EXISTING BUILDING SERVICES INSTALLATIONS

COMPATIBILITY WITH LOW CARBON DH SCHEMES
MAIN COMPONENTS OF LOW CARBON DH NETWORKS

- Energy Centre
- Low Carbon Technologies
- Connecting Pipework Network
- Back-up Top-up Technologies
- Connected Buildings
MAJOR VISIBLE COSTS OF A LOW CARBON DH SCHEME

Energy Centre

Low Carbon Technologies

Connecting Pipework Network

Civils associated to it
MAJOR OPERATIONAL HIDDEN COSTS OF A LOW CARBON DH SCHEME

Full running hours of LZC technologies (overall efficiency and contribution to network of the LZC)

O&M

EXISTING BUILDINGS SERVICES INSTALLATIONS AND THEIR COMPATIBILITY WITH LOW CARBON DH SCHEMES
04/10/2017
WHAT DRIVES THEIR COST AND PERFORMANCE? => THE NETWORK OPERATING TEMPERATURES AND DELTA T

\[ q_m = \frac{P}{(c_p \Delta T)} \]

- \( q_m \) = mass flow rate (kg/s) (= volume flow rate in litres / second)
- \( P \) = Heat load (kW)
- \( c_p \) = specific heat capacity of water (= 4.18kJ / kgK)

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\[ \Delta T \rightarrow q_m \]

Mean Temperature (MT) concept

MT = (Flow T + Return T) / 2

Flow and/or Return T MT

Flow and/or Return T MT
WHAT DRIVES THEIR COST AND PERFORMANCE? => THE NETWORK OPERATING TEMPERATURES AND DELTA T

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WHAT DRIVES THE OPERATIONAL TEMPERATURES AND THEREFORE THE DELTA T AND THE MEAN TEMPERATURES
EXISTING BUILDINGS COMPATIBILITY WITH LZC NETWORK: WHAT TO LOOK FOR

• Are Heating and Hot water systems wet systems at the connected buildings?

• Has insulation and heat losses been minimised as much as reasonably and economically possible?

• Are the existing secondary Heating and Hot water systems flow temperatures below the intended DH flow temperature. (Network flow temperature shall at least be 5 to 3 degrees higher)

• Are the existing secondary Heating and Hot Water systems return temperatures aligned with the ones recommended by CP1 District Heating code of practice?; is this return temperature around 5 to 3 degrees lower than the intended DH return temperature?; If not, have they been minimised as far as possible?
**RECOMMENDED RETURN TEMPERATURES FOLLOWING CP1 DISTRICT HEATING NETWORK CODE OF PRACTICE**

<table>
<thead>
<tr>
<th>Circuit</th>
<th>Return temperature</th>
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<tbody>
<tr>
<td>Radiators</td>
<td>Max 40</td>
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<tr>
<td>Fan-coil units</td>
<td>Max 40</td>
</tr>
<tr>
<td>Air handling unit</td>
<td>Max 40</td>
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<tr>
<td>Underfloor heating</td>
<td>See Note 1</td>
</tr>
<tr>
<td>Domestic hot water service (DHWS) instantaneous heat exchanger on load</td>
<td>Max 25 °C for 10 °C cold feed temperature</td>
</tr>
<tr>
<td>DHWS cylinder with indirect coil</td>
<td>Max 45 °C when heating up from cold at 10 °C</td>
</tr>
<tr>
<td>DHWS calorifier with external plate heat exchanger</td>
<td>Max 25 °C for 10 °C cold feed temperature</td>
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**ISSUES WITH EXISTING BUILDINGS**

Some existing HTG systems still operates at 82-71 or 80 -60

Fans and hot water cylinders heating coils still generate high returns due to either poor design or excess of flow rate going through them.

Room temperature control is not controlled by low flow thermostatic radiator valves. Volume flow rates and hence return temperatures under part-loads are not optimised across radiators.
Commonly used fixed speed pumps for secondary heating system leading to the existence of multiple by-passes

Use of static balancing valves in heating and hot water systems leading to poor flow rate control in changing demands conditions

Variable speed pumps with poor turn down ratio constantly running again promoting the use of by-pass valves

Poor valve authority of existing 2 port Motorised valves and/or again with poor turn down ratio

RECOMMENDED RETURN TEMPERATURES FOLLOWING CP1 DISTRICT HEATING NETWORK CODE OF PRACTICE
RECOMMENDED RETURN TEMPERATURES FOLLOWING CP1 DISTRICT HEATING NETWORK CODE OF PRACTICE

Existence of Three port diverting valves in some cases raising the return temperature

Again fixed speed pumps on secondary domestic hot water re-circulating systems

Poor balancing of the hot-water return by the use of lockshield ball valves, double regulating valves or commissioning valves
HOW HIGH RETURN TEMPERATURES AFFECT LOW CARBON HEAT NETWORKS

- Lower the contribution of the renewable technologies such as Low temperature Heat pumps, Air Source Heat pumps and Solar
- Increase the size of pipework therefore capital cost of the network
- Limit the use of flexible pipework or reduce its life span considerably
- Increase size of thermal store back at the energy centre
- Increase the heat losses at the network
- Increase pumping cost as major flow rates will be needed
REDDUCING FLOW AND RETURN TEMPERATURES AT EXISTING HEATING SYSTEMS

**Htg system Temperatures (Radiators )**

Most buildings designed and built prior to 1990 are likely to have employed system temperatures of 82°C flow and 71°C return. Less older buildings were most likely designed with system temperatures of 80°C flow and 60°C return.

