A NEW CODE OF PRACTICE FOR SURFACE WATER SOURCE HEAT PUMPS

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Building Energy Solutions

www.cibse.org/CP2

SURFACE WATER source heat pumps

- Sea, rivers, canals & lakes are huge renewable source of energy
- Huge opportunity to provide low carbon heating/cooling to buildings
- Under-used low carbon technology
- Nascent technology compared to GSHP
- Need clear minimum standards to ensure good feasibility, design, construction & operation
- DECC are supporting/encouraging
- Renewable Heat Incentive available

The Code of Practice

- Voluntary code
- Minimum standards, not guidance
- New build & existing
- Small & large
- Heating & cooling
- For the whole supply chain
- For client tendering
- Underpins training
- Launched online March 2016

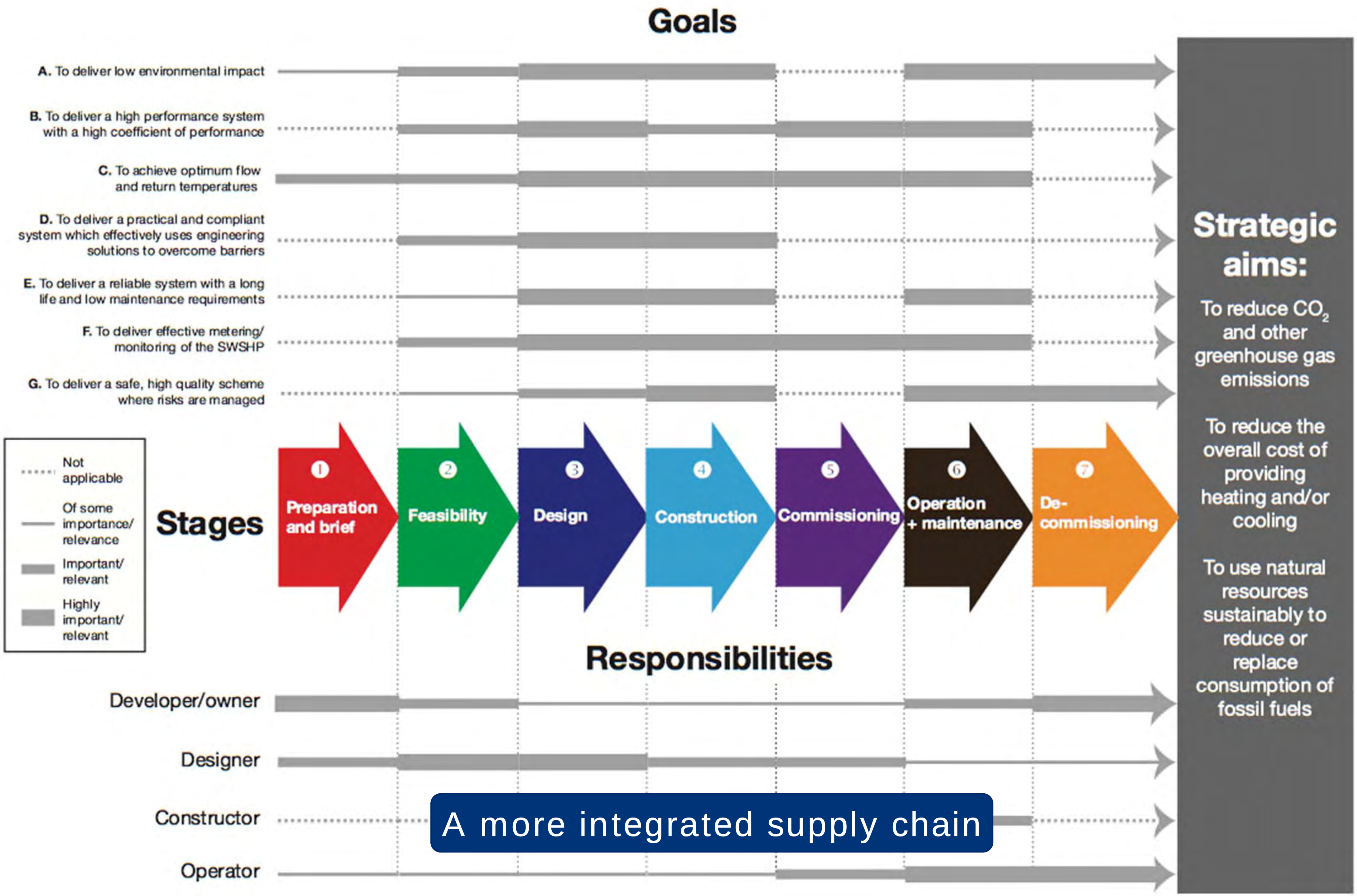
Steering Committee → Author

CIBSE CHP&DH Group

GSHP association

HPA HEAT PUMP ASSOCIATION

CP2 SWSHPs Code of Practice



A more integrated supply chain

1. Preparation and briefing

Objectives:

1.1 To commission the project in accordance with the Code of Practice

1.2 To develop the specification/project brief

Key support tasks:

- ☑ Review feedback from previous projects
- ☑ Pre-application discussions with statutory and regulatory bodies
- ☑ Research opportunities for collaboration
- ☑ Agree schedule of services, design responsibility matrix and information exchange
- ☑ Prepare project delivery plan, including technology and communication strategies and consideration of common standards to be used

Information exchange to next stage (feasibility consultant):

- Strategic brief
- Project specification
- Initial project brief

Standards not set before

2. Feasibility

Objectives (see also Figure 35):

2.1 To assess environmental impacts and benefits

2.2 To identify and quantify the most suitable surface water source and the best method for energy exchange

2.3 To determine what permissions are necessary to access the water

2.4 To determine heat pump location and water abstraction and discharge (or closed loop heat exchanger) details, including cost estimates

2.5 To accurately estimate peak and seasonal heating and cooling demands

2.6 To agree suitable load-side operating flow rates and control strategies

2.7 To select the most appropriate heat pump system

2.8 To assess operation and maintenance needs and costs

2.9 To conduct a financial analysis in order to comprehensively evaluate the installation options

2.10 To analyse risks and carry out a sensitivity analysis

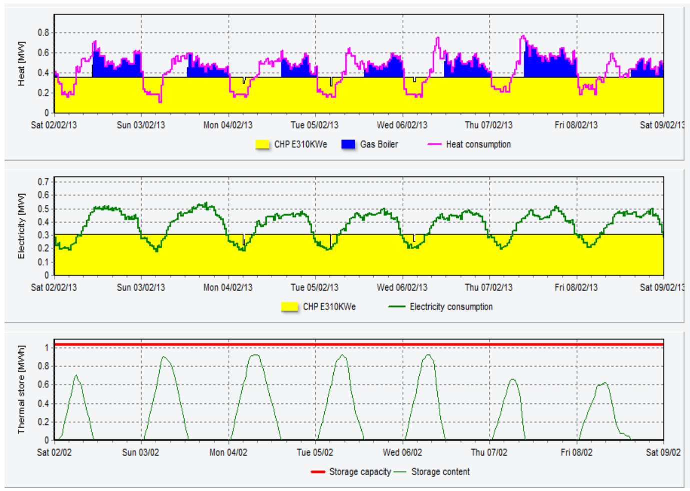
Key support tasks:

- ☑ Review client brief
- ☑ Further pre-application discussions with statutory and regulatory bodies
- ☑ Prepare risk assessments
- ☑ Undertake third party consultations as required and any research and development aspects
- ☑ Review and update implementation plan
- ☑ Develop: sustainability strategy, maintenance and operational strategy, construction strategy, health and safety strategy

