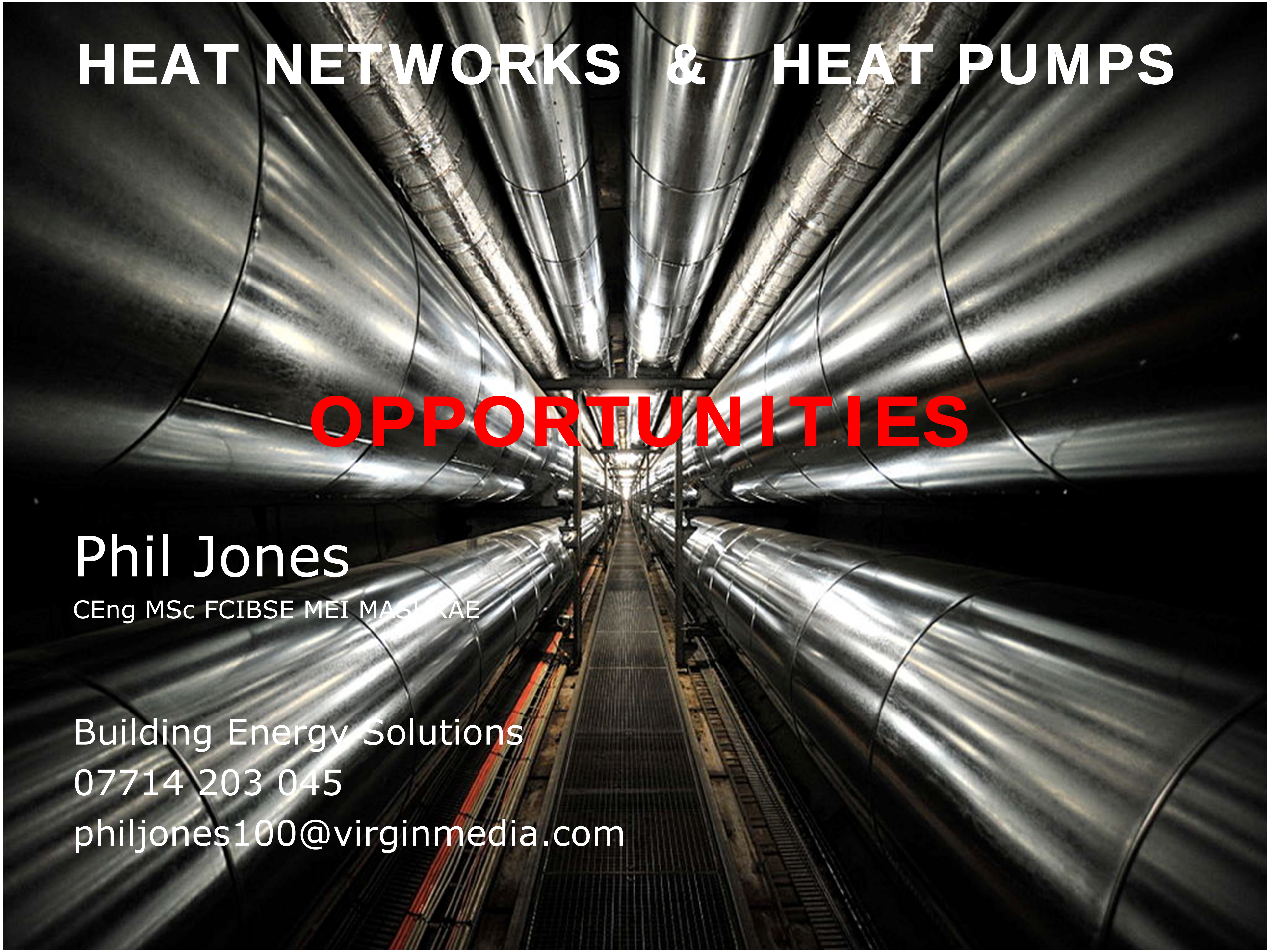

HEAT NETWORKS & HEAT PUMPS

OPPORTUNITIES

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Building Energy Solutions
07714 203 045
philjones100@virginmedia.com

DISTRICT HEATING

HEAT NETWORKS


Use high insulation standards….
& low return temperatures….
& wide Delta T
70/50C ?
Changing the 82/71C mentality!

Think PEX!
Pre-insulated fl-EX-ible

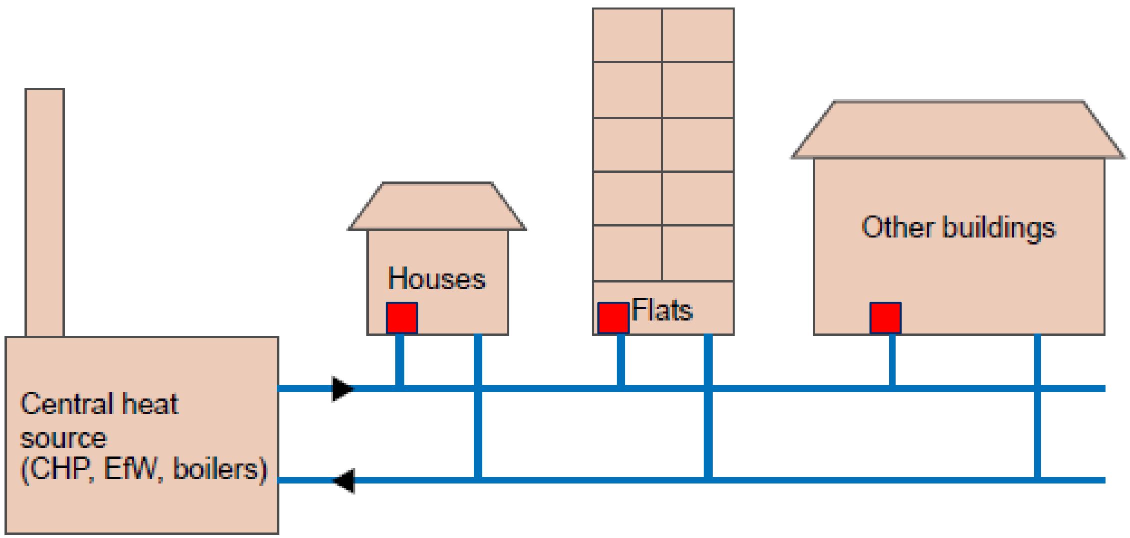
Seek soft dig v hard dig

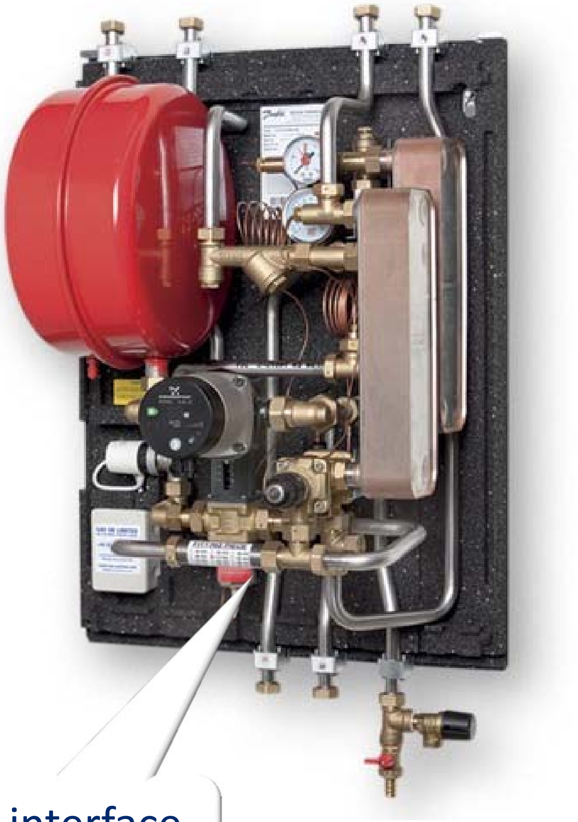
Cost ~£500/m - £1500/m

Typical district heating pipe lay

HEAT INTERFACE UNITS

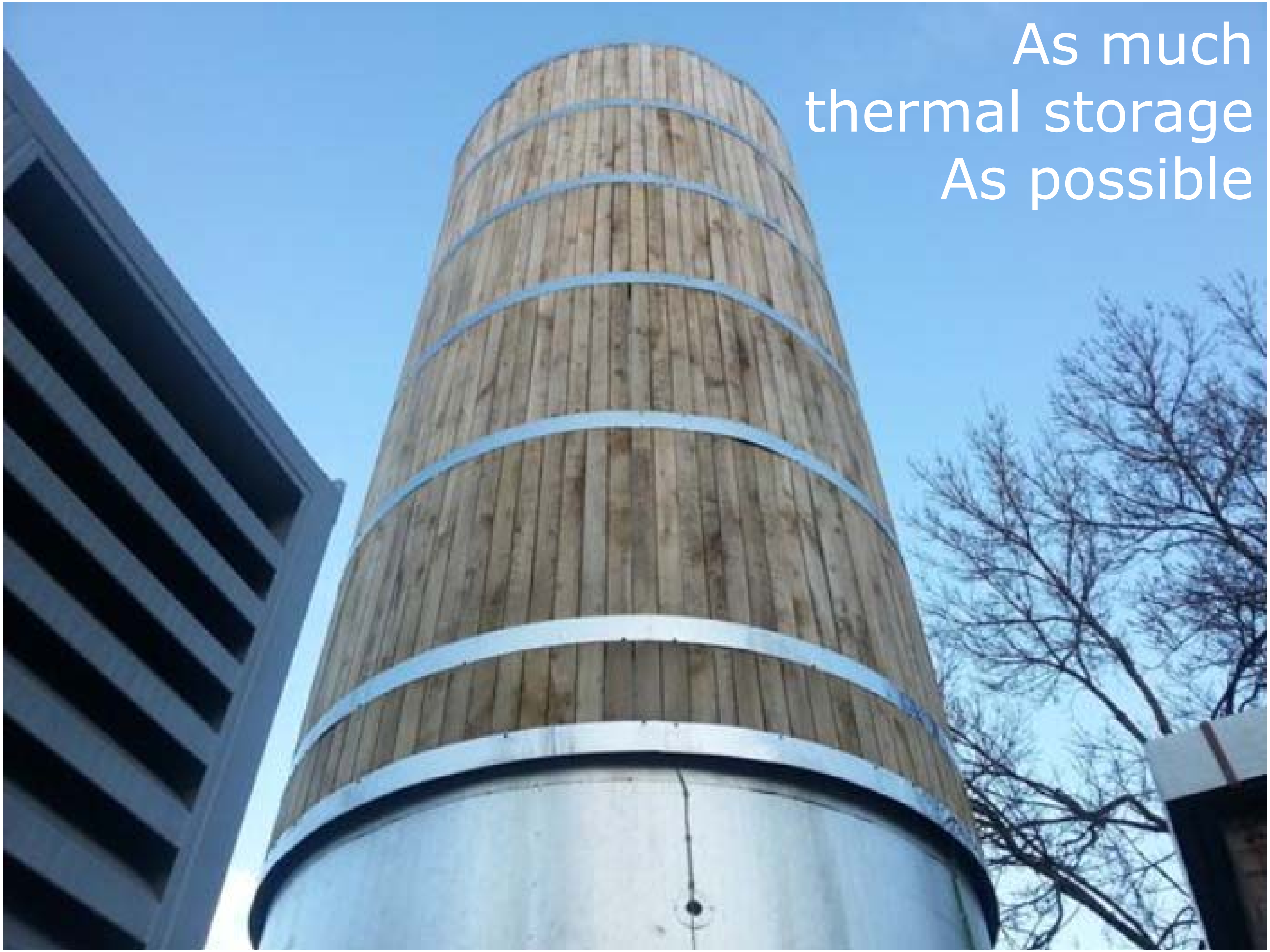
- Replaces the boiler in individual buildings





