Challenging Domestic Hot Water Temperatures

Steve Vaughan - **AECOM**

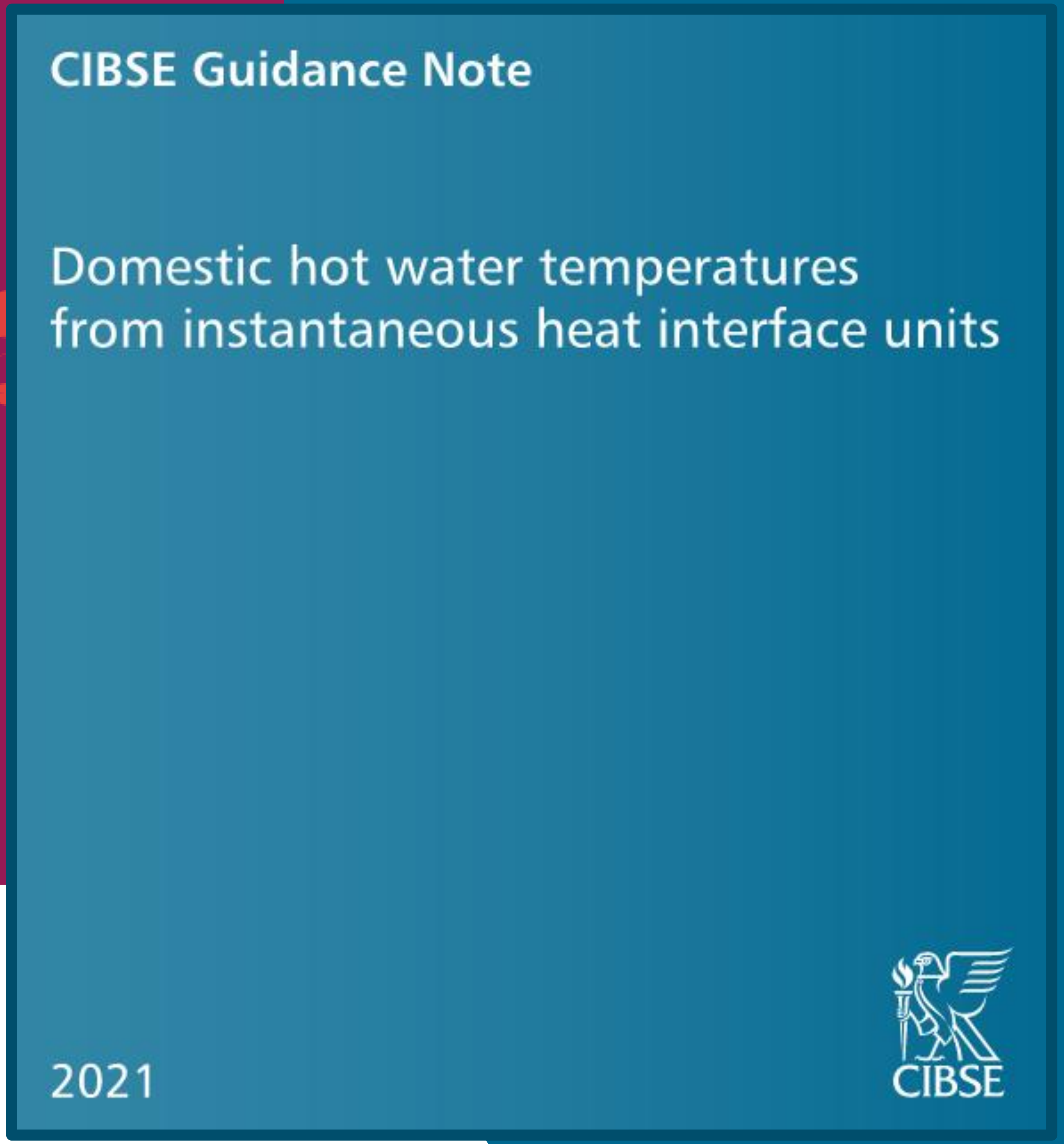
Agenda

Overview:

- ➢ Domestic hot water and district heating system performance
- ➢ Why hot water temperature matters
- ➢ Legionnaires disease

Documents summarised:

- ➢ CIBSE CP1 Heat Networks: 2020
- ➢ CIBSE Guidance Note 2021: DHW Temperatures from Instantaneous HIU's



Be aware:

- Relates only to Residential Applications
- Instantaneous DHW delivery
- Low water content DHW systems
- The impact on Public Health Engineering Designs

What is the biggest challenge of lowering domestic hot water temperature?

Introduction

Discussion Panel Members:

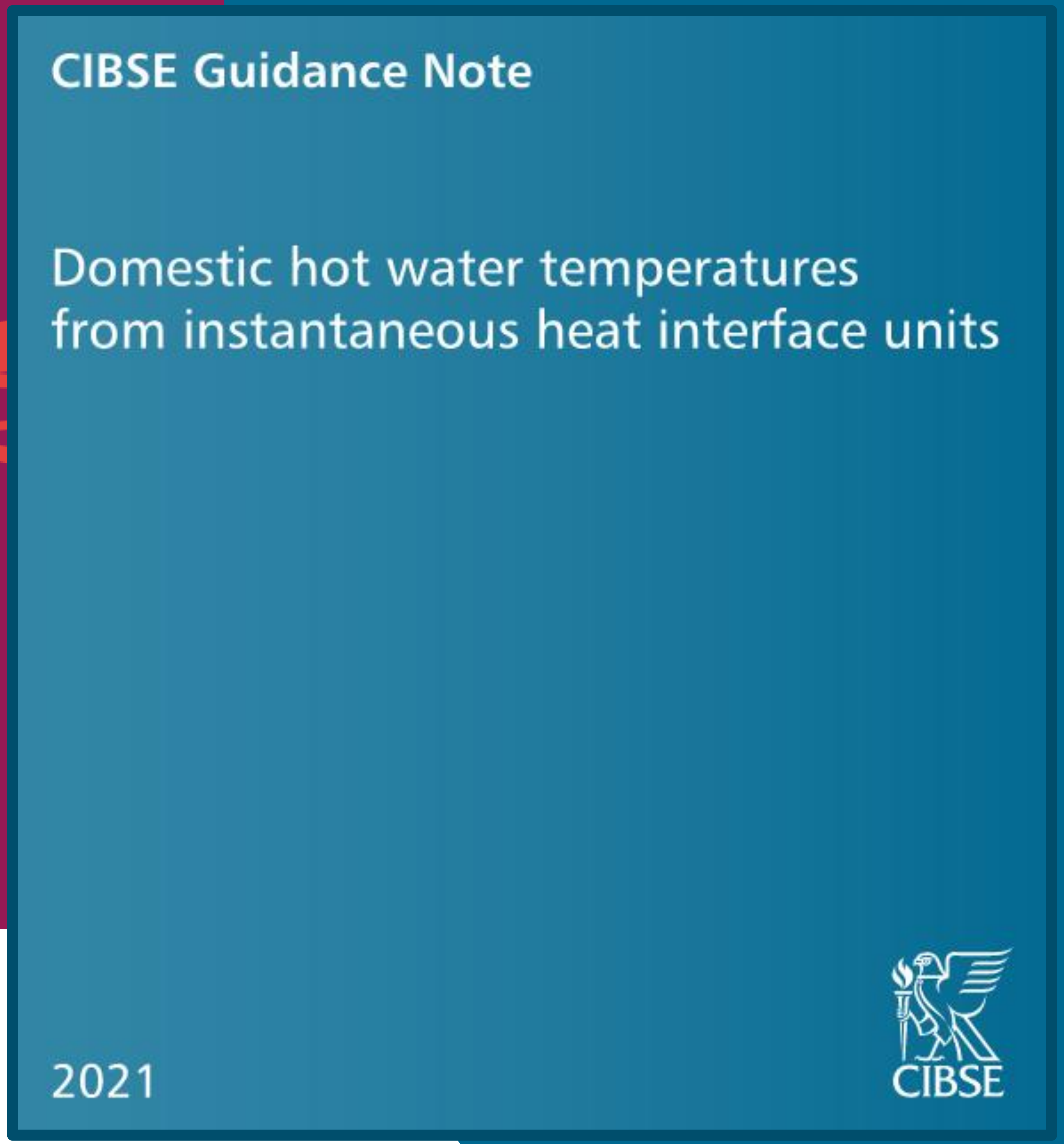
Malcolm Atherton, Water Consultants Ltd
Consultant *Public Health Engineer and Legionella Risk Assessor*

Rob Boyer, AECOM
Sustainability Consultant and Net Zero Energy Solutions Expert

David Corner, Oventrop
Heat Interface Unit Expert

Gareth Jones, Fairheat
Heat Network Expert

Kevin Ray, BEAMA
Thermostatic Mixing Valve Expert



Considerations

Domestic Hot Water and System Performance:

Rob Boyer, AECOM

Sustainability Consultant and

Net Zero Energy Solutions Expert

Why Hot Water Temperature Matters:

Gareth Jones, Fairheat

Heat Network Expert

Considering Legionella:

Malcolm Atherton, Water Consultants Ltd

Consultant *Public Health Engineer and*

Legionella Risk Assessor

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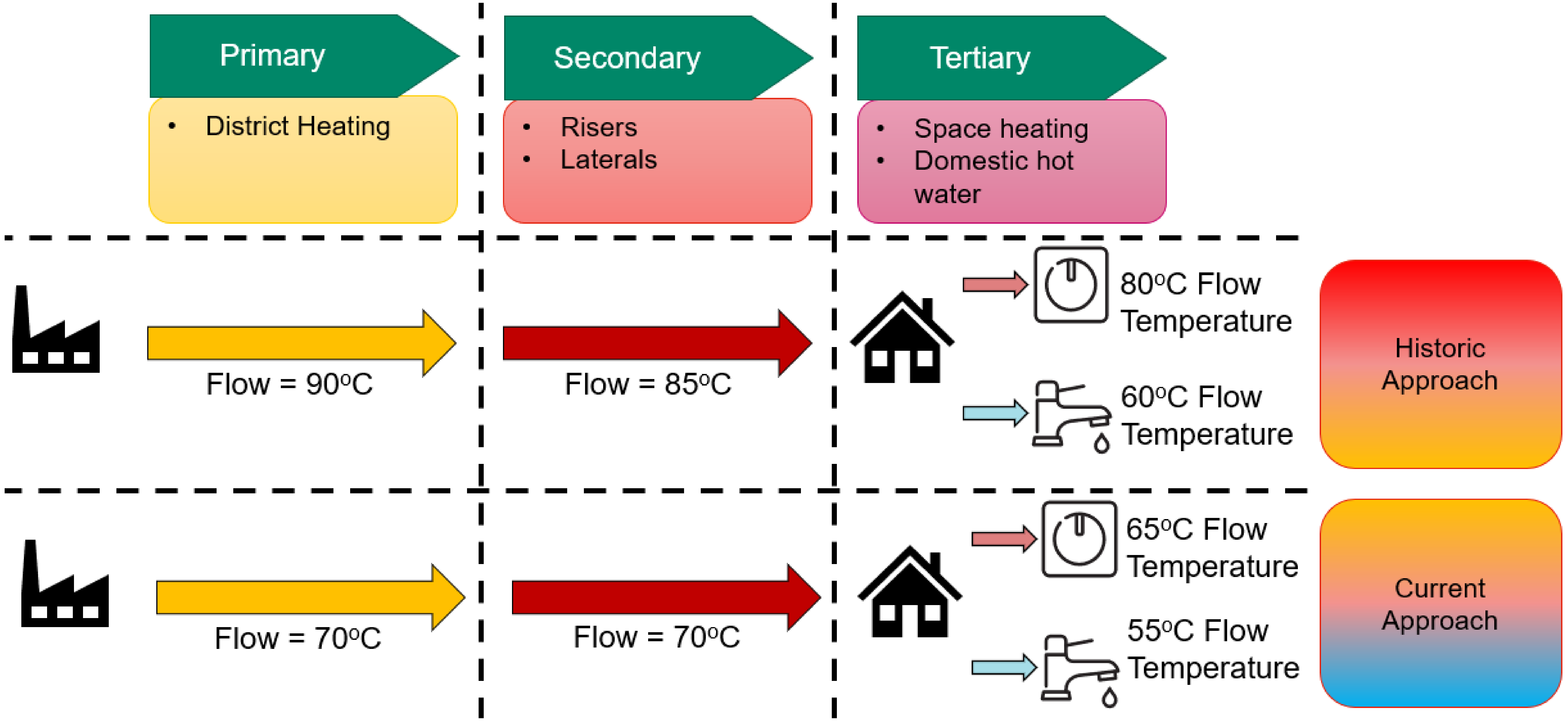
Domestic Hot Water and System Performance