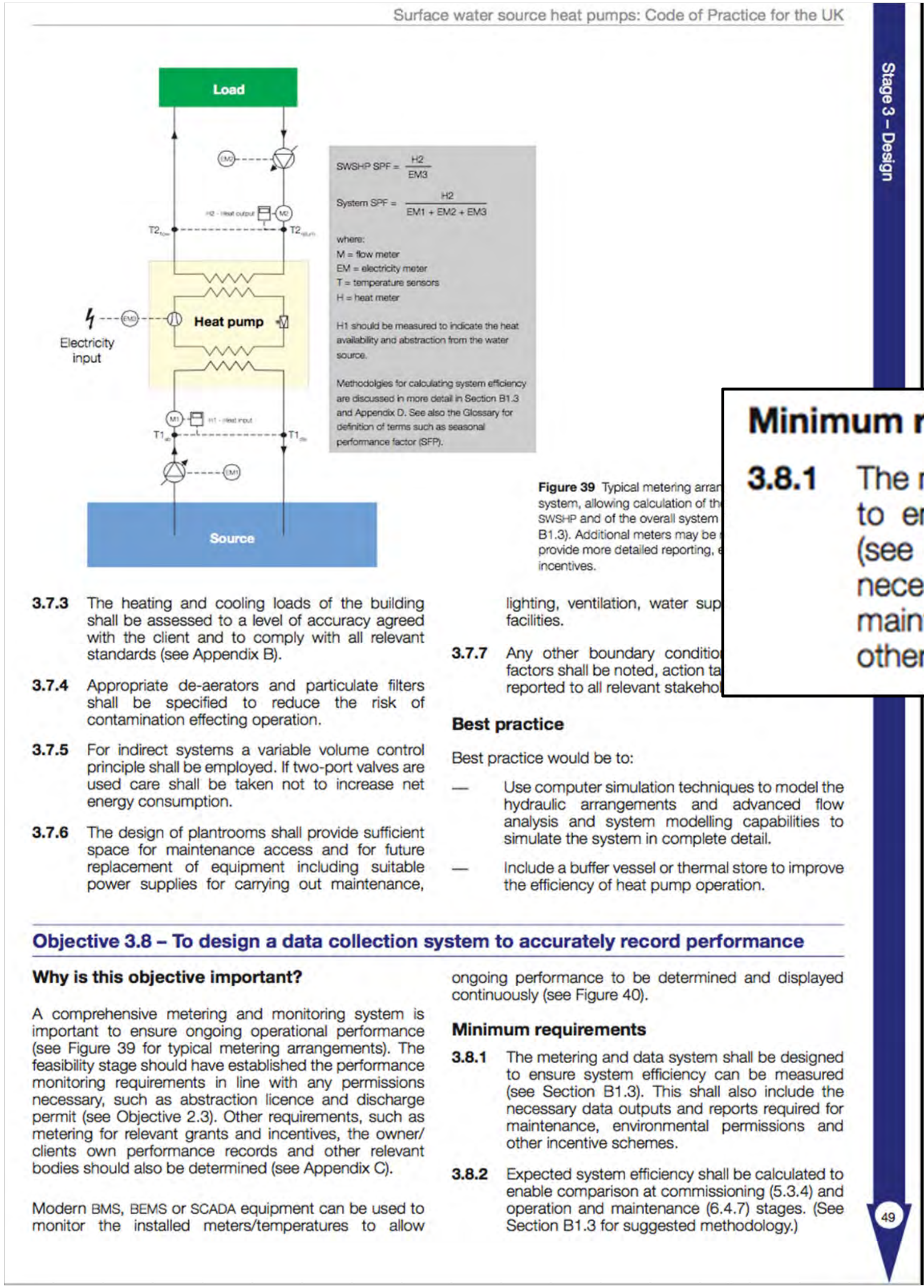
Information exchange to next stage (design team):

- Feasibility study
- Concept design, including outline structural and building services design
- Associated project strategies
- Preliminary cost information

Projects often go wrong at this early stage



Standards not set before



Surface water source heat pumps: Code of Practice for the UK

Stage 3 – Design

SWSHP SPF = H2 / EM3

System SPF = H2 / (EM1 + EM2 + EM3)

where:
M = flow meter
EM = electricity meter
T = temperature sensors
H = heat meter

H1 should be measured to indicate the heat availability and abstraction from the water source.

Methodolgies for calculating system efficiency are discussed in more detail in Section B1.3 and Appendix D. See also the Glossary for definition of terms such as seasonal performance factor (SFP).

Figure 39 Typical metering arran[...] system, allowing calculation of th[...] SWSHP and of the overall system [...] B1.3). Additional meters may be [...] provide more detailed reporting, [...] incentives.

3.7.3 The heating and cooling loads of the building shall be assessed to a level of accuracy agreed with the client and to comply with all relevant standards (see Appendix B).

3.7.4 Appropriate de-aerators and particulate filters shall be specified to reduce the risk of contamination effecting operation.

3.7.5 For indirect systems a variable volume control principle shall be employed. If two-port valves are used care shall be taken not to increase net energy consumption.

3.7.6 The design of plantrooms shall provide sufficient space for maintenance access and for future replacement of equipment including suitable power supplies for carrying out maintenance, lighting, ventilation, water sup[...] facilities.

3.7.7 Any other boundary conditio[...] factors shall be noted, action ta[...] reported to all relevant stakeho[...]

Best practice

Best practice would be to:

— Use computer simulation techniques to model the hydraulic arrangements and advanced flow analysis and system modelling capabilities to simulate the system in complete detail.

— Include a buffer vessel or thermal store to improve the efficiency of heat pump operation.

Objective 3.8 – 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 39 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 2.3). Other requirements, such as metering for relevant grants and incentives, the owner/clients own performance records and other relevant bodies should also be determined (see Appendix C).

Modern BMS, BEMS or SCADA equipment can be used to monitor the installed meters/temperatures to allow ongoing performance to be determined and displayed continuously (see Figure 40).

Minimum requirements

3.8.1 The metering and data system shall be designed to ensure system efficiency can be measured (see Section B1.3). This shall also include the necessary data outputs and reports required for maintenance, environmental permissions and other incentive schemes.

3.8.2 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.)

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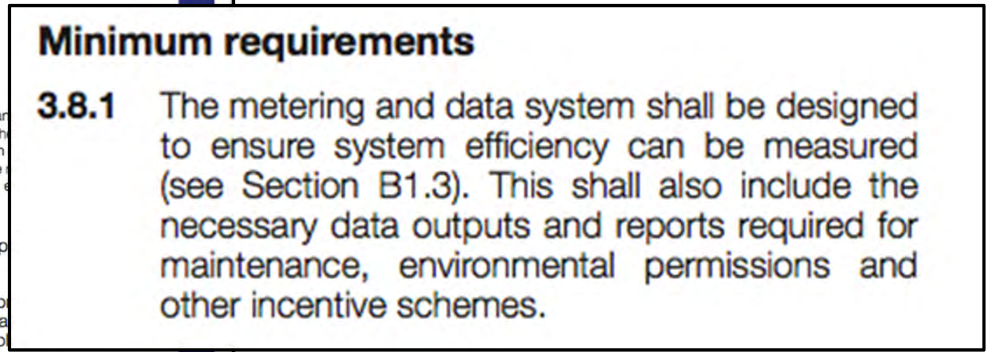

Minimum requirements

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New CIBSE written style

'Shall' rather than should

Case studies to show approaches/issues

6. Operation and maintenance

Objectives:

6.1 To reduce health and safety risks to staff, customers and the general public

6.2 To minimise environmental impacts of operation and maintenance

6.3 To deliver a cost-effective efficient maintenance schedule that maxim system efficiency, reliability and asset life

6.4 To provide appropriate monitoring and reporting, including reliability a CO_2 emissions

Key support tasks:

- ☑ Conclude activities listed in handover strategy, including post-occupancy evaluation, review of project performance, project outcomes and research and development aspects
- ☑ Updating of project information, as required, in response to ongo client feedback until the end of the building's life

Information exchange (to owner/developer):

- Annual reports and regular performance monitoring reports (inclu problems and remedial works), as agreed
- All data and feedback to owner/developer including planned and unplanned maintenance reports and costs

7. Decommissioning

Objectives:

7.1 To decommission the heat pump

7.2 To decommission the source side

Key support tasks:

- ☑ Produce decommissioning plan
- ☑ Engage with Environment Agency and other regulatory bodies on processes of decommissioning and the level of requirements for site reinstatement

Information exchange (to decommissioning team and regulatory bodies):

- Decommissioning plan
- Reports in line with F-Gas and other regulations
- Reports to Environment Agency and other regulatory bodies as required
- Report to owner/operator

