DISTRICT HEATING & HEAT NETWORKS CPD
CPD PRESENTATION

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OBJECTIVES

- What is district heating? - Understand basic principles and advantages of DH

- Potential heat sources – What options are available

- Biogas / Anaerobic digestion – How it works and what feedstocks can be used

- Pipe materials and properties (steel and polymer) – Selecting appropriate pipe materials for each individual project

- Installation and design – What key data is needed to size a pre-insulated pipe network
REHAU COMPANY HISTORY

UK LOCATIONS

Private Company

- 1948 Founded in the Bavarian town of REHAU
- 1962 First UK Sales Office and Warehouse opened in Slough
- 1975 First Manufacturing Plant was opened in Amlwch
- 1995 Opening of the new headquarters in Ross-on-Wye
- 2003 REHAU celebrated its 40th anniversary trading in the UK
REHAU DIVISIONS
UNLIMITED POLYMER SOLUTIONS

Industry

FURNITURE, HOUSEHOLD APPLIANCES, HOSES AND INDUSTRIAL DEVELOPEMENTS

Automotive

EXTERIOR, WATER MANAGEMENT, AIR MANAGEMENT & SEALING

Building Solutions

WINDOW AND CURTAIN WALLING TECHNOLOGY, BUILDING TECHNOLOGY, CIVIL ENGINEERING
WHAT IS DISTRICT HEATING?

DEFINITION

Hot water or steam is centrally produced

- Transported via insulated pipe network
- Connected to individual properties via a heat exchanger
- Heat metered
- Heat delivered via conventional heating systems
WHAT IS DISTRICT HEATING?

BENEFITS

Making use of waste heat from power generation can dramatically improve energy efficiency

More efficient to produce energy locally, minimise losses

Community based heat sources (e.g. central biomass plant) maximise benefits of renewables

Minimise maintenance using one central plant – no individual gas checks required

Improved SAP rating & eligible for RHI
WHAT IS DISTRICT HEATING?

POTENTIAL BARRIERS

Lack of district heating (DH) experience in UK -> Higher cost to install as perceived as ‘higher risk’

Lack of awareness of DH and historically poorly conceived schemes

Community acceptance required – once installed, lack of control by end user

Control of tariffs for varying usage from end users

“71% of people thought a district heating system could be better than current individual systems in homes” - Research for UKGBC & Zero Carbon Hub 2009
WHAT IS DISTRICT HEATING?

INDIRECT CONNECTIONS

Indirect connections:

- Each house needs a heat exchanger off the DH network
- Individual house metering monitors & control and then bills based on the amount of heat used
- ‘Smart metering’ – no site readings
- Typically operated by ESCOs (Energy Supply Companies)

Direct connections can also be used (no heat exchangers required) but each property is not isolated, therefore not normally preferred.
USE OF DISTRICT HEATING
UK COMPARED TO EUROPE

Percentage of Houses Supplied by District Heating

UK District Heating now nearly 2% = 600,000 dwellings plus non-domestic buildings
COST SAVINGS PER DWELLING
DISTRICT HEATING BENEFITS

Avoided costs per dwelling:

• Gas network / connection
• Gas meter
• Gas boiler
• Individual flues
• Immersion heater
• Simpler plumbing

Additional benefits:

• Heat availability 24/7
• Minimal individual dwelling maintenance
USE OF DISTRICT HEATING
RENEWABLE HEAT INCENTIVE (RHI)

- Biomass and biogas (anaerobic digestion) are included in the RHI from Summer 2011. This will be mean income for every kWh of biomass / biogas heat energy produced.

- Only for commercial buildings in Phase 1 - domestic properties will be included in Phase 2 (late 2012)

- District heating and CHPs both supported, see DECC RHI extract below.

