CIBSE CPD – Heat Network design considerations

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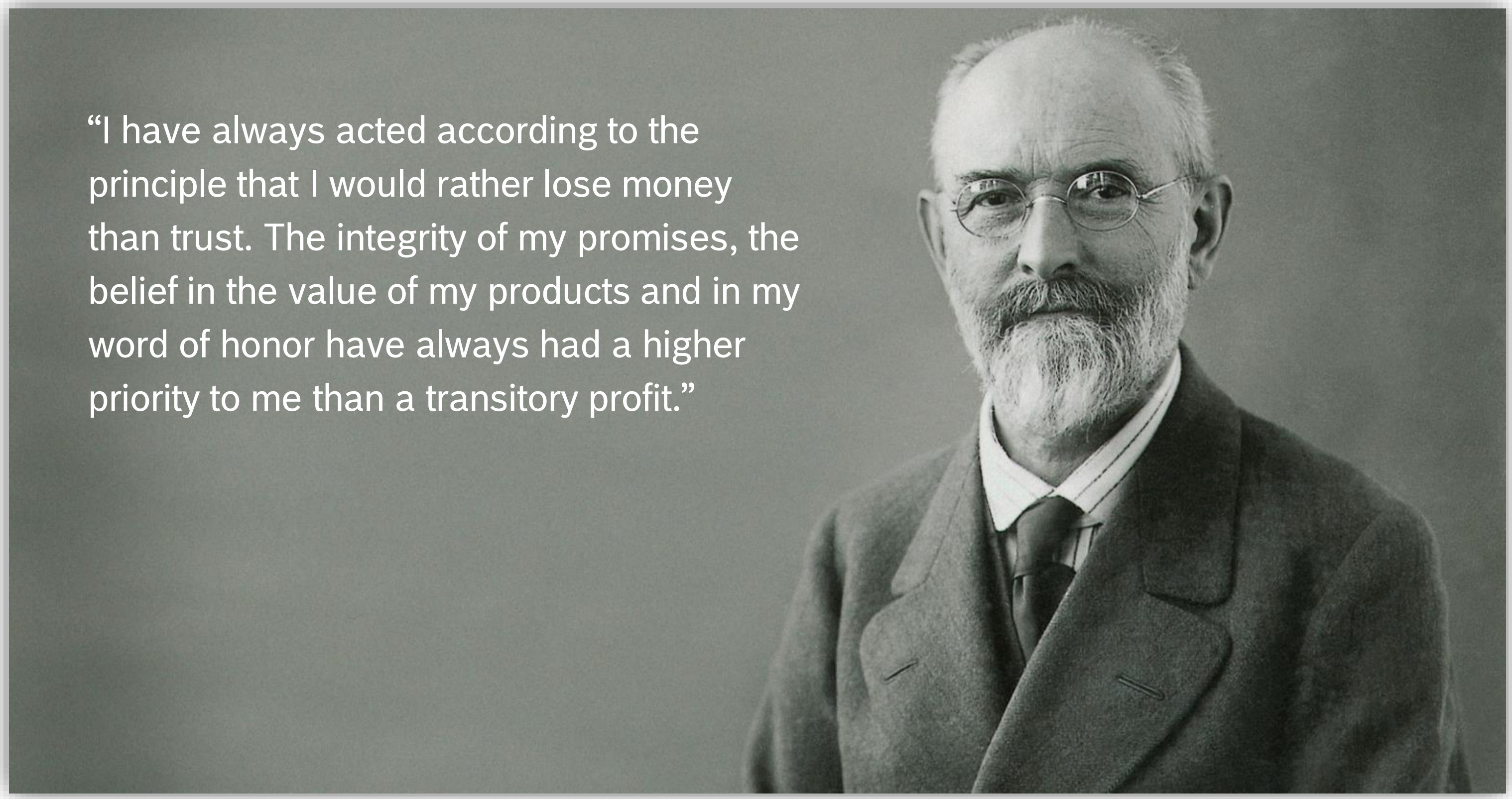

"I have always acted according to the principle that I would rather lose money than trust. The integrity of my promises, the belief in the value of my products and in my word of honor have always had a higher priority to me than a transitory profit."