The whole supply chain

Key goals that run across all stages of the plan of work

A. Low environmental impact

B. High performance system

C. Optimum flow & return temperatures

D. Practical/compliant engineering system

E. Reliable system, long life & low maintenance

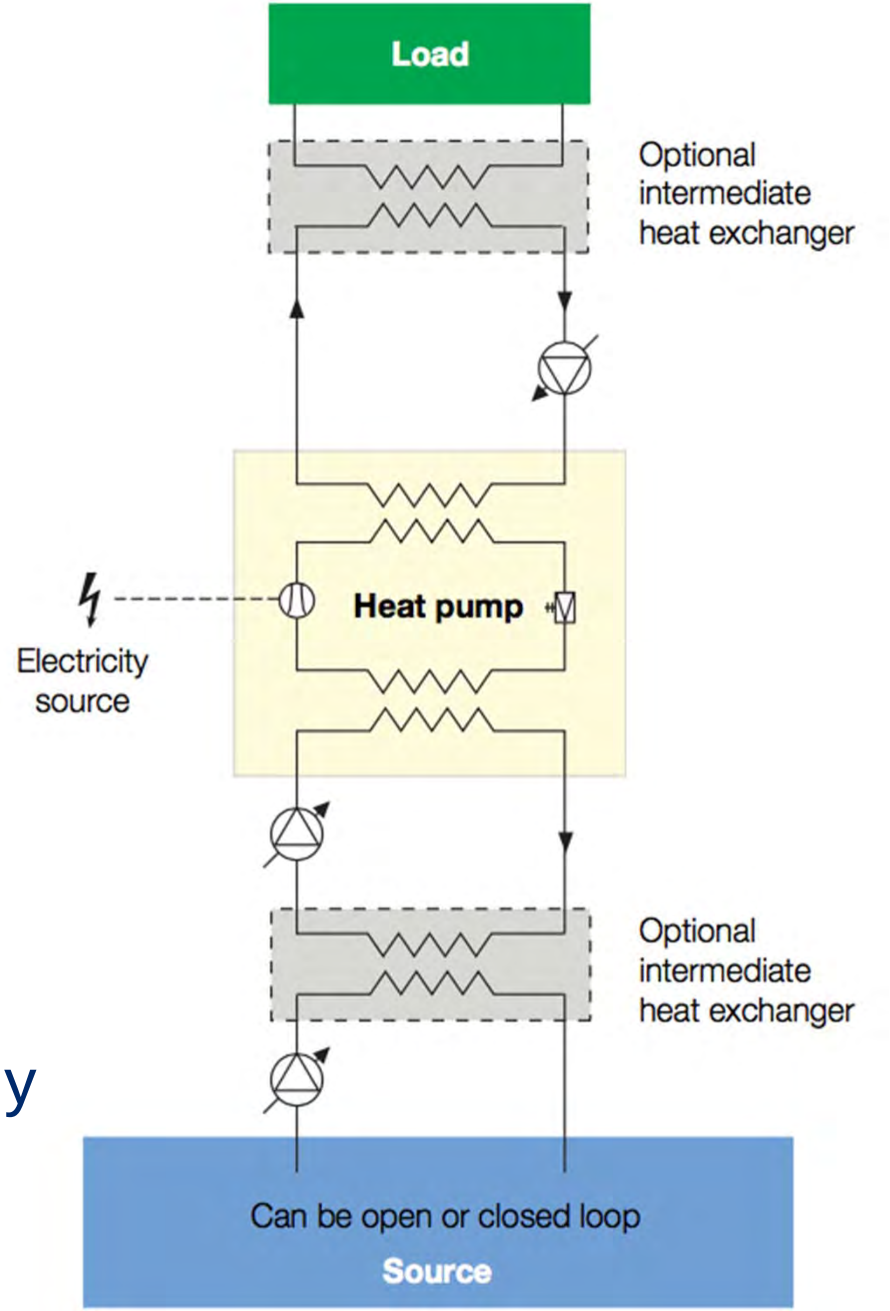
F. Effective metering/monitoring of the SWSHP

G. Safe, high quality scheme

But these goals are linked!

SURFACE WSHPs

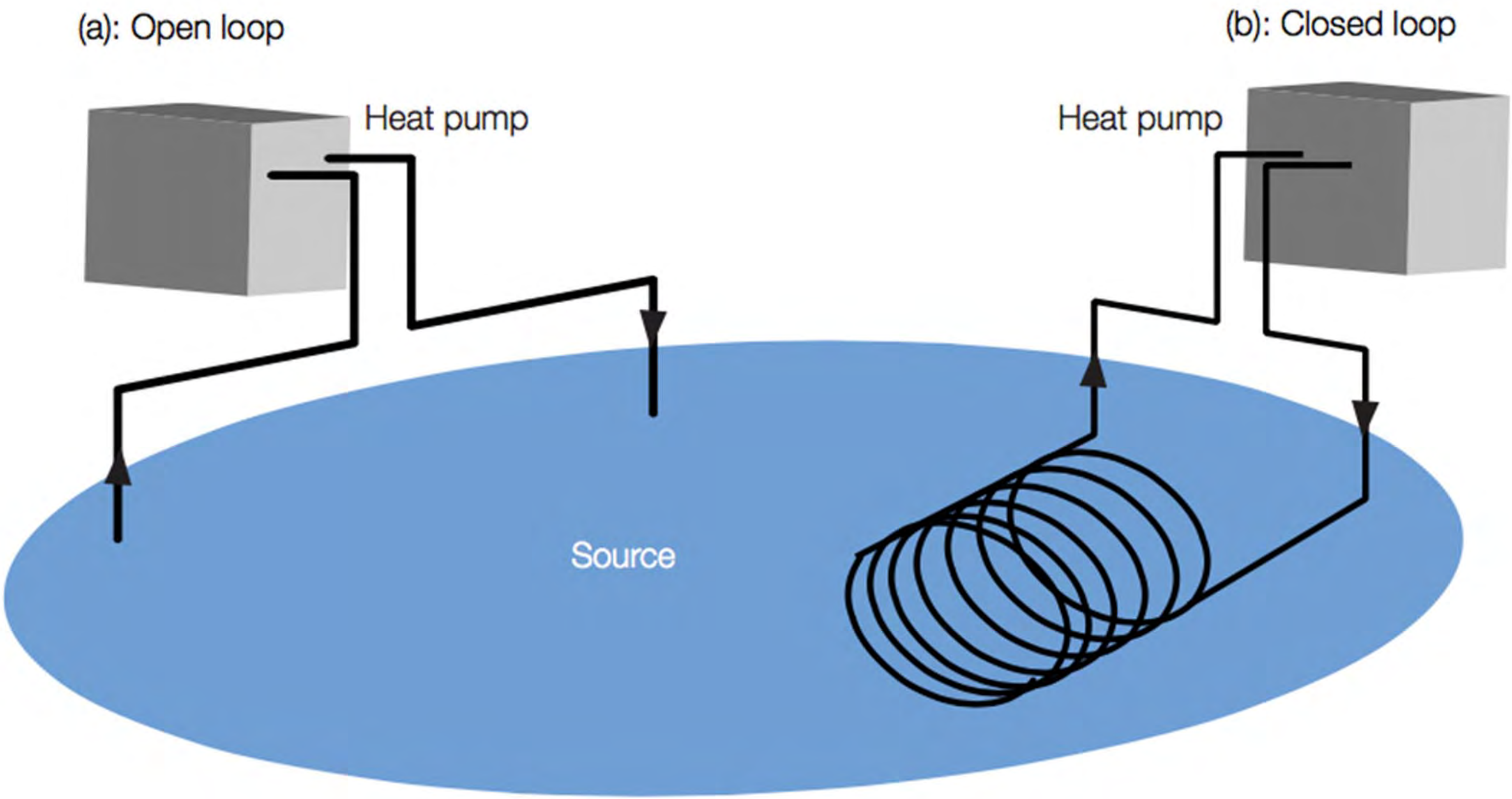
- Supply temperature?
- Heating or cooling?
- Sizing? (monovalent)
- Water source?
- Open or closed loop?
- Abstraction-discharge $\Delta T = 3°C$
- Civils design & costs
- Environmental & regulatory issues



Source characteristics

Sea (see Section B2.1)	— Relatively constant source temperatures — Saline — Stratification — Riparian activities can be an issue e.g. affecting submerged pipework — Fish and other marine life including, molluscs, shellfish and crustaceans — Storms and tidal — Detritus, such as plastic bags	RNLI (multiple projects)
Canal (see Section B2.4)	— Very slow water movement with temperatures range from 2 °C to 25 °C across the year — Boats and canoeing — Sludge and accretions — Regular dredging and other riparian activities can be an issue effecting submerged pipework — Detritus, such as plastic bags, shopping trolleys etc. — Riparian activities can be an issue, e.g. affecting submerged pipework — In urban areas, greater potential for vandalism — Fish and other aquatic life including, molluscs, shellfish and crustaceans	GlaxoSmithKline, London