The next hurdle of system performance in heating systems

Rob Boyer – AECOM

Domestic Hot Water and System Performance

Ongoing Change in Thermal Limitation



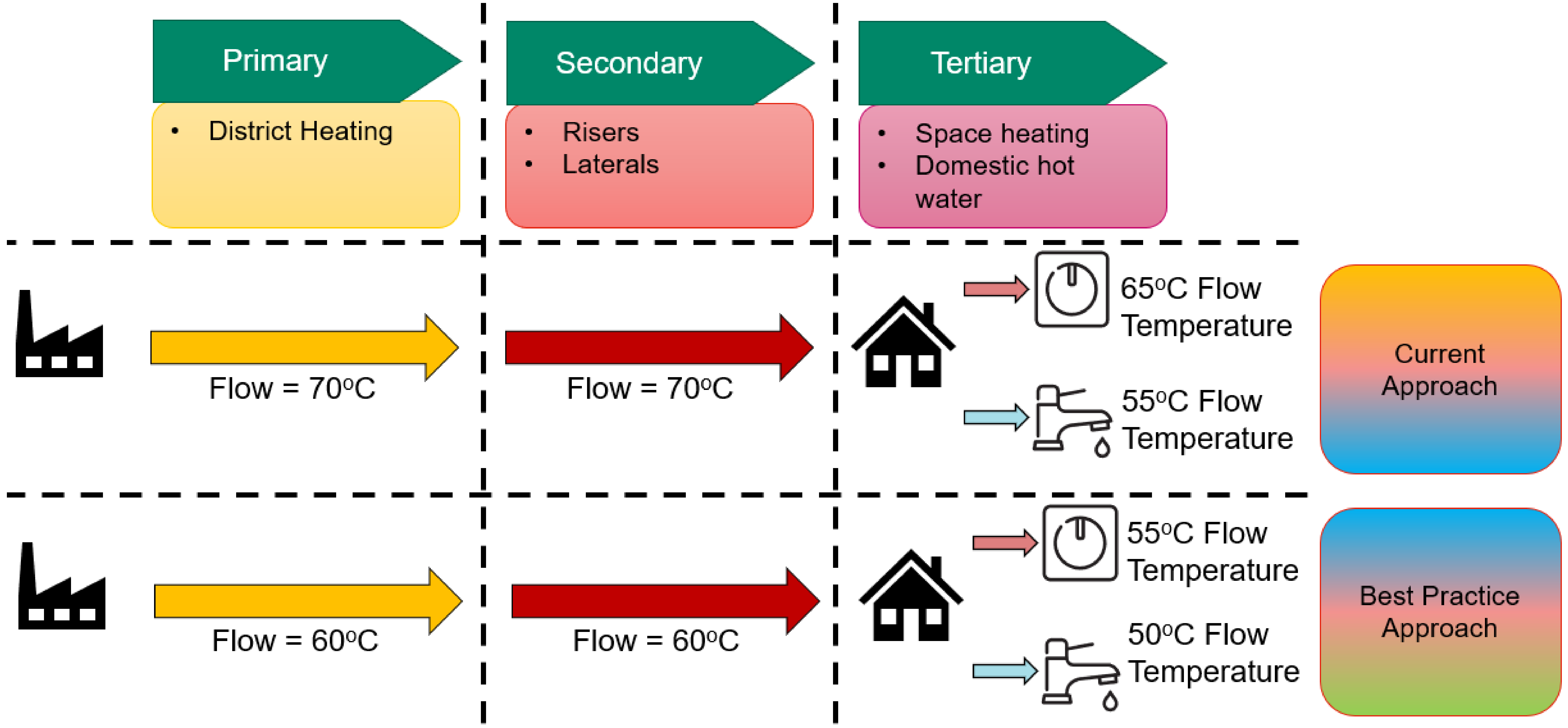
Domestic Hot Water and System Performance

Change in Thermal Limitation

	Historic	Common	Comment on Approach
Temperature	Flow – 90°C Return – 70°C	Flow – 70°C Return – 40°C	Radiator design and instant DHW
Diversified Load per Dwelling	>4.0 kW	<2.5 kW	Correct application of diversity standards and use of operational data
Insulation thickness	Standard	Improved	Increased thicknesses
Secondary Loss	1,733 kWh/unit (DLF = 2.0 or 50%)	876 kWh/unit (DLF = 1.45 or 31%)	Potentially £57 saving and carbon performance
DHW Loss	2.0 kWh/day DHW @ 60°C	1.0 kWh/day DHW @ 55°C	Potentially £30 saving and carbon performance

Domestic Hot Water and System Performance

Ongoing Change in Thermal Limitation



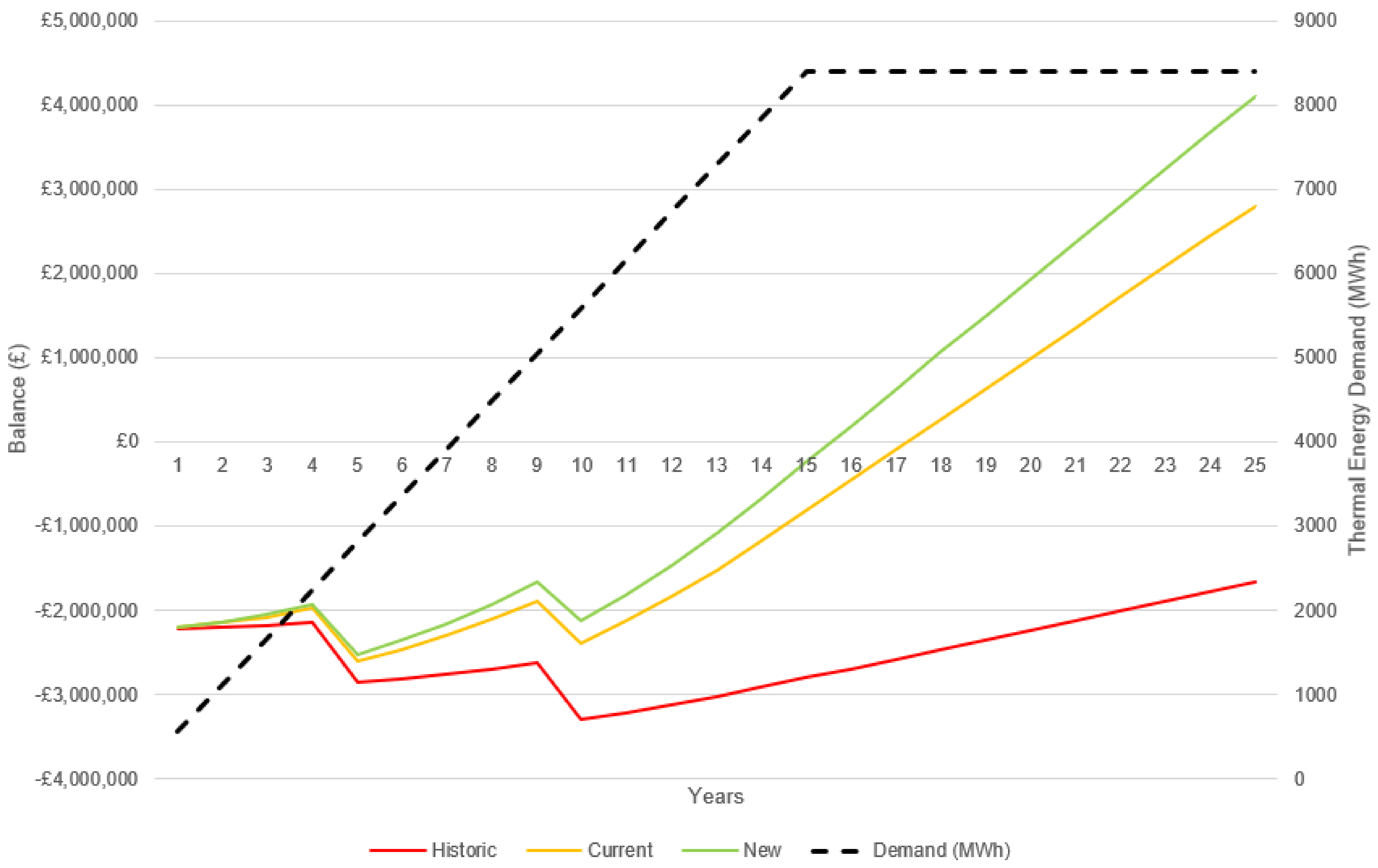
Domestic Hot Water and System Performance

Ongoing Change in Thermal Limitation

	Common	Best Practice	Comment on Approach
Temperature	Flow – 70°C Return – 40°C	Flow – 60°C Return – 33°C	Underfloor heating
Diversified Load per Dwelling	<2.5 kW	<2.5 kW	Correct application of diversity standards and use of operational data
Insulation thickness	Improved	Improved	Reduced thickness due to lower temperatures
Secondary Losses	876 kWh/unit (DLF = 1.45 or 25%)	550 kWh/unit (DLF = 1.24 or 20%)	Potentially £30 saving and carbon performance
DHW Loss	1.0 kWh/day DHW @ 55°C	0.7 kWh/day DHW @ 50°C	Potentially £9 saving and carbon performance

Domestic Hot Water and System Performance

Commercial Impact



Why Hot Water Temperature Matters

The benefits of lower hot water temperatures

Gareth Jones – Fairheat

Benefits of lower DHW temperatures

- Facilitates transition to heat pumps on heat networks – improved SCOP = reduced £/kWh cost of heat
- Reduced network losses = reduced £/kWh cost of heat
- Reduced risk of scalding

DHW the limiting factor on operating temps

- UFH becoming ubiquitous on new build developments = typically max 45°C
- As a result, DHW temperatures are now typically the limiting factor on HN flow temperatures
- 5°C has a major impact in the context of heat pumps and heat network efficiency

A few degrees matter for heat pumps

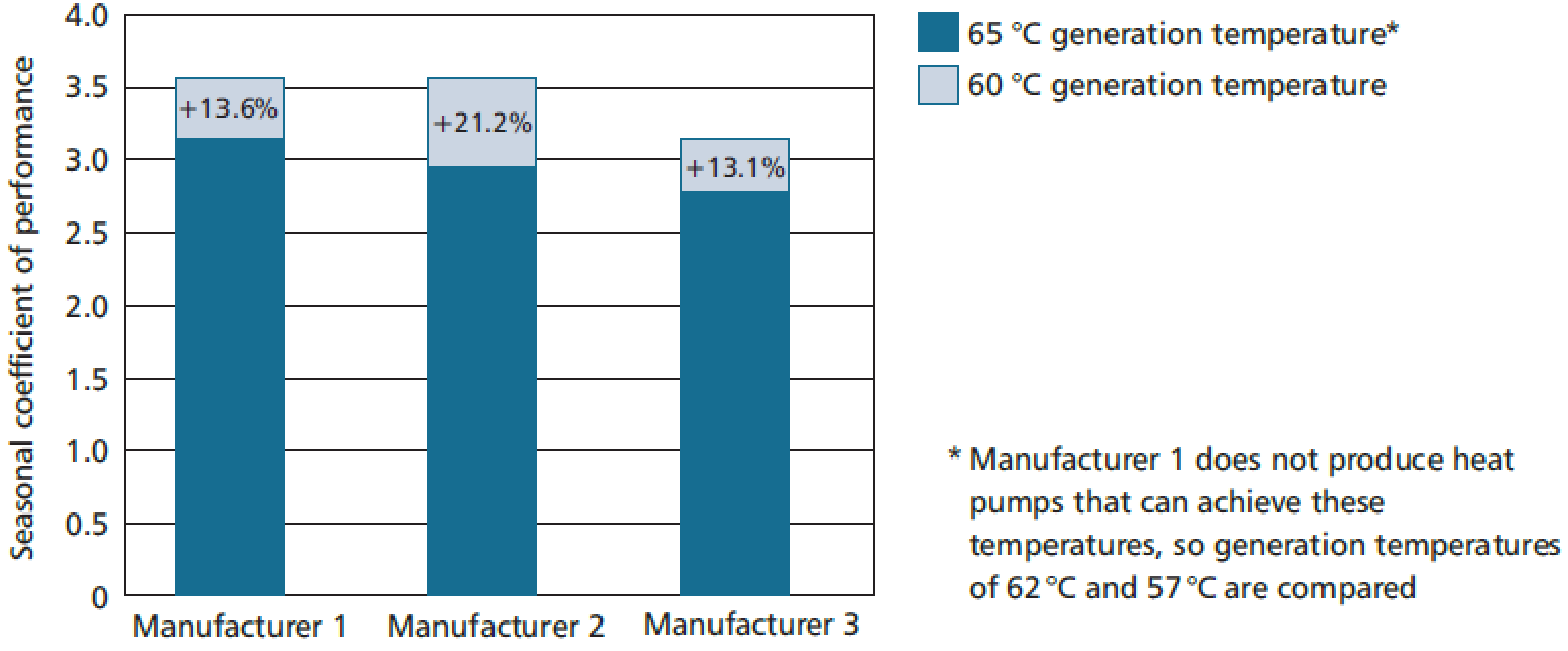
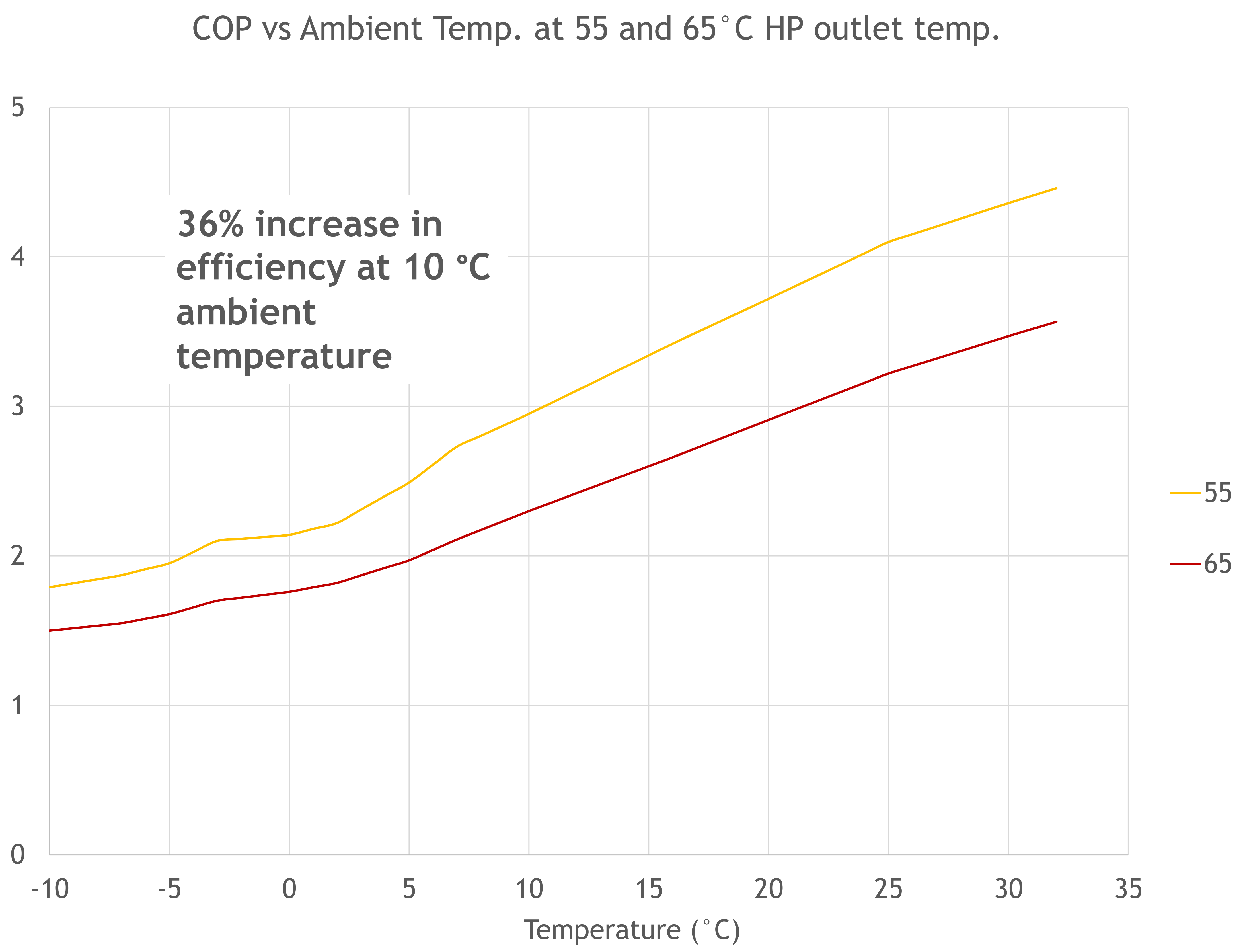