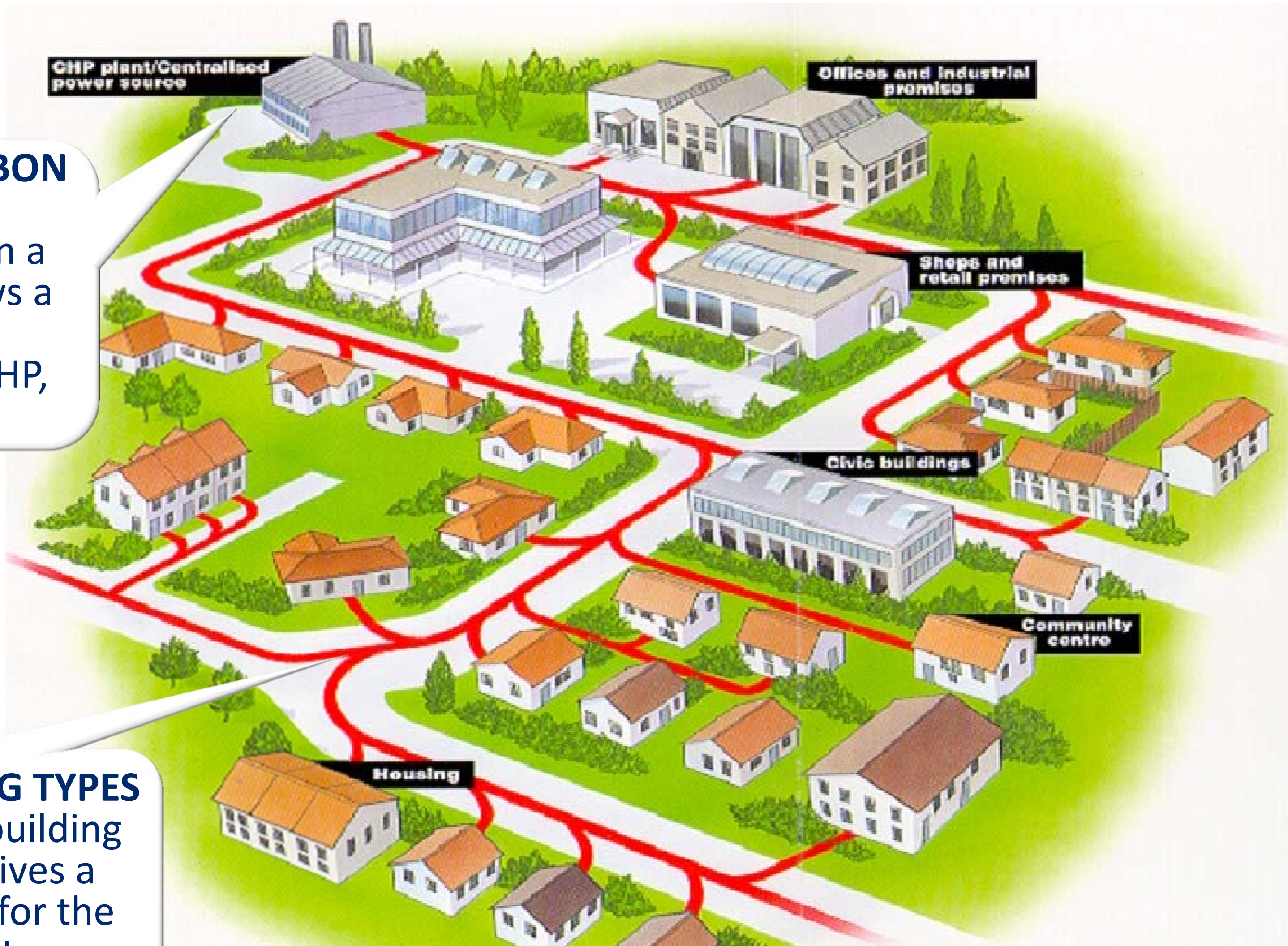
Typical interface unit

Use the right diversity, commission & control


As much
thermal storage
As possible

DISTRICT HEATING SYSTEMS

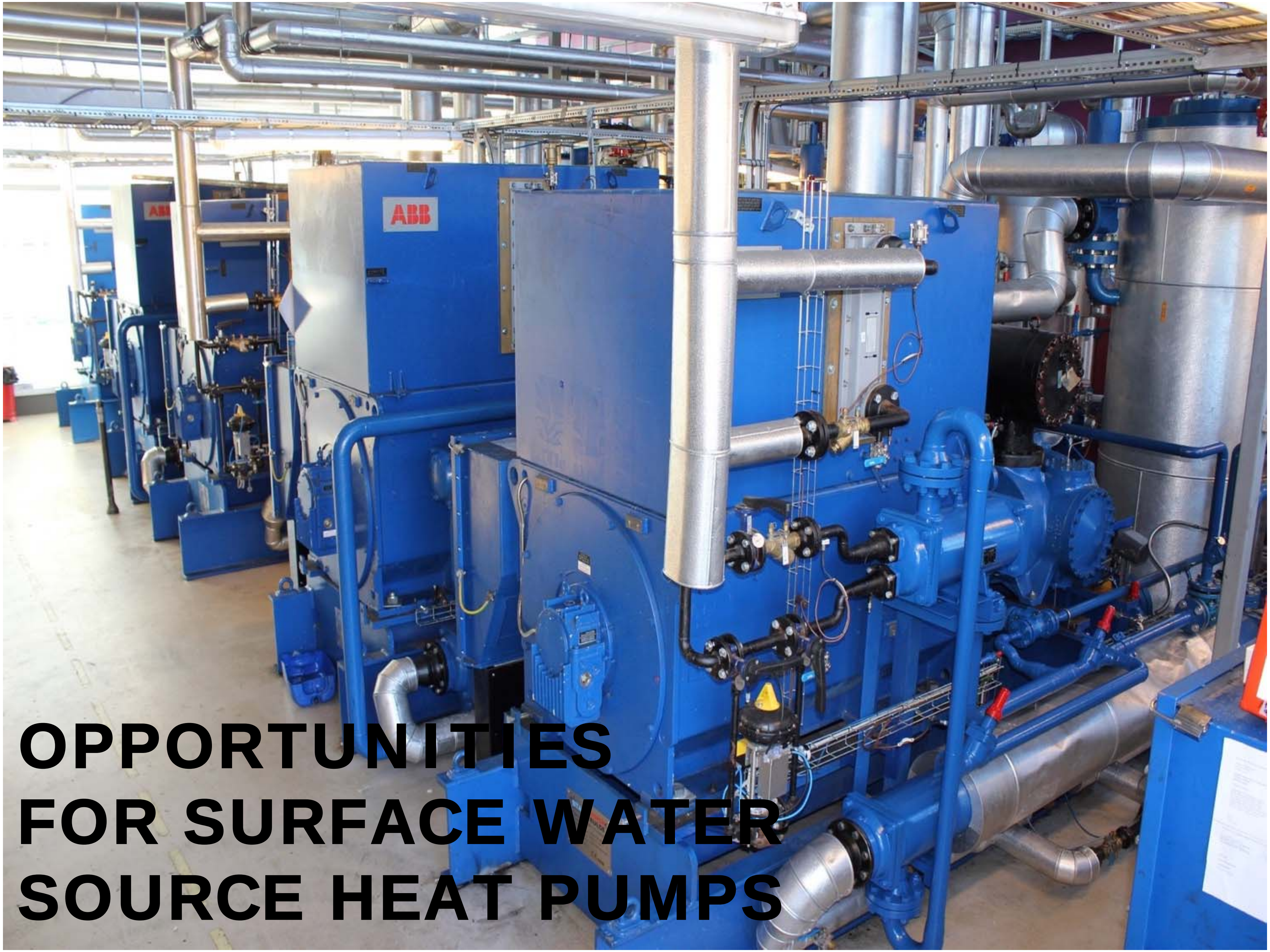
A MIX OF LOW CARBON TECHNOLOGIES
Supplying heat from a central source allows a range of options including CHP, SWSHP, GSHP & biomass



A MIX OF BUILDING TYPES
Adding different building loads together gives a steady base load for the central plant

Heat Networks are an enabling technology

OPPORTUNITIES FOR SURFACE WATER SOURCE HEAT PUMPS



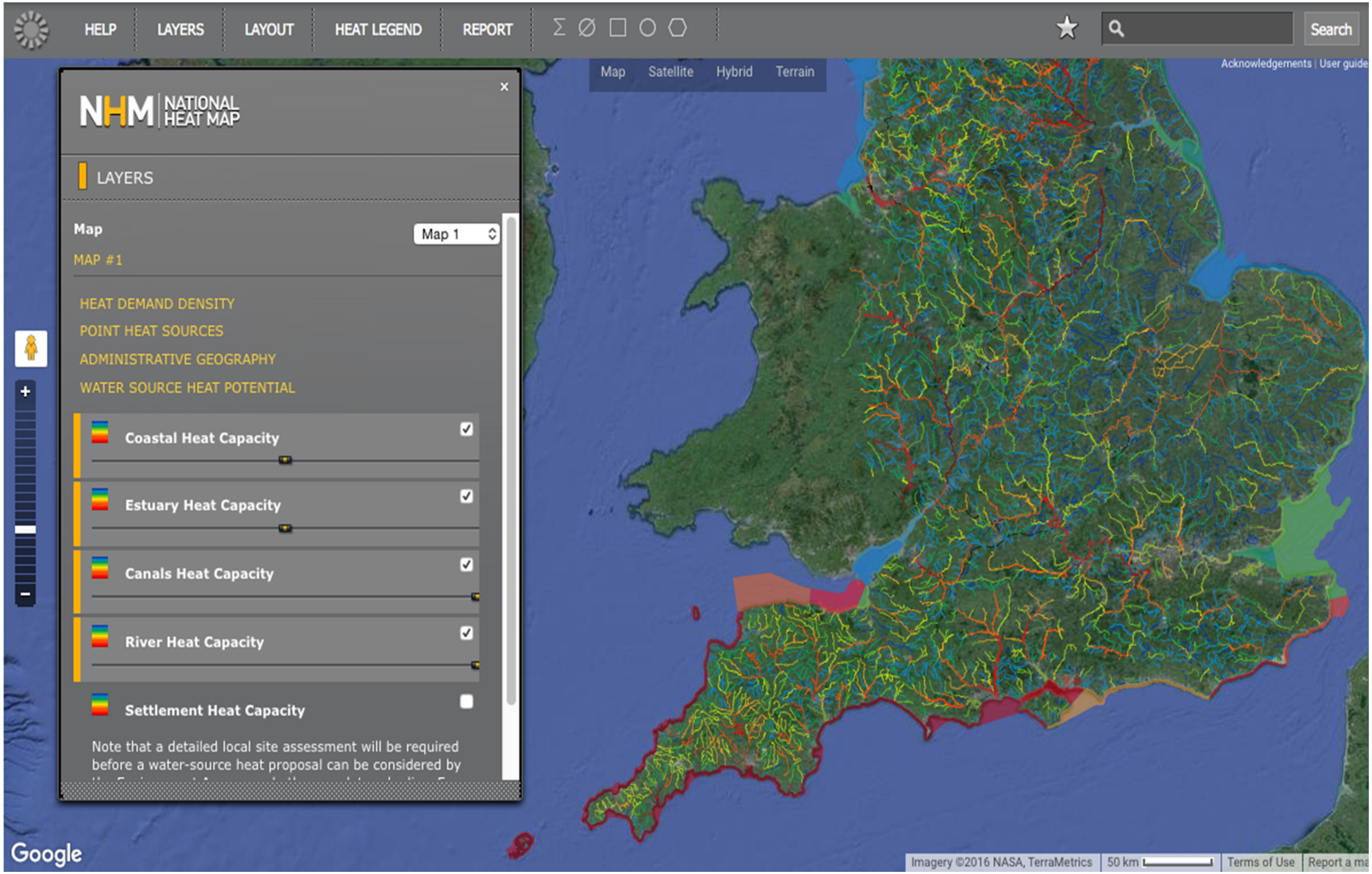

A renewable resource
STEAM MILL
…in the built environment!

