Scope

- Low temperature district heating: what, why, who?
- Introducing a current IEA-DHC project 'Towards 4th Generation District Heating (4GDH): Experiences with and Potential of Low Temperature District Heating Case studies'
- Case studies
- IEA-DHC programme and future activities

Low temperature district heating: what is it?

- The commonly used supply temperature for district heating schemes has decreased…
- … and is typically categorised as:
  - 1st generation district heating STEAM
  - 2nd generation HIGH TEMPERATURE WATER 120C
  - 3rd generation MEDIUM TEMPERATURE WATER 90C
  - 4th generation LOW TEMPERATURE WATER 55C

Low temperature district heating: why do it?

- It suits new-build developments with high levels of energy efficiency where the motivation is clear: it reduces cost and enables renewables
- For the distribution system it reduces:
  - capital cost
  - heat losses
  - thermal stresses
- Assists penetration of renewable heat
- Extends the usefulness of directly available surplus heat - let's use the energy no-one else wants!

Low temperature district heating: who's doing it?

- Well-documented examples include the new-build scheme at Lystrup here in Denmark
- Pilot schemes also include solar thermal schemes at Okotoks (Canada), and the 'zero carbon' development at Greenwatt Way in Slough (UK)
- However, there also examples where low temperature systems have been chosen historically due to a particular source supply temperature, eg Kysehir (geothermal) and Heerlen (minewater)
- Existing schemes, often over-engineered, may also benefit financially from reducing supply temperatures

Towards 4th Generation District Heating (4GDH): Experiences with and Potential of Low Temperature District Heating

- A project that is supported by the International Energy Agency implementing agreement District Heating & Cooling (IEA-DHC)
- Focus is on very low temperature (supply 50° – 55 ° C) systems
- Potentially extends locally available useful sources of residual and renewable heat
- Goal is to bring experience, knowledge and solutions for 4GDH to a level where they are ready for much wider implementation

Towards 4th Generation District Heating (4GDH): Experiences with and Potential of Low Temperature District Heating

- Assembling information on early exemplar schemes supplying new-build highly energy-efficient buildings
- Analysing lessons from early examples of low temperature systems
- Examining how the legionella issue can be addressed
- Determining what the practicality is for extending to lowering the supply temperature of existing 'conventional' district heating systems

Lystrup Case Study

- Low temperature district heating network for newly-built low energy single family houses
- Comprises 40 low-energy class 1 terraced houses
- Radiator designed for flow temperature of 50 ° C and return of 25 ° C
- Connected to the city district heating scheme
- A mixing shunt lowers the supply temperature to 55 ° C
- Volumes of water on the secondary side are restricted to 3 litres to avoid problems with legionella

Lystrup Case Study

- Overall performance very positive
- It has proved possible to provide customers with 50 ° C supply via the shunt
- Heat losses have been 25% of conventional 80/40 ° C systems
- Space heating consumption has been higher than expected, but this is because indoor temperature has been higher than the 20 ° C setpoint. Residents of these low temperature DH houses have been comfortable!
- Substation performance is crucial: return temperatures have varied between 26 ° C (fine) and 43 ° C (occurred due to one substation malfunction)

Kirsehir, Turkey, Case Study

- Availability of geothermal heat at 57 ° C was the driver for this low temperature system (back-up boilers can increase this to 61 ° C)
- It was estimated that this would be sufficient to satisfy the heating requirements of existing housing since the radiators were sufficiently over-dimensioned. Design temperature -12 ° C same as Denmark
- In operation since 1994 without customer complaint
- Relatively high return temperature of about 40 ° C – but hardly matters due to geothermal source
- Investments in geothermal systems in Turkey have 5-8 year payback

Chalvey Case Study

- Chalvey Zero Carbon Homes DH system is an experimental development that aims to demonstrate that Zero Carbon can be achieved with district heating
- supplied by biomass pellet boiler, ground source heat pump, air source heat pump, with some solar thermal
- Comprises 10 homes built to very high level of energy efficiency
- Operating supply temperature of 50 ° – 55 ° C
- Lowering the return temperature crucial to plant efficiency, minimising pipe sizing and pumping energy.

Chalvey Case Study

- Headline result so far is simple: it works! There are no apparent difficulties with 50 ° – 55 ° C supply for new-build
- Thermal store means plant can run when its most advantageous: solar thermal when its sunny, air source heat pump in the afternoon when the ambient temperature is highest
- The principal issue is achieving a low return temperature so as to achieve efficient performance of plant and thermal store

Other examples…?

- Okotoks solar thermal: widely disseminated particularly in ECBCS Annex 49
- Heerlen Minewater scheme: very low temperature heat supply spurred by availability of minewater (scheme also includes high temperature cooling)
- Others? Please let me know!

IEA District Heating & Cooling programme

- Carries out a programme of internationally based research and development of which the 4th Generation District Heating (4GDH) project is one
- It has a policy voice through its links to the IEA Secretariat
- It is the only global research programme for this technology
- Current member countries are Canada, Denmark, Finland, Germany, Korea, Norway, Sweden, UK, USA…
- … and we warmly invite new member countries to join us at a concessionary rate

Current IEA-DHC projects

- Towards 4th Generation District Heating (4GDH): Experiences with and Potential of Low Temperature District Heating
- Economic Design and Optimisation in Integrating Renewable Energy and Waste Heat with District Energy Systems
- Improved Maintenance Strategies for District Heating Pipelines

IEA-DHC initiative in planning: Smart DHC Networks in Low Temperature Energy Systems

- Will amplify the work of the existing 4GDH project
- Fundamental link between low temperature systems, integration of renewables, thermal storage, heat demands of future buildings…
- … all of which together imply the need for smart controls, smart DHC networks
- IEA-DHC is still planning this initiative, so if you are interested in joining please contact me or dietrich.schmidt@ibf.fraunhofer.de

What are the Future Research Priorities?

- Greater use of residual and renewable energy sources, and low temperature networks → smart thermal grids
- Links between smart thermal grids and smart electricity grids
- Better controls, sub-stations, integration of thermal storage
- Reducing the cost of DH infrastructure
- Efficient way to install new DH systems for new towns and cities

For more about this project or the IEA-DHC programme, contact:

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