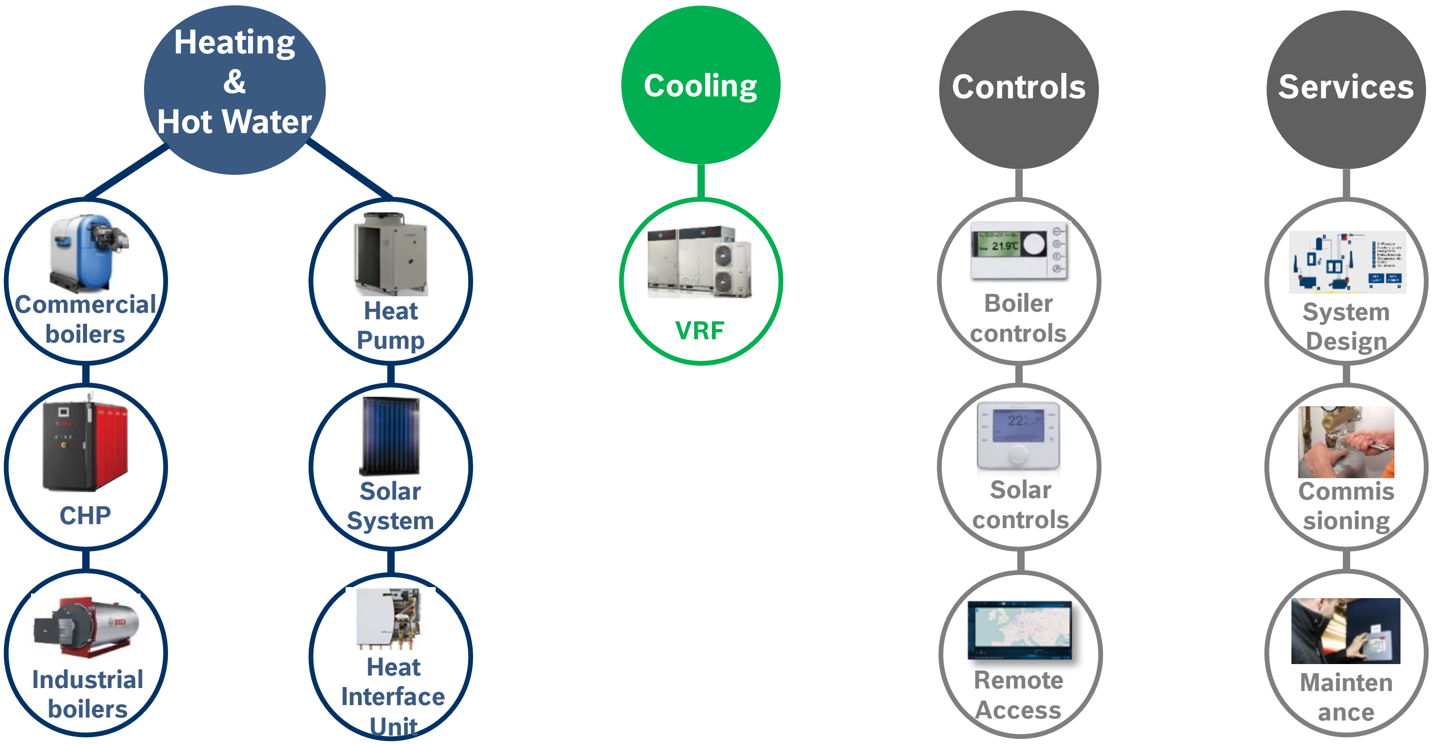
The Robert Bosch Foundation

- ➔ Established in 1964
- ➔ Supports solely charitable purposes
- ➔ €1 Billion Euros donated since 1964 when it was founded
- ➔ 92 % of the company's capital stock is held by the foundation
- ➔ Total project grants in 2014 were over € 56 million
- ➔ Areas supported: Science and research, health and humanitarian aid, international relations, education and society, society and culture

Example of activities

- ➔ Youthbridge - a charitable initiative of the British-German Association: partnership with schools
- ➔ Bosch Technology Horizons Award - a nation-wide writing competition for young people about engineering topics

Product portfolio



Contents

- Introduction to Heat Networks
- Calculating Flow Rates and Selecting Pipe Sizes
- Calculating Buffer Size and Heating Plant
- Low Carbon and Renewable Heat Sizing
- Refine The Design – Hints & Tips

Heat Network Design

Heat Networks offer potential for energy and CO_2 savings. But they need close attention to design, installation and operation.

Poorly performing Heat networks are usually traced back to poor design, installation and commissioning being “flawed from the start”.