Source: DECC
## Use of District Heating

**Renewable Heat Incentive (RHI)**

<table>
<thead>
<tr>
<th>Tariff name</th>
<th>Eligible technology</th>
<th>Eligible sizes</th>
<th>Tariff rate (pence/kWh)</th>
<th>Tariff duration (Years)</th>
<th>Support calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small biomass</td>
<td>Solid biomass; Municipal Solid Waste (incl. CHP)</td>
<td>Less than 200 kWh</td>
<td>Tier 1: 7.6</td>
<td>20</td>
<td>Metering&lt;br&gt;Tier 1 applies annually up to the Tier Break. Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.: kWh x 1,314</td>
</tr>
<tr>
<td>Medium biomass</td>
<td>Solid biomass; Municipal Solid Waste (incl. CHP)</td>
<td>200 kWh and above; less than 1,000 kWh</td>
<td>Tier 1: 4.7</td>
<td>20</td>
<td>Metering&lt;br&gt;Tier 1 applies annually up to the Tier Break. Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.: kWh x 1,314</td>
</tr>
<tr>
<td>Large biomass</td>
<td>Solid biomass; Municipal Solid Waste (incl. CHP)</td>
<td>1,000 kWh and above</td>
<td>2.6</td>
<td>20</td>
<td>Metering</td>
</tr>
<tr>
<td>Biomethane</td>
<td>Biomethane injection and biogas combustion, except from landfill gas</td>
<td>Biomethane all scales, biogas combustion less than 200 kWh</td>
<td>6.5</td>
<td>20</td>
<td>Metering</td>
</tr>
</tbody>
</table>

*Source: DECC*
**POWER GENERATION**

**HEAT ONLY**

Off-site generation, waste heat from:

- Industrial Process
- Power Stations

On-site generation:

- Traditional gas or oil fed boilers
- Biomass / biogas
COMBINED HEAT AND POWER

BASIC PRINCIPLE

Traditional power plant

Energy in 100%

Heat losses 70%

Useful electricity 30%

Combined heat & power plant (CHP)

Energy in 100%

Heat losses 15%

Useful electricity 30%

+ Useful heat 55%
COMBINED HEAT AND POWER

HOW IT WORKS

CHP offers the following benefits:

- Produces both heat and electricity on site
- More efficient use of energy - 80-90% efficient
- Cost savings of 15-40% compared to traditional methods (gas boilers and national grid)
- Responsive heat supply – heat can be stored

Not fuel source dependent - powered either using fossil fuels or renewable sources (such as biomass or biogas).
BIOMASS CHP
INTRODUCTION

Biomass district heating schemes work well because:

- **Biomass boilers are often bulkier** than traditional boilers, hence typically located in external plant room, not individual houses

- Require **regular wood chip or pellet deliveries** to only one central plant

- Can be located discreetly on site extremes
With the energy from 1kg of biomass you can:

- heat an iron (1000W) for ca. 10 mins
- run a television (80W) for ca. 1hr 45 mins
- light a lightbulb (60W) for ca. 2 hr 20 mins
ANAEROBIC DIGESTION (AD) CHP

INTRODUCTION

1. Cow manure is heated to produce methane
2. Methane generated sent to CHP unit for electrical generation.
3. Excess heat from CHP fed back into fermenter and used for district heating
4. Solid waste reused as fertiliser
BIOSGAS / ANAEROBIC DIGESTION
POSSIBLE FEEDSTOCKS

Organic substances which can be used in anaerobic digestion systems:

- Animal waste (e.g. cow / pig manure)
- Unused crops (leaves, stalks) & grass cuttings
- Abattoir / slaughterhouse waste
- Food waste
In district heating networks with renewable energy sources (e.g. solar thermal), excess heat is wasted in the summer.
PRE-INSULATED PIPEWORK
OPTIONS FOR PIPE MATERIALS

- Steel pipe
- Polymer pipe with closed cell insulation
- Polymer pipe with open cell insulation
PRE-INSULATED PIPEWORK
STEEL PIPES

Advantages:
- Strong material – resistant to impact damage
- Larger diameter sizes available
- Capable of withstanding higher flow temperatures

Disadvantages:
- Only straight lengths possible
- Joints required every 6-12m
- High installation costs
- Corrosion problems (therefore warning systems are required)

$\lambda \approx 0.027 \text{ W/mK}$
Closed cell insulation:

Advantages:
- Excellent thermal insulation
- No water ingress if outer jacket punctured
- No thermal expansion (self-compensating)
- More flexible compared to steel
- Long coil lengths possible (less joints)

Disadvantages:
- Less flexible compared to open cell

$\lambda = 0.022 \text{ W/mK}$
PRE-INSULATED PIPEWORK
TWO TYPES OF PIPE INSULATION – OPEN CELL

Open cell insulation:

Advantages:
- Greater flexibility
- Simpler jointing / installation (foam easily removed)
- Ideal for confined spaces

Disadvantages:
- Closed cell pipes have improved thermal insulation

$\lambda = 0.043 \, \text{W/mK}$
PRE-INSULATED PIPEWORK

PIPE MAKEUP

Leak detection systems are required, therefore reduced costs.