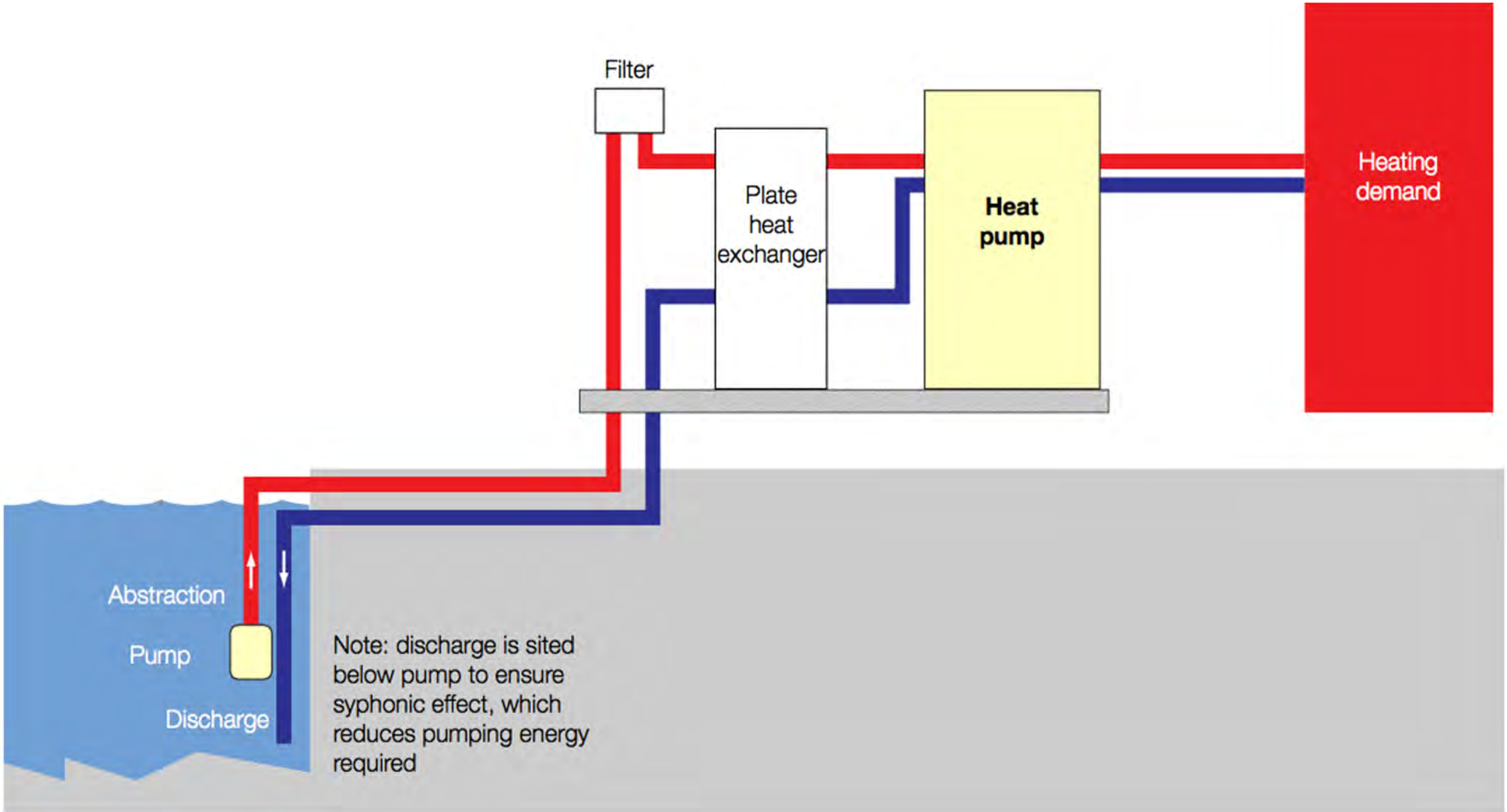
Open or closed?



Closed loop

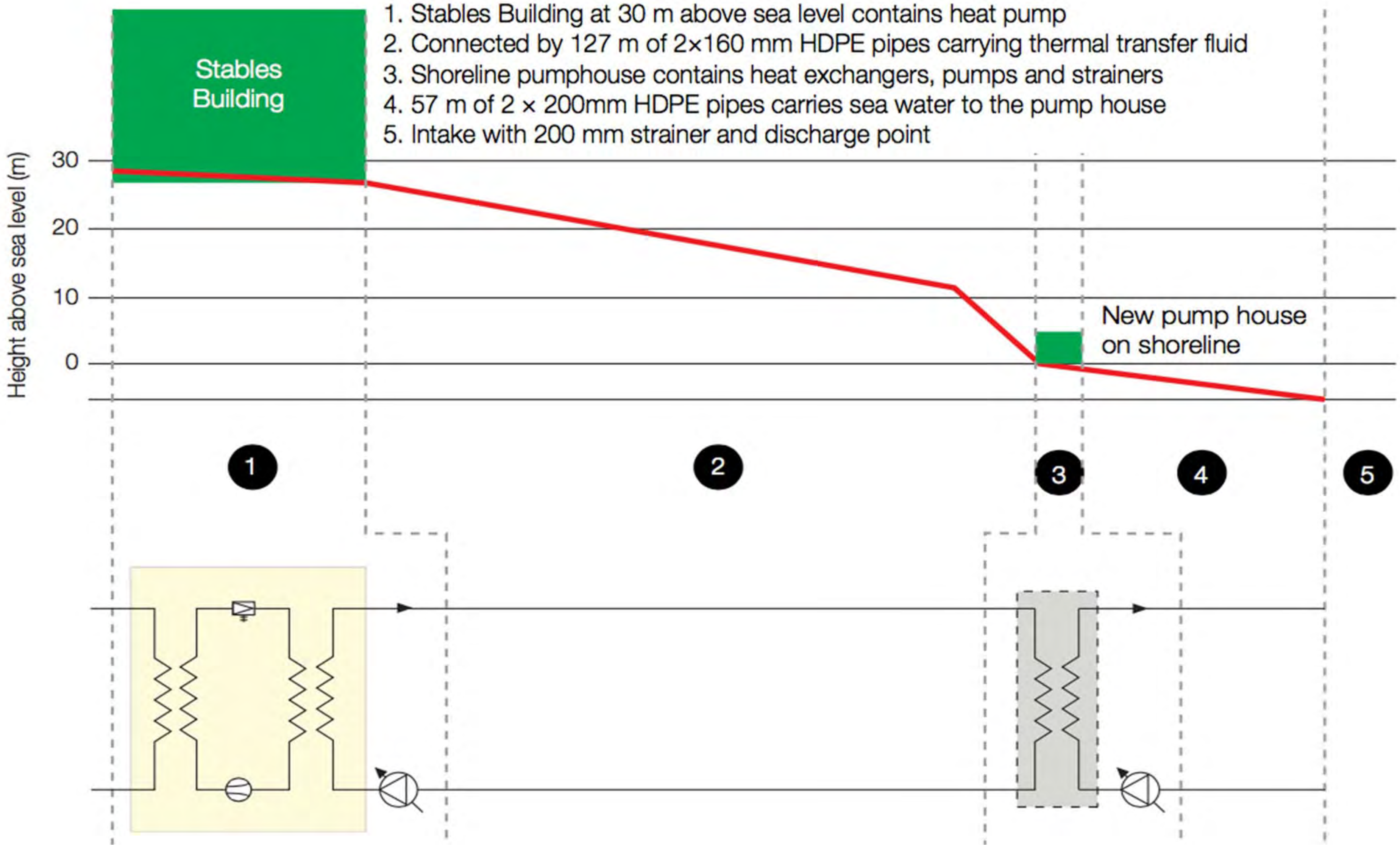
RNLI Kinsale (Closed loop)

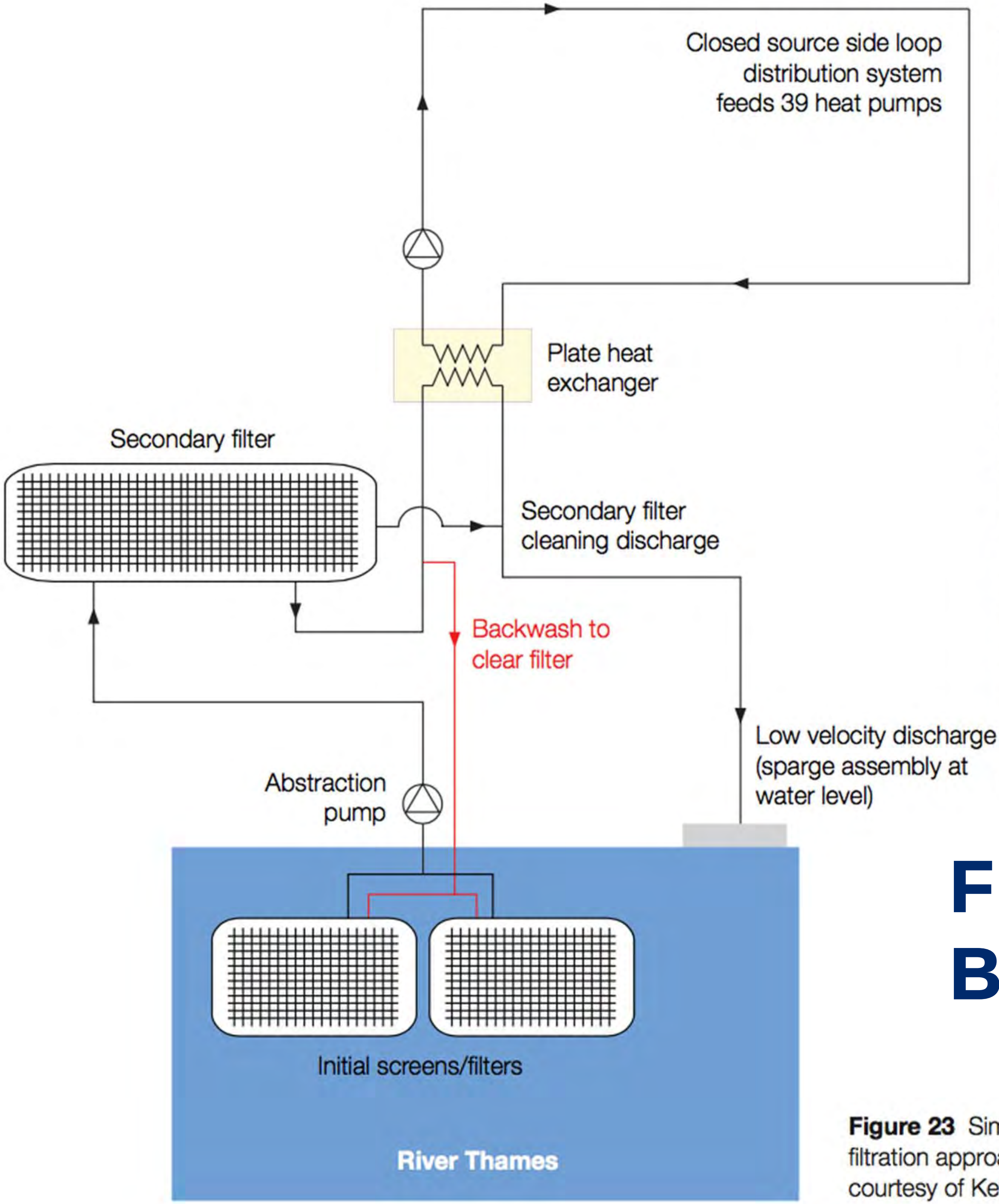
RNLI (Open Loop)