It results in heat loss, over heating of common areas, poor control and inefficient heat production.

Heat networks are a natural monopoly, meaning customers need protection.

General guidance for the approach to heat network projects can be found in CIBSE CP1.

It sets out the stages of a project life cycle

Gives a general overview of the technical stages

It highlights some of the potential pitfalls

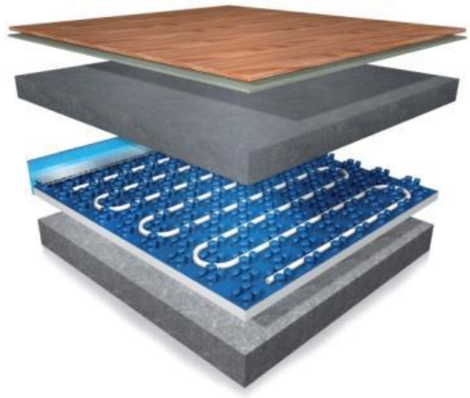
It doesn't give detailed design methodology

Key steps for the designer

- Know the proposed scheme and set sensible requirements for DHW and heating
- Calculate the flow rates using a recognised diversity standard
- Calculate the thermal store to meet peak diversified DHW demand
- Calculate the heating plant
- Select plant based around operational efficiency and whole life costs
- Give clear design intent to ensure the heat network is built to operate efficiently and reliably

Secondary heating system

- Calculate heat losses as normal
- Optimise for low temperatures if possible
- CP1 guidance is for radiator systems to operate at 70/40
- Observe the Part L requirements (Domestic heating compliance guide – communal heating) for return temperatures – radiators below 50°C return.
- Consider pre-set TRV’s

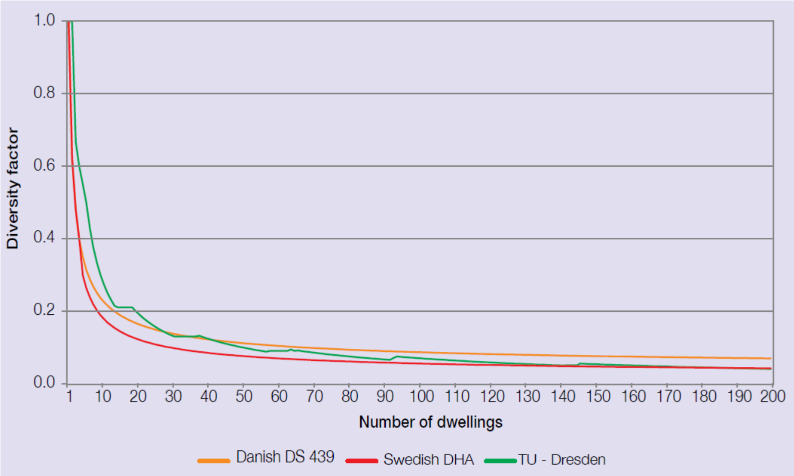


DHW requirements

- Determine the DHW flow rate and temperature required to give the specified comfort level
- Lower temperatures give advantages to heat network efficiency
- HSE ACOP L8 gives guidance for minimum 50°C when using instantaneous water heating
- Consider position of HIU to reduce dead legs
- Summer bypasses reduce any delay in DHW delivery
- Be realistic about the requirements

DHW requirements

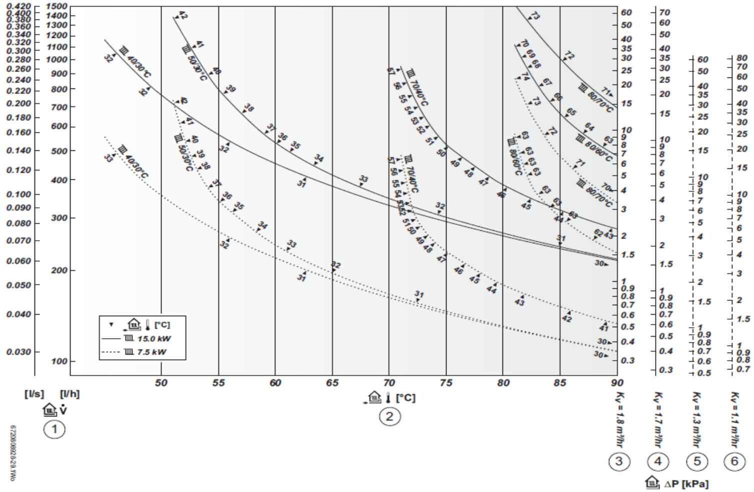
- CP1 guides to use the Danish DS439 standard to apply diversity for DHW draw off
- Apply the diversity factor to each section of the network

