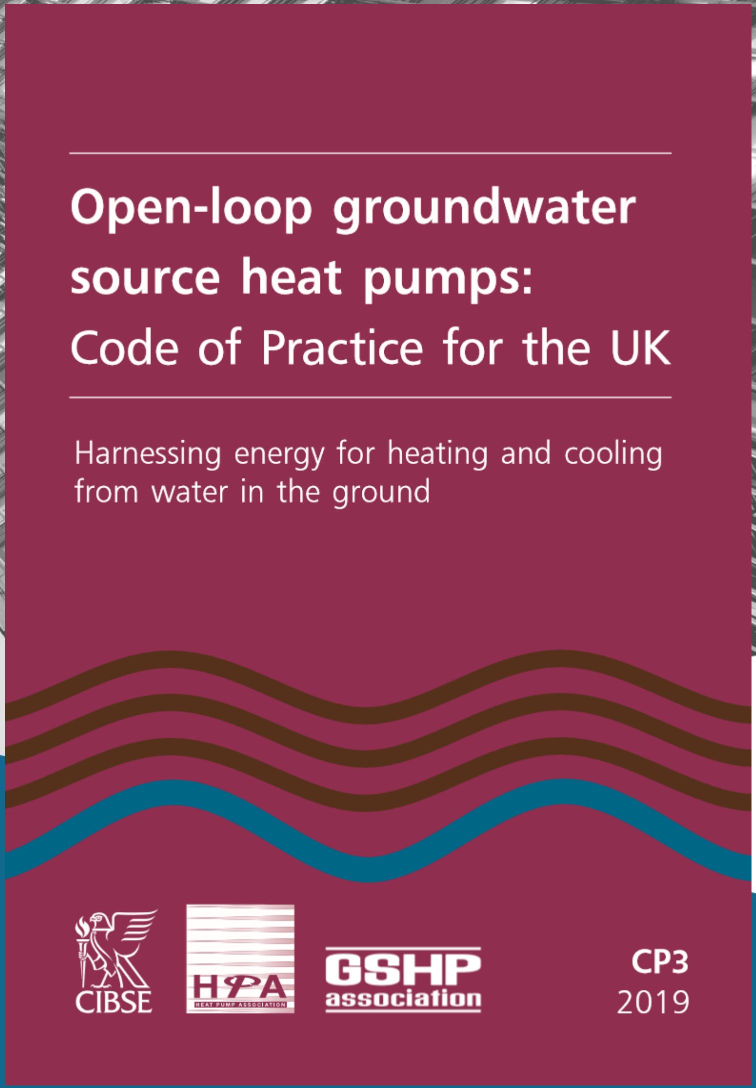
Low carbon heating and cooling from groundwater for commercial & residential developments and district networks



