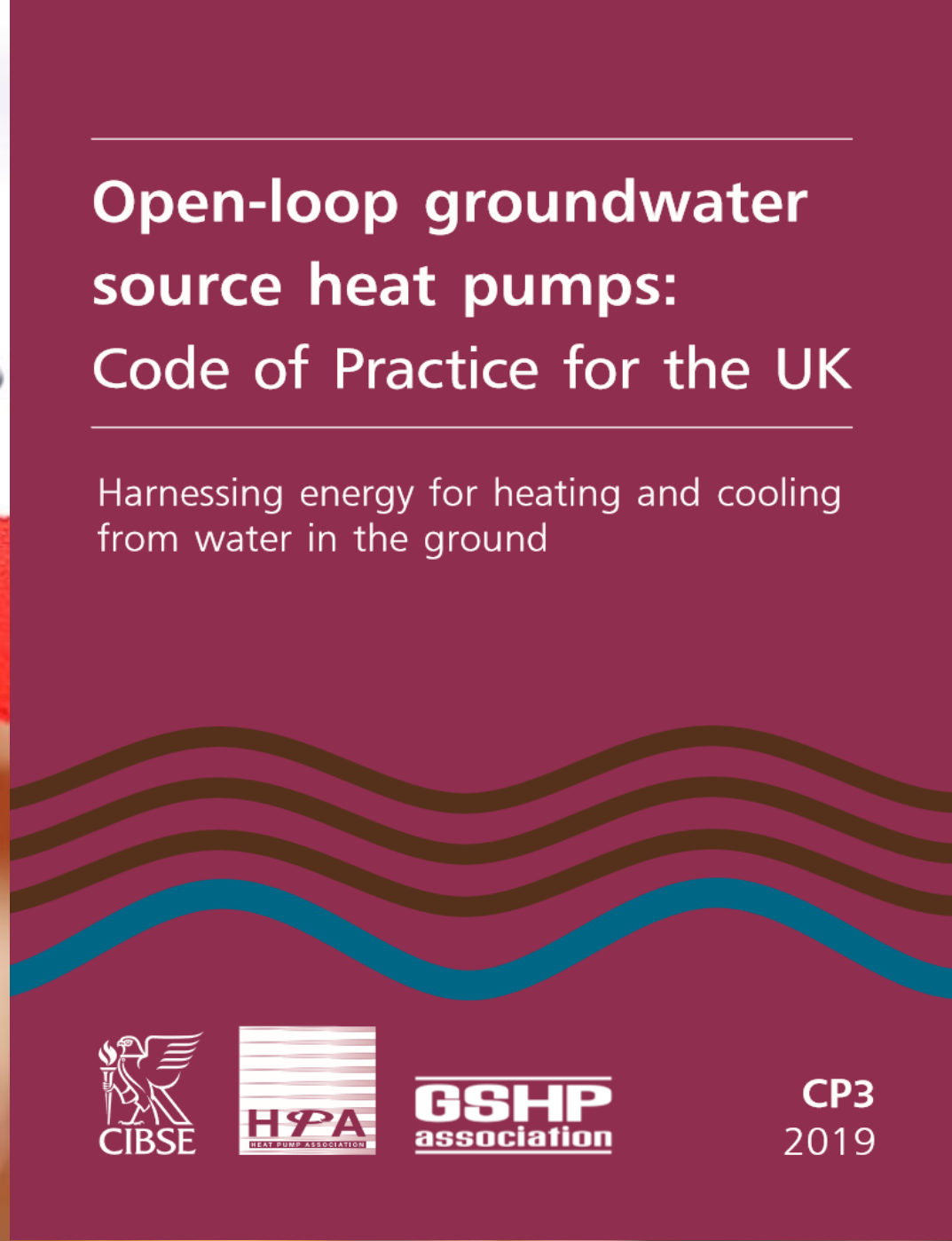
CP3 - Open-loop groundwater source heat pumps

Harnessing energy from water in the ground for heating and cooling

Phil Jones
Chair - CP3 Steering Committee
philjones100@virginmedia.com
07714 203045



WHAT IS A CODE OF PRACTICE?