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 minimum standards to ensure good feasibility, design, construction, operation
- Renewable Heat Incentive available

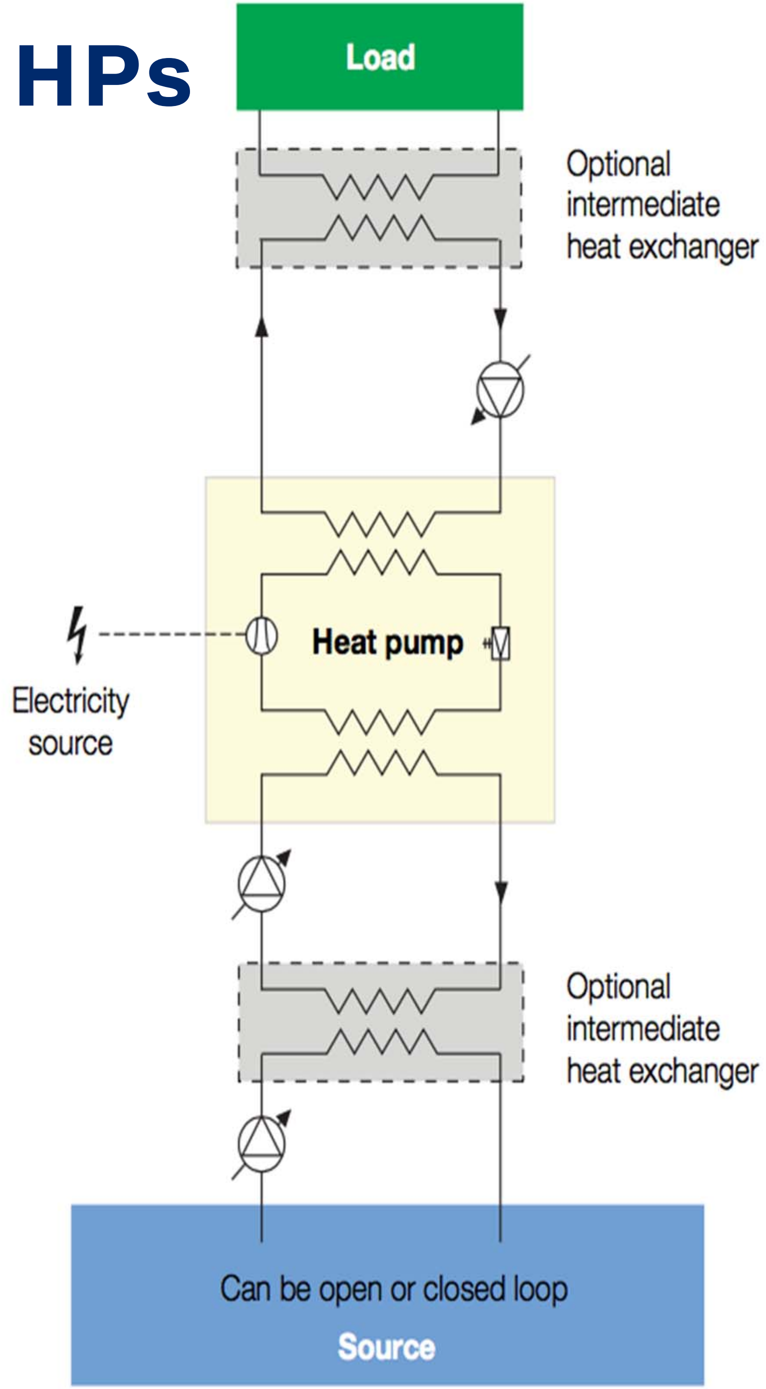
£300M Heat Networks Investment Programme

BEIS Water Source Heat Map

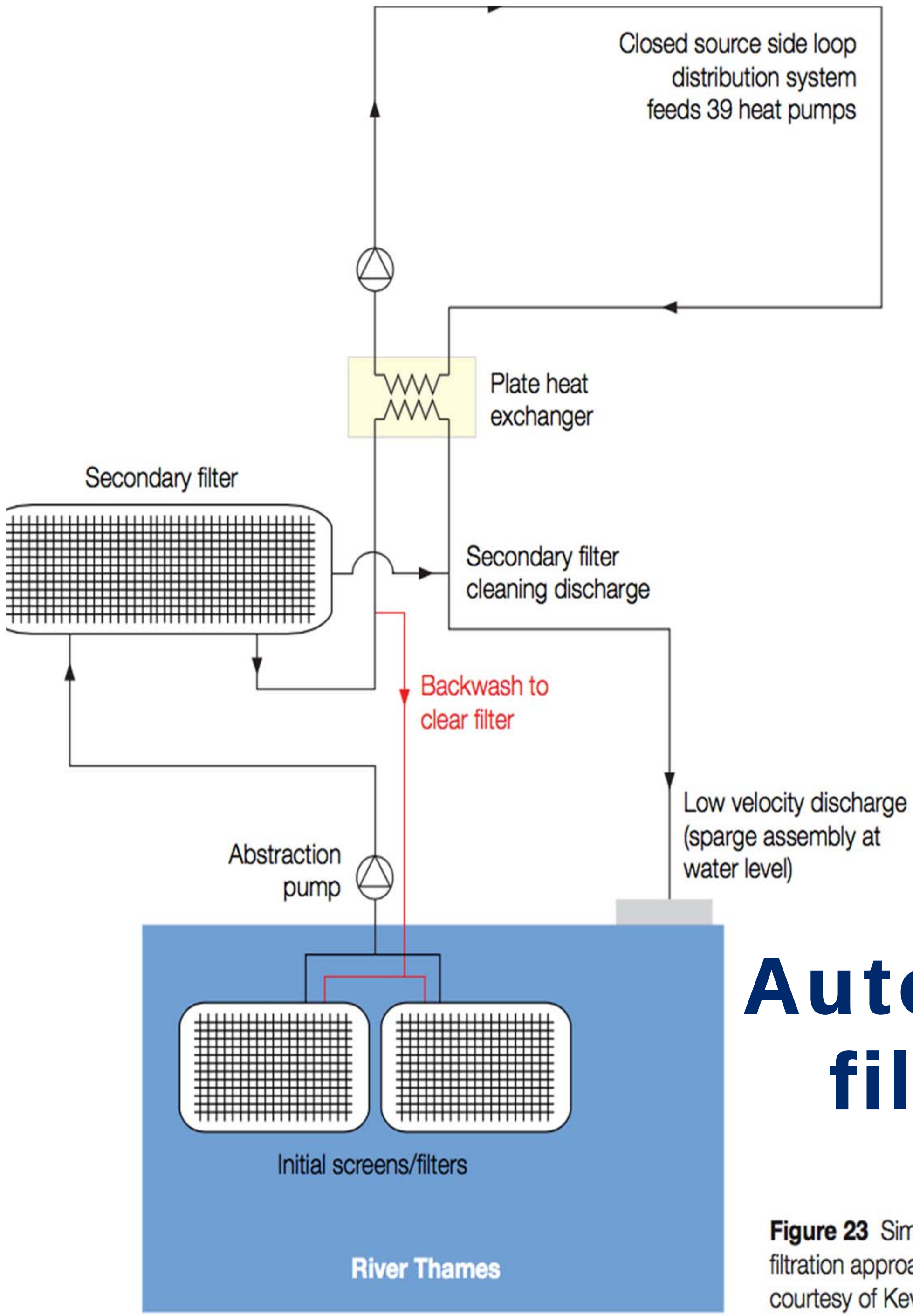


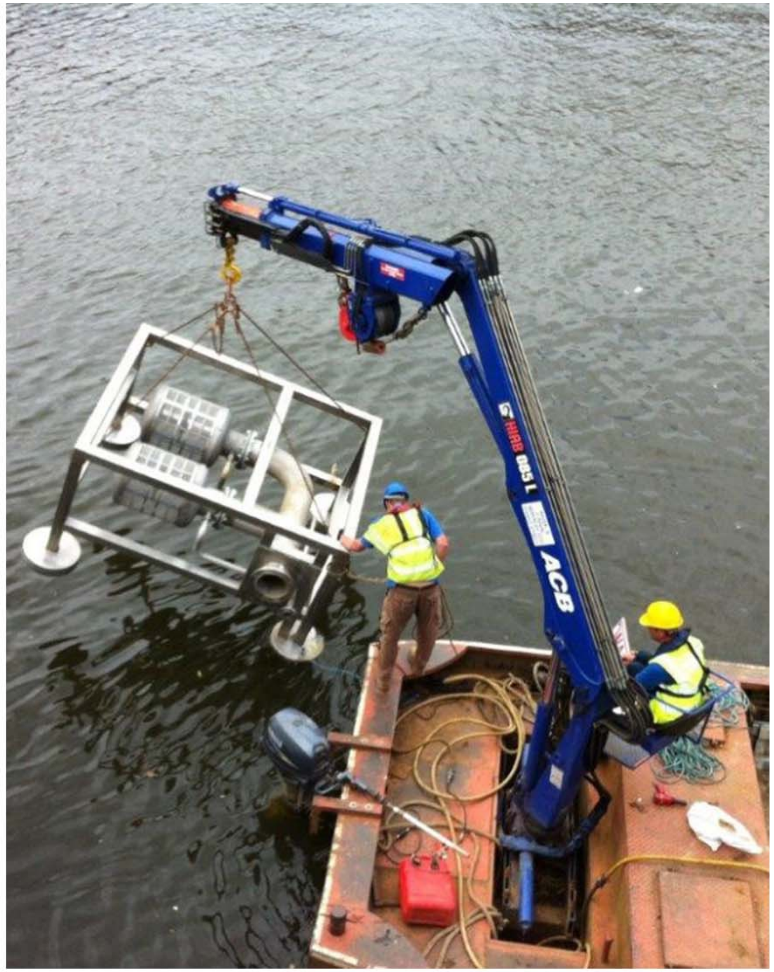
'Surface Water Source' HPs

- Supply temperature?
- Heating or cooling?
- Sizing? (monovalent)
- Water source?
- Open or closed loop?
- Abstraction-discharge ΔT=3°C
- Civil's structures/costs
- Environmental & regulatory issues