National Trust
Plas Nwyd

Plas Nwyd

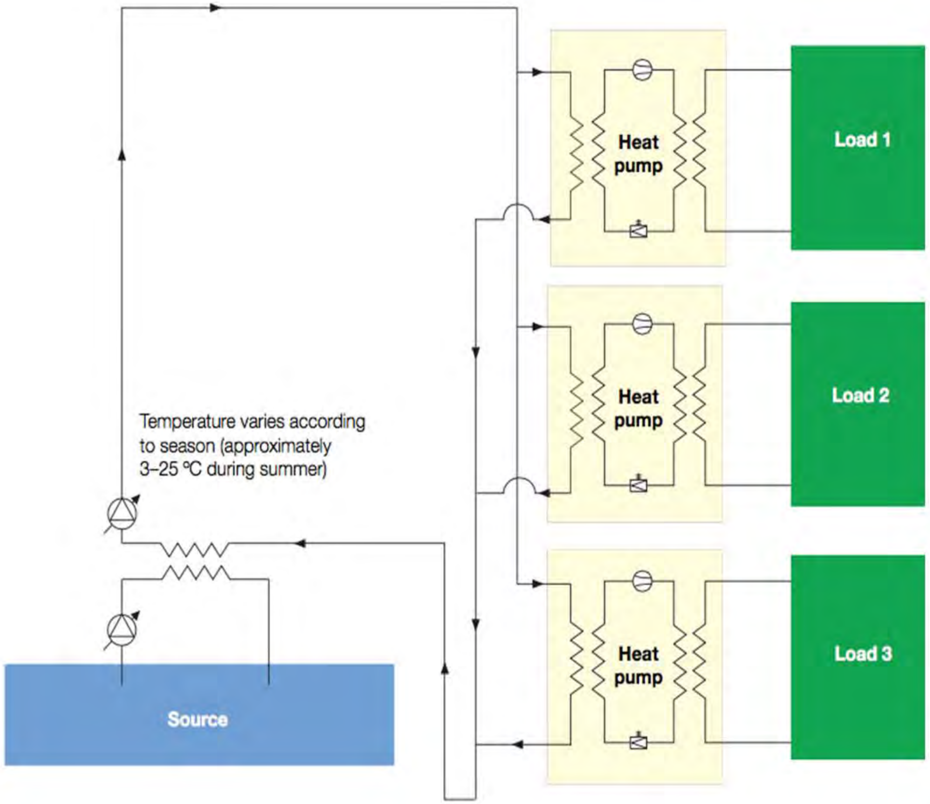

Stables Building
1. Stables Building at 30 m above sea level contains heat pump
2. Connected by 127 m of 2×160 mm HDPE pipes carrying thermal transfer fluid
3. Shoreline pumphouse contains heat exchangers, pumps and strainers
4. 57 m of 2 × 200mm HDPE pipes carries sea water to the pump house
5. Intake with 200 mm strainer and discharge point
Height above sea level (m)
30
20
10
0
New pump house on shoreline
1
2
3
4
5



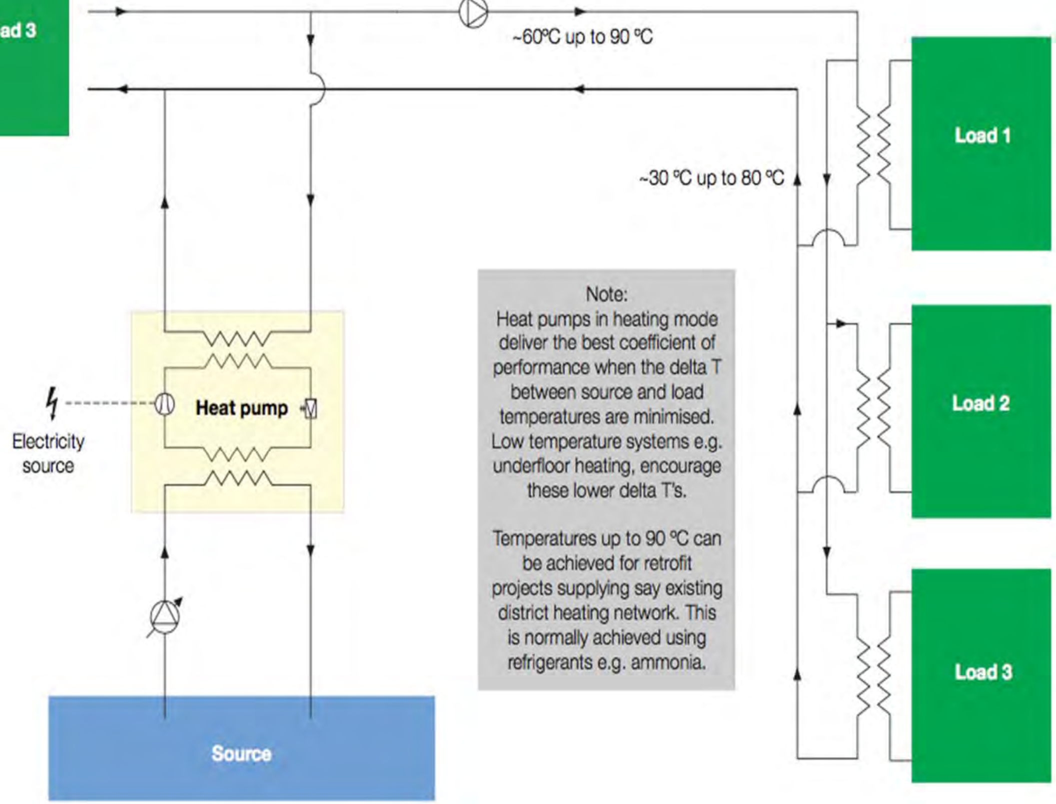
Filtration & Backwash

Figure 23 Simplified schematic showing the two stage filtration approach used at Kingston Heights (reproduced courtesy of Kevin Byrne)