Figure 5 Increase in SCOP with decrease in generation temperature



…and for heat network losses

Table 6 Comparative performance of design approaches

	Typical practice	Recommended practice
HIU generation temperature	55 °C	50 °C
Heat network flow temperature	65 °C	60 °C
Annual heat loss per dwelling	876 kW·h	774 kW·h [–11%]

Basis of table data: annual average internal temperature: 22 °C.

5°C also critical when it comes to scalding

Table 2 Type of scalding burn injury based on time of exposure (Dansk Standard, 2009)

	Time of exposure in minutes and seconds							
Temperature	45 °C	50 °C	55 °C	60 °C	65 °C	70 °C	75 °C	80 °C
Type of burn								
Adult								
3rd degree	>60 min (e)	300 s	28 s	5.4 s	2.0 s	1.0 s	0.7 s	0.6 s (e)
2nd degree	>60 min (e)	165 s	15 s	2.8 s	1.0 s	0.5 s	0.36 s	0.3 s (e)
Child								
3rd degree	50 min (e)	105 s	8 s	1.5 s	0.52 s	0.27 s	0.18 s	0.1 s (e)
2nd degree	30 min (e)	45 s	3.2 s	0.7 s	0.27 s	0.14 s	<0.1 s	< 0.1 s (e)

(e) = estimate

- Effectively a 10 fold increase in risk moving from 50°C to 55°C
- 755 people treated in hospital for scalding from hot water taps during the year 2017-18

Low DHW temps de facto practice in UK

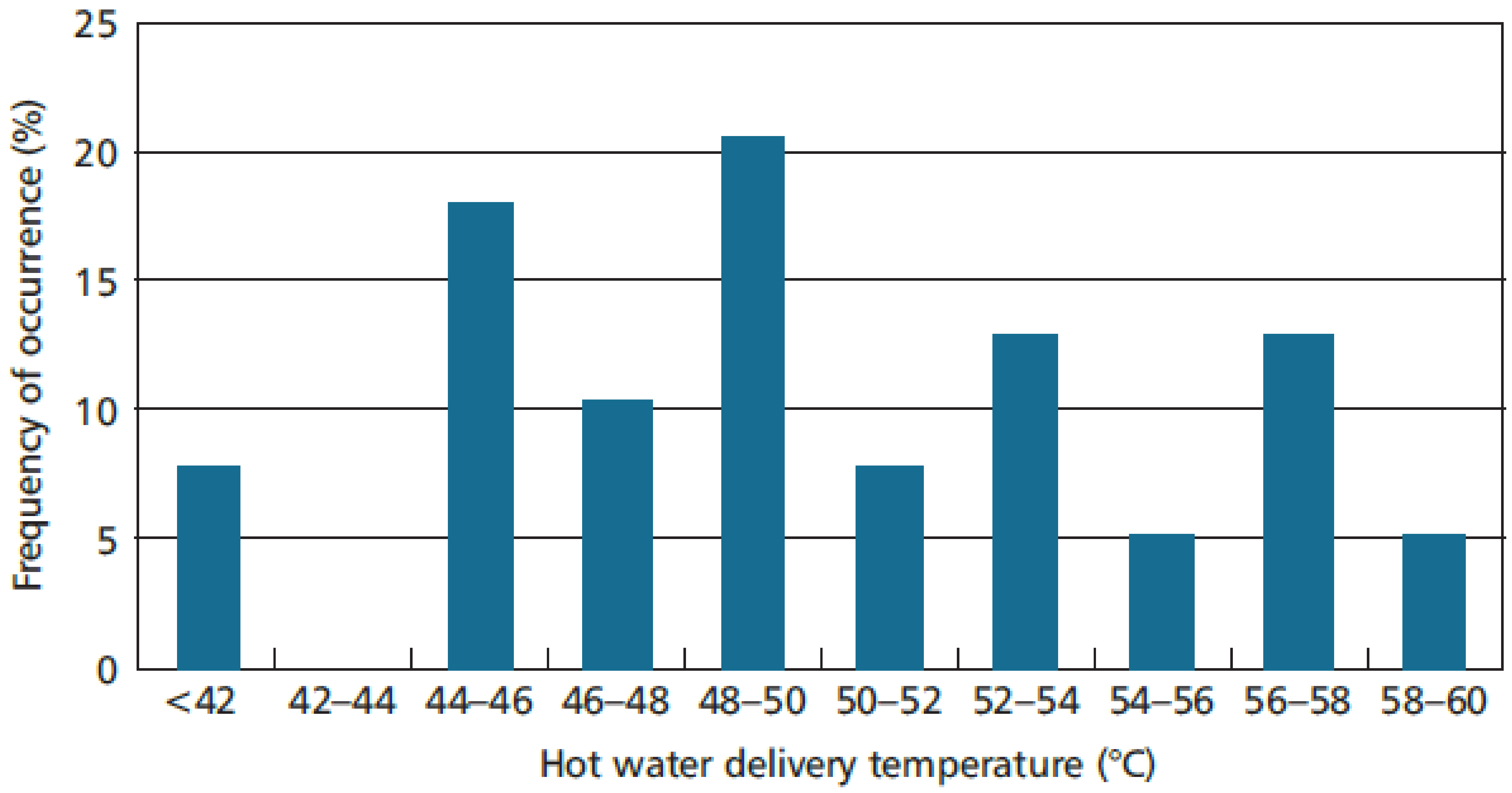


Figure 3 Frequency of domestic hot water delivery temperatures for combi boilers (source: Energy Saving Trust, 2008)

<50% in study at or below 50°C

13 million combi boilers in the UK (2011)

532 confirmed cases of Legionnaires' disease in 2018

- 35% travel
- Domestic cases predominantly from cooling towers and spa pools

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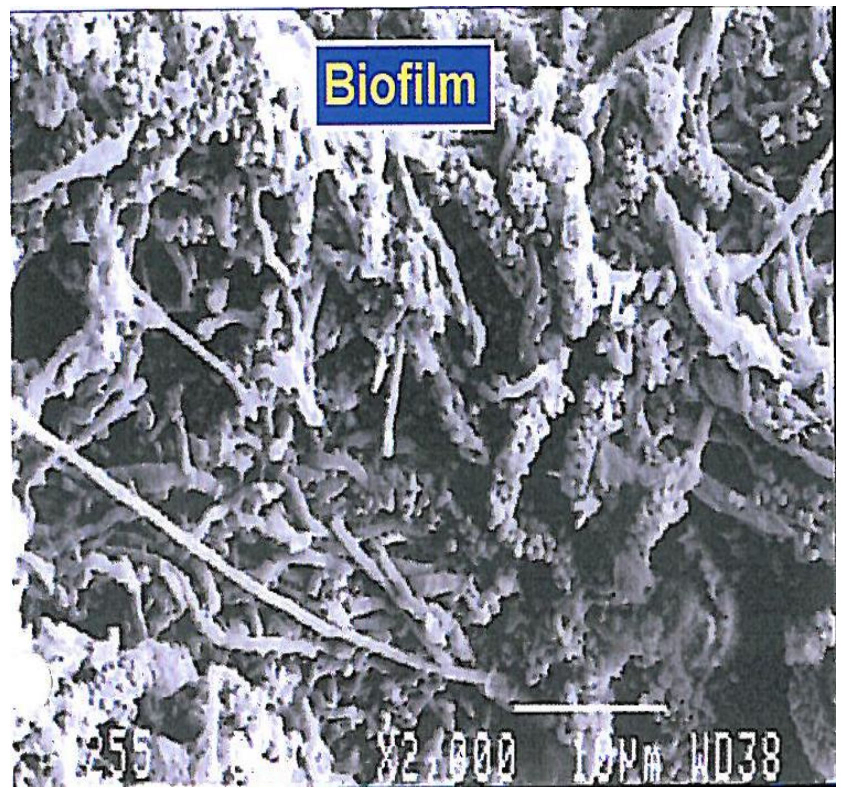
Legionnaires' disease

Malcolm Atherton – Water Consultants Ltd

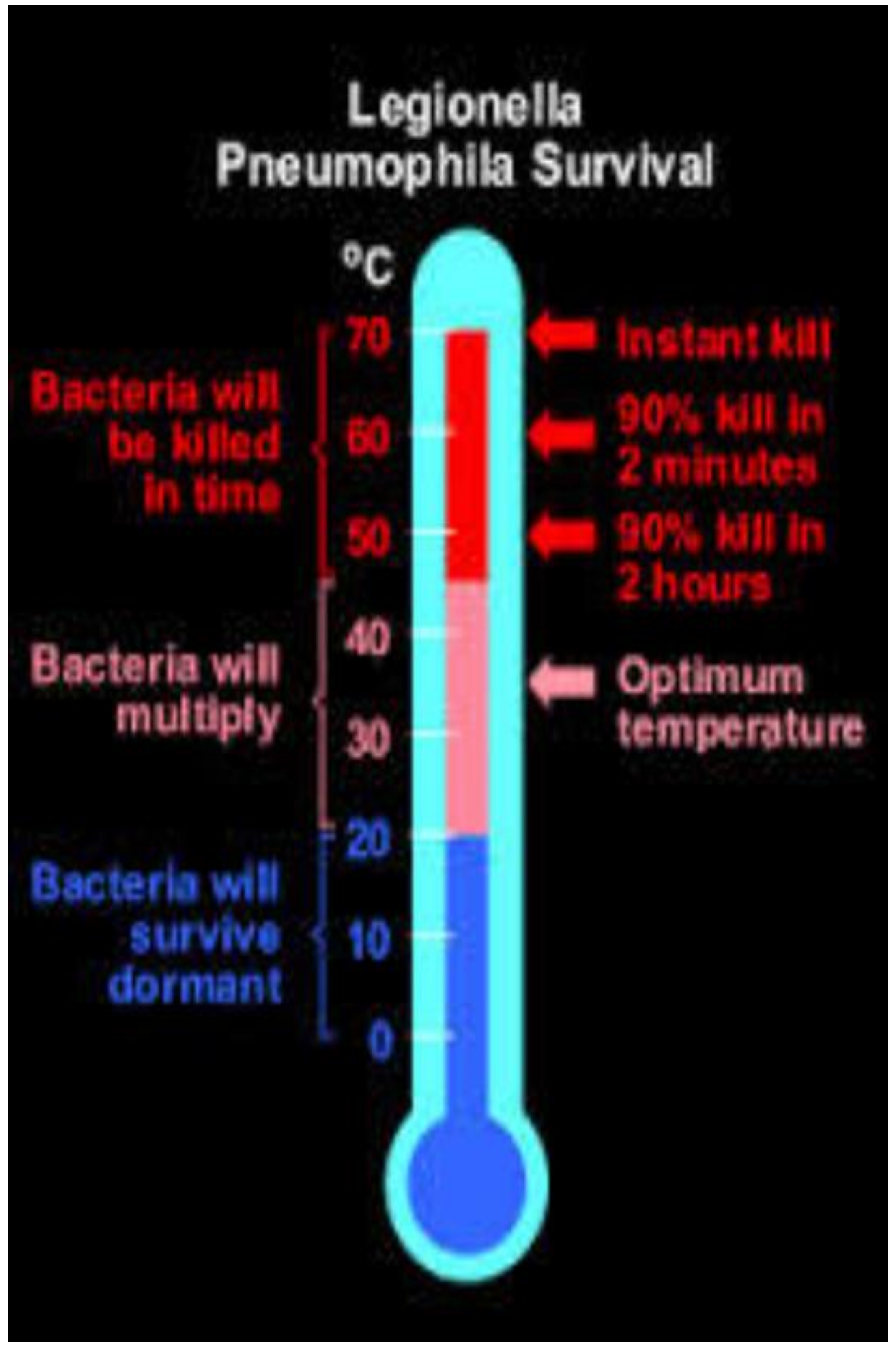
What does it look like & who/how do you normally catch it?