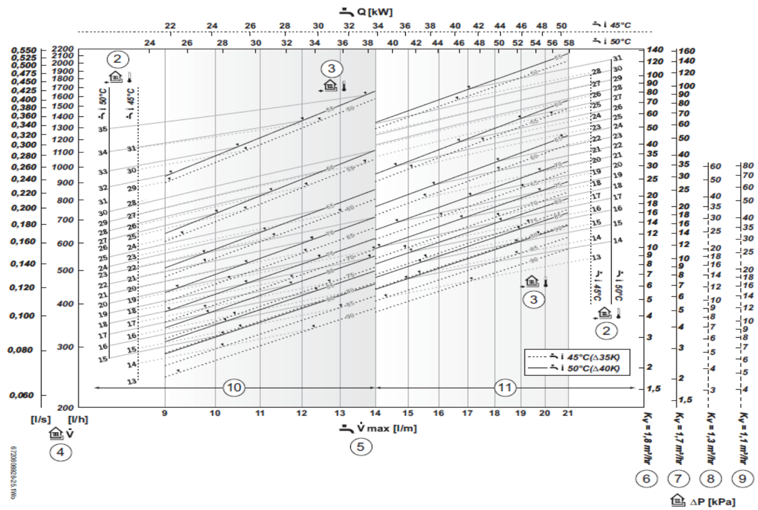


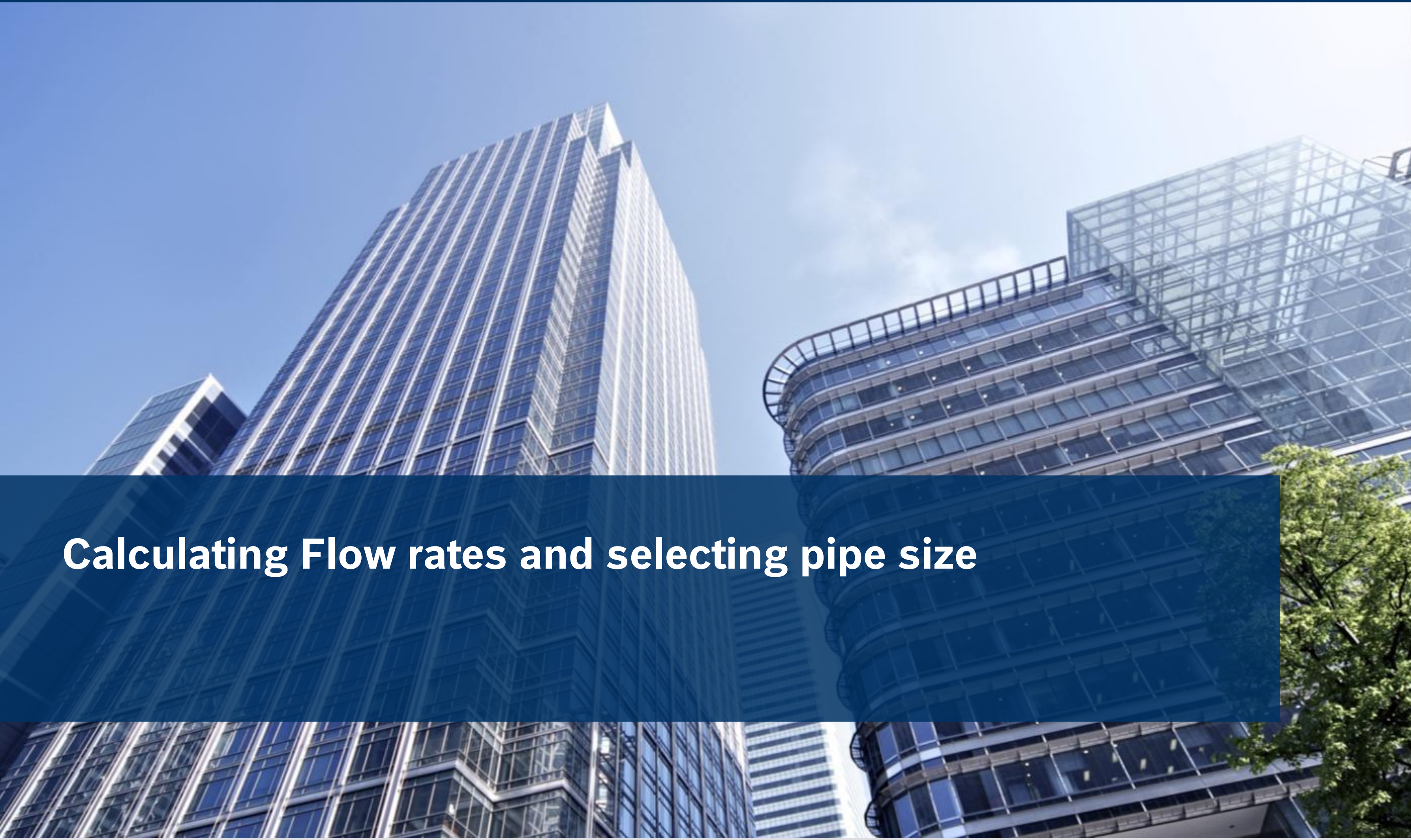
Preparing to start the design

Obtain data from the chosen HIU performance.

- Return temperature in DHW mode