National Trust
Plas Nwyd

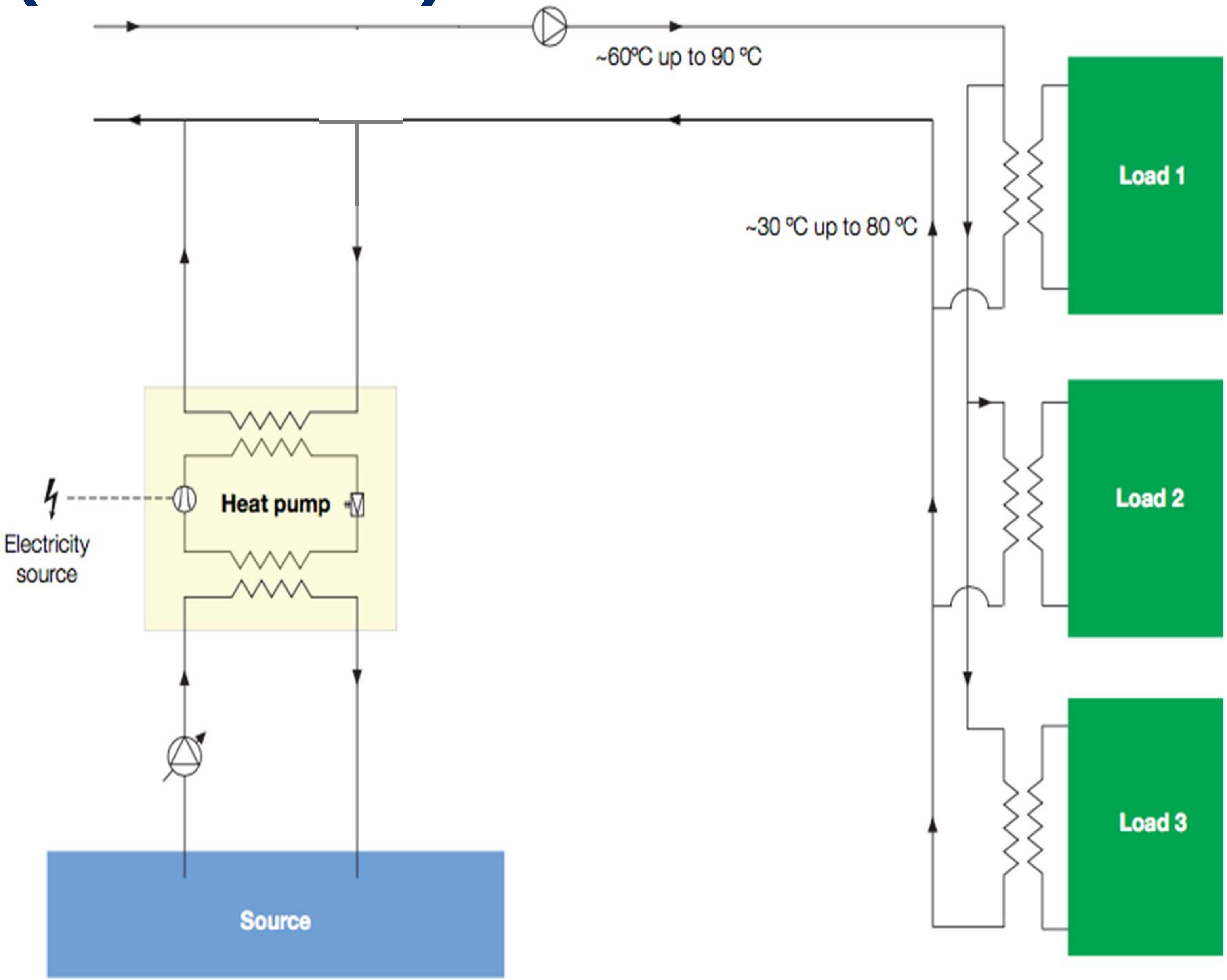




Automatic self cleaning filtration & Backwash

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

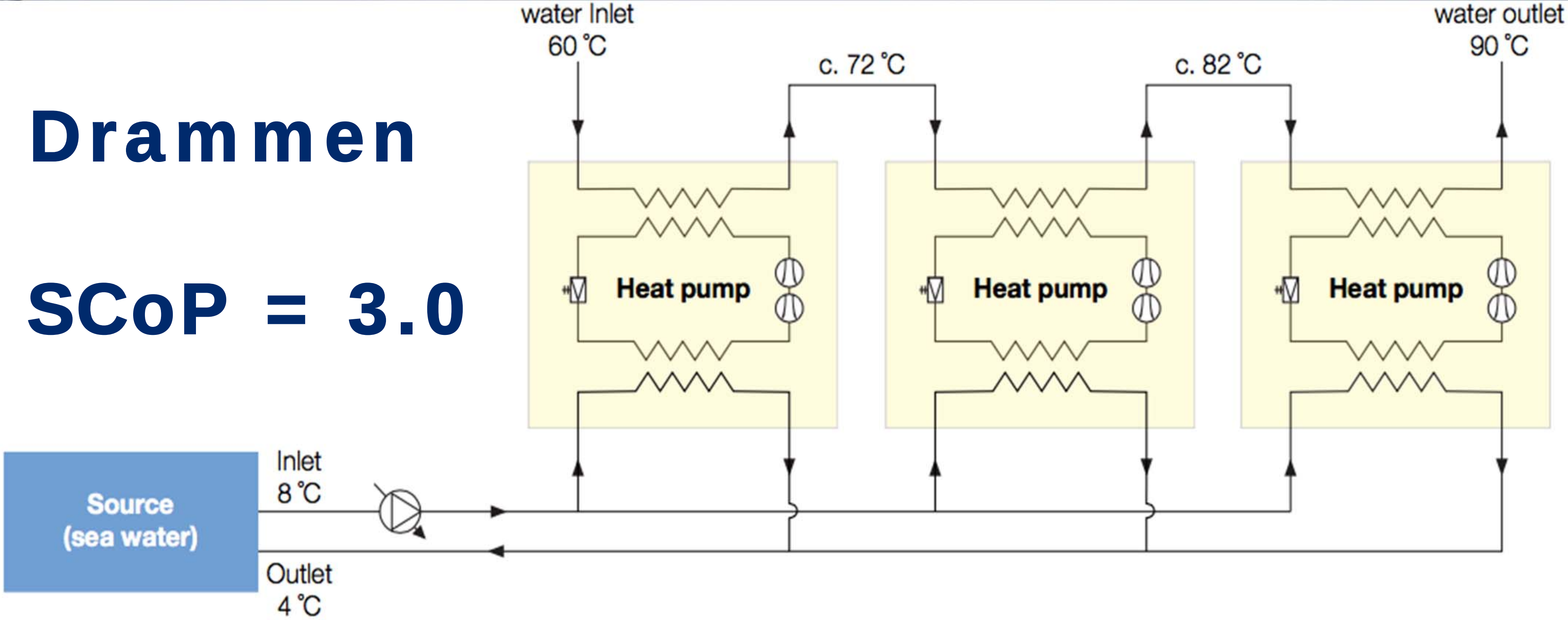
Load side loop [Heat Network] (Drammen)



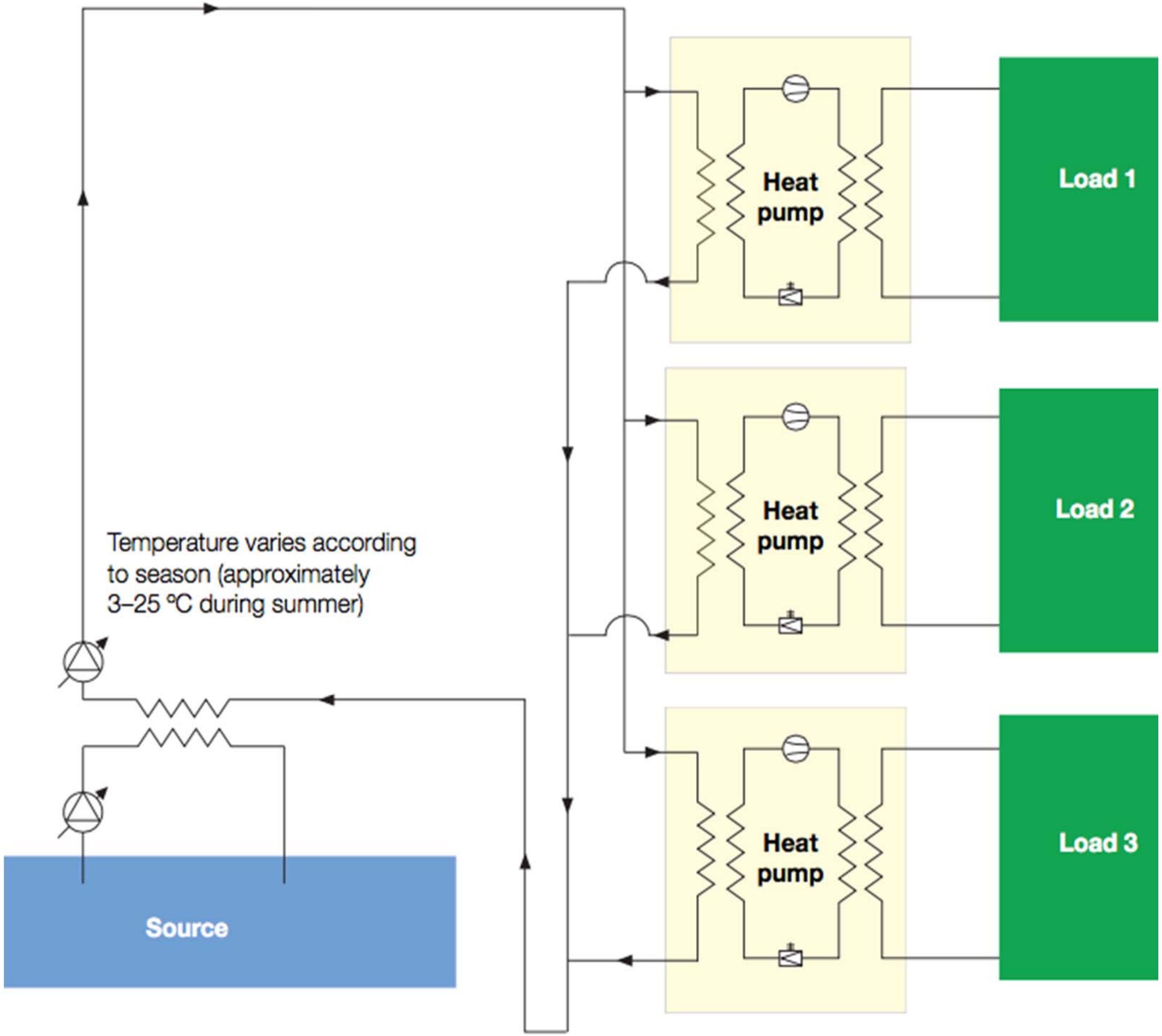

The mighty Drammen
13 MWth

Drammen

SCoP = 3.0



Source side loop (Kingston)



Kingston Heights

A river runs through it!


Kingston
Heights


Kingston
Heights
An ambient loop!


GSK
(Brentford)

SETTING STANDARDS

CP1 – Heat Networks

www.cibse.org/CP1

CP2 – SWSHP

www.cibse.org/CP2

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 CP1 & CP2
  - FIND SOMEONE WITH TRAINING
  - CARRY OUT A THOROUGH FEASIBILITY STUDY


HEAT NETWORKS & HEAT PUMPS
May the Code be with you….
Raising standards for heat supply
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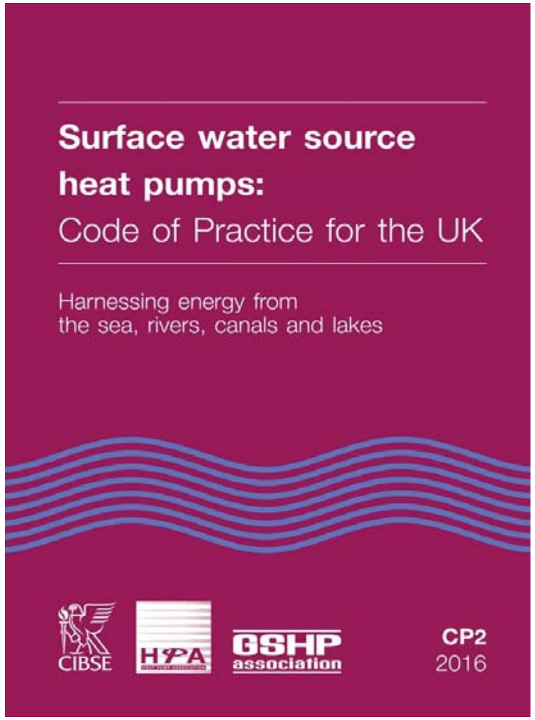

NIC WINCOTT: CP2 AND CP3 LEAD AUTHOR

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GSHP association

CIBSE

Engineering a sustainable built environment

What is a Code of Practice?

- **Code of Practice** is a set of written rules which explains how people working in a particular profession should behave

  What should be done   What you should do.

- **Guidance** is something that provides direction, advice or instruction to inform a decision or course of action

  How it should be done   How to do it.