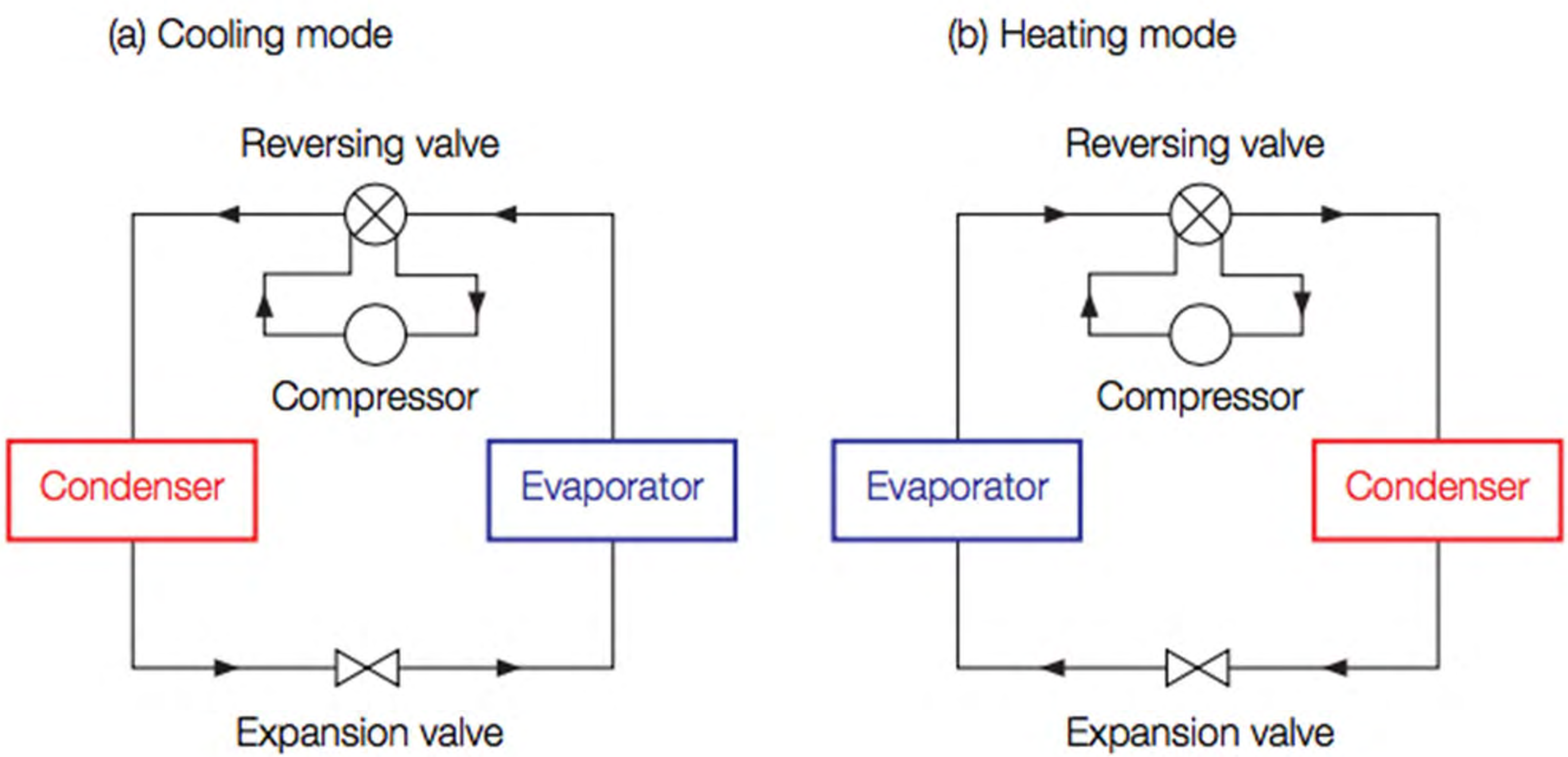
SWSHP Case Studies



- Source side loop (Kingston)
- Load side loop [Heat Network] (Drammen)



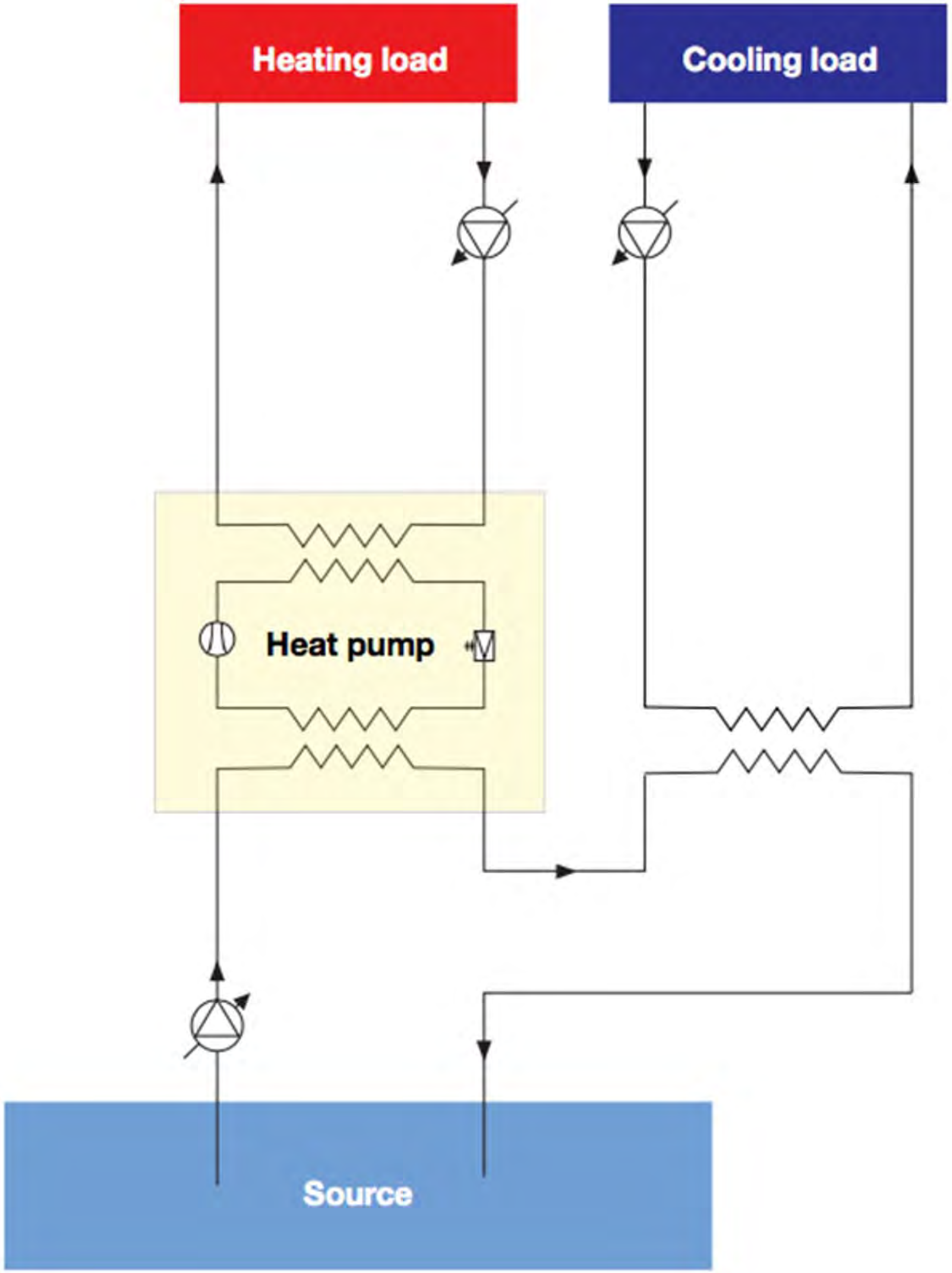
Reversible SWSHPs to provide Heating & Cooling



THE THREE DEGREES !

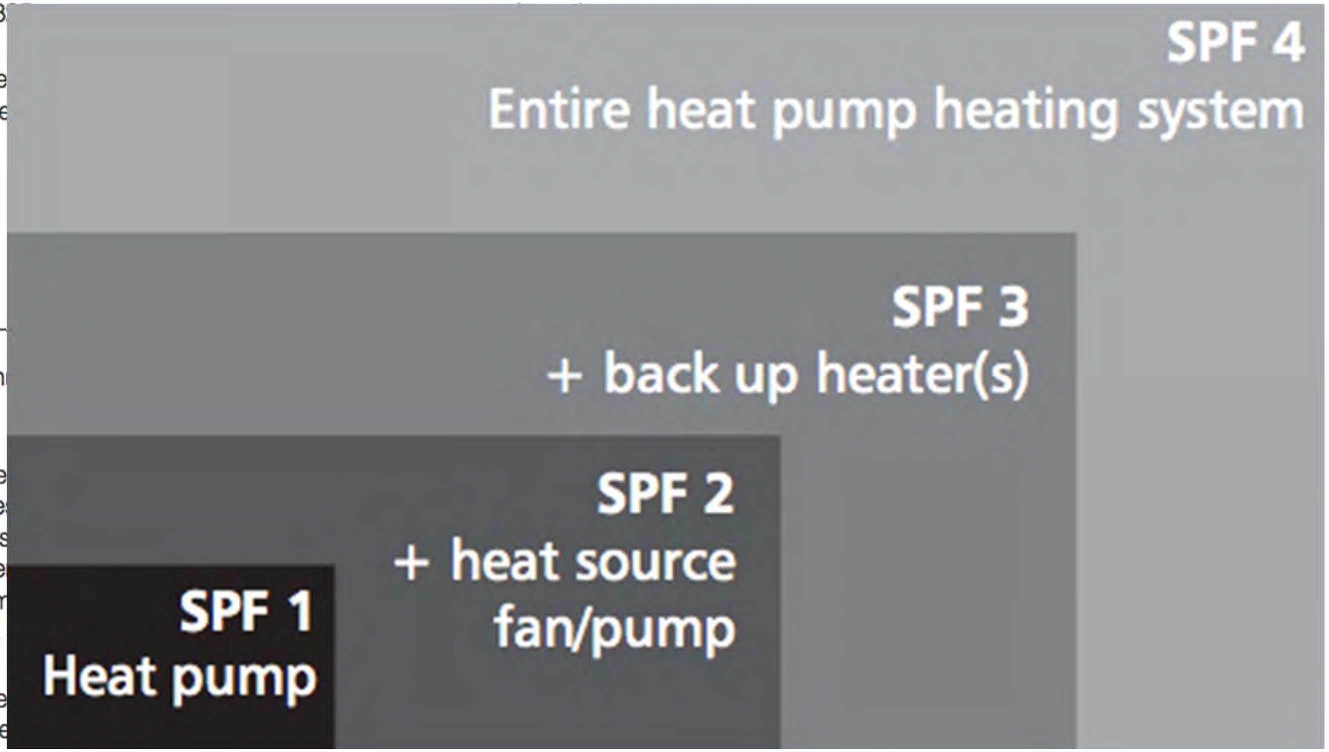
Aim for
ΔT = 3°C

Cool down then heat back up?