- Return temperature in Heating mode at the chosen operating temperature.
- kW output to produce DHW at the chosen flow rate







Calculating Flow rates and selecting pipe size

Heat Network Design

Design the network – explore pipe work runs

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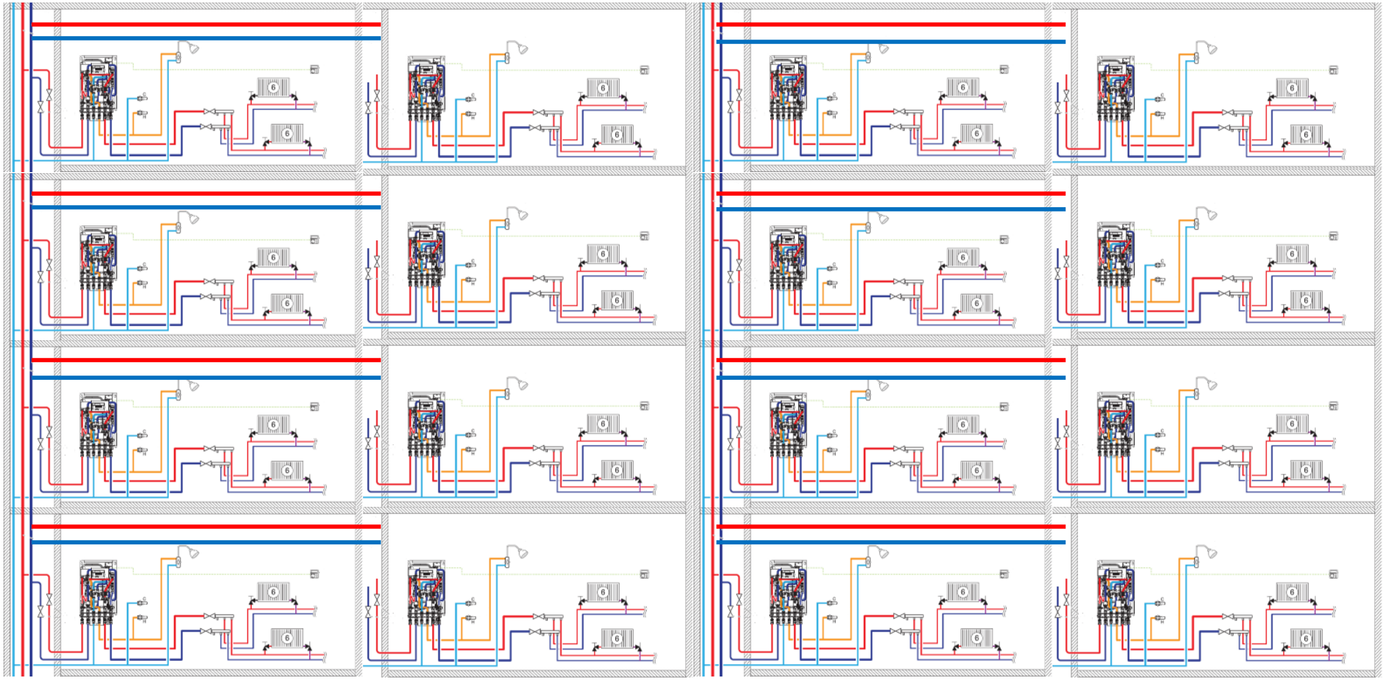
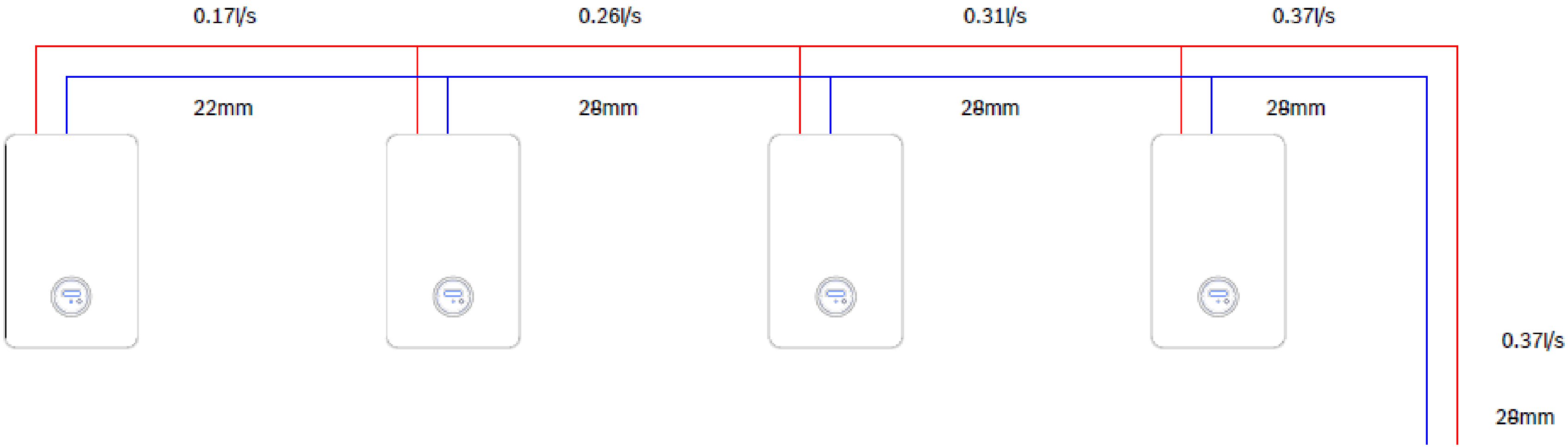
Heat Network Design