The Building Centre, Store Street,
LONDON WC1E 7BT

2nd July 2019

CP3 Open-loop groundwater source heat pumps: Code of Practice for the UK

Harnessing energy from water in the ground
for heating **and** cooling

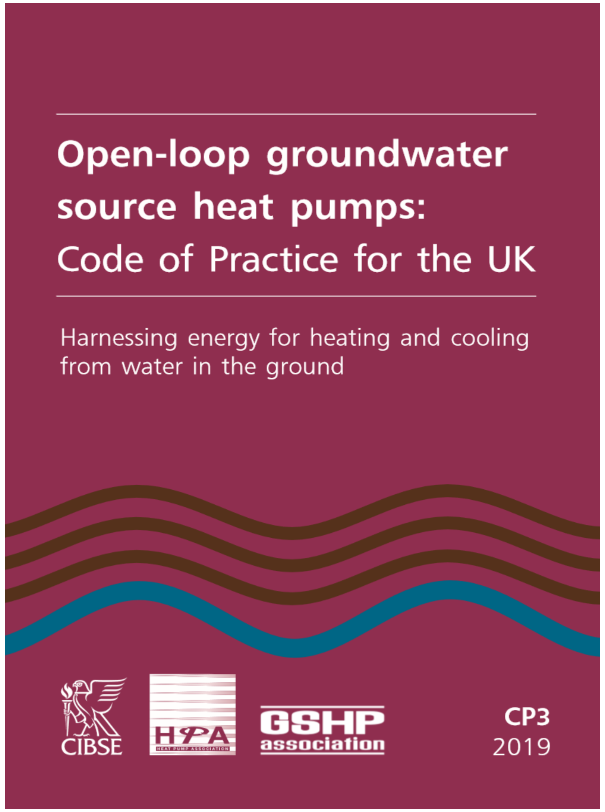
Nic Wincott: Lead Author

njwincott@gmail.com

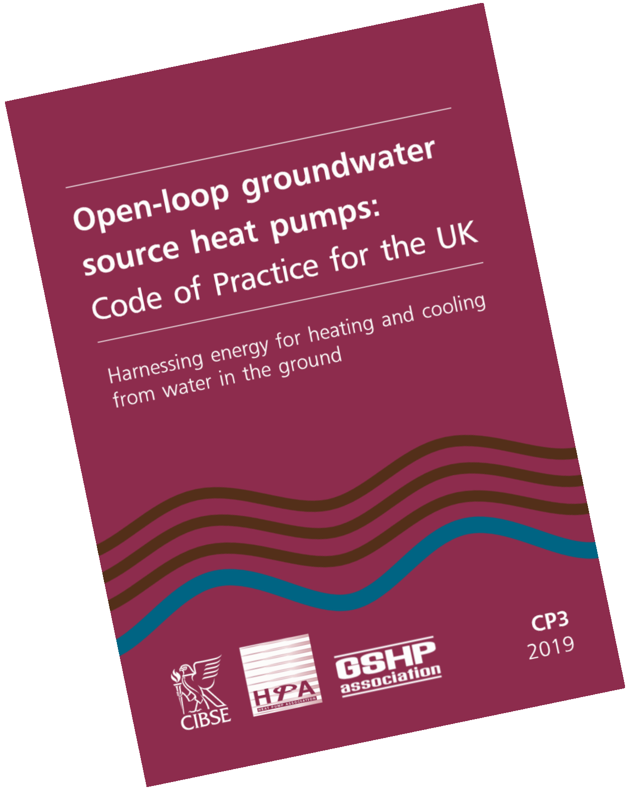
07836 661551

https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q0O00000GOpOTQA1

CP3 - 3rd in the series



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



Thank you to all involved……

Department for Business, Energy & Industrial Strategy

- BEIS and CIBSE for their funding & support.
- The HPA & GSHPA and the 20+ strong, diverse steering committee of industry experts and stakeholders.
- The companies and individuals for their input both formal and informal during the consultation process: www.cibse.org/CP3consultation
- The peer reviewers (and others who contributed their time freely) to ensure relevance and accuracy.

And:…..

Environment Agency

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The Coal Authority

GSHP association HPA CIBSE

Why install a GWSHP?

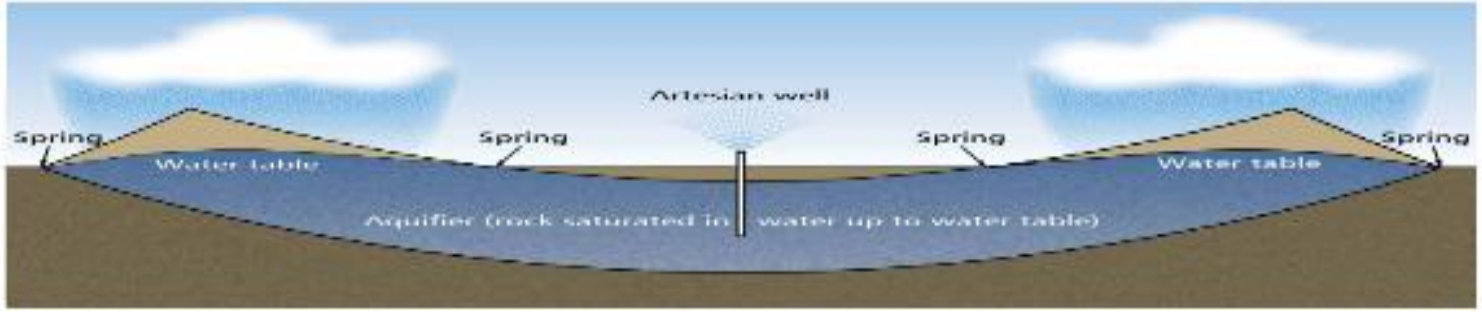
Economic Benefit

In most cases a key motivating factor is financial:

- Government Grants and Incentives – RHI, HNIP
- GWSHP systems can return an attractive ROI and mitigate against rising energy prices
- Any increase in CAPEX compensated by OPEX saving over lifetime reducing TOTEX
- Other costs saving e.g. Gas supply and flue unnecessary
- Can provided heating and/or cooling – significantly improving efficiency and reducing costs
- A low carbon alternative to combustion based systems