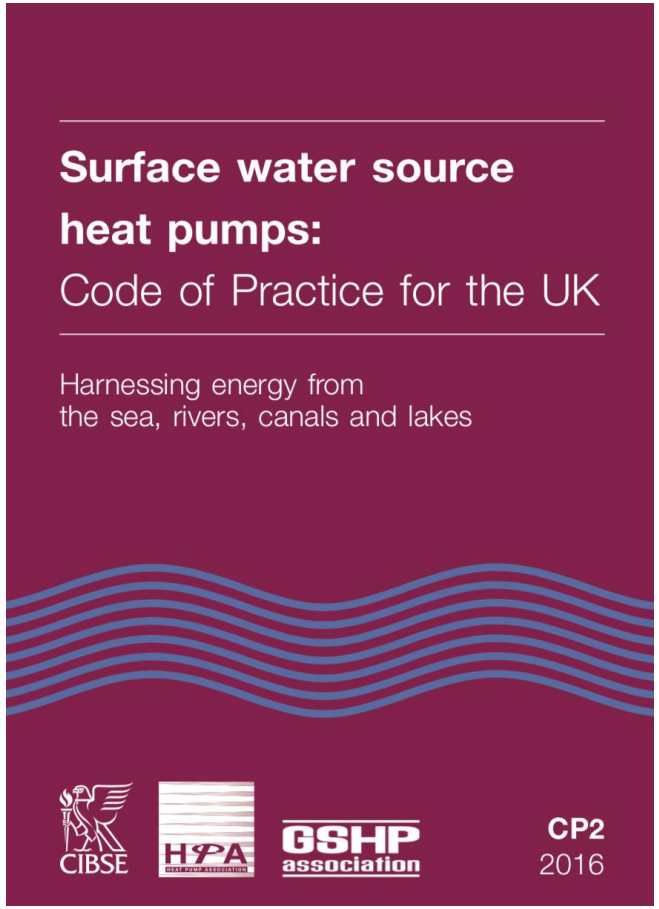
- Sets Minimum Standards
- Sets Best Practice standards where possible
- Avoids reproducing existing guidance
- Provides confidence in the technology
- Connects the supply chain
- Underpins tendering & contracts
- Underpins training and accreditation
- Provides confidence to developers/specifiers
- Takes the sector to the next level