- **Standards** provides a reliable basis on which common expectations can be shared regarding specific characteristics of a product, service or process

  How well it should be done   How well to do it.

Why is a Code needed?

- Address the **problems** being identified
- Formalise a **design approach** that follows the key principles of good design
- Provide a **standard specification** for procurement bodies
- Set **minimum standards** for designs
- Provide a basis for **certifying** approved professionals
- Improve **consumer confidence**
- Respond to potential **increase in SWSHP installations**

Water Source Heat Map

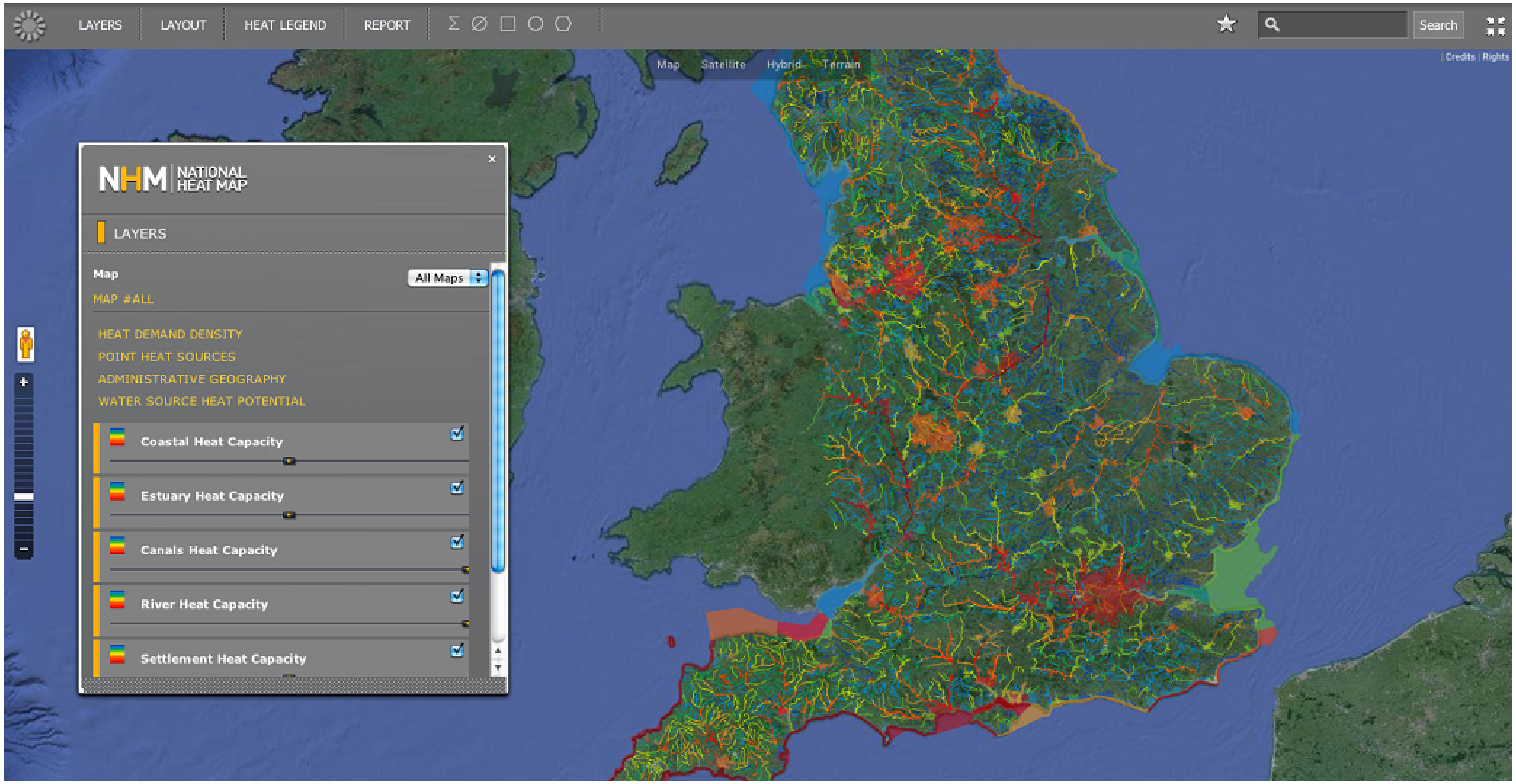

Figure 1 DECC Water Source Heat Map, 2015 (tools.decc.gov.uk/nationalheatmap/)

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Strategic aims:

To reduce CO_2 and other greenhouse gas emissions

To reduce the overall cost of providing heating and/or cooling

To use natural resources sustainably to reduce or replace consumption of fossil fuels

Strategic Aims

1. To reduce CO_2 and other greenhouse gas emissions
2. To reduce the overall cost of providing heating and/or cooling
3. To use natural resources sustainably to reduce or replace consumption of fossil fuels

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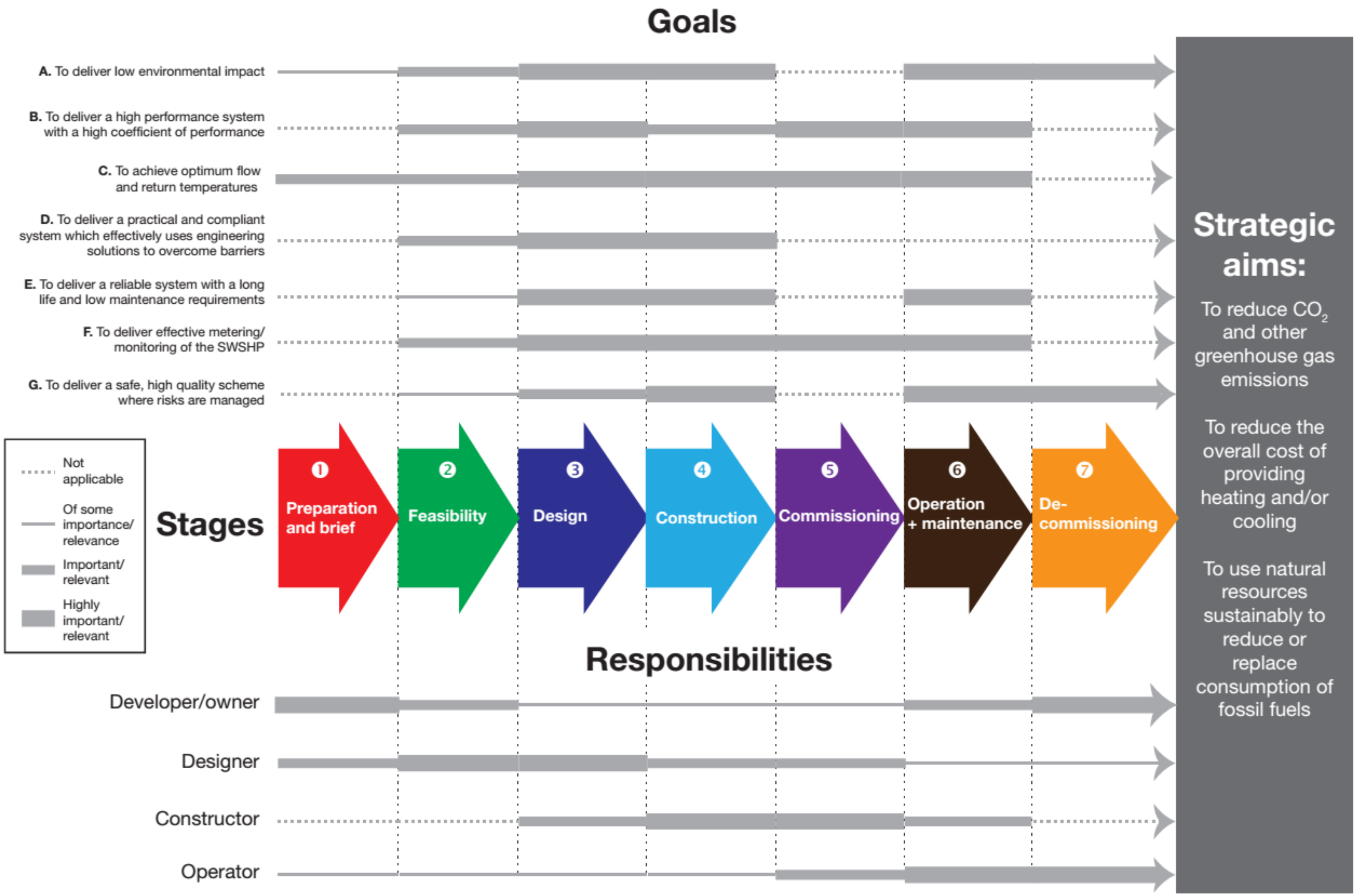
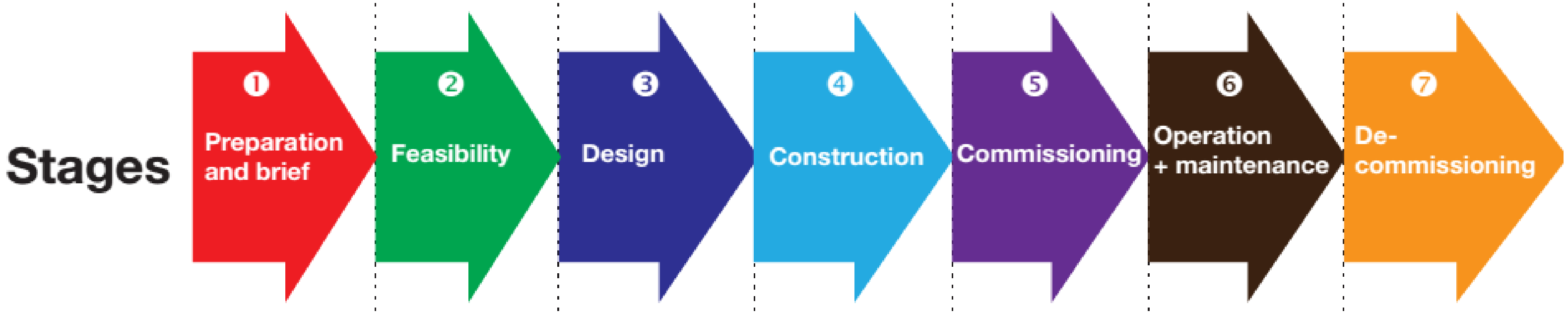
Structure of the Code

- **Goals:** Key issues that must be considered throughout the development.
- **Stages:** These define the discrete steps from the initial feasibility through to the eventual operation of the network
- **Objectives:** These are the issues that must be considered at each of the stages.
- **Minimum Requirements:** These set out the requirements that must be followed to achieve the objectives
- **Best Practice Standards:** These set out the additional measures that can be employed to go beyond the minimum standards