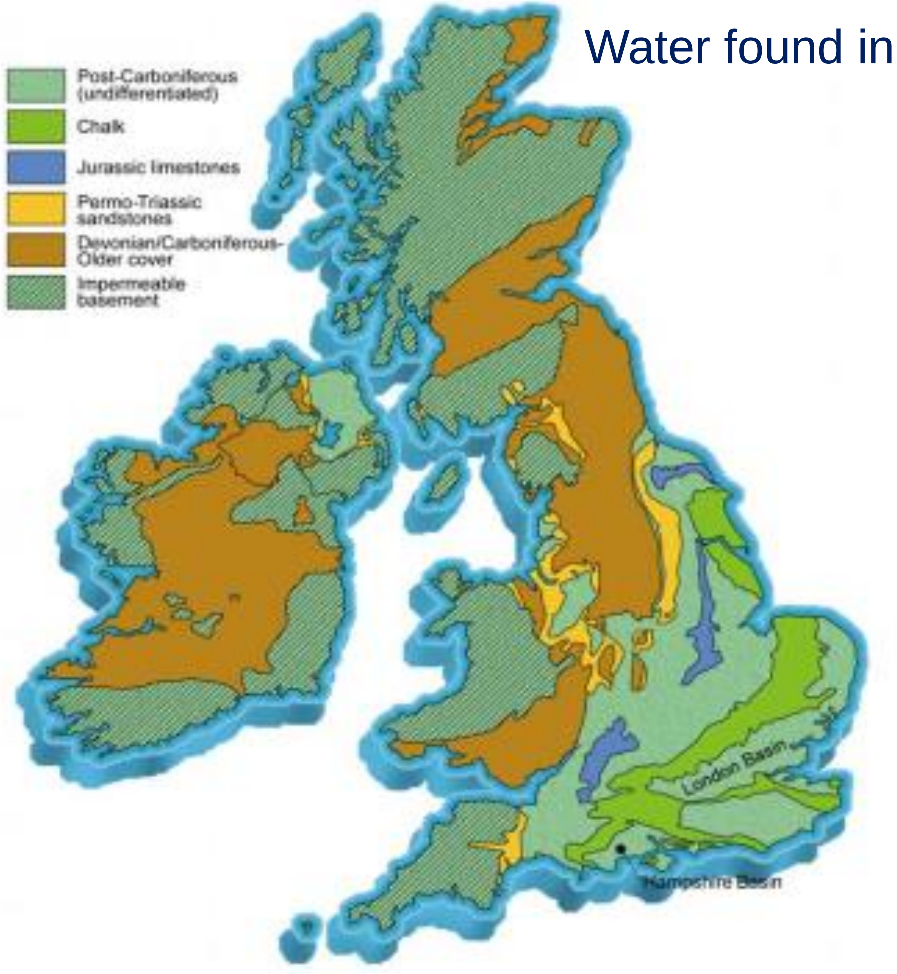
Legislative requirements

To comply with national and international legislation e.g.: Climate Change Act of 2008, Carbon Reduction Commitment (CRC) Energy Performance Building Directive (EPBD), Renewable Energy Sources Directive (RES), Climate Change Levy (CCL), Building regulations Etc.