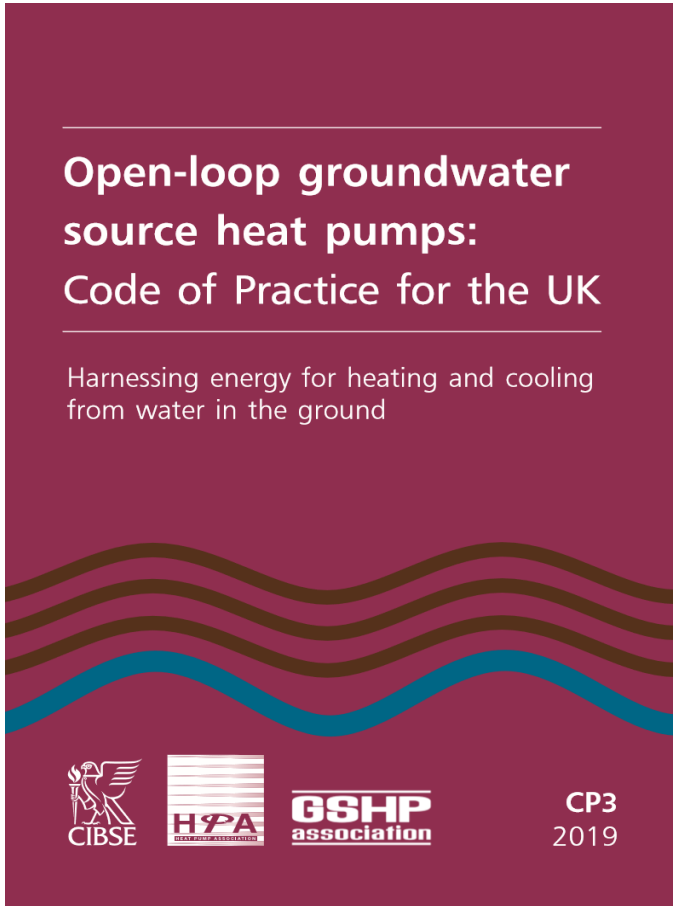
CIBSE CHP&DH Group

ade Bringing Energy Together

CIBSE

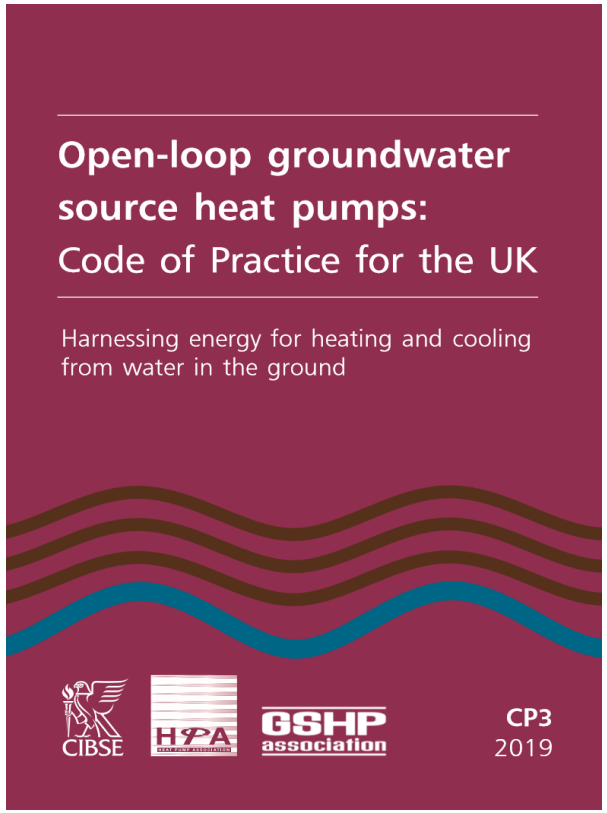
CP3 is the 3rd in the series





https://www.cibse.org/knowledge/cibse-publications/cibse-codes-of-practice

Thanks to everyone involved



CP3 is a collaborative publication

Department for Business, Energy & Industrial Strategy

- Consortium funded by BEIS
- Led by CIBSE in association with HPA & GSHPA
- Supported by a 20+ strong, diverse steering committee of industry experts and stakeholders.
- With input from many more companies during the consultation process

With important contributions from:

Environment Agency

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The Coal Authority

GSHP association

HPA HEAT PUMP ASSOCIATION

CIBSE

Part A: How to use this Code

The Code comes in 3 parts

A1 Introduction

- A1.1 Strategic purpose
- A1.2 What is an open-loop groundwater source heat pump?
- A1.3 Why install an open-loop groundwater source heat pump?

A2 Readership and scope of the Code of practice

- A2.1 Readership
- A2.2 Scope

A3 Structure of the Code of Practice

- A3.1 Themes
  - (A) To deliver low environmental impact
  - (B) To deliver a high-performance system with a high coefficient of performance
  - (C) To achieve optimum flow and return temperatures
  - (D) To deliver a practical and compliant system using engineering solutions to overcome technical barriers
  - (E) To deliver a cost effective reliable system with a long life and low maintenance requirements
  - (F) To deliver effective metering/monitoring of the GWSHP
  - (G) To deliver a safe, high quality scheme where risks are managed
- A3.2 Responsibilities

Part B: Challenges and opportunities

B1 The heat pump

- B1.1 Types of heat pump
- B1.2 Heating and cooling
- B1.3 Key design issues

B2 Groundwater sources and their characteristics

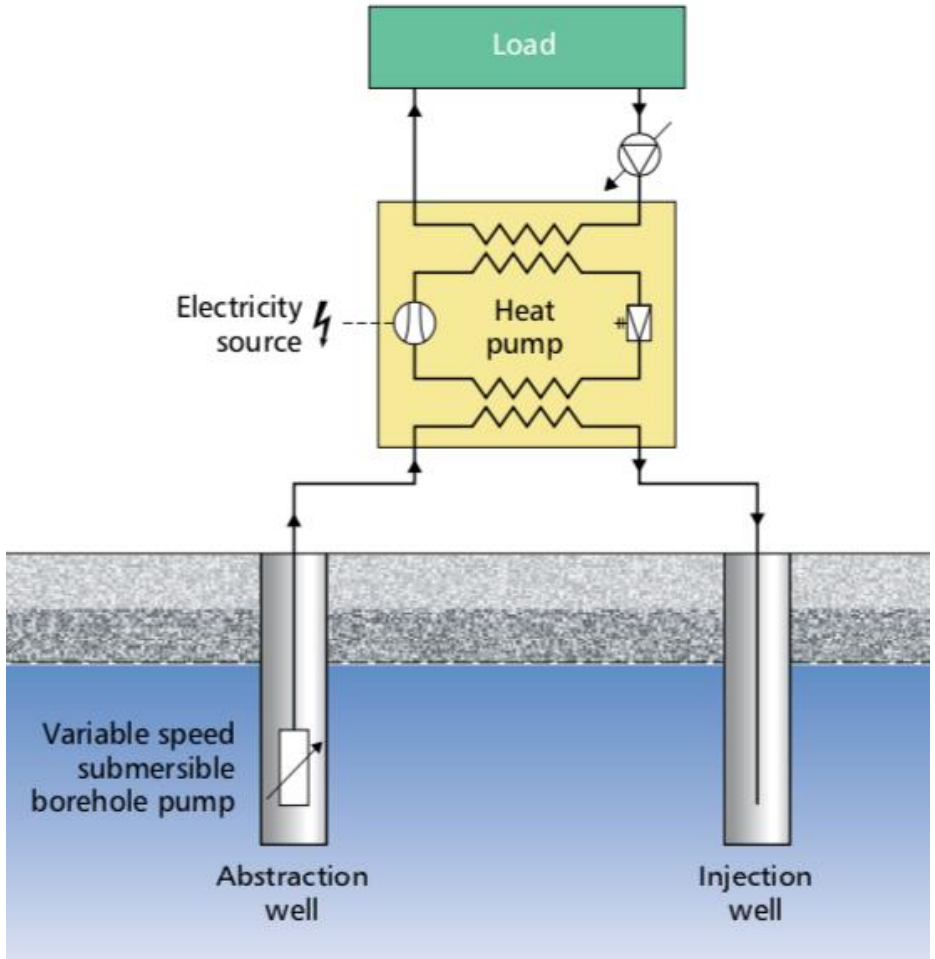
- B2.1 Aquifers: the occurrence of groundwater in the subsurface
- B2.2 Water wells and boreholes
- B2.3 Groundwater from flooded mines and quarries