- Normally contracted by inhaling legionella bacteria, either in tiny droplets of water (aerosols in which it can survive upto 2hrs at a relative humidity of 65%), or in droplet nuclei (particles left after water has evaporated) contaminated with legionella, deep into the lungs.



- Person-to-person spread has not been documented (although one case exists in Brazil [2015])
- Initial symptoms include high fever, chills, headache & muscle pain. May develop a dry cough & most suffer difficulty with breathing. About a third of patients infected also develop diarrhoea or vomiting & about half become confused or delirious.
- Can be treated effectively with appropriate antibiotics.

Legionella pneumophila survival



- Incubation period between 2-10 days (usually 3-6 days).
- Not everyone who may be exposed to the bacterium will develop symptoms of the disease & those that don't develop "full blown" disease may only show signs of a mild flu-like infection.
- Susceptible population includes immunosuppressed patients, men more susceptible than women, those over 45 years old, smokers, alcoholics, diabetics, those with cancer or kidney disease & anyone with an impaired immune system.

Legionella - Designers responsibility (1)

Health and Safety at Work Act, sections 3 & 6; ACoP Para 75 states:

"Designers, manufacturers, importers, suppliers & installers of water systems that may create a risk of exposure to legionella bacteria, must:

a) ensure, so far as is reasonably practicable, that the water system is so designed & constructed that it will be safe and without risks to health when used at work;

b) provide adequate information for the user about the risk & measures necessary to ensure that the water systems will be safe and without risks to health when used at work. This should be updated in the light of any new information about significant risks to health & safety that becomes available, so that dutyholders can ensure relevant changes are made to their risk assessments and controls."

Legionella - Designers responsibility (2)

ACoP Para 80 states "*Hot and cold water systems should be designed & constructed so they:*

a) take account of and comply with the Water Supply (Water Fittings) Regulations 1999 and the Scottish Water Byelaws

b) aid safe operation (e.g. without deadlegs, or if this is not possible, limit the length of deadlegs and disconnect or remove redundant or non-essential standby plant)

c) reduce stored cold water to the minimum needed to meet peak needs

d) aid cleaning & disinfection (e.g. by providing suitable access points in the system

e) minimise heat gain / loss (e.g. hot & cold water pipes and storage tanks should be insulated)."

Legionella - HSG274 Part 2: Some salient points

- This guidance is for dutyholders & employers, which includes those in control of premises e.g. landlords & those with Health and Safety responsibilities to others, to help them comply with their legal duties.

- It gives practical guidance on how to assess & control the risks due to legionella bacteria i.e. risk assessments and control measures / monitoring.

- It deals with the types & applications of hot and cold water systems; provides information on the different types, design & use of systems available to supply water.

- It deals with water system design & commissioning.

- It gives advise on the use & fitting of thermostatic mixing valves (TMV's); it should be a comparative assessment of scalding risk v's risk of infection from legionella.

Legionella - HSG274 Pt 2, clauses 2.68 – 2.70 (low storage volume heaters)

- No greater than 15 litres capacity – generally regarded as lower risk
- Example = small building without people considered "at risk"; daily water usage inevitable & sufficient turnover of entire system; cold water direct from wholesome mains (no stored water tanks); hot water fed from instantaneous heater or low storage volume heaters (supplying outlets at 50°C); only outlets are toilets & wash basins (no showers).
- These heaters serving hot water outlets should be able to achieve peak temperature of 50-60°C. Unit not capable of achieving this, e.g. pre-set thermostat, only be used where there's a very high turnover or an alternative control measure is in place.
- Low storage volume heaters, including electric showers, often have spray nozzle outlets & should be inspected, cleaned & descaled as part of showerhead and hose cleaning regime.

CIBSE CP1

Heat networks: Code of practice for the UK

Steve Vaughan - AECOM

Code of Practice 1 Heat Networks: 2020

Key statements (delivery temperatures):

- Peak DHW demand to be diversified based on Danish Standard DS 439 (p.74-75)
- Identifies that Scaling of plate heat exchangers is much reduced below 55°C (p.84)
- DHW design stated to deliver minimum 45°C within 45 seconds (p.87)
- Care should be taken to avoid over estimation of peak DHW flow rates, leads to oversizing of pipework and higher heat losses (p.108)
- Requires the HIU to achieve 50°C at the heat exchanger outlet, unless there is a particular requirement (p.176)

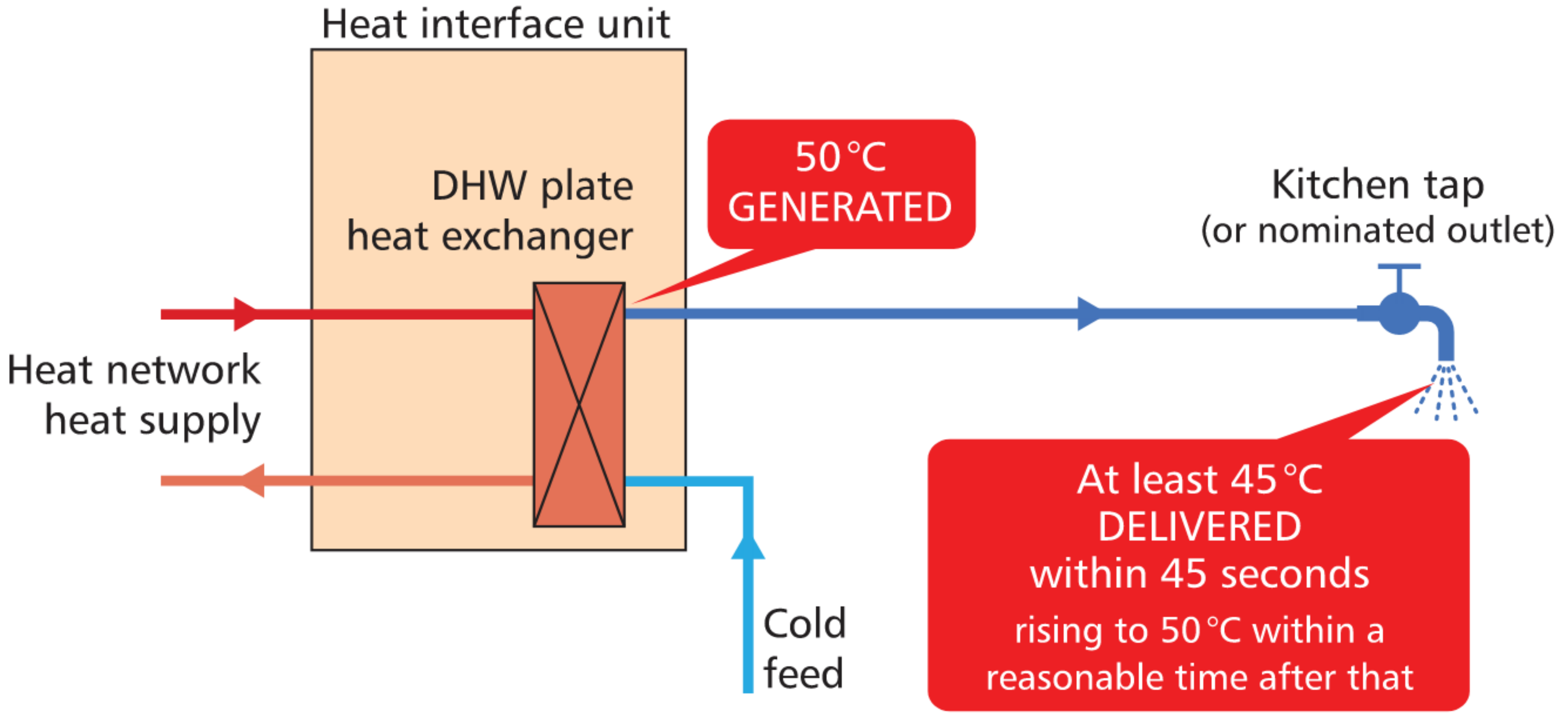


Figure 29 DHW temperature *generated* by an instantaneous HIU versus the service actually *delivered* to the consumer

CIBSE Guidance Note

Domestic hot water temperatures from instantaneous heat interface units: 2021

Steve Vaughan - AECOM

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CIBSE Guidance Note 2021:

Domestic hot water temperatures from instantaneous heat interface units

Key statements (delivery temperatures):

- Requirements for systems with instantaneous DHW are not well understood across the industry, often erroneously based on standards for storage systems (p.2)
- It is not necessary for low volume instantaneous systems to be provided with facilities for pasteurisation or other means of biological control (p.2)

CIBSE Guidance Note 2021:

Key statements (design standards):

- Table 1 (p.4) lists a selection of standards (17No.) that indicate a clear lack of agreement in guidance provided.

Standard	Distributed hot water	Hot water to taps/TMVs
Key standards		
HSE HSG274 *Legionnaires' Disease. Part 2: The control of legionella bacteria in hot and cold water systems*	Low storage volume systems should be able to achieve peak temperature of 50–60 °C	Supplied at 50 °C
HSE ACoP L8 *Legionnaires' Disease: The control of legionella bacteria in water systems*		Supplied at 50 °C
British Standard BS EN 806-2: 2005: *Specifications for installations inside buildings conveying water for human consumption. Design*		For central hot water systems, 30 seconds after fully opening a draw-off fitting the water temperature should not be less than 60 °C, unless otherwise specified by local or national regulations
British Standard BS 8558: 2015: *Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages*		Delivered at or above 50 °C within 1 minute of running the water
Building Regulations, Approved Document G* *Sanitation, hot water safety and water efficiency*	Does not exceed 60 °C	Maximum temperature at bath tap of 48 °C
British Standard BS 6700: 2006 + A1: 2009: *Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification* (no longer current but cited in Approved Document G)	Stored and distributed at a temperature of not less than 60 °C	Temperature at the discharge point of 50 °C after 1 minute
WRAS *Water Regulations Guide*	Not less than 55 °C (this may not be achievable where provided by instantaneous or combination boilers)	Not less than 50 °C within 30 seconds after fully opening the tap (this may not be achievable where provided by instantaneous or combination boilers)
CIBSE TM13 *Minimising the risk of Legionnaires' disease*	Stored at >60 °C with distribution temperature of 55–60 °C	Minimum 50 °C, max flush time to achieve this of 1 minute

Additional standards		
British Standard BS 8580-1: 2019: *Water quality. Risk assessments for Legionella control. Code of practice*	Maintained at 50 °C or above (circulating hot water system)	Target to reach minimum of 50 °C within 1 minute of turning on (non-circulating hot water systems)
British Standard BS 6465-3: 2020: *Sanitary installations. Code of practice for selection, installation and maintenance of sanitary and associated appliances*		Delivering at around 50 °C
CIBSE Guide G *Public health and plumbing engineering*	Maintained above 50 °C, preferably at 55 °C	
Institute of Plumbing (CIPHE) *Plumbing Engineering Services Design Guide*	Minimum 50–55 °C	50 °C attainable at all taps within 30–60 seconds
CIBSE/ADE CP1 *Heat networks: Code of Practice for the UK*		The hot water delivery temperature at the instantaneous HIU shall be set to 50–55 °C; temperatures in this range are acceptable provided the volume of water is small and the *Legionella* risk can be controlled
BSRIA BG/62 *Heat Interface Units*	Generation temperature of at least 55 °C for once-through, non-storage domestic hot water systems based on HIU with plate heat exchanger	At least 50 °C
NHBC Standards		At least 50 °C within 1 minute of running the water, 55 °C at kitchen sink
TMVA Guide *The Control of Hot Water Temperatures in Domestic Properties*	Hot water should be maintained at 60–65 °C to reduce microbiological contamination	
BRE IP 14/03 *Preventing Hot Water Scalding in Bathrooms: using TMVs*		Temperature should never exceed 46 °C at taps

* For use in England only. Similar guidance is available for Scotland, Wales and Northern Ireland.
TMV = thermostatic mixing valve

>60
60 - 65
50 - 55
60
>50
50

CIBSE Guidance Note 2021:

Key statements (user requirements for DHW temperatures – kitchen sink):

- BEAMA States that 'water should be available between 46 and 48°C to ensure thorough removal of grease, but this is not governed by any published recommendations (p.9)
- It can therefore be assumed that all the commercially available hand dishwashing detergents in Europe will be effective using hot water tap temperatures of 45°C and above (p.9)
- Proctor and Gamble state 39-41°C is the normal temperature range that consumers would use for the Fairy Liquid produce (p.9)
- Table 3 shows recommended minimum temperatures (p.9)

Table 3 Supply temperature requirements (°C)

Outlet	NHBC Standards	CIBSE Guide G
Bath tap	40	44
Shower	40	41
Wash basin tap	40	43
Kitchen tap	55 (50*)	50 to 60

*50 °C will be adopted by NHBC from January 2022.

