Fourth to Fifth Generation District Heating

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8 October 2020
How has district heating developed?

- When did district heating start?
- What are the trends over the five generations?
- How is it evolving?
- Change of heat source
- Lowering of heat distribution temperature
- Lowering of heat losses to the ground
- Combustion gives way to heat transfer
Heat network trends to lower distribution temperatures and higher efficiency

1st GENERATION
STEAM
- Pressurized steam pipes
- In concrete ducts
- <200°C
- Heat sources:
  - Steam storage
  - Coal Waste

2nd GENERATION
ON SITE CONSTRUCTION
- Pressurised hot water
- Heavy equipment
- Large on-site plant
- >100°C
- Heat sources:
  - Heat storage
  - CHP coal
  - CHP oil
  - CHP biomass
  - CHP waste heat

3rd GENERATION
OFF-SITE
- Pre-insulated pipes
- Off-site plant construction
- <100°C
- Heat sources:
  - CHP coal
  - CHP oil
  - CHP biomass
  - CHP waste heat

4th GENERATION
MULTI VECTOR
- Improved controls
- 50-60°C
- Heat sources:
  - CHP waste / coal / oil
  - Gas / waste / oil / coal
  - Biomass / CHP biomass
  - Industrial waste heat
  - Thermal storage

5th GENERATION
AMBIENT TEMPERATURE
- Controls integration
- Heating and Cooling
- Modular expansion
- Demand Side Management
- 5-20°C
- Heat sources:
  - Water via heat pumps
  - Waste heat
  - Thermal storage
- Electrical sources:
  - Grid
  - Wind
  - PV
  - CHP
  - Large scale solar thermal

GSHPA
GROUND SOURCE HEAT PUMP ASSOCIATION
Fourth Generation District Heat Network

Heat from *energy centre* from gas, CHP, high temperature heat pumps or a mix

If heat pumps are used, the carbon emissions are greatly reduced

Flow temperature typically $60^\circ$C
Fifth Generation District Heating - Balanced Energy Network provides the lowest possible carbon emissions allows heat sharing between customers, increasing energy efficiency single circuit provides heating and cooling simultaneously

Flow temperature 5-20ºC
Balanced Energy Network
Ambient temperature network allows polymer pipework with limited insulation
Radically cheaper than installing heavily insulated (often steel) pipework
From 4th generation steel pipes to 5th generation polymer
Balanced Energy Network - heat sharing network
some buildings need heating
some buildings need cooling
some buildings need both
Fifth Generation Heat Network

- A Fifth Generation Heat Network employs
  - an ambient ground temperature distribution loop
  - a heat pump in each building to transfer heat into the building (or out of it)
  - Demand Side Response to avoid peak loads on the Grid (and earn income)
  - thermal energy storage to exploit heat pumps and Demand Side Response

- A Fifth Generation Heat Network does not employ combustion
  - and therefore issues no on-site CO₂
  - and no on-site NO₂
  - and no particulates

- A Fifth Generation Heat Network offers
  - radically cheaper installation cost
  - ability to recycle heat between buildings
  - the flexibility to expand or contract without major cost implications
  - ability to use waste heat at any temperature above 25°C
  - lower maintenance cost than combustion boilers
A BEN can grow in a modular fashion
- reflects real world development patterns
- benefits shared between segments
- infrastructure costs are minimised
High Temperature Heat Pump
Designed by ICAX and J&E Hall
Available in units from 300kW to 2MW
Available in ground or marine versions
Temperature output up to 80°C
Allows retrofit without changing heat distribution system in existing buildings
Heat Pump Retrofit in London

London aims to be a net zero carbon city by 2030 and to have the best air quality of any major city.

28 London Boroughs have declared climate emergencies with over half committed to achieving net zero by 2030.
Heat Pump Retrofit in Southwark

- Experience with Balanced Energy Network
- Working with Southwark
- London Aquifer
- Hydrogeology experience
- Working with Environmental Agency
- Lower heat distribution temperatures
- High temperature heat pumps
- Controls in an integrated environment

Three community heated housing estates in Southwark:
Consort, Newington, Wyndham

Fourth Generation district heating with High Temperature Heat Pumps

Newington is predicted to save over 25,000 tonnes of CO$_{2e}$ over 25 years
Water Source Heat Pump Retrofits elsewhere

- ICAX is well placed to advise on other large scale projects to save on carbon emissions in London or elsewhere
- And to deliver the retrofit installations
- Including high temperature heat pumps
Questions....

www.gshp.org.uk

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