B3 Types of installation

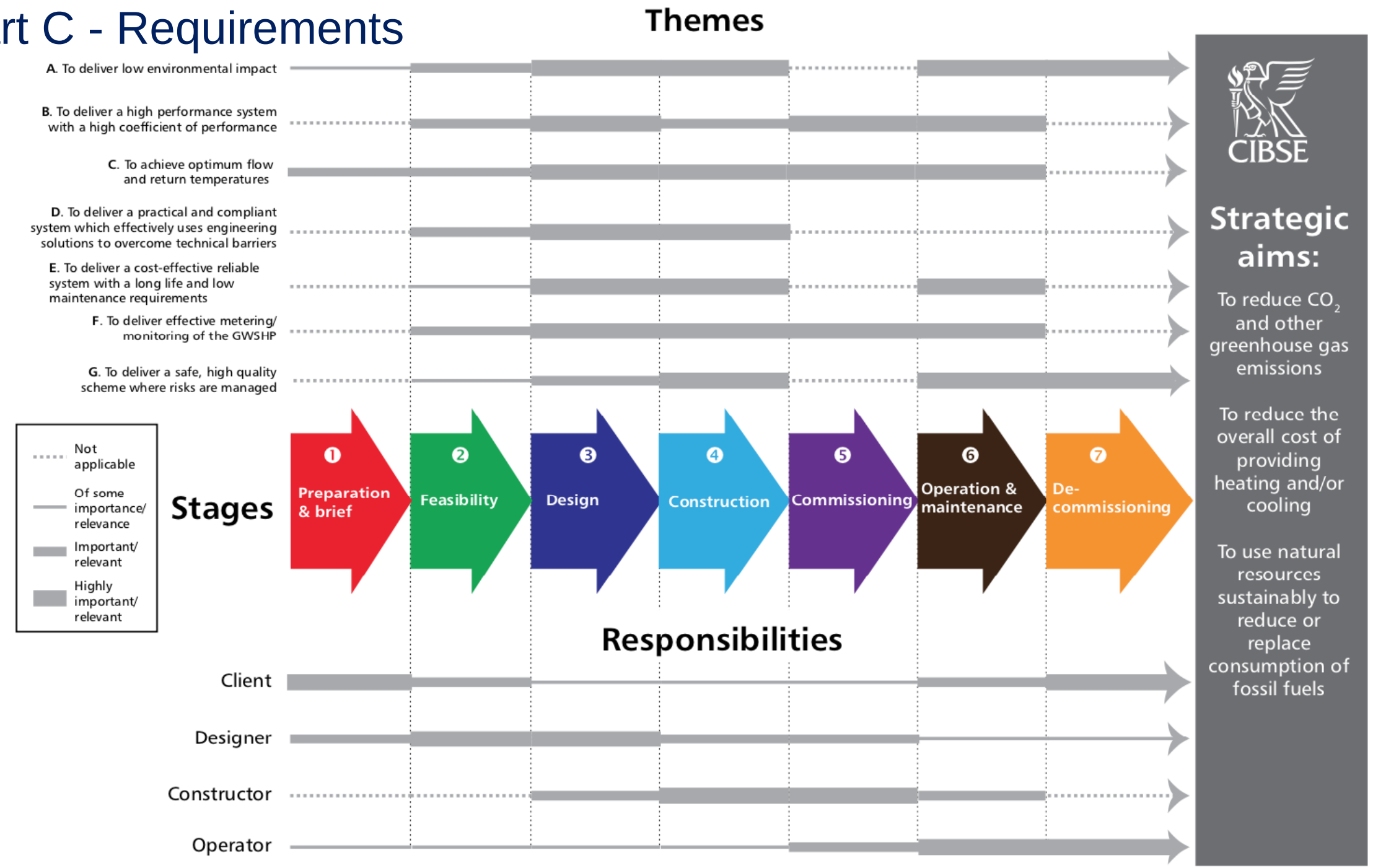
- B3.1 Open-loop doublet systems: abstraction with injection to aquifer
- B3.2 Open-loop systems: abstraction only with discharge to surface water or sewer
- B3.3 Standing column wells (SCWs): abstraction and injection to the same well or shaft
- B3.4 Hybrid and mixed technologies

B4 Challenges and opportunities

- B4.1 Heat networks (load side)
- B4.2 Source side networks (SSN)
- B4.3 Multivector and multivalent systems
- B4.4 Retrofit installations
- B4.5 Free cooling and heating
- B4.6 Aquifer thermal energy storage (ATES)



Part C - Requirements



Objective 3.9: To design a data collection system to accurately record performance

Why is this objective important?

