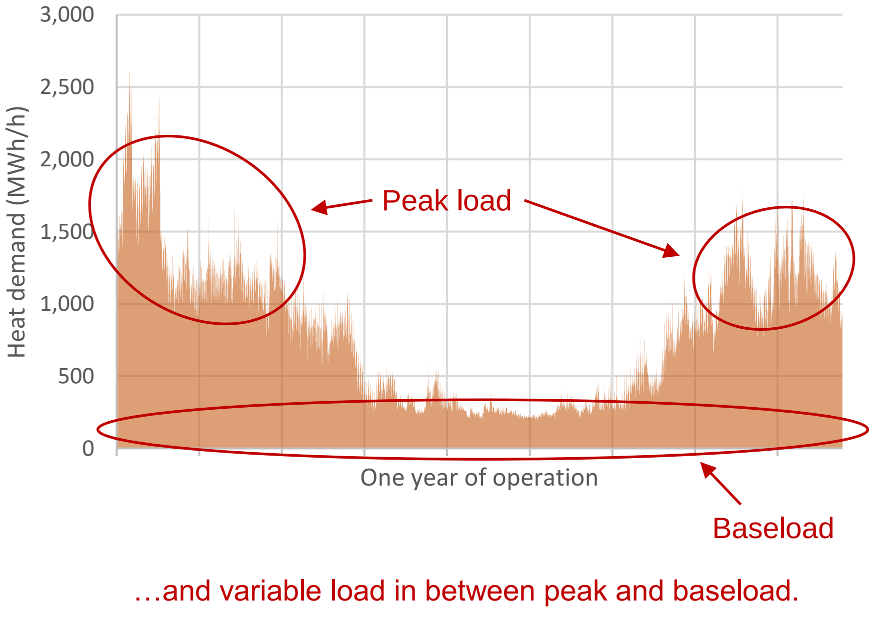


Key topics in the presentation

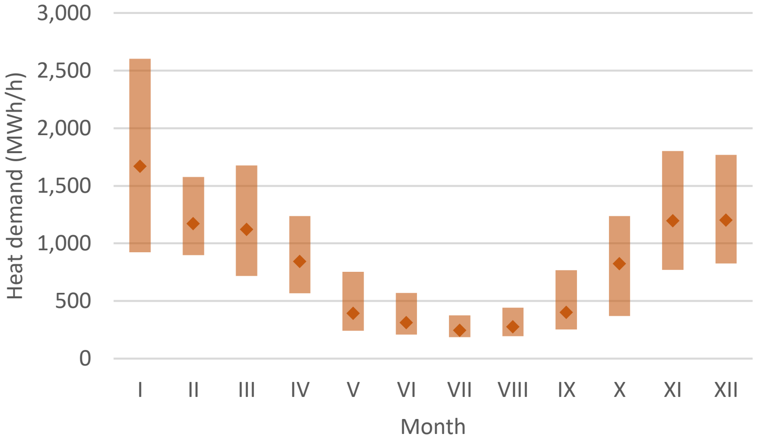
1) Demand profile and how different heat supply options combine; challenge and how it could be overcome?
2) Importance of the distribution system and the role of the distribution temperature level?
3) Barriers for developing district heating; perspective of new and existings systems

Demand profile

Base, variable and peak load identification



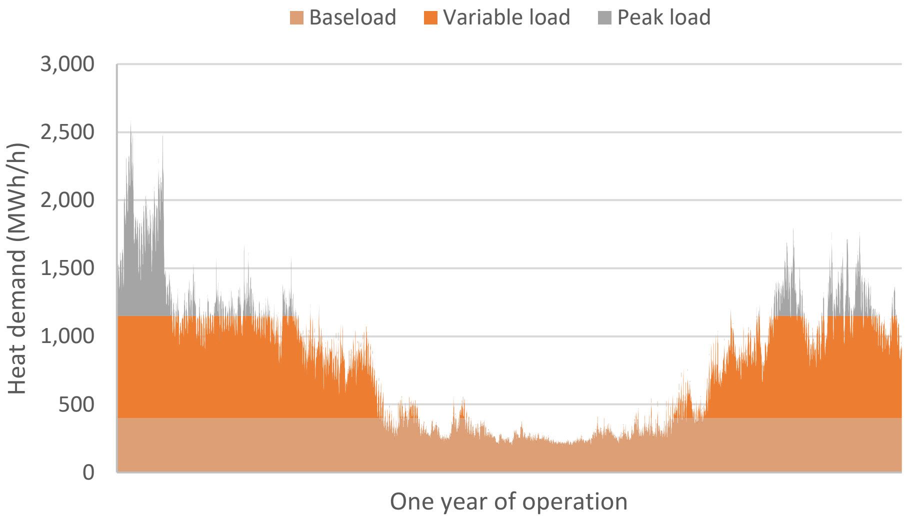
- Example; open data on Helsinki DH system[1]
- 7 TWh, 2 600 MW peak load
- Seasonal, monthly variations show clearly



1) https://www.helen.fi/helen-oy/vastuullisuus/ajankohtaista/avoindata

Base, variable and peak load

A simplified example



Heat supply	Capacity	Utilisation rate	Share in heat supply
Baseload	400 MW	90 %	45 %
Variable load	750 MW	50 %	46 %
Peak load	~1 500 MW	5 %	9 %

- New heat sources replace base/variable load
  - High investment costs → high utilisation rates, or
  - Base load by nature (excess heat), or
  - Mostly available outside heating season
- Less space and less space for new sources and the existing heat supply
- Peak load easier to manage (e.g. electric boilers and storages)