The SWSHP Plan of Work

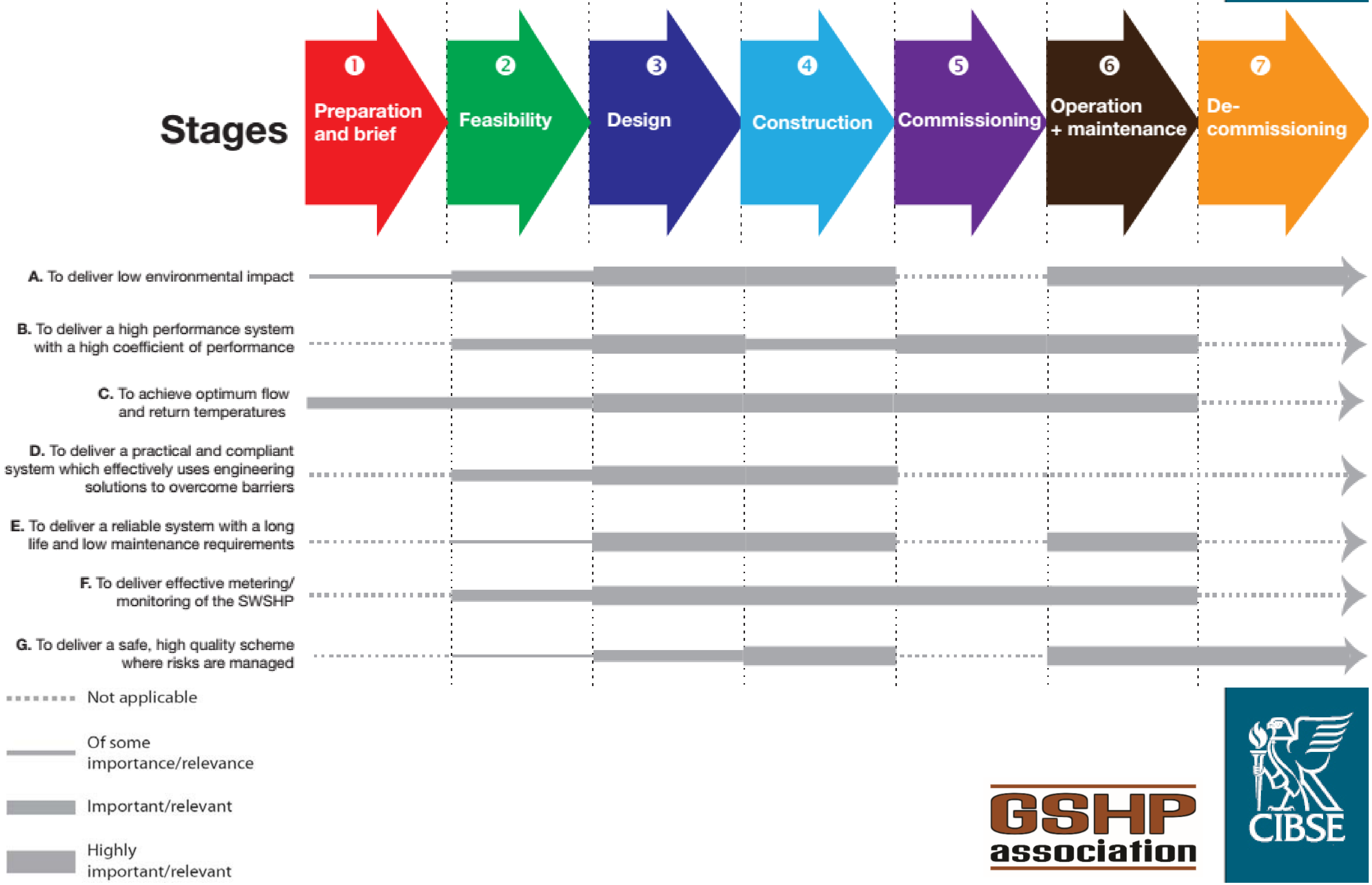


Stages



- Represent discrete steps in the development of a SWSHP installation
- The end of each step usually marks either a decision point or a change in responsibility
- Some potential overlaps in timing however
- Different risks at different stages
- Errors made earlier can filter through

Plan of Work - Goals



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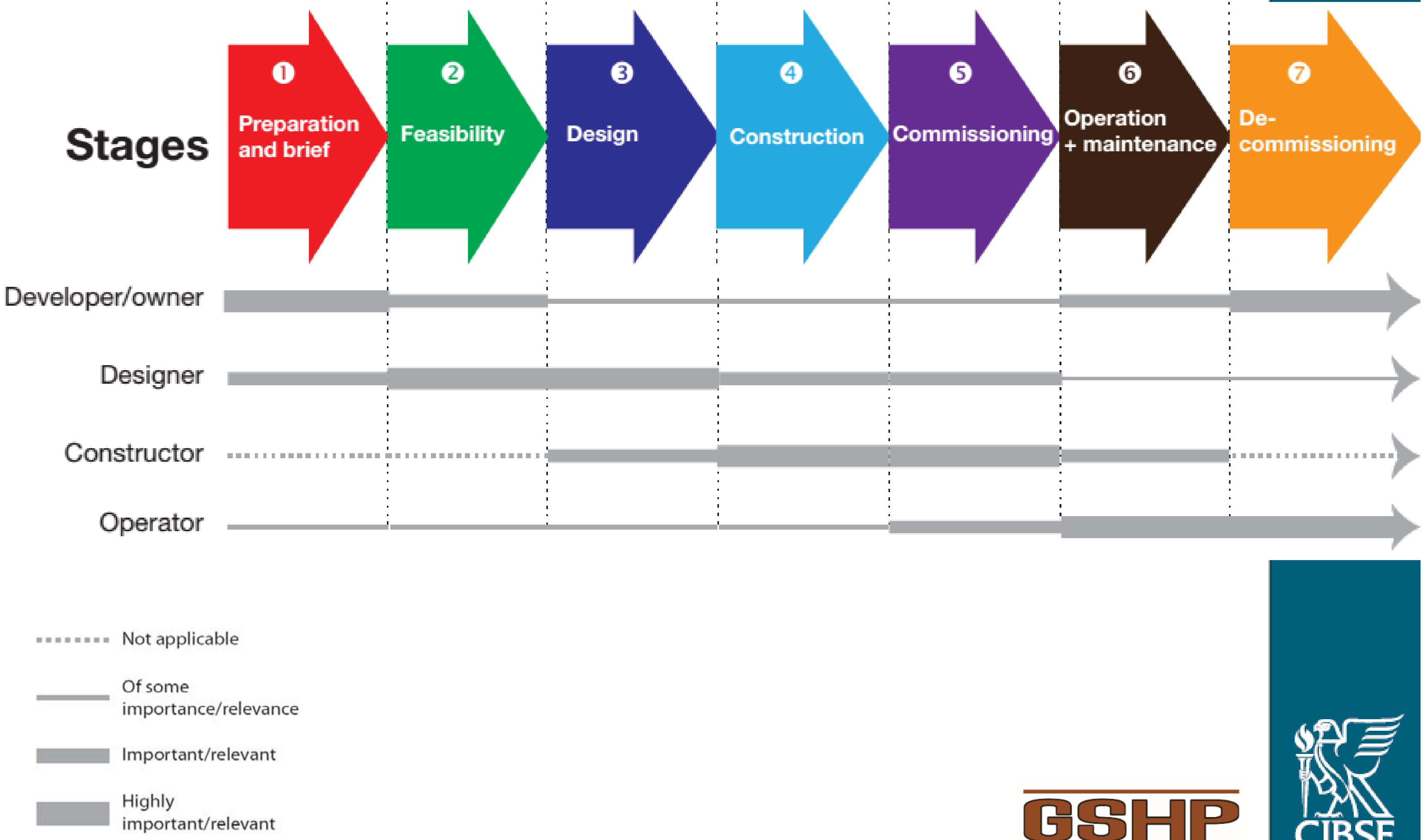
CIBSE

Responsibilities



Objectives

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

Objectives

Explains **why** the objective has been set

Sets out the specific **minimum** requirements to meet the objective

Objective 2.8 – To assess operation and maintenance needs and costs

Why is this objective important?

Operation and maintenance needs to be considered at the feasibility stage so that costs can be included in the economic model. The main costs will be for fuel and electricity and the main revenues will be for heat sold and in the case of CHP, electricity sold. Electricity may be sold to a licensed supplier or sold direct to customers via a 'private wire' network.

Estimates also need to be made for non-energy operating costs. It is useful to split these costs into fixed and variable costs.

Minimum requirements

2.8.1 An operational model shall be set-up for use in the economic analysis which shall calculate the energy balance for the system including network heat losses from which operating costs and revenues can be determined for use in the economic model.

2.8.2 Maintenance costs shall be estimated for: CHP or other primary plant, peak boilers, heat network (including the surveillance system, make-up water and water treatment) and buildings.

2.8.3 Costs shall be estimated for heat meter reading and billing.

2.8.4 Costs shall be estimated for staffing, management, business rates, insurances and other overheads.

2.8.5 The cost of parasitic electricity consumption for pumping energy, ventilation and burner fans, lighting, etc within the energy centre shall be included. In the absence of detailed information, a figure for such electricity use of 2% of the annual heat supplied to the heat network shall be used.

2.8.6 A long term repair/replacement strategy shall be developed to ensure that the true long term costs of maintaining the plant required for the scheme are fully taken into account.

Best practice

Best practice could be to base costs on data obtained from actual operating schemes where full details of the scheme are available to ensure it is of a similar type to that being proposed.

Suggests **additional** measures that go beyond the minimum requirements

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Key support tasks and Information exchange

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

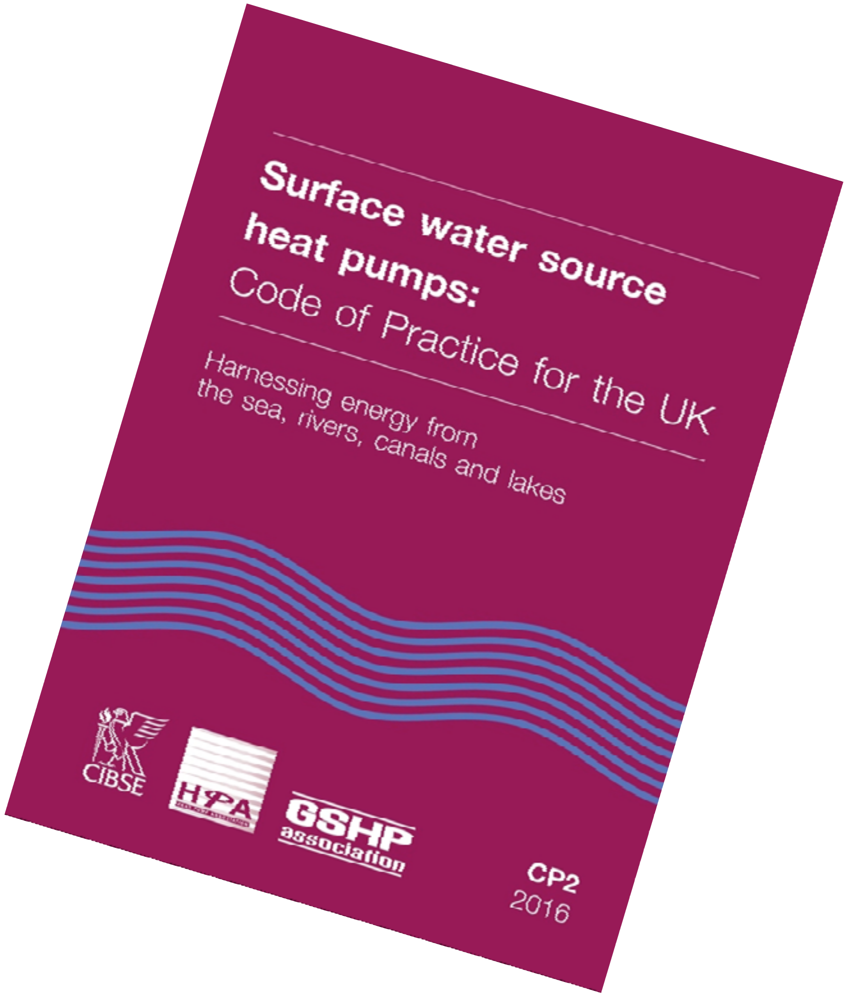
Information exchange to next stage (design team):

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

CP2 Training

Next training session:

27th and 28th September



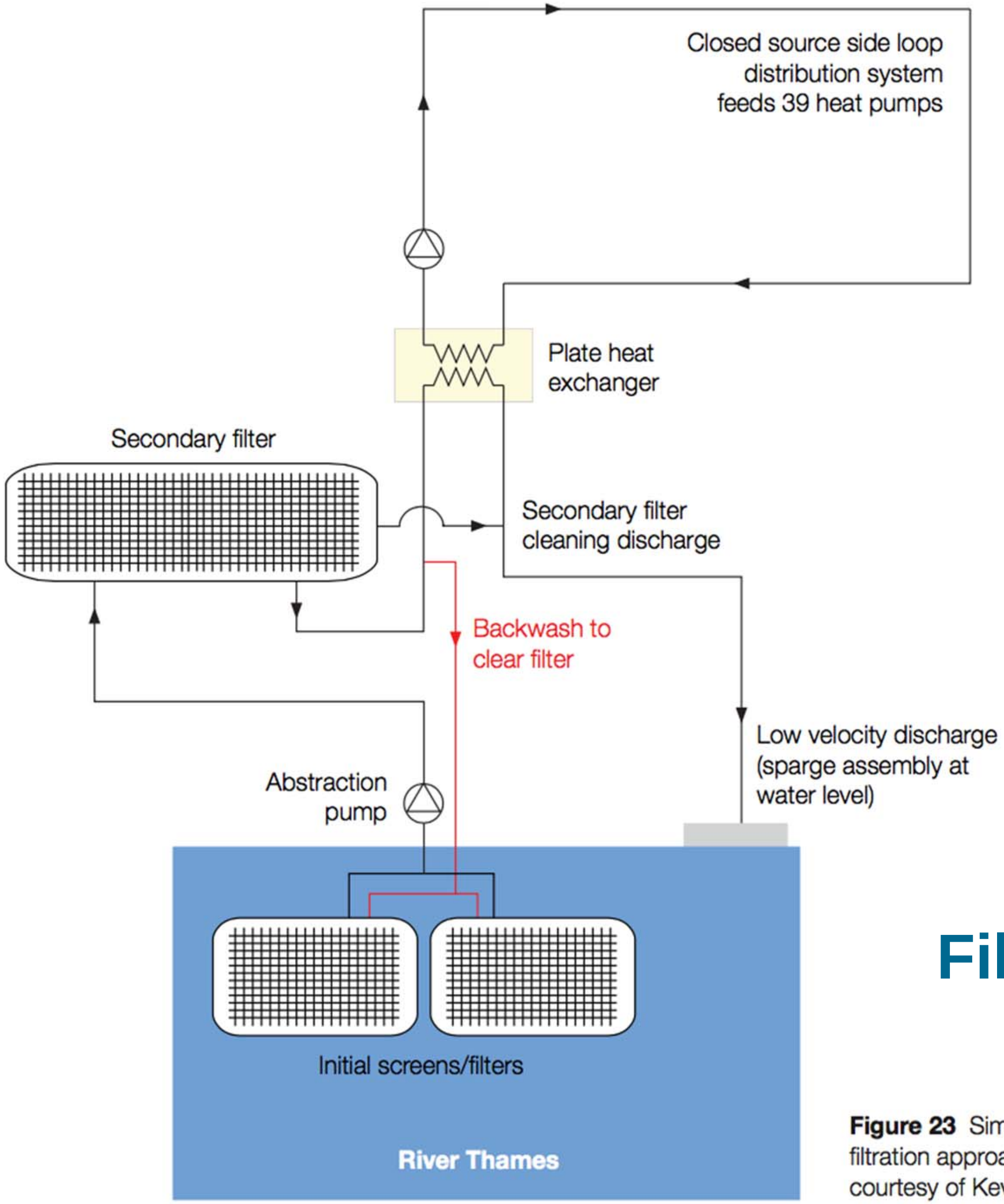
CASE STUDIES

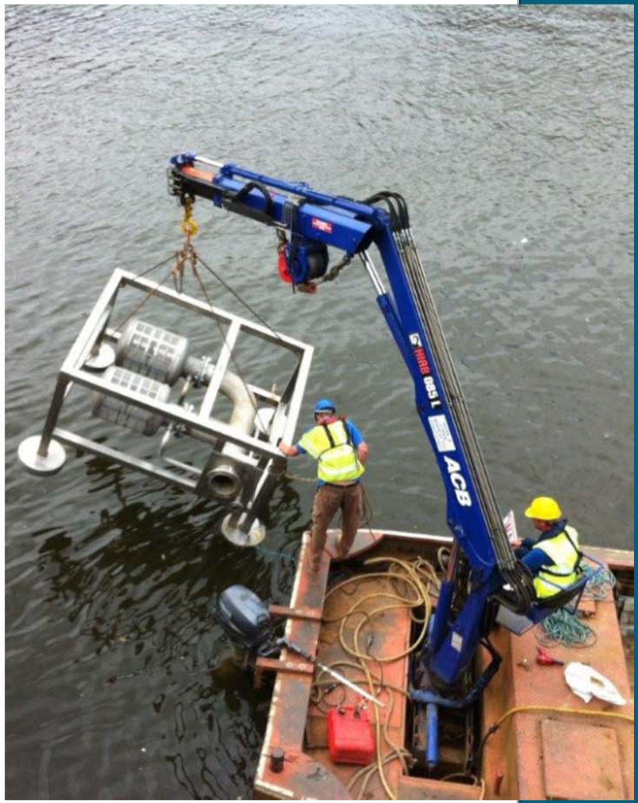
SWSHP Applications #1

Kingston Heights

Source side (low temp) network used for both heating and cooling

Open Loop design detail	
Inlet port	Dual self-cleaning, 1.5 mm intake screen assembly 10 m out into the river, fixed with pilings, with clear height to water level of 2.5 m
Discharge port	Low velocity horizontal header at water level
Flow and return pipework	250 mm diameter; intake 20 m; return 5 m
Extraction pump specification	Self-priming, located in plant-room, 57 l/s at 4 m suction lift and 20 m differential head – each. Max intake flow 270 m³/hr
Filtration arrangements	Secondary filters, with automated backwash, capable of filtration from 300 down to 70 µm





Filtration & Backwash

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

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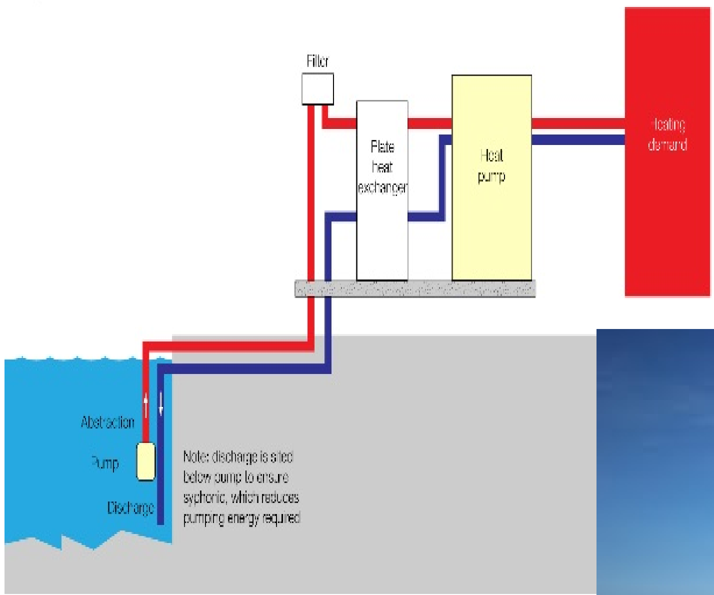
SWSHP Applications #2

RNLI

RNLI have innovative ongoing programmes

Diverse novel systems developed to match widely different locations. Prefabrication

Figure 8: RNLI case study (redrawn)



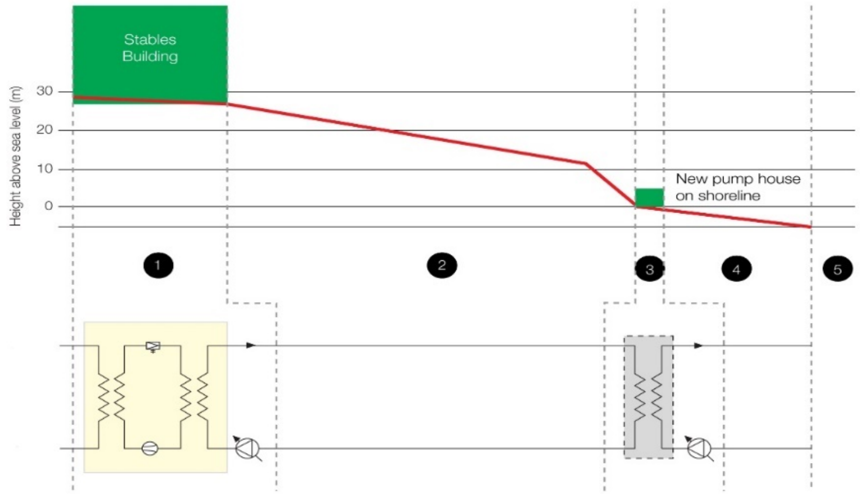
www.rnli.org/aboutus/aboutthernli/Pages/Innovation.aspx

RNLI Kinsale (Closed loop)

SWSHP Applications #3

Plas Newydd

Overcomes uncertain loads and elevation issues.



Notes:
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 to the shoreline pump house
3. Shoreline pumphouse contains heat exchangers, pumps and strainers
4. 57 m of 2×200 HDPE pipes carries sea water to the pump house
5. Intake with 200 mm strainer and discharge point

www.nationaltrust.org.uk/article-1355838486323/

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National Trust
Plas Nwydd

SWSHP Applications #4

GSK Brentford – Canal Cooling

Enhancing the Canal with a Water Feature

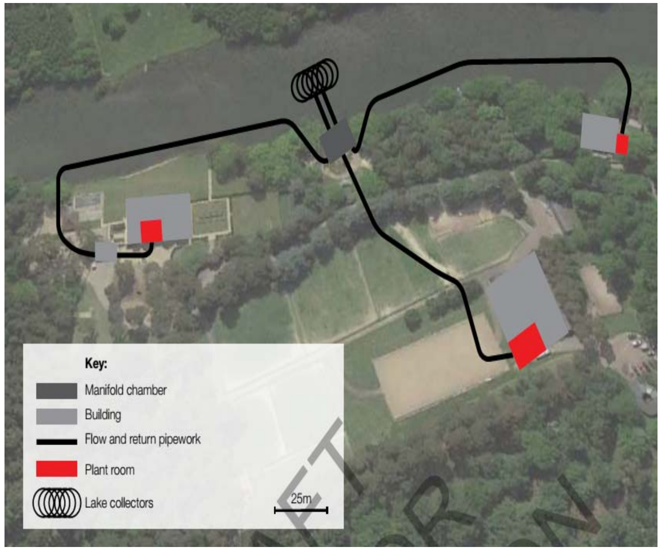
Used to cool Data Centre

GSK (Brentford)


GSK (Brentford)

SWSHP Applications #5: Source side network

Tattleton Estate, West Sussex



- Serving 5 buildings
- combined output 90kW using 18 elements submerged in nearby lake at 2.5M
- CoP 4.11 to BS14511 B5/W45

SWSHP Applications #6

Kings Mill Hospital - Mansfield

Large Closed Loop System using Hydroplates

SWSHP Applications #7: Load side network

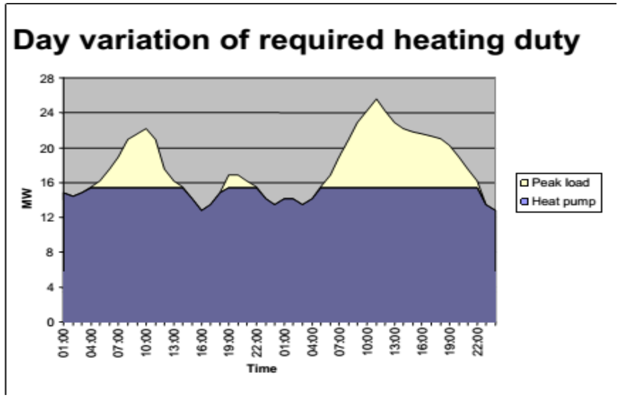
Drammen, Norway.