A comprehensive metering and monitoring system is important to ensure ongoing operational performance (see Figure 49 below for typical metering arrangements). The feasibility stage should have established the performance monitoring requirements in line with any permissions necessary, such as abstraction licence and discharge permit (see Objective 2.2). Other requirements, such as metering for relevant grants and incentives, the client's own performance records and other relevant bodies should also be determined (see Appendix C).

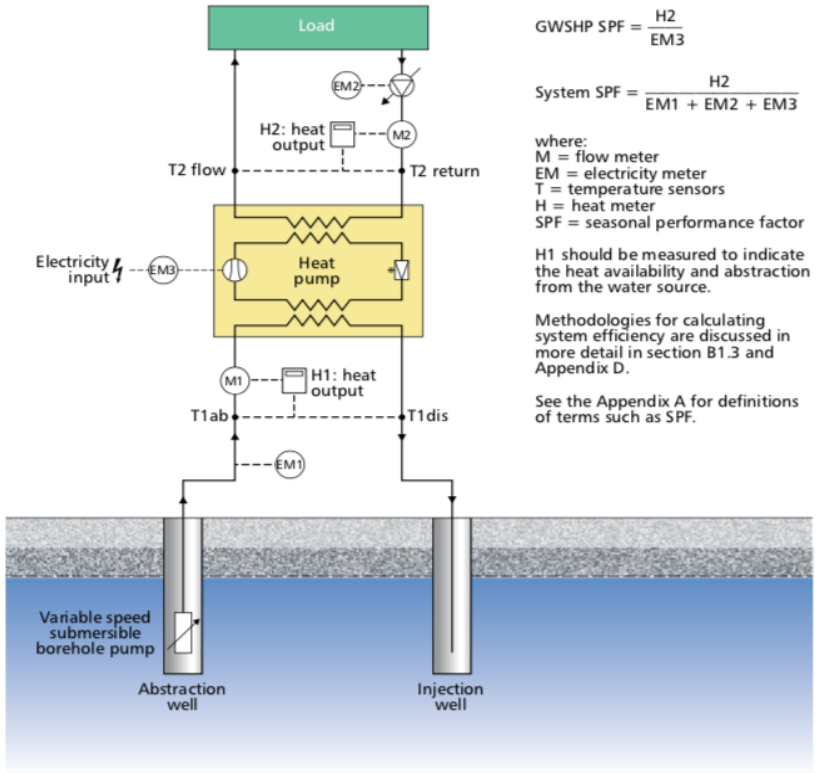


Figure 49 Typical metering arrangements for an open-loop GWSHP system, allowing calculation of the efficiency of the GWSHP and of the overall system (see also section B1.3); additional meters may be required in order to provide more detailed reporting, e.g. for grants and incentives

Modern BMS, BEMS, AMR or SCADA equipment (see Appendix A for definitions) can be used to monitor the installed meters/temperatures to allow ongoing performance to be determined and displayed continuously (see Figure 50).

A more prescriptive written style

Minimum requirements

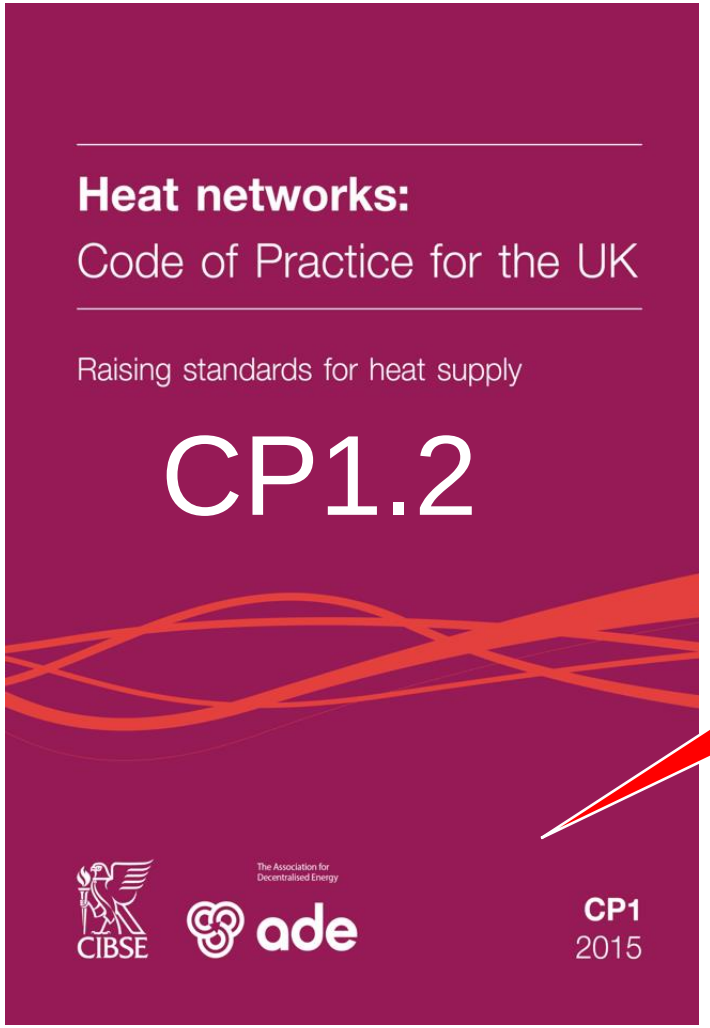
3.9.1 The metering and data system shall be designed to ensure that system efficiency can be measured and recorded. This shall also include the necessary data outputs and reports required for maintenance, environmental permissions and incentive schemes, see Figure 49.