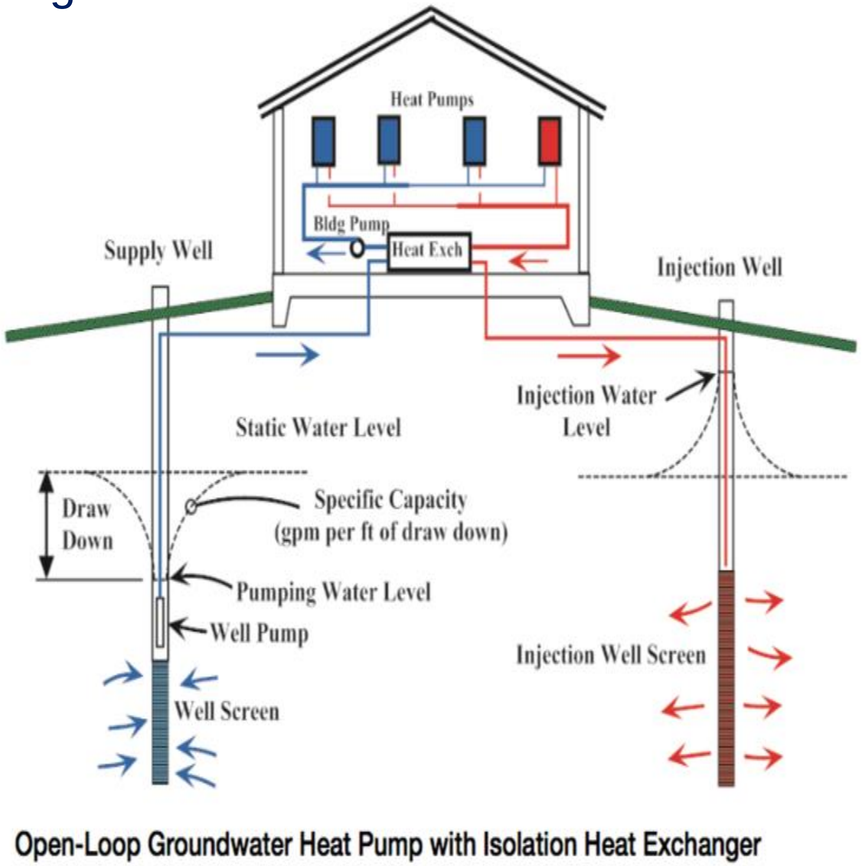


Ground Water – Where and How

Water found in or under the ground – including Minewater



Temporary wellhead on artesian borehole



The geology of Britain and its aquifers

A typical “doublet” groundwater system

Ground Water – Abstraction, Injection and Separation

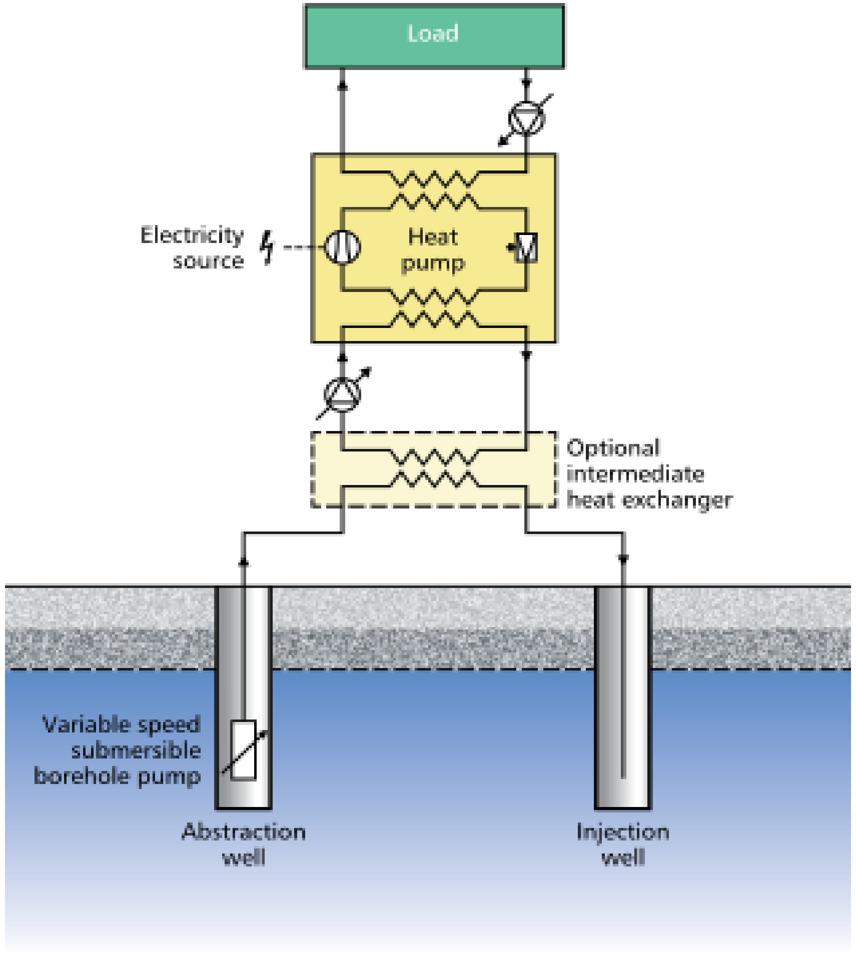


Figure 20 Simplified schematic showing optional heat exchanger