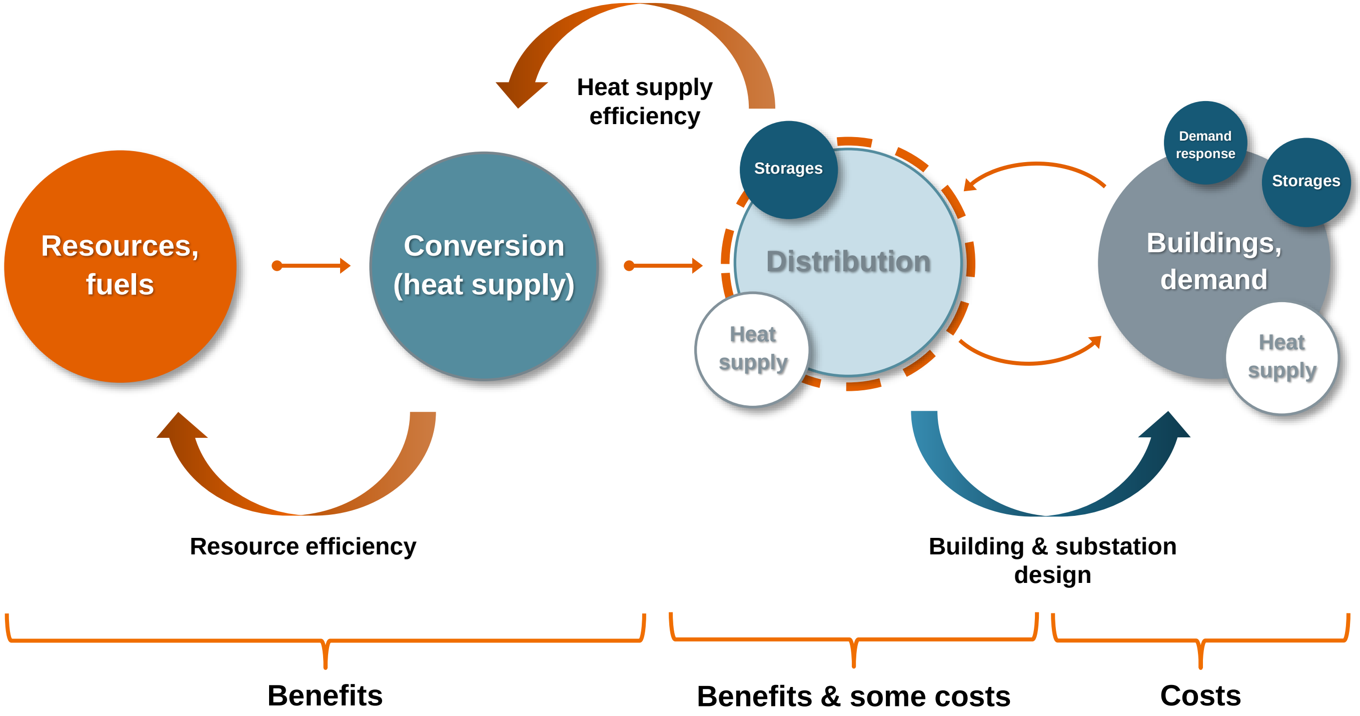
→ A real need to understand alternative, optimal combinations; local conditions and operational environment plays a part

Growing the feasible operational range?

New heat sources feasible with less operational hours

- Low distribution temperatures
- Mapping new heat sources and their potential
- Building codes enabling lower temperature levels
- Tax related incentives, support, other financial incentives
- New technologies maturing, old ones getting more efficient
- Sector-coupling related opportunities; getting value from flexibility
- Open heat market or single operator; makes no difference, both would aim for the optimal operation of assets (heat supply)
  - Open market could attract more companies, stakeholders?

Impact of distribution temperature level



Transition to low temperature distribution.

→ **Fair and transparent allocation of costs and benefits required**

Barriers for developing DH

Barrier description	Existing systems	New DH systems
Benefits of DH remain unclear, or long lead-time before full benefits realised		X
High upfront investment costs for the network		X
Aging or not properly maintained building heating / heat distribution systems	X	X
No accurate data on excess heat sources & renewable resources	X	X
Network capacity insufficient for low temperature distribution	X	
Existing heat supply does not combine well with new heat sources	X	

→ **High upfront investment, technology/system lock in, transition management, various involved stakeholders, uneven distribution of costs/benefits, local solutions needed**

Sources of information

- IEA DHC Technology Collaboration Programme (TCP) Annex programme[1]
  - XI-01: Transformation roadmap from high to low temperature DH system (2014-2017)
  - XII-04: Stepwise transition strategy and impact assessment for future DH systems (2017-2020)
  - XIII-05: Optimized transition towards low-temperature and low-carbon DH systems (2020-)
  - TS1: Low Temperature DH for Future Energy Systems (2012-2017)
- Helsinki Energy Challenge[2], 1 M€ competition
  - Finalists (15) to be selected in 11/2020, Winner in 2/2021
- Large-scale implementation of low temperature system are not that numerous, smaller examples exist (e.g. TS1 report) and many are being planned and designed
  - Europe towards positive energy districts booklet[3] contains a lot of planned concepts

1) https://www.iea-dhc.org/index.php?id=293
2) https://energychallenge.hel.fi/
3) https://jpi-urbaneurope.eu/app/uploads/2020/06/PED-Booklet-Update-Feb-2020_2.pdf

Summary

- **Technology for distributing heat** in densely populated urban areas
- District heating represents **an essential infrastructure** for integrating renewable and excess heat sources
- Large connected heat load; more opportunities for 1) integration of **large amounts of excess heat** and 2) realising the **flexibility potential**
- Target; an **optimal combination of heat sources** supplying the heat demand (more complex challenge than it seems)
- Low distribution temperature **improves the efficiency** and feasible operational range for many new (and old) heat sources
- Compatible building systems and their temperature level a **key enabler**

beyond
the obvious

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