Retrofit to High Temp Heat Network Large ΔT

Installed Capacity. 13.3 MW

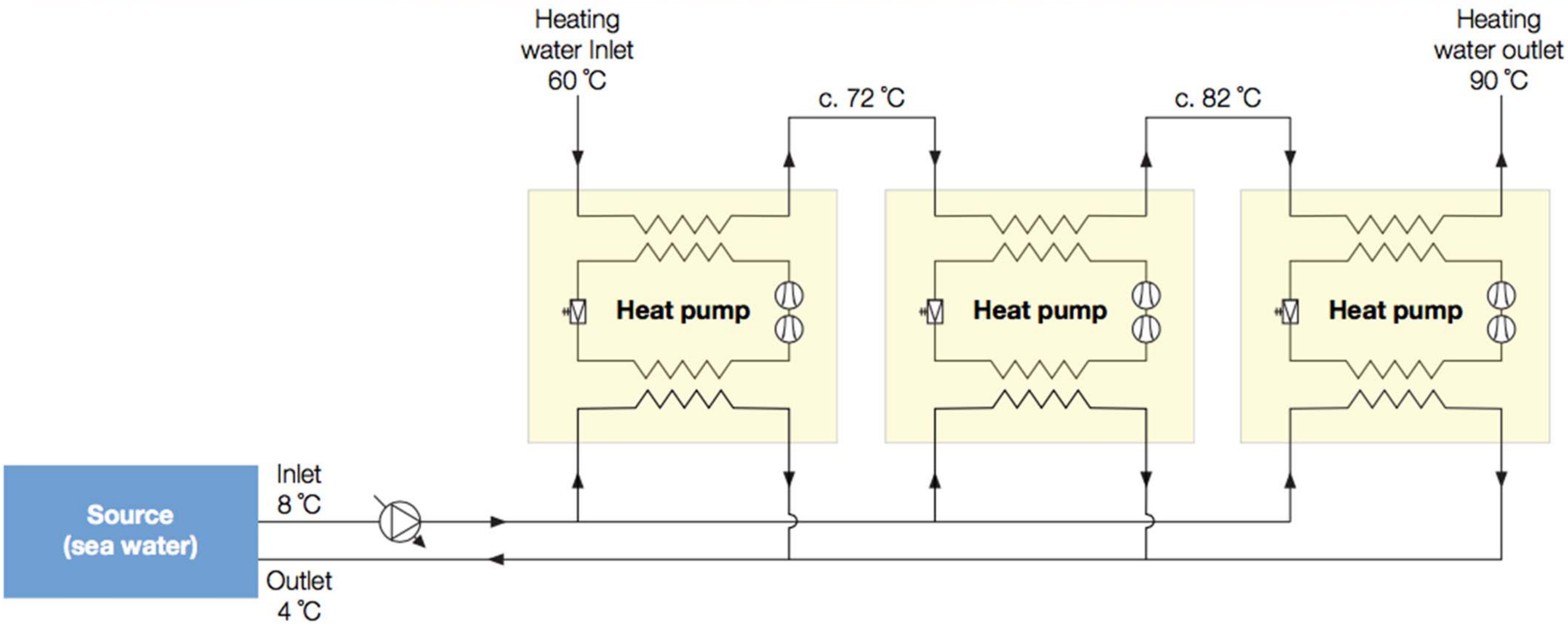
Annual CoP 3.05 Input temp ± 6°C Output 90°C

Annual Saving £2 Million + 15,000 tons CO_2



www.ehpa.org/technology/best-practices/large-heat-pumps/drammen-district-heating-norway/

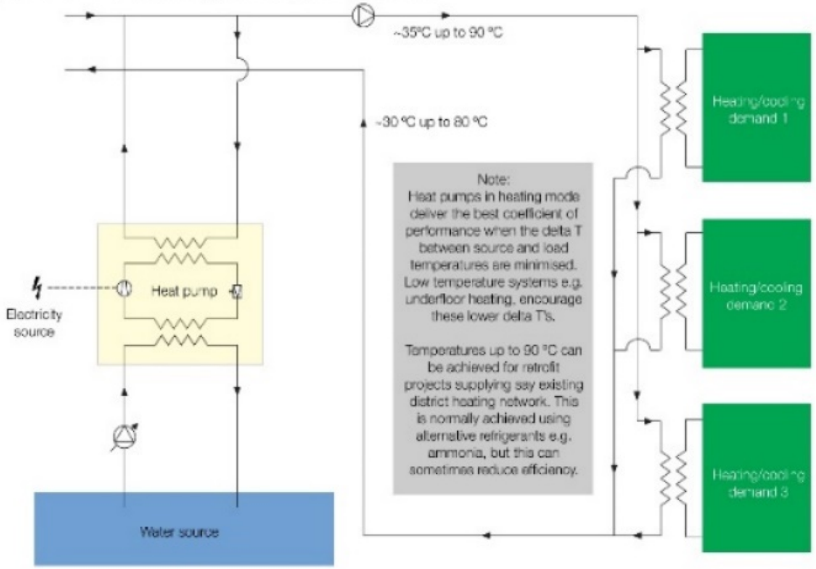

Drammen


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 ℃

SWSHP Applications #8: Load side network

Värtan Ropsten, Stockholm

Figure 6b: SWSHP on a load side loop (district heating network) - reverse return



www.geopower-i4c.eu/docs/20120503-Anders_Hill-Fortum.pd

Installed between 1984-86 uses Sea water from Stockholm Harbour as the heat source

6 x 70MW Heat pumps (total 420MW)

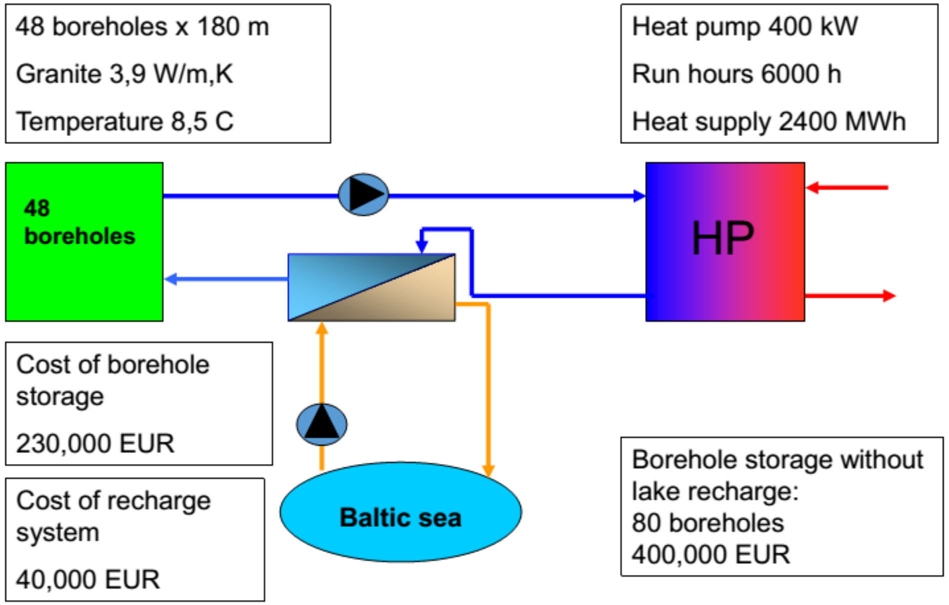
Input Temp ± 2.5°C output to 80°C

Capacity Range 100% to 10%.

CoP Max 3.75

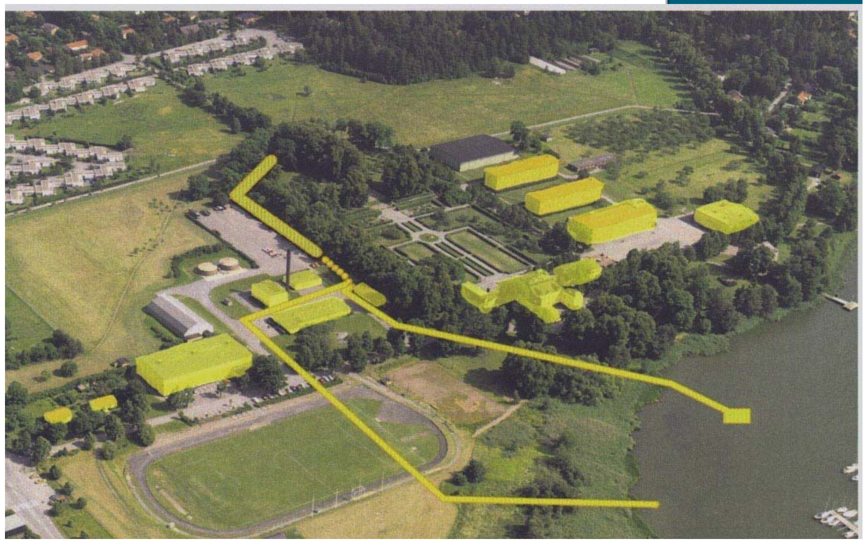
SWSHP Applications #9: Hybrid

Nasby Park, Stockholm

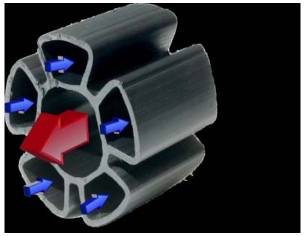


Surface Water BTES Recharge - Borehole numbers were reduced (and hence CAPEX) by recharging with the warmer surface water during the Summer

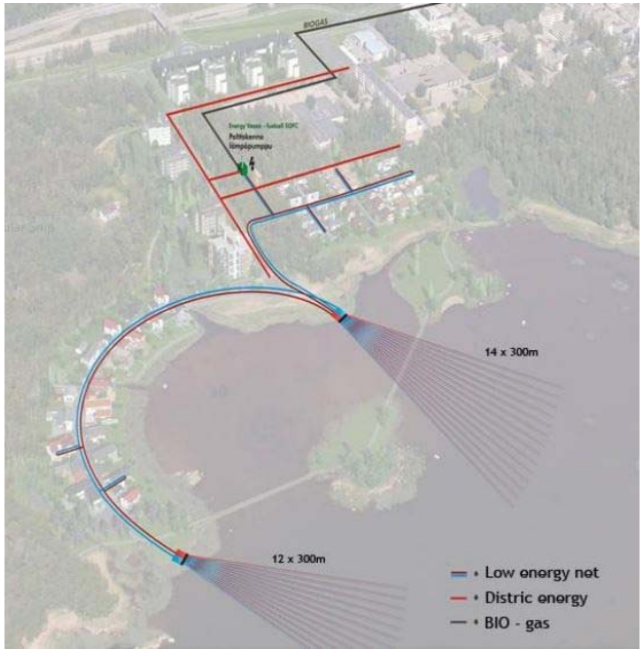
CAPEX Saving 130,000 EUR (in 2004)
Est payback 4.2 Years actual 3 years



SWSHP Applications #10: Source side



Energy Vaasa, Finland



Collector embedded into ”Warm” sediment (14 °C)

Novel collector pipes installed by Horizontal Directional Drilling (HDD). This avoids sea bed ”anchor”-risk

Thermal Transfer Fluid goes to a heat pump
in each property at source temperature

Annual average energy supplied 1.2 GWh,
Total Heat Pump power 400 kW
Individual Heat Pumps range from 9 kW → 22 kW

https://www.youtube.com/watch?v=eoleWYJlc1E

CP3 GROUND WATER SOURCE HEAT PUMPS: CODE OF PRACTICE

And on to the next one….

- **Code of Practice on Groundwater** first Steering Committee on 12 September
- **Structure** similar to CP2
- **Call for Case Studies** we want the support, input and ideas of GSHPA members
- **Training** to accompany the Code of Practice to be launched next year

Thank you for listening

Any Questions?

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GSHP association

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