Minimise lateral runs as these lead to greater heat losses
Bear in mind potential for over heating common areas

Work out each section flow rate for each section, based on the number of HIU fed from that section

$$Q_{T(section)} = (F \bullet (kW_{DHW} / 4.2 \bullet \Delta T_{DHDHW})) + (kW_{HTG} / 4.2 \bullet \Delta T_{DHHTG})$$



Pipe sizing start point 250Pa/m max, but iterative process required to look at least life cycle cost (CP1 3.6)

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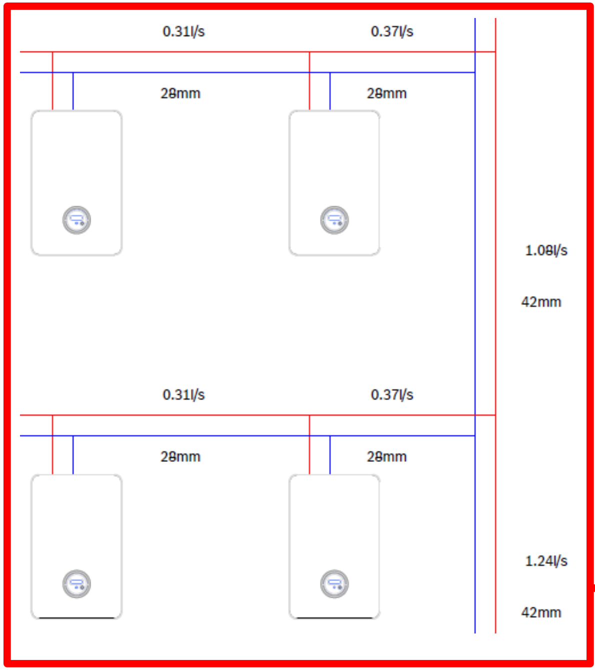
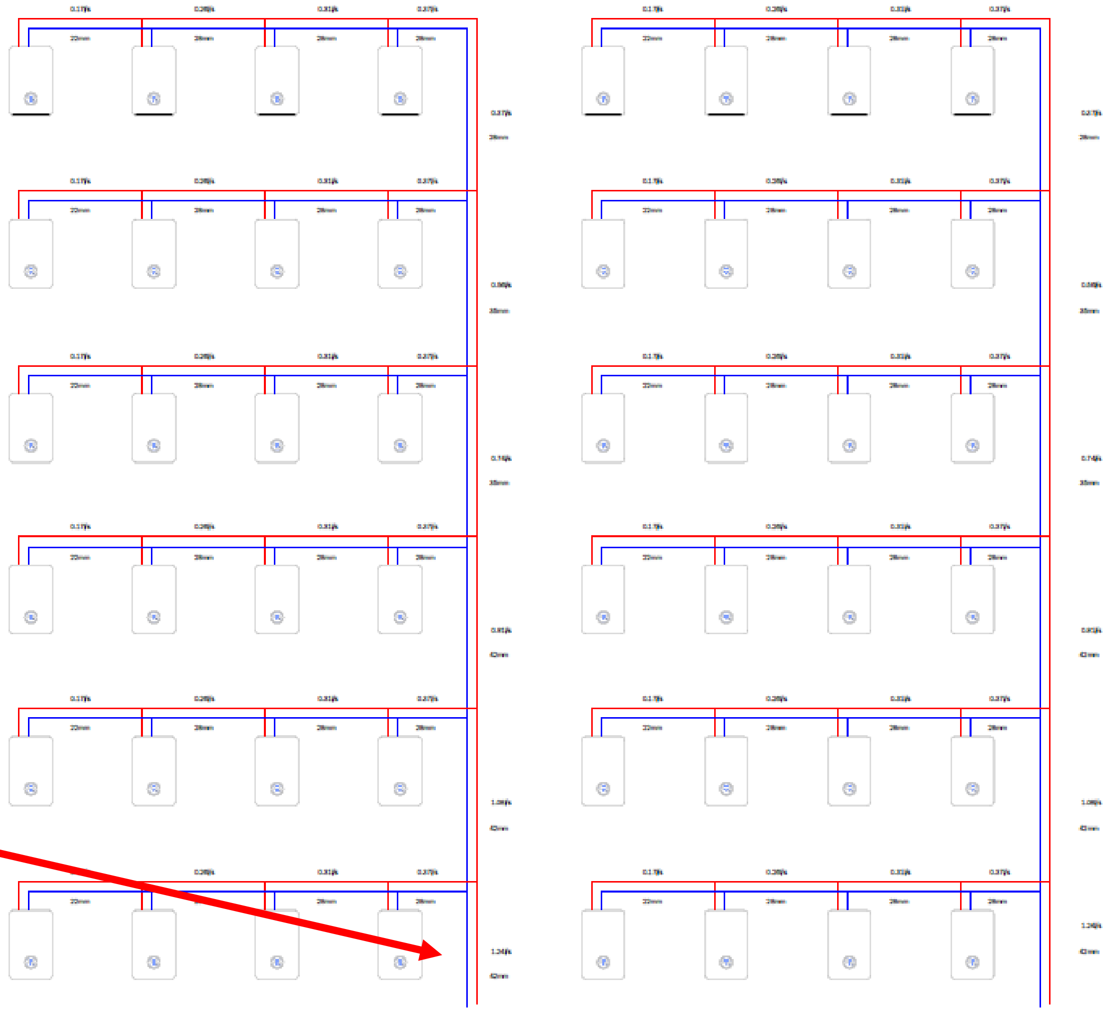
Heat Network Design

Work back to calculate the flow rates for the risers





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Calculating Buffer size and heating plant

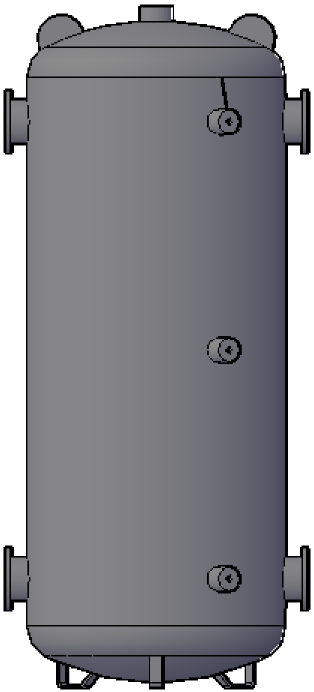
Energy centre – buffer vessel requirement