For example, a building with an internal heating system designed for 82°C/71°C, could operate with 80°C/50°C if heat losses from the building could be reduced by 26%.

This table is only a valid comparison to old 82°C/71°C existing systems.

To compare against not so old 80°C/60°C system another table shall be produced based on how the change in mean temperature across the more modern radiators affect their outputs.

<table>
<thead>
<tr>
<th>Flow Temperature</th>
<th>85</th>
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REReducing Flow and Return Temperatures at Existing Heating Systems

Effect of changes in heating coil output with differing flow and return temperatures

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Htg system Temperatures (Coils)

Same as radiator

Facts
Many heating systems have been designed to accommodate a proportion of ‘oversizing’ to heat emitters.

In recent years the majority of the existing buildings have been retrofit with better insulation

Conclusion
In many instances this means that the reduction in heat emitter output through reducing rads operating temperatures might not impact on the ability to maintain the building at the desired temperature

EXISTING BUILDINGS SERVICES INSTALLATIONS AND THEIR COMPATIBILITY WITH LOW CARBON DH SCHEMES
04/10/2017
BALANCING MORE EFFICIENTLY THE HEATING SYSTEM TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES

Make sure TRVs are installed in all radiators (low flow, integrated DPV)

Use of variable speed pumps (VSP).
Increase the number of VSPs to minimise minimum system flow at part load

Control the VSP/s using differential pressure control transmitters located at the index leg or at certain levels of the raisers in high raise buildings
BALANCING MORE EFFICIENTLY THE HEATING SYSTEM TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES
Balance the flow at the different radiator circuits with differential pressure control valves.

Remove all by-passes in the system.

Protect the VSP with a PICV across the pump when the minimum flow of the pump is reached and make sure the pump is switched off after running at minimum flow for a time.
BALANCING MORE EFFICIENTLY THE HEATING SYSTEM TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES

Replace existing radiators with higher efficient radiators. This radiators will need less secondary mean temperature to achieve the same output than the existing ones at higher mean temperature.

Replace radiator for underfloor heating to minimise mean temperature and therefore achieve low return temperature.
REDUCING THE HOT WATER SERVICES SYSTEM RETURN TEMPERATURES AND/OR OPTIMISE IT TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES WHEN CONNECTED TO DH

COMMON INDIRECT HOT WATER SYSTEMS

COMMON DIRECT HOT WATER SYSTEMS
Promote direct DHW to apartments or households by the use of local plate heat exchangers / HIUs instead of hot water cylinders. Its proximity to the tabs will mean no need of re-circulation and legionella risk.

If the HIU is combined with the heating make sure the selected HIUs deliver low WART
REDUCING THE HOT WATER SERVICES SYSTEM RETURN TEMPERATURES AND/OR OPTIMISE IT TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES

IF CYLINDER IS TO REMAIN

Replace existing cylinder + coil for a higher efficient low return temperature cylinder that uses heat exchanger to heat up the water

Promote the use of pre-heat plate to further reduce return temperatures
REDUCING THE HOT WATER SERVICES SYSTEM RETURN TEMPERATURES AND/OR OPTIMISE IT TO MINIMISE HIGH SYSTEM RETURN TEMPERATURES

IF HOT WATER RE-CIRCULATION SYSTEM IS TO REMAIN

Replace lockshield, double regulating or commissioning valves for safe and efficient temperature balancing valves

Temperature controlled VSP

Check actual maintained return temperature and reduce it if possible still making sure there is no risk of legionella
DH BUILDING SUBSTATIONS TYPES

TYPES OF TYPICAL SUBSTATIONS CONNECTIONS TO BUILDINGS

Single plate heat exchanger; 1no. single stage plate.

2 Parallel plate heat exchangers; 2no. single stage plates.

2 parallel plate heat exchangers; 1no. Single stage plate for Htg and 1no. 2 stage plate for hot water.

EXISTING BUILDINGS SERVICES INSTALLATIONS AND THEIR COMPATIBILITY WITH LOW CARBON
DH SCHEMES
04/10/2017
PUTTING SOME NUMBERS TOGETHER

50 Buildings; 100kW each; Peak 5MW

£10k per building to reduce T; £500k spent

40% of Peak LZC Tech. 2MW HP

High T HP; 300£/kW; £600k

Low T HP; 100£/kW; £100k

£500k Saved already

Pipe Reduction saving; 3.5km; £100k saved

Reduction in Heat Losses a year; 6k/y; £240k saved

Reducing Pumping; 2k/Year; £80k

Plantroom space, Thermal Store Size......
SUMMARY

DH F&R temperatures is a key parameter to the design and operation of a DH network. It is predominantly determined by the secondary heating hot water systems of the connected buildings.

Existing secondary heating and hot water systems shall be modified and re-balanced to achieve or get closer to the CP1 recommended F&R temperatures.

For heating system upgrades underfloor heating and low temperature radiators shall be used were possible.

Secondary heating and hot water system shall be properly balanced with the use of VSP, PICV, DPCV, temperature controlled balancing valves.

Fixed speed pumps, three port diverting valves, bypass and static balancing valves shall be avoided.

Hot water storage and hot water recirculation system shall be avoided where possible.

If recirculated DHW system is a must 2 stage plates are the preferred option.

Re-circulated DHWS variable speed pump and dynamic balancing valves shall be temperature controlled.

Heat exchangers should be designed for a maximum temperature drop of 3°C between network flow and building flow and between network return and building return.
THANK YOU