3.9.2 Expected system efficiency shall be calculated to enable comparison at commissioning (5.3.4) and operation and maintenance (6.4.7) stages. (See section B1.3 for suggested methodology.)

'Shall' rather than 'should'

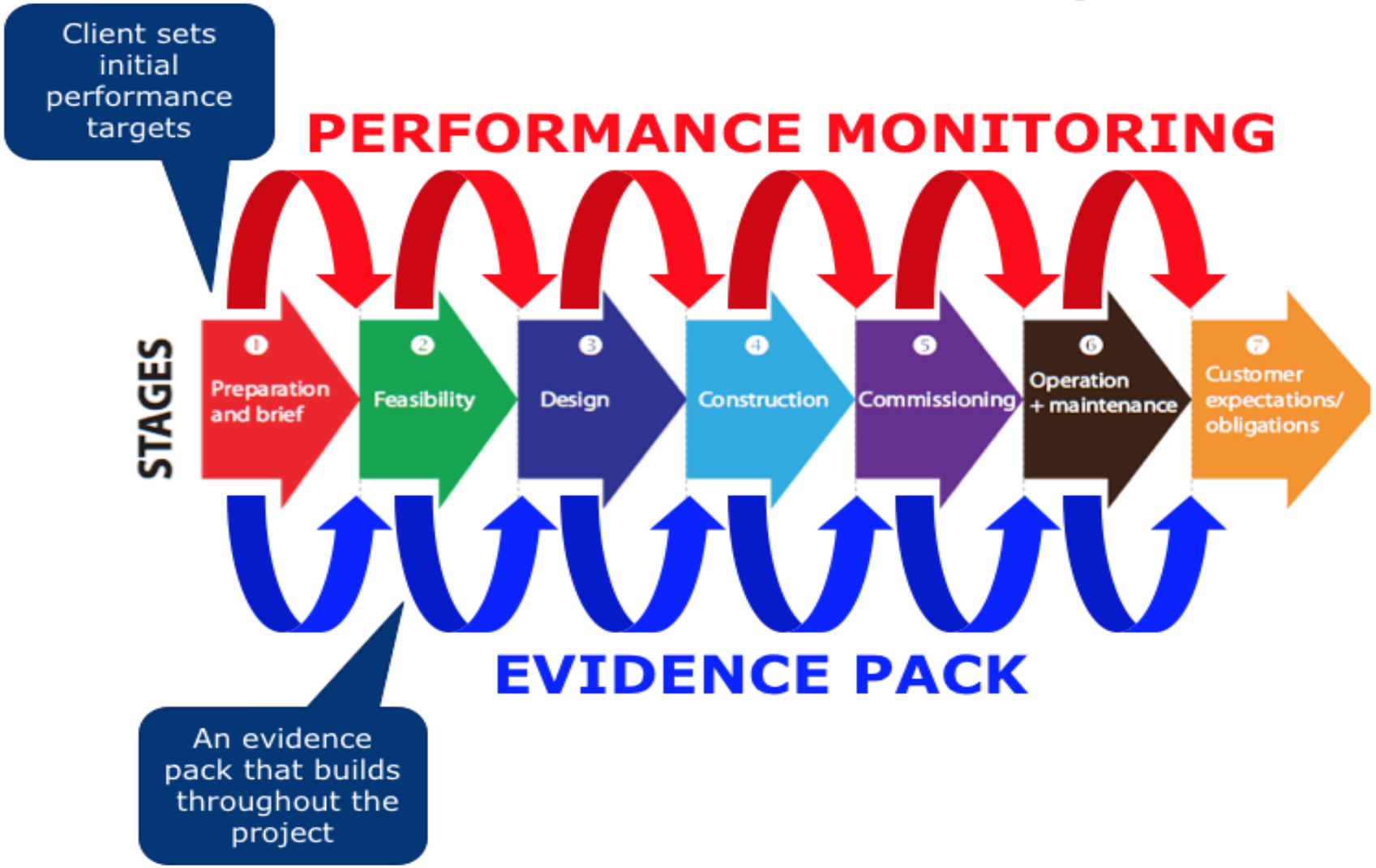
Heat Networks Code of Practice CP1.2

Coming Soon!