Sized to take 10 minutes of the peak DHW demand
(based on 2/3 of the buffer capacity being available)

$$V_B = 900 \bullet F \bullet Q_{DHW}$$

Project example

900 • 0.1136 • 7.81l/s = 799 litres



Heat generators – peak sizing

$$kW_{Boilers} = (\text{number of HIU} \cdot kW_{HTG}) + (V_B \cdot 4.2 \cdot \Delta T_{DHDHW})/3600$$

Project example

$$kW_{Boilers} = (48 \cdot 3.5kW) + (799 \cdot 4.2 \cdot 50.3)/3600$$

$$= 215kW$$

- This is minimum size to cope with demand
- Redundancy has to be considered

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Heat Network Design

Renewable and low carbon heat source sizing principles

Renewable heat sources

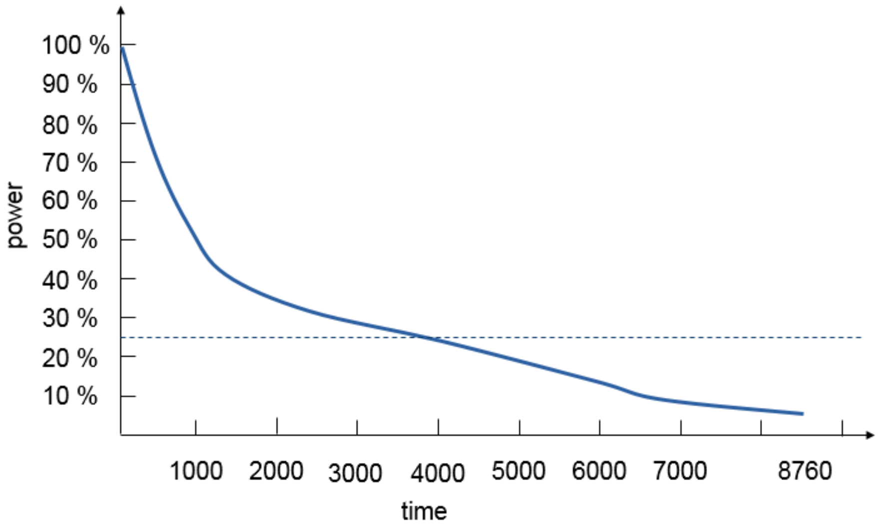
A key driver for Heat Networks is their ability to take heat from any source. Their scale lends itself to renewable technologies or waste heat

Heat sources such as solar thermal, heat pumps and CHP are common.

Low return temperatures suit renewable technologies

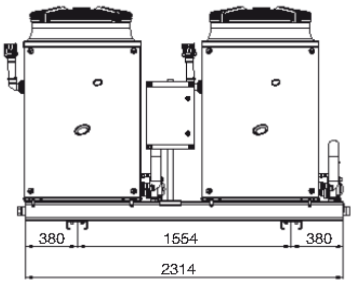
Sizing of the renewable heat source

Take into account that there are significant periods of the year where the demand will be below 25% of the peak



Balance the capital cost against the benefit.

Around 40% of the peak can be optimal



Refine the design – hints and tips

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Variable flow pumps and differential pressure control

- Helps to maintain return temperatures
- Can cut pump energy by up to 80% (BSRIA)
- Helps to maintain differential pressure control

When selecting the pump make sure it operates efficiently at the 10% - 25% range since a great deal of the time will be spent operating in this range.

Differential pressure feedback to pump at extremities of network

Temperature controlled bypasses only – **no fixed bypasses**

Differential Pressure control

- Design into the network from the start
- Adopt recognised methods
- Commission correctly

Constant pressure controlled pumps

DPCV in each HIU

Effective flow regulation

Insulation requirements

- Network losses should not exceed 15% of annual heat consumption
- Insulation to BS5422 may not be appropriate for 24/7 operation
- Insulation should be continuous and close jointed
- All valves, fittings, flanges and pumps should be insulated
- Pipework right up to the HIU should be insulated
- Focus on branch ends – experience shows these are problem areas
- HIU should be insulated

For new build, even greater attention is needed to avoid over heating

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