Steel pipes corrode over time, require additional polymer / galvanised coating.

No leak detection required, therefore reduced costs.

No corrosion in polymer pipes, no additional layers needed.
Cross-linked polyethylene (PE-Xa) has the following benefits:

- Temperature resistant to +95°C
- High chemical resistance
- Oxygen barrier
- Simple jointing process
PRE-INSULATED PIPEWORK
PIPE INSULATION MATERIAL

Polyurethane foam

≤ 0.0216W/mK (Min) required by BS EN 253

Closed cells -> watertight even if outer seal penetrated

Single foam piece

Foamed with Pentane (containing no CFCs or HFCs):
PRE-INSULATED PIPEWORK
PE-Xa COMPRESSION SLEEVES

- Only **two components**: fitting and sleeve
- Ideal for below ground applications
- Can be used in all weather conditions
- Minimal bore reduction
- Totally **secure, permanent fitting**
PRE-INSULATED PIPEWORK

PIPE CONNECTIONS

Advantages of shroud system:

- High insulating properties
- No hot works -> improved health & safety
- Fast and simple installation
- Permanent and reliable connection
PRE-INSULATED PIPEWORK

THERMAL EXPANSION

- Minimal expansion with bonded insulation

- Open cell insulated pipe requires provision for thermal expansion (fixing brackets)

- Pre-insulated pipe only recommended for below ground applications
PRE-INSULATED PIPEWORK
REQUIRED ACCESSORIES FOR POLYMER PIPES

- Shrouds, sealing rings and foam for pre-insulated joints
- End caps (wet and dry versions) for watertight pipe terminations internally
- Wall sealing rings for wall penetrations
- Fittings (tees / reducers / elbows / adapters)
PRE-INSULATED PIPEWORK
INSTALLATION

- Cover 600mm minimum 800mm with traffic loads
- 100mm of 0.8mm grade sand around the pipe
- Pipe positions:
  - Besides each other
  - On top of each other

Warning tape must be used!
DISTRICT HEATING & HEAT NETWORKS

CASE STUDIES

Park 25, Gatwick

- 250 housing development by Bellway Homes

- 840kW wood pellet biomass boiler

- Ring main around site – branches to each individual apartment

- RAUTHERMEX supplied in lengths up to 760m
DISTRICT HEATING & HEAT NETWORKS
CASE STUDIES

East Holme, Dorset

- 16 houses connected to community district heating network
- 25, 32, 40 and 50mm RAUVITHERM DUO pipes used, some in trenches up to 400m long
- 120 tonnes of waste timber on site to be used to feed biomass boiler
District Heating & Heat Networks
Case Studies

Link Housing Association, Stirling

- 200kW wood chip biomass boiler
- 37 houses for University of Stirling student accommodation
Lochaber School, Fort William

- Remote energy centre using a 540kW wood pellet biomass boiler
- 400m of RAUTHERMEX, including 160mm UNO
ANAEROBIC DIGESTION
CASE STUDY

Much Fawley Farm AD plant, Herefordshire

- AD plant fed by slurry, maize & silage
- RAUVITHERM pipework connects hot water from CHP to chicken sheds
- 2,500m of pipework in total (75 UNO & 32 DUO)
ANAEROBIC DIGESTION
CASE STUDY

Alderley Edge AD plant, Cheshire

- Produces heat and electricity from tomato plant leaves and waste tomatoes.
- Plant built by Biotech Services

Used 400m of RAUBIO digester heating pipework
CPD SUMMARY

- Understand the pros and cons of DH networks and how they can be best utilised.

- Use the benefits of on-site generation with CHPs to reduce demand on fossil fuels and increase system efficiencies.

- Understand how anaerobic digestion works and the potential of producing energy from waste (and reducing landfill).

- Selecting appropriate pipe materials for each individual project, based on pros and cons of steel and polymer.

- Designing a well-sized DH system is vital for ensuring highest possible energy efficiencies and low pressure losses.
RENEWABLE ENERGY SOLUTIONS
RELIABILITY FOR GENERATIONS

Ground-air heat exchanger

Low energy windows / curtain walling

District heating pipework

Underfloor heating/cooling

Ground-source probes/collectors

Stormwater management

Rainwater harvesting
THANK YOU FOR YOUR ATTENTION
ANY QUESTIONS?

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