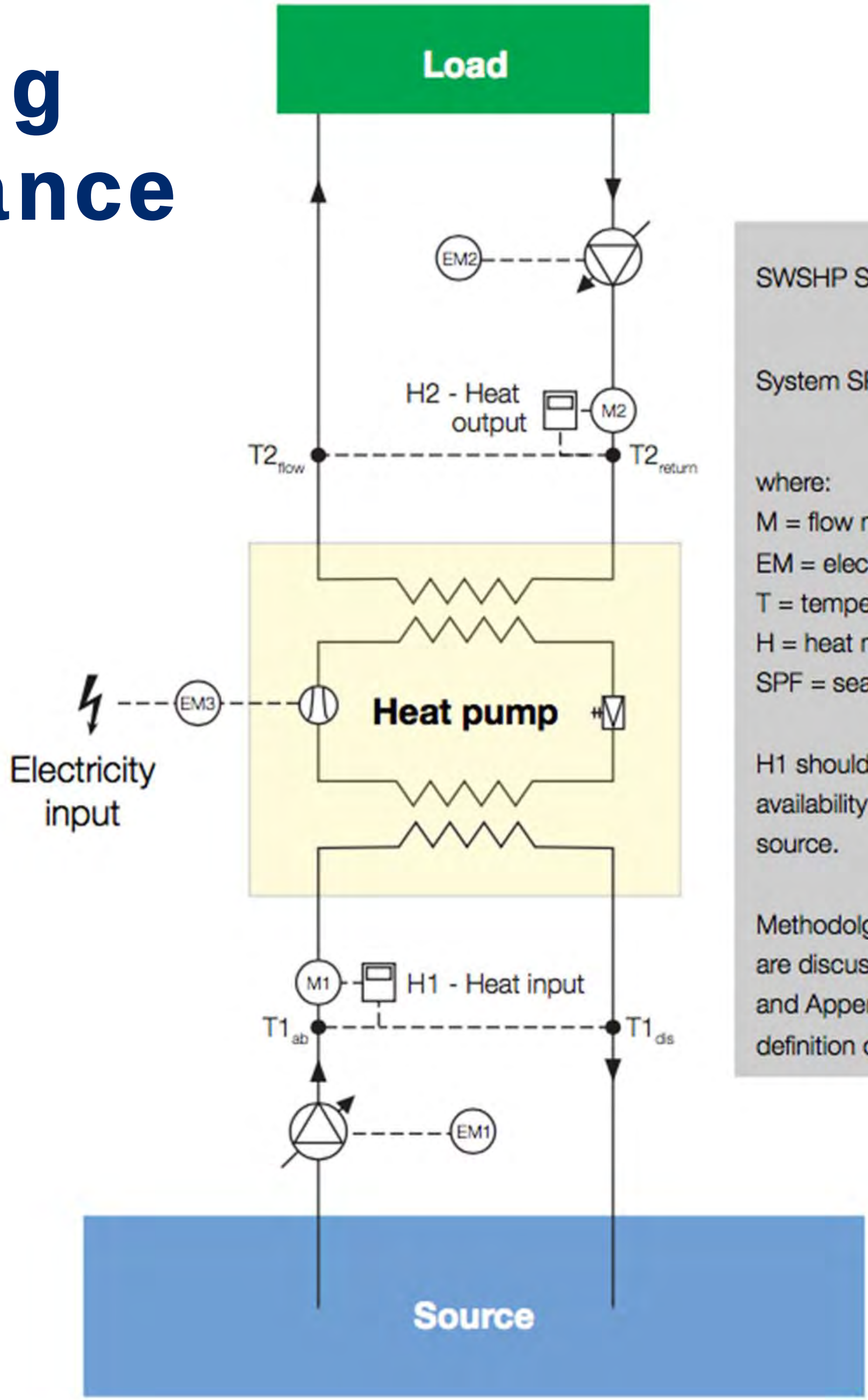


MEASURING PERFORMANCE

Methodology*	Type	Definition	Stage	Minimum requirement in this Code of Practice	Why is this important?	Typical system boundary (see Figure 11 and Appendix D)
Coefficient of performance (CoP)	Calculated	Heat output / electrical power input An expression of the efficiency of a machine in heating mode, at a selected source and load temperature. It is an instantaneous figure rather than an average. Expressed as a single figure or sometimes as a percentage.	Feasibility, design, commissioning	n/a	To help select an appropriate heat pump and monitor its performance.	SPF_1
Seasonal coefficient of performance (SCoP)	Calculated	Method for calculating SPF (see below) at design stage, as defined in BS EN 148 Expressed as a single sometimes as a perce	Design	3.8.2	To update calculations made at feasibility stage	SPF_4
Seasonal performance factor (SPF)	Measured	Annual heat out / ann electrical power in A ratio expressing the of a heat pump by de heat output over the s total energy input ove season. Calculation m defined in BS 15316. Expressed as a single sometimes as a perce				



Measuring performance



$$\text{SWSHP SPF} = \frac{H2}{EM3}$$

$$\text{System SPF} = \frac{H2}{EM1 + EM2 + EM3}$$

where:

M = flow meter

EM = electricity meter

T = temperature sensors

H = heat meter

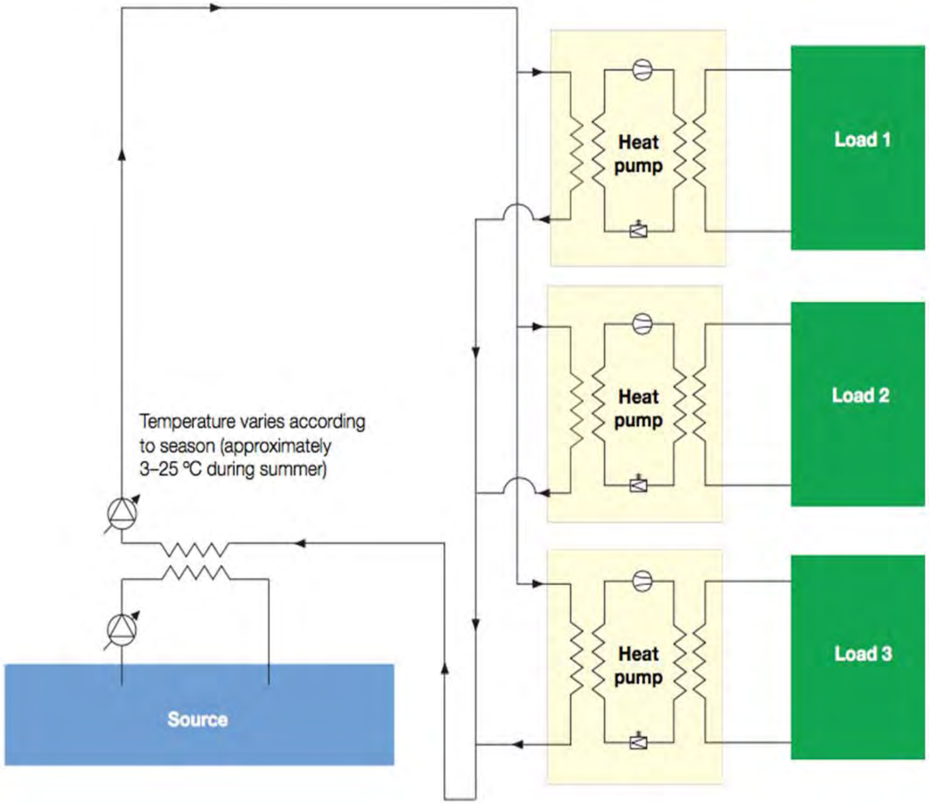
SPF = seasonal performance factor

H1 should be measured to indicate the heat availability and abstraction from the water source.