Watch this space

The CP1.2 process



The checklists

CP1 STAGE 2 Feasibility checklist

Use the drop-down to colour code columns D-G as per the key and include changes/explanation for variance/exceptions in column H

OBJECTIVE		KEY OUTPUTS	CP1 output developed?	Included in evidence pack?	Output signed-off?	RISK level	Risk mitigation	Change/Reason for variance/Exception
2.1	To achieve sufficient accuracy of peak heat demands and annual heat consumptions	Output 2.1a - Energy (heat, cooling & electricity) mapping report	YES	YES	YES	MEDIUM		
		Output 2.1b - Accurate estimates of heat demands	N/A	N/A	N/A	HIGH		
		Output 2.1c - Predicted future heat demands	N/A	N/A	N/A	HIGH		
		Output 2.1d - Report on potential stakeholders	NO	NO	NO	HIGH		
2.2	To identify the most suitable low carbon heat sources and location of an energy centre	Output 2.2a - Energy Masterplanning report	N/A	N/A	N/A	HIGH		
		Output 2.2b - Heat network energy model	N/A	N/A	N/A	HIGH		
		Output 2.2c - Heat source(s) assessment report	YES	N/A	N/A	HIGH		
		Output 2.2d - Energy centre location report	YES	YES	YES	MEDIUM		
2.3	To determine the location of top-up and standby boilers and use of existing boilers	Output 2.3a - Top-up & standby heat source(s) report	YES	YES	YES	HIGH		
		Output 2..3b - Control strategy report	YES	YES	YES	LOW		
2.4	To select suitable operating temperatures	Output 2.4a - Target operating temperatures report	YES	YES	NO	HIGH		
		Output 2.4b - Network control strategy report	YES	N/A	N/A	HIGH		
		Output 2.4c - Heat Exchanger approach temperatures report	NO	NO	NO	HIGH		
2.5	To define heat network distribution routes, pipe sizes and costs	Output 2.5a - Network pipe routes & sizing report	N/A	N/A	N/A	HIGH		
		Output 2.5b - Initial insulation thickness calculations	NO			HIGH		
		Output 2.5c - Initial network cost calculations	YES	YES	YES	HIGH		
2.6	To determine building connection costs including heat metering	Output 2.6a - Direct/indirect connection report	YES	YES	YES	HIGH		

Evidence pack

Building the evidence pack

Assessing performance against targets

STAGE 2 Feasibility performance targets		STAGE 2 client targets	Calculated & included in evidence pack?	Output signed-off?	RISK level	Risk mitigation	Change/Reason for variance/Exception
ECONOMIC VIABILITY Cost of heat delivered p/kWh (Annual average all inclusive)	ENERGY CENTRE - Average variable cost (p/kWh)		NO	YES	MEDIUM		
	ENERGY CENTRE - Average fixed costs (£/yr)		NO	YES	HIGH		
	BUILDING/BLOCK (Additional to EC) - Average variable cost (p/kWh) [Block by block if different]		YES	YES	HIGH		
	BUILDING/BLOCK (Additional to EC) - Average fixed cost (£/yr) [Block by block if different]		YES	YES	HIGH		
	DWELLING - Average variable cost (p/kWh)		YES	YES	HIGH		
	DWELLING - Average fixed costs (£/dwelling/yr)		YES	YES	HIGH		
ENERGY CENTRE EFFICIENCY (% annual average all inclusive)	ENERGY CENTRE PLANT EFFICIENCY (%) of each plant item e.g. LZC1, LZC2, Boilers etc		YES	YES	HIGH		
NETWORK HEAT LOSSES (Annual average kWh/yr)	ENERGY CENTRE - Primary heat network loss (kWh/yr)		YES	YES	HIGH		
	BUILDING/BLOCK - Average primary Summer return temperature at the building/block (°C)		YES	YES	HIGH		
	BUILDING/BLOCK - Average primary Winter return temperature at the building/block (°C)		YES	YES	HIGH		
	BUILDING/BLOCK - Secondary heat network loss (kWh/dwelling/yr)		YES	YES	HIGH		
	DWELLING - HIU Average return temperature based on HIU performance and space heating design and set up (°C)		YES	YES	HIGH		
	DWELLING - HIU standby heat losses (W)		YES	YES	HIGH		
	DWELLING - Time to deliver 45°C to the kitchen tap		YES	YES	HIGH		
ENVIRONMENTAL Heat carbon intensity Kg CO_2/kWh heat	ENERGY CENTRE - Kg CO_2/kWh heat (Annual average all inclusive)		YES	YES	HIGH		

Does it do what the client asked for in the first place?

Sign-off at each stage

STAGE 2 Feasibility SIGN-OFF			STAGE 2 fully signed-off?	Date both fully signed-off?	KEY Risk mitigation actions	KEY Changes/Reason for variance/Exception
Have all the CP1 outputs been produced for STAGE 2?	*Client signature*	*Client technical advisor signature*	YES			
Have all the agreed performance targets been set for STAGE 2?	*Client signature*	*Client technical advisor signature*	N/A			
Have the STAGE 2 outputs/targets been included in the evidence pack?	*Client signature*	*Client technical advisor signature*	NO			
Has the level of risk been allocated to the STAGE 2 outputs/targets?	*Client signature*	*Client technical advisor signature*				
Has an optional independent assessment been carried out and reported to the client	*Client signature*	*Heat Network Consultant signatur*	YES			

A more formalised approach right across the supply chain

GSHP association

HPA HEAT PUMP ASSOCIATION

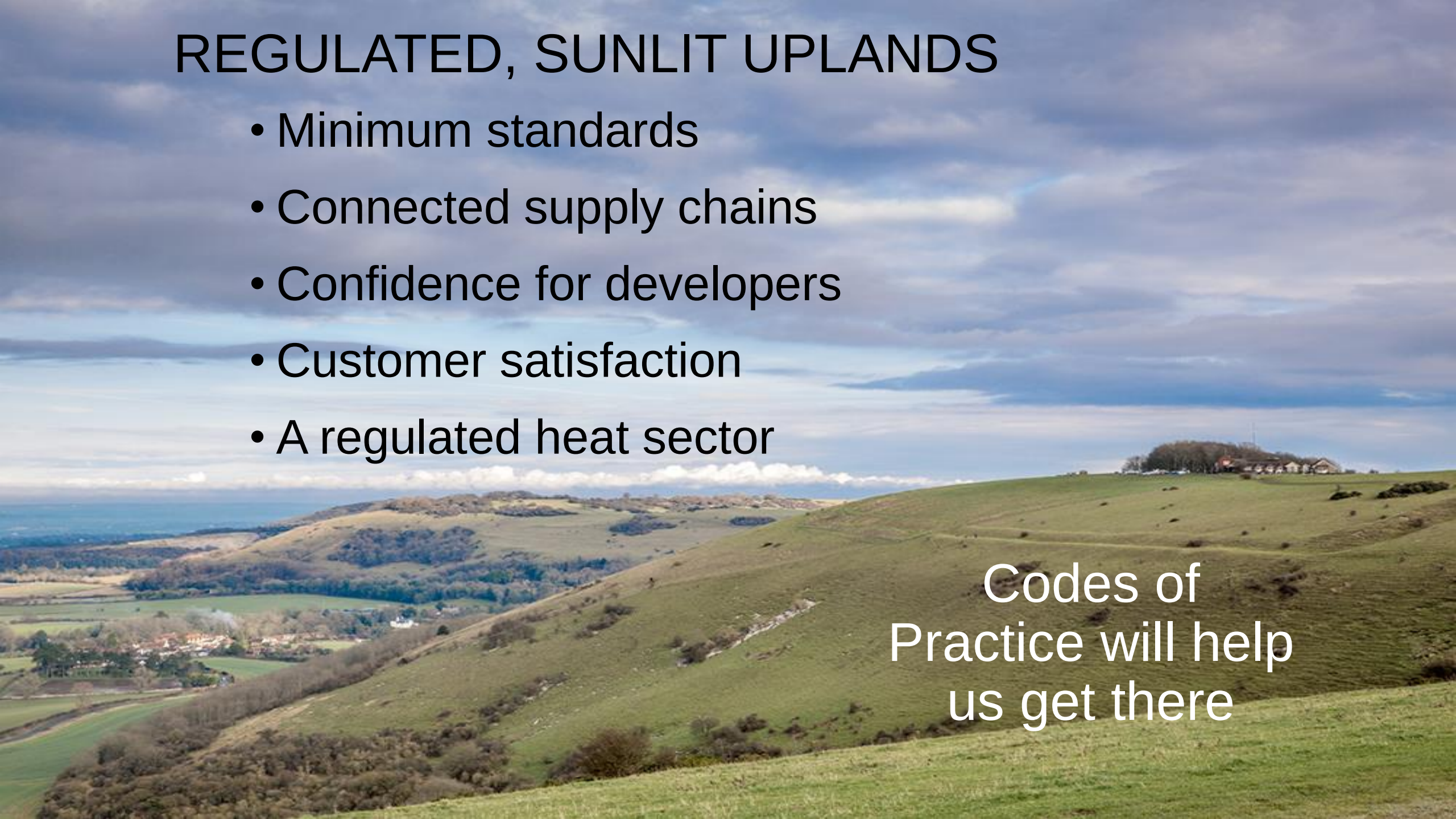
CIBSE

THE HEAT SECTOR JUNGLE

- An unregulated forest
- Unconnected supply chains
- Developers lack confidence
- Customer dissatisfaction

REGULATED, SUNLIT UPLANDS

- Minimum standards
- Connected supply chains
- Confidence for developers
- Customer satisfaction
- A regulated heat sector



Codes of Practice will help us get there

May the Code be with you!

CP3 - Open-loop groundwater source heat pumps

Harnessing energy from water in the ground for heating and cooling

philjones100@virginmedia.com
07714 203045

Open-loop groundwater source heat pumps:
Code of Practice for the UK

Harnessing energy for heating and cooling from water in the ground

CIBSE HPA GSHP association

CP3
2019