CIBSE Guidance Note 2021:

Key statements (minimising the risk of burns):

- Requirement G3(4) of Building Regulations 2020 states: *‘The hot water supply to any fixed bath must be so designed and installed as to incorporate measures to ensure that the temperature of the water that can be delivered to the bath does not exceed 48°C’*. (p.6)

The Building Regulations 2010

Sanitation, hot water safety and water efficiency

G

APPROVED DOCUMENT

(4) The hot water supply to any fixed bath must be so designed and installed as to incorporate measures to ensure that the temperature of the water that can be delivered to that bath does not exceed 48°C.

Prevention of scalding

3.65 The hot water supply temperature to a bath should be limited to a maximum of 48°C by use of an in-line blending valve or other appropriate temperature control device, with a maximum temperature stop and a suitable arrangement of pipework.

3.67 In-line blending valves and composite thermostatic mixing valves should be compatible with the sources of hot and cold water that serve them.

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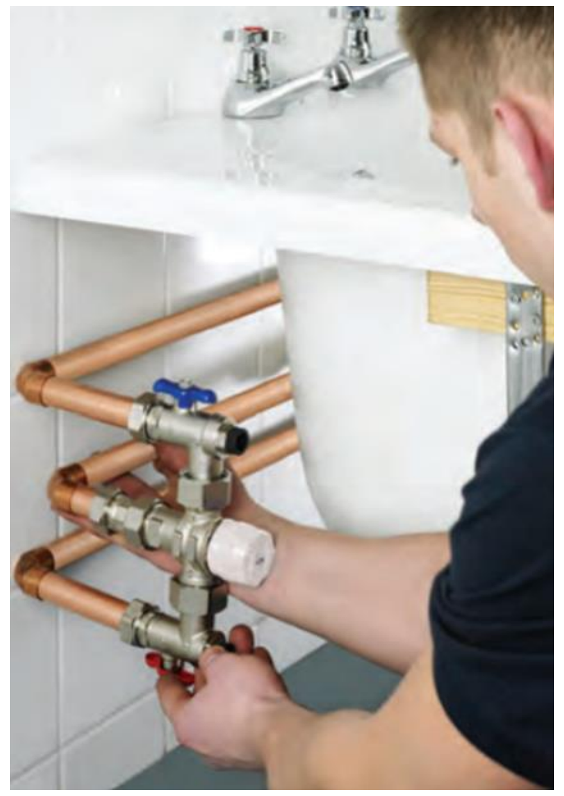
CIBSE Guidance Note 2021:

Key statements (minimising the risk of burns):



- Compliance with AD G3 is commonly achieved by use of thermostatic mixing valve (TMV) at outlet that presents scalding risk (p.6)
- TMV's provide a dual function (p.6):
  - Blending hot and cold water to a safe temperature
  - Automatically shutting off the supply of blended water when the cold water supply fails
- However, no mention of TMV certification or potential warranty issues.

Certified to NSF TMV2

CIBSE Guidance Note 2021:

Key statements (minimising the risk of burns):

- For instantaneous systems, the secondary shut-off function can be provided inherently within the design of the hot water system. Figure 2 shows recommended pipework configuration – <u>no separate IV for cold to TMV</u>(p.7).

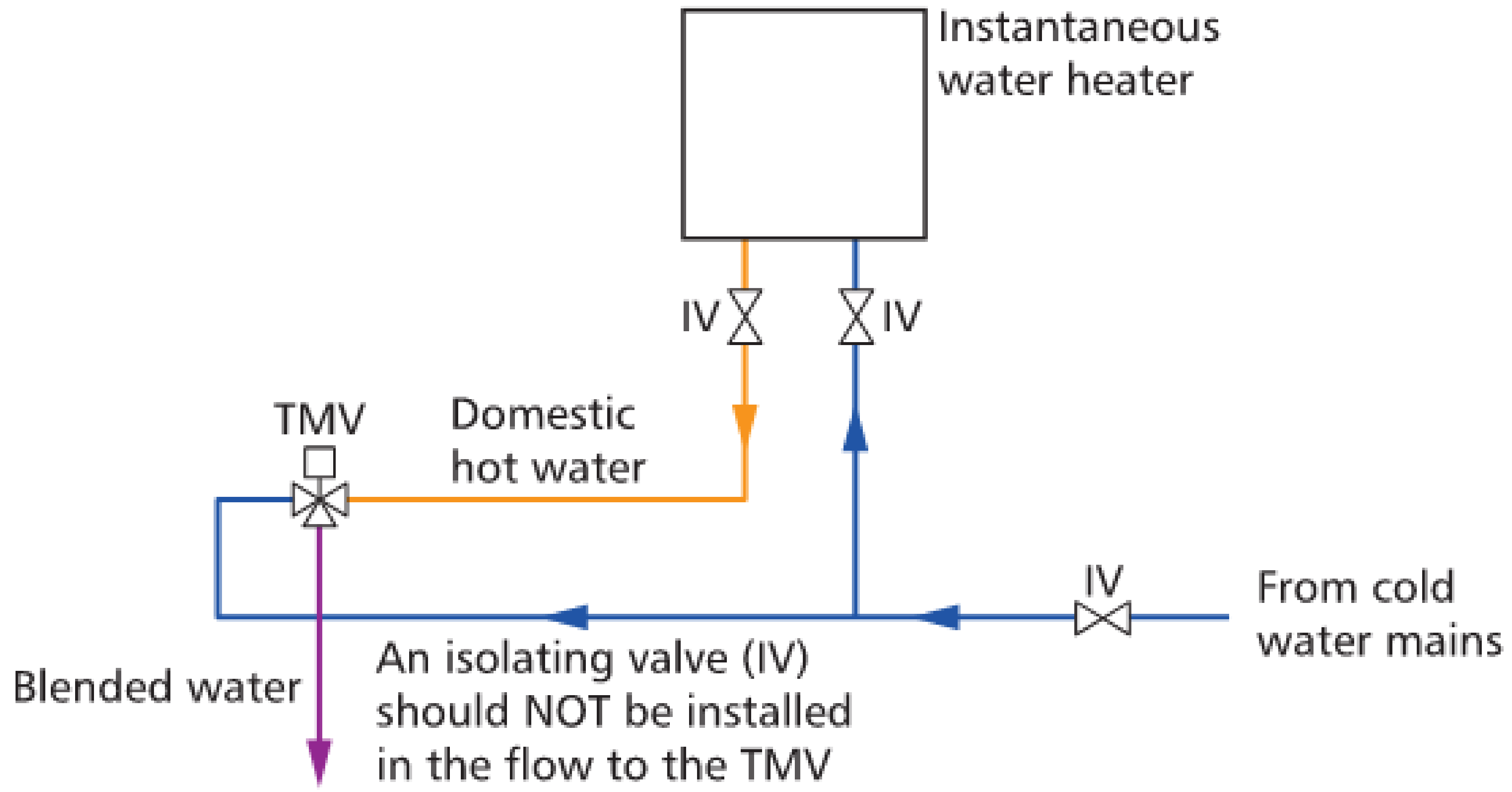


Figure 2 Pipework arrangement to prevent hot water bypass in event of cold water failure

CIBSE Guidance Note 2021:

Key statements (Legionnaires' disease and low volume instantaneous DHW heaters):

- Traditionally, hot water systems in the UK have included water storage, with temperature used to reduce the risk of legionella growth (p.7)
- However, this is not required for instantaneous systems with high rates of turnover (p.7)
- HSG274 requires that risk assessments should be performed for all DHW systems (p.7)
    - ➢ Including Low volume (no greater than 15 litres) instantaneous systems

HSE

Health and Safety Executive

Legionnaires' disease

Part 2: The control of legionella bacteria in hot and cold water systems

CIBSE Guidance Note 2021:

Key statements (Legionnaires' disease and low volume instantaneous DHW heaters):

- HSE was consulted and considers HIU providing instantaneous DHW to dwelling should be included under definition of low storage volume (no greater than 15 litres) and therefore a lower risk system (p.7)

HSE

Health and Safety Executive

Legionnaires' disease

Part 2: The control of legionella bacteria in hot and cold water systems

Low storage volume heaters

2.68 Low storage volume heaters (ie no greater than 15 litres) such as instantaneous units and POU heaters, may be generally regarded as lower risk.

- HSG274 Part 2 states for low water volume systems (p.7):
  - Should be able to achieve peak temperature of 50 to 60^{o}C
  - Temperatures less than 50^{o}C should only be permitted where there is high turnover (or alternative control)
  - There is no requirement for either minimum temperature or delivery time at the tap.

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CIBSE Guidance Note 2021:

Key statements (Legionnaires' disease and low volume instantaneous DHW heaters):

- Lower risk scenario: Health and Safety Executive consulted and considers HIU providing instantaneous DHW to dwelling should be included under definition of low storage volume (no greater than 15 litres) and therefore a lower risk system (p.7)

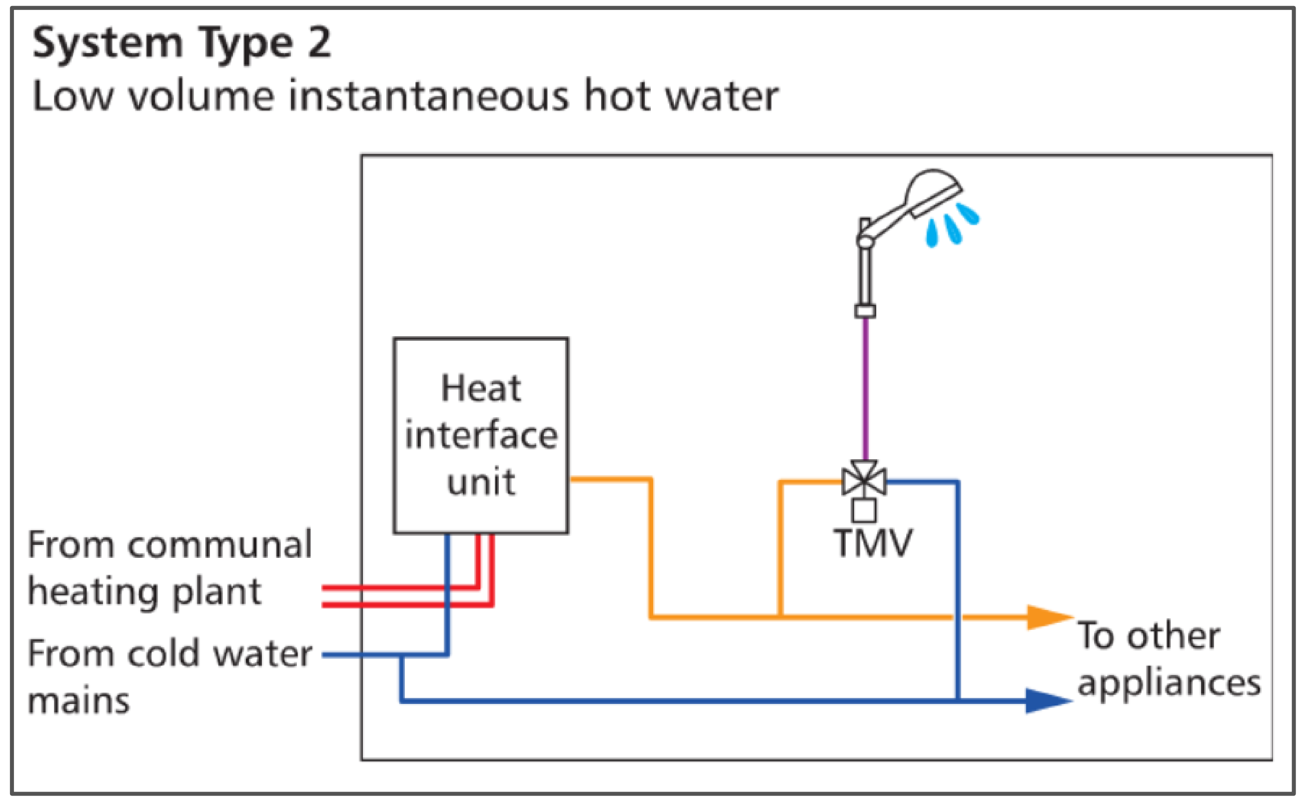
Lower risk scenario

This scenario has been agreed with the HSE as a lower risk system.