Methodolgies for calculating system efficiency are discussed in more detail in Section B1.3 and Appendix D. See also the Glossary for definition of terms such as SPF.

Kingston Heights

SWSHP Case Studies



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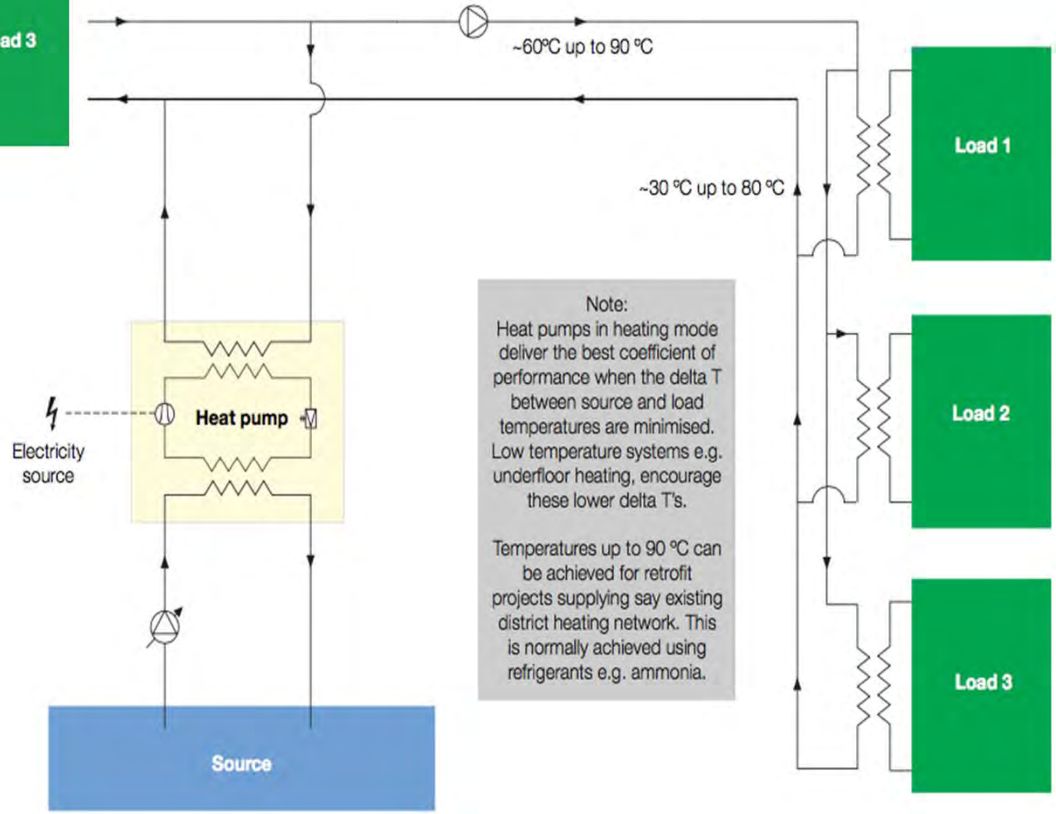
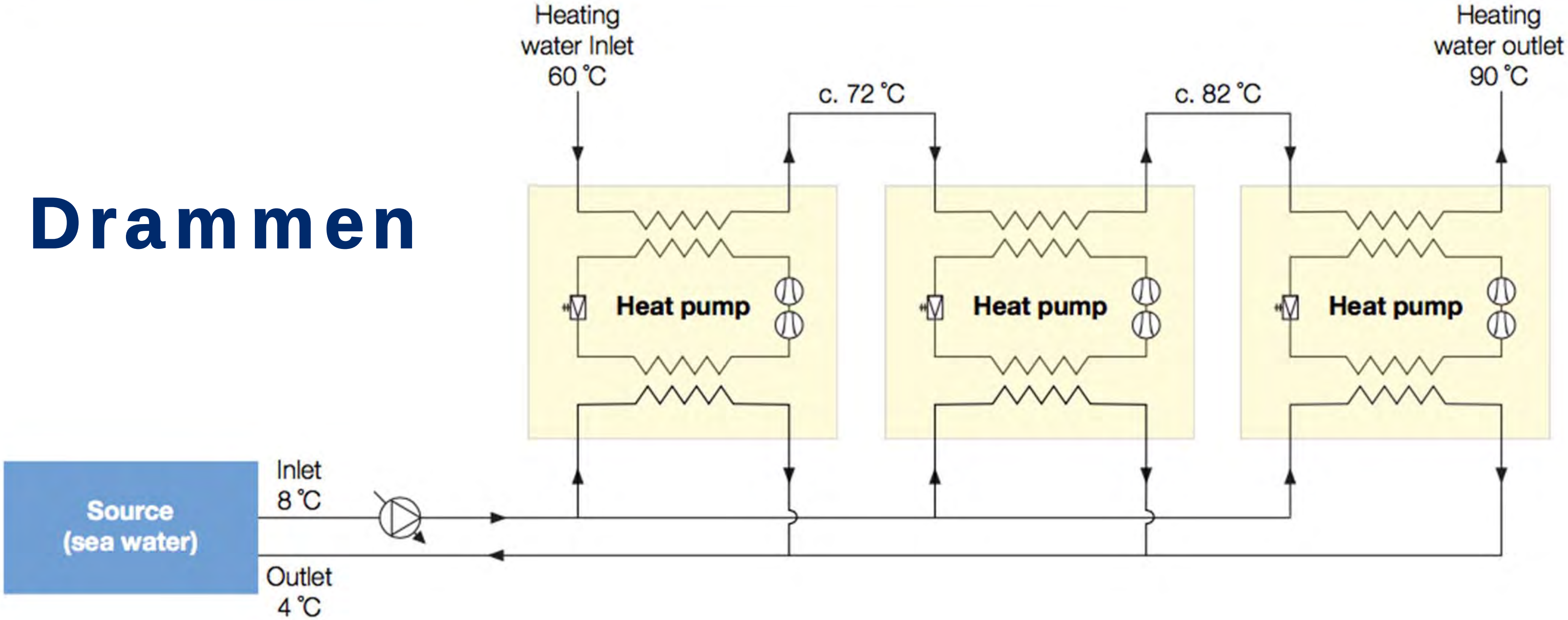
- Load side loop [Heat Network] (Drammen)




Drammen

Drammen


Heating
water Inlet
60 ℃
c. 72 ℃
c. 82 ℃
Heating
water outlet
90 ℃
Heat pump
Heat pump
Heat pump
Source
(sea water)
Inlet
8 ℃
Outlet
4 ℃

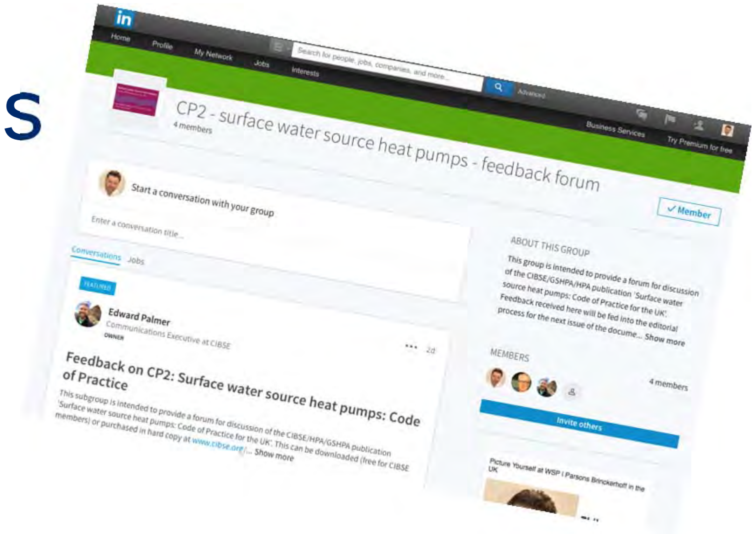

GSK
(Brentford)


GSK
(Brentford)


GSK
(Brentford)

TRAINING

- Trained people essential
- To underpin implementation of standards
- Supported by GSHPA
- Delivered by CP2 authors
- 10-11th May, Balham



FEEDBACK

- www.cibse.org/CP2feedback

Conclusions

- Successful CIBSE/GSHPA/HPA partnership
- Gained industry consensus
- Promotes an under used technology
- Regular review
  - Best practice becomes minimum standard?
- Already being used in projects
  - Indicates the need for standards
- Training in place
- Checking and policing - Maybe in future?

NEXT STEPS

- Look for high heat density opportunities close to rivers, canals etc.
- Look for existing heat networks
- If you are thinking of developing a SWSHP scheme then......
  – DOWNLOAD A COPY OF THE CODE OF PRACTICE
  – FIND SOMEONE WITH TRAINING
  – CARRY OUT A THOROUGH FEASIBILITY STUDY

May the Code be with you....

Harnessing energy from the sea, rivers, canals and lakes

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