Part of the BRE Trust
Low Temperature District Heating
Robin Wiltshire
BRE
Building futures Group
26 April 2012

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 are 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 °C – 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 °C – 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
– 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:

Robin Wiltshire (Chair, IEA-DHC)  wiltshirer@bre.co.uk
Andrej Dentsch, AGFW (Operating Agent, IEA-DHC)  IEA-DHC@agfw.de