— Block of flats served by communal heating system and communal boosted cold water system.

— Each dwelling/flat has its own low volume HIU to generate instantaneous hot water (System Type 2 – see Figure 1).

— There is no stored hot water, and each HIU contains less than 15 litres of water (as per HSG274 Part 2, paragraph 2.68).



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Key statements (Legionnaires' disease and low volume instantaneous DHW heaters):

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  - > There is no requirement for either minimum temperature or delivery time at the tap.

HSE Health and Safety Executive

Legionnaires' disease

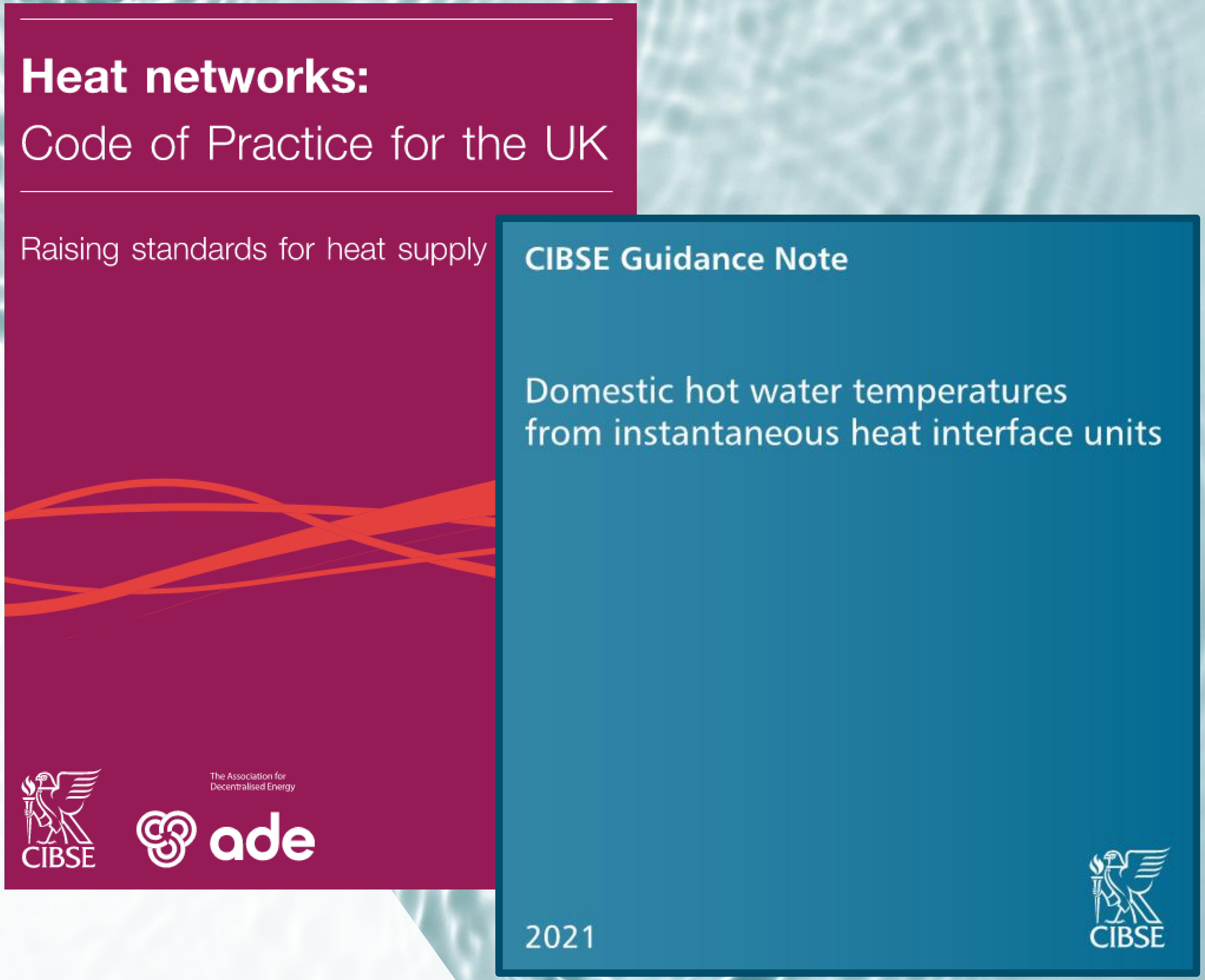
Part 2: The control of legionella bacteria in hot and cold water systems

2.69 Low storage volume heaters serving hot water outlets should be able to achieve a peak temperature of 50–60 °C and where the thermostat is set at these temperatures for this purpose, staff and other users should be informed not to adjust the heater. A unit which is not capable of achieving this, eg a preset thermostat, should only be used where there is a very high turnover or an alternative control measure is in place.

2.70 Low storage volume heaters, which includes electric showers, often have spray nozzle outlets and these should be inspected, cleaned and descaled as part of the showerhead and hose cleaning regime.

2.71 If these units are not regularly used or set to supply warm water, the risk from legionella is likely to increase dramatically and may increase further, where the units are supplied from a cold water storage tank. The risk assessment should take into account the usage of the units, the susceptibility of those using the units and include a suitable monitoring regime where the risk is considered significant.

Summary


Heat networks:
Code of Practice for the UK
Raising standards for heat supply
CIBSE
The Association for Decentralised Energy
ade
CIBSE Guidance Note
Domestic hot water temperatures from instantaneous heat interface units
2021
CIBSE

CIBSE Guidance Note 2021

The recommended approach within guide:

- 50^{o}C Domestic hot water temperatures can be used without compromising safety or user function (p.15)

- GENERATION - set at 50^{o}C at point of generation (p.15)

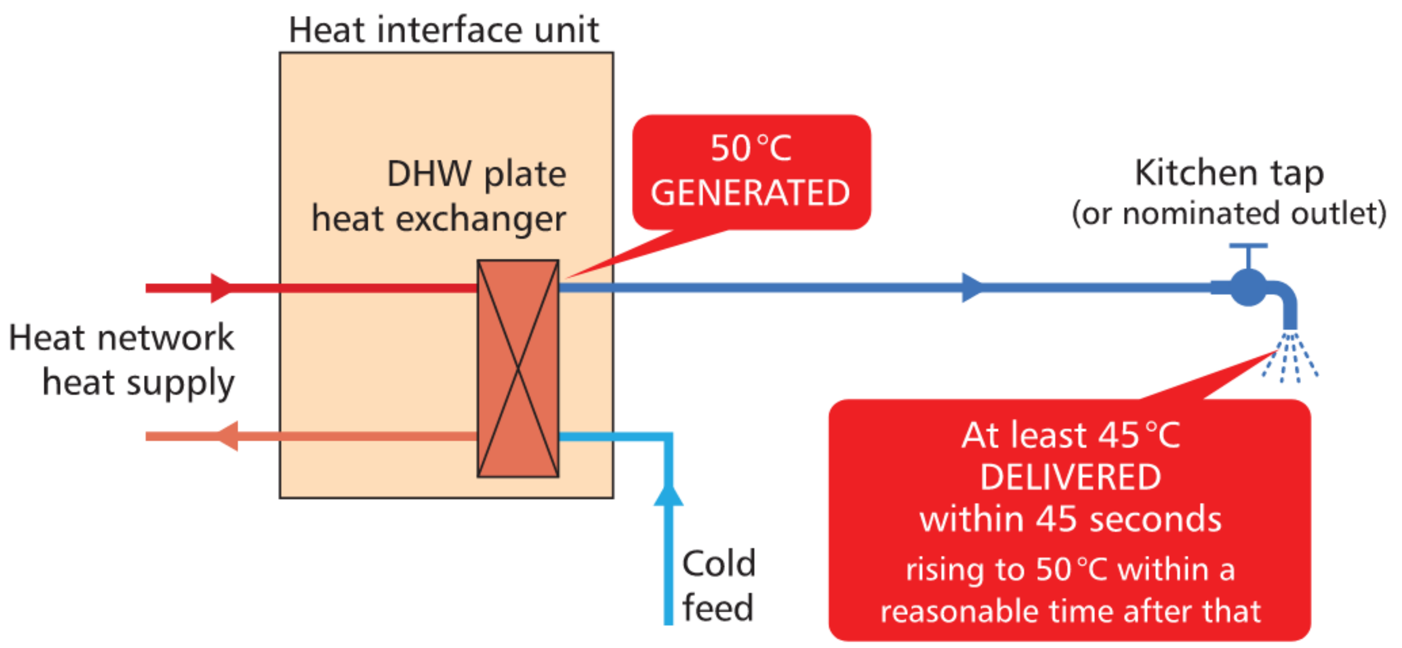


Figure 8 DHW temperature GENERATED by an instantaneous HIU versus the service DELIVERED to the consumer

- DELIVERY – Supply at kitchen tap should be minimum of 45^{o}C within 45 seconds, rising to 50^{o}C within a reasonable time after that (p.15)

- PIPEWORK – DHW pipework should be the minimum size and length possible to deliver the required blended temperature at the tap (p.15)
  - ➢ These recommendations do not apply to systems with venerable users, where it is expected that the risk assessment would be appropriate to their particular needs.
  - ➢ Not all HIUs available on the market have the facility to measure DHW temperature at the point of generation. This is required to ensure the requirements of HSG274 are met.

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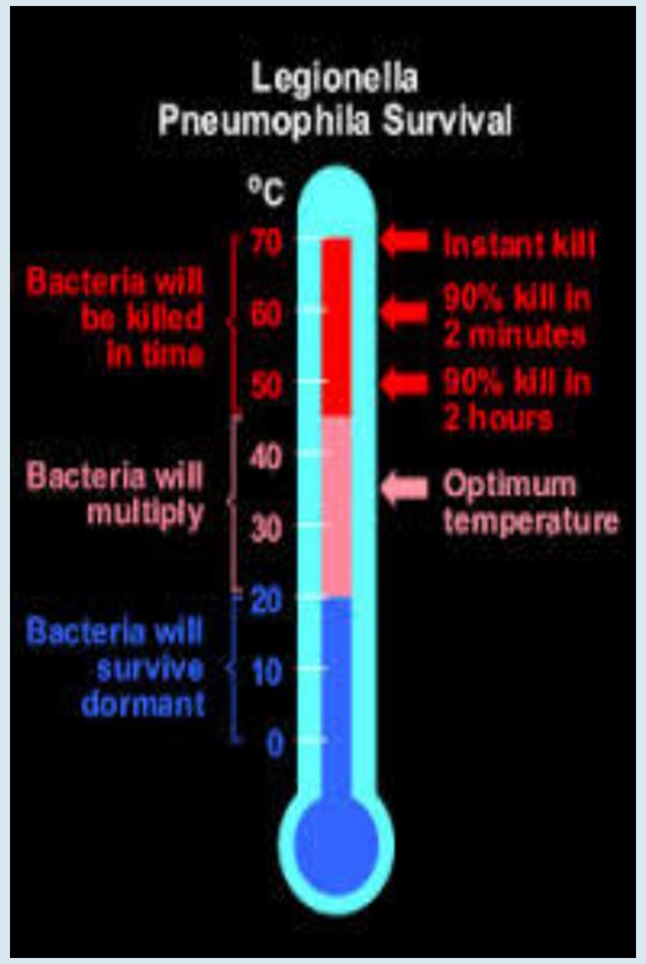
What next?

. . . . Debate and Q & A

Debating the challenges . . . .

Delivering DHW at 50ºC



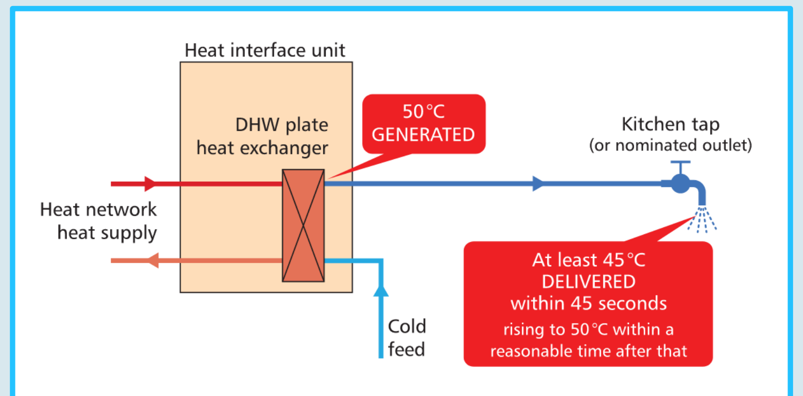
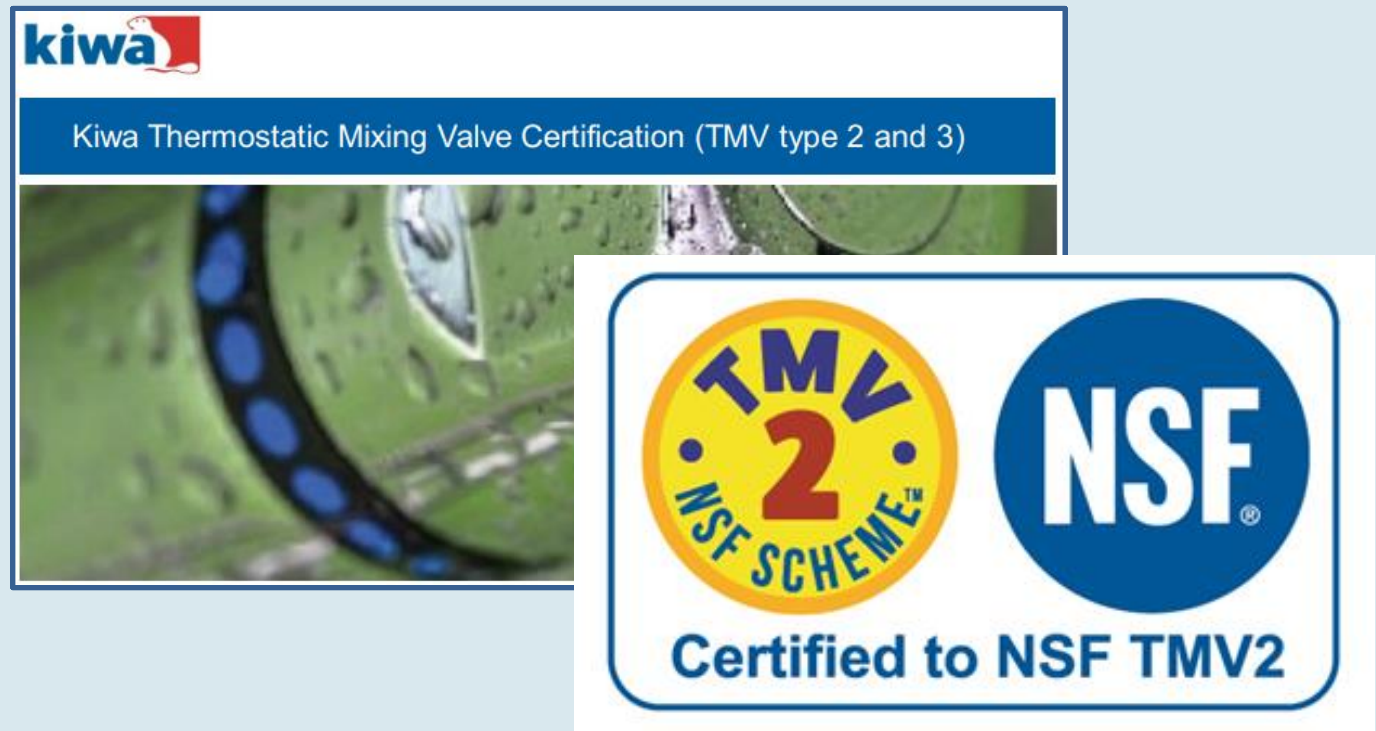


Figure 8 DHW temperature GENERATED by an instantaneous HIU versus the service DELIVERED to the consumer

Certification compliance for TMVs – Approach and differential temps.

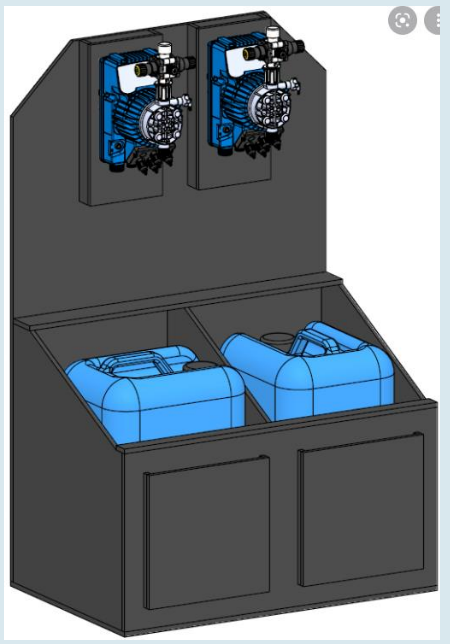


Stable DHW temperatures from HIU's – How accurate?

Debating the challenges

Is further reduction to DHW temperature an option –
Can TMVs be omitted?

Are alternatives to temperature regime for legionella control necessary?



The Impact on Thermostatic Showers

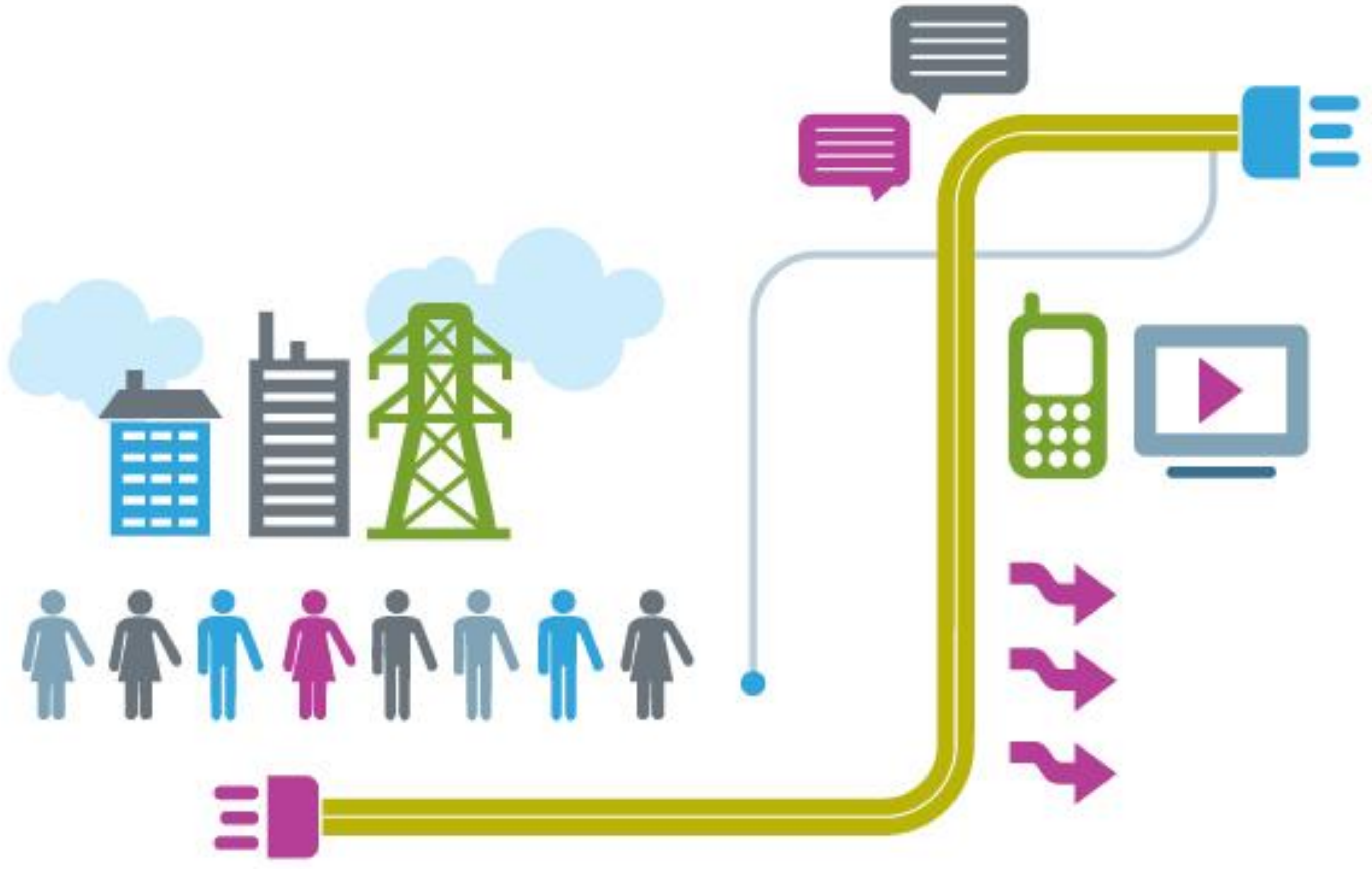
Thermostatic Mixing Valves

Kevin Ray - BEAMA

SAFETY REQUIREMENTS FOR HOT WATER

BEAMA Water Safety and Hygiene (WASH)

Representing manufacturers of water safety devices, including Thermostatic Mixing Valves



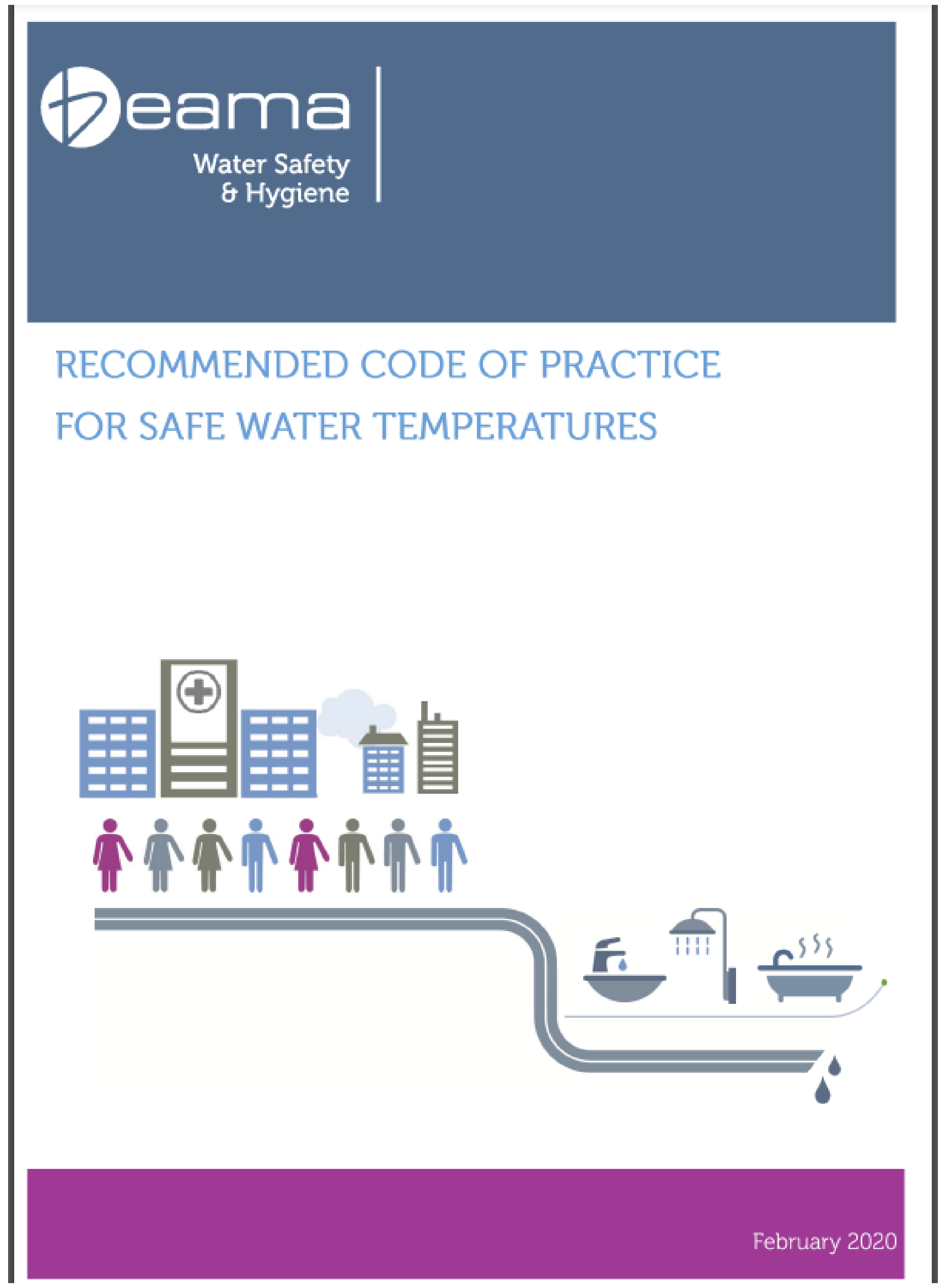
Water Safety and Thermostatic Mixing Valves

Building owners or managers have a duty of care to users and occupiers

Following a risk assessment, a design for a safe hot water supply can be determined

This usually uses TMVs in the form of under-sink units or mixer taps/showers

More detail on applications and guidance for risk assessments in the BEAMA code of practice
Further consideration is comfort, with stable temperature supply independent of pressure variation


beama
Water Safety & Hygiene

RECOMMENDED CODE OF PRACTICE FOR SAFE WATER TEMPERATURES

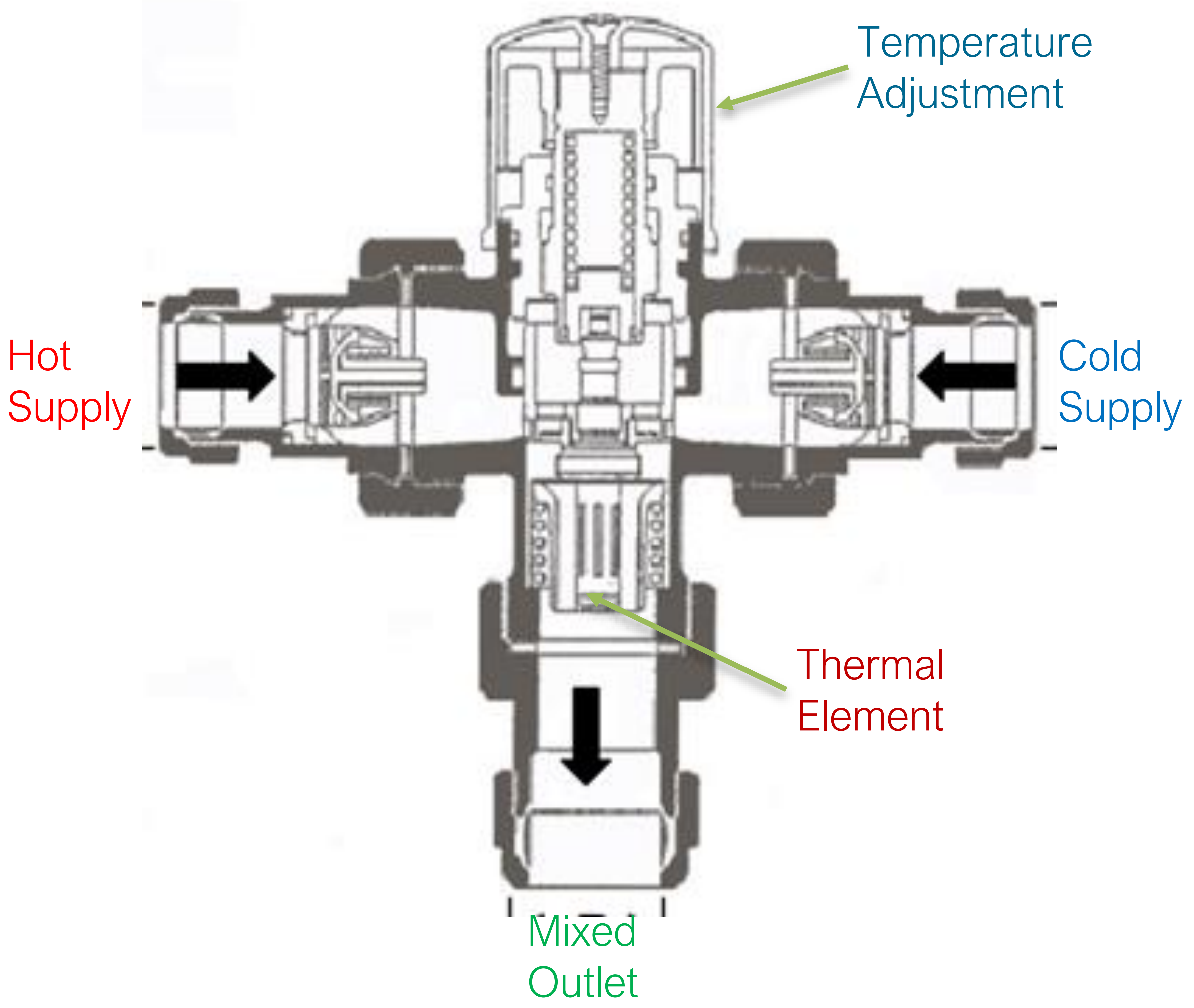
February 2020

How do TMVs Work

- Thermal element responds to temperature change by expanding/contracting
- Moves the mixing valve to reapportion the supply of hot or cold water
- Most TMVs require a differential between hot supply and mixed outlet of between 6 and 10 Deg C.
- Lower differential will cause sluggish response and loss of accuracy in outlet temperature

TMVs have safety features and will shut on loss of hot or cold supplies

- Important to note that TMV function is evolving to meet the needs of new system designs e.g. lower differential, higher cold feed temperatures.
- Further details from BEAMA WASH members, visit the BEAMA website for details



Typical TMV Arrangement

TMV Approvals

2 approval schemes for TMVs

TMVs are generally designed and manufactured to meet one or other, or both of the following:

TMV2

- Valves are tested to residential building standards, eg BS EN 1111 and 1287 as a minimum performance level

- Part G3 of building regulations requires that in new build and where bathroom works are taking place then *"The hot water supply to any fixed bath must be so designed and installed as to incorporate measures to ensure that the temperature of the water that can be delivered to that bath does not exceed 48˚C."*

Certified to NSF TMV2

TMV3

- Certified to the requirements of NHS estates document DO8 for use in healthcare applications

- Suitable for use where the resident is regarded as vulnerable to scalding

- Generally suitable for higher operating pressures

Hot Water System Design

Important to design the hot water system following a suitable risk assessment of the outlets and the building use

Pipework from the TMV to outlet should be short to avoid bacterial growth

Selection of an appropriate TMV should consider the manufacturers specification eg temperature differential, operating temperature and system pressure to achieve the required design

TMVs should be set and tested to deliver the appropriate temperatures at the outlets.

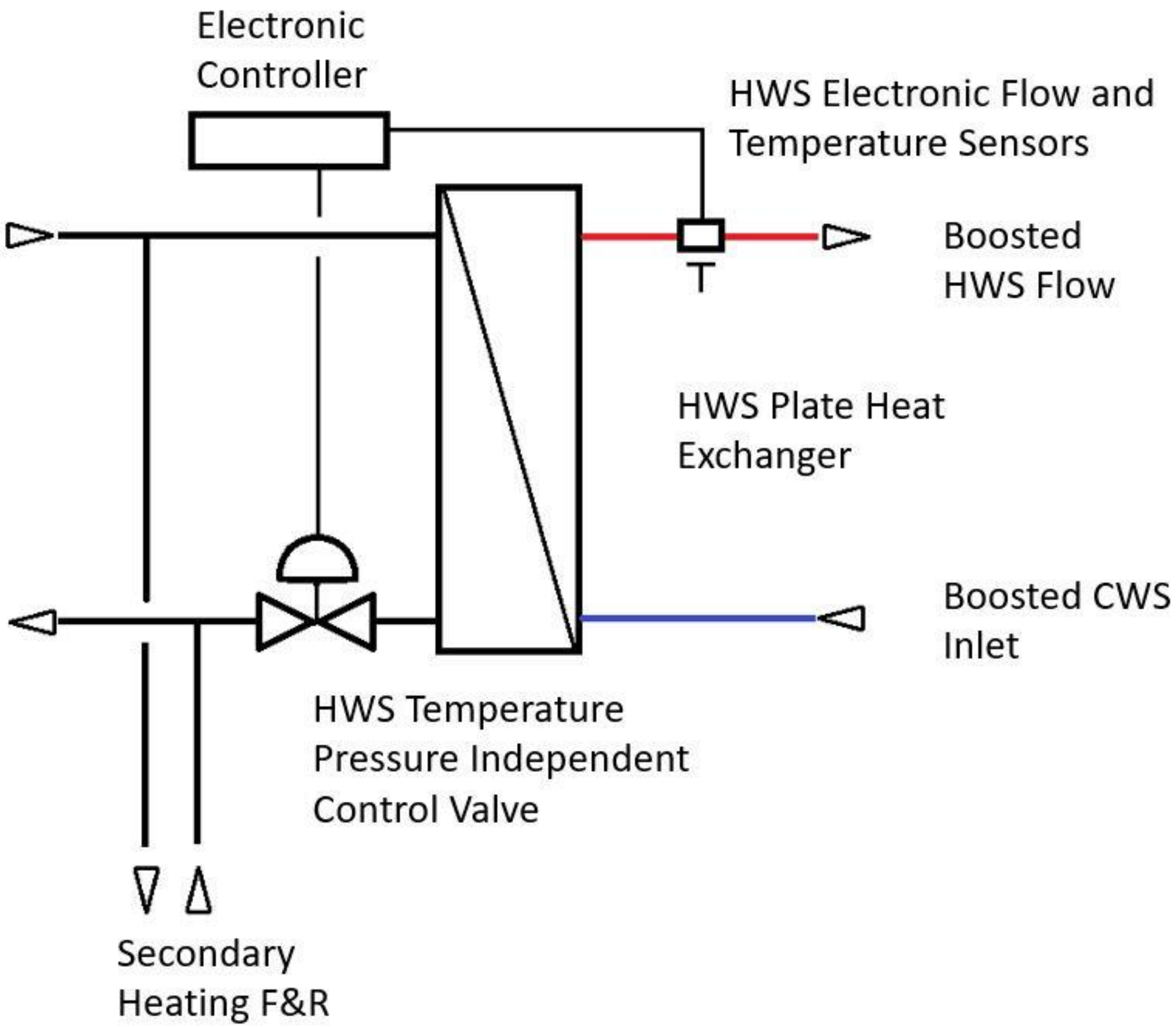
Generally considered to be :

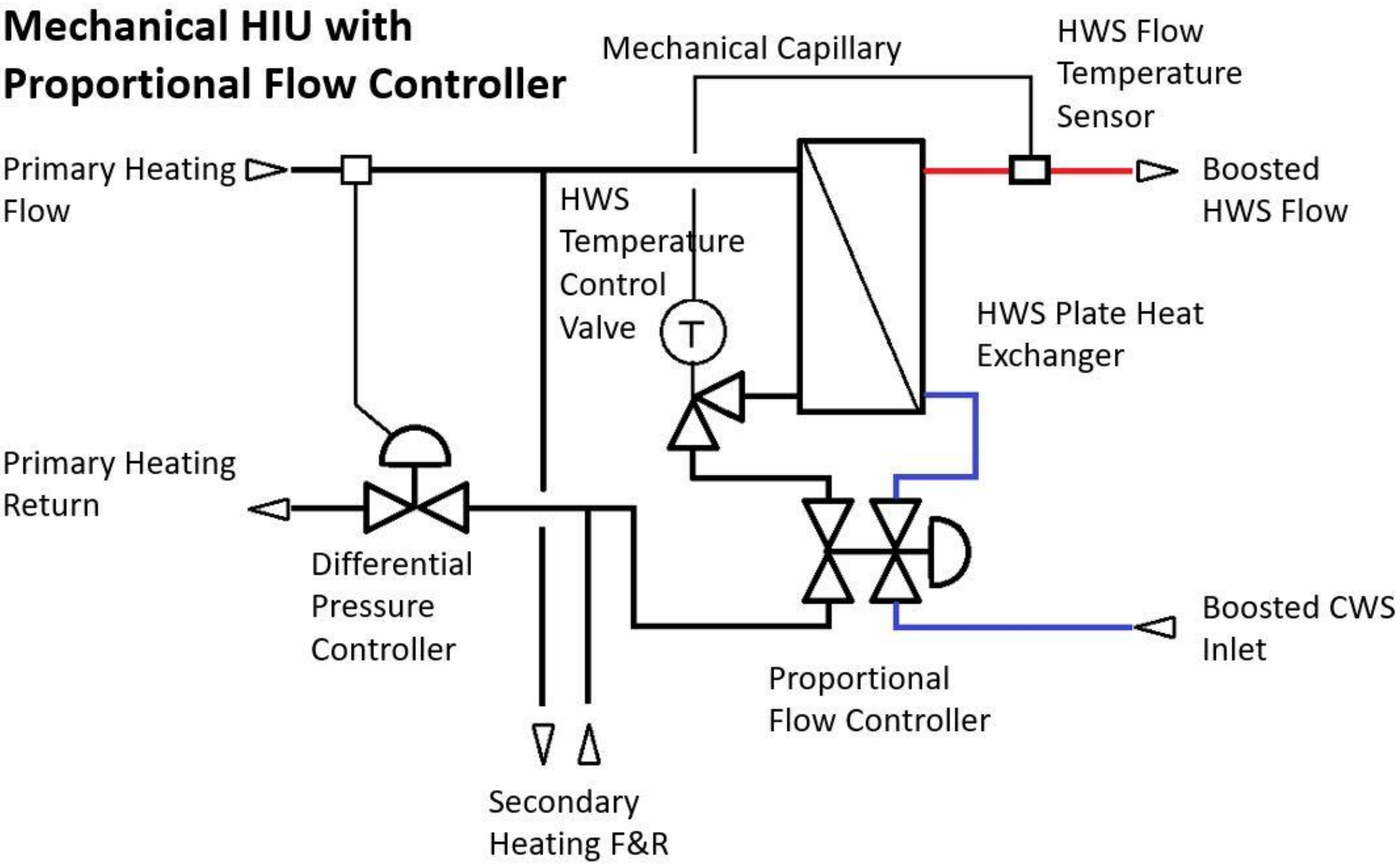
- 44°C for an unassisted bath fill
- 46°C for an assisted bath fill
- 41°C for shower applications
- 41°C for washbasin applications
- 38°C for bidet applications

TMV Maintenance

- It is important TMVs are checked on installation and regularly serviced in accordance with manufacturers operating and installation instructions
- The recommended intervals and tests differ slightly between TMV2 and TMV3 valves
- This is particularly important in areas of hard water or contamination which may affect the operation and especially in critical applications
- Water outlet temperatures should be checked at the outlet regularly
- Both hot and cold supplies should be turned off separately to check the fail safe operation

Electronic HIU




Mechanical HIU with
Proportional Flow Controller
Mechanical Capillary
HWS Flow
Temperature
Sensor
Primary Heating
Flow
Boosted
HWS Flow
HWS
Temperature
Control
Valve
T
HWS Plate Heat
Exchanger
Primary Heating
Return
Differential
Pressure
Controller
Boosted CWS
Inlet
Proportional
Flow Controller
Secondary
Heating F&R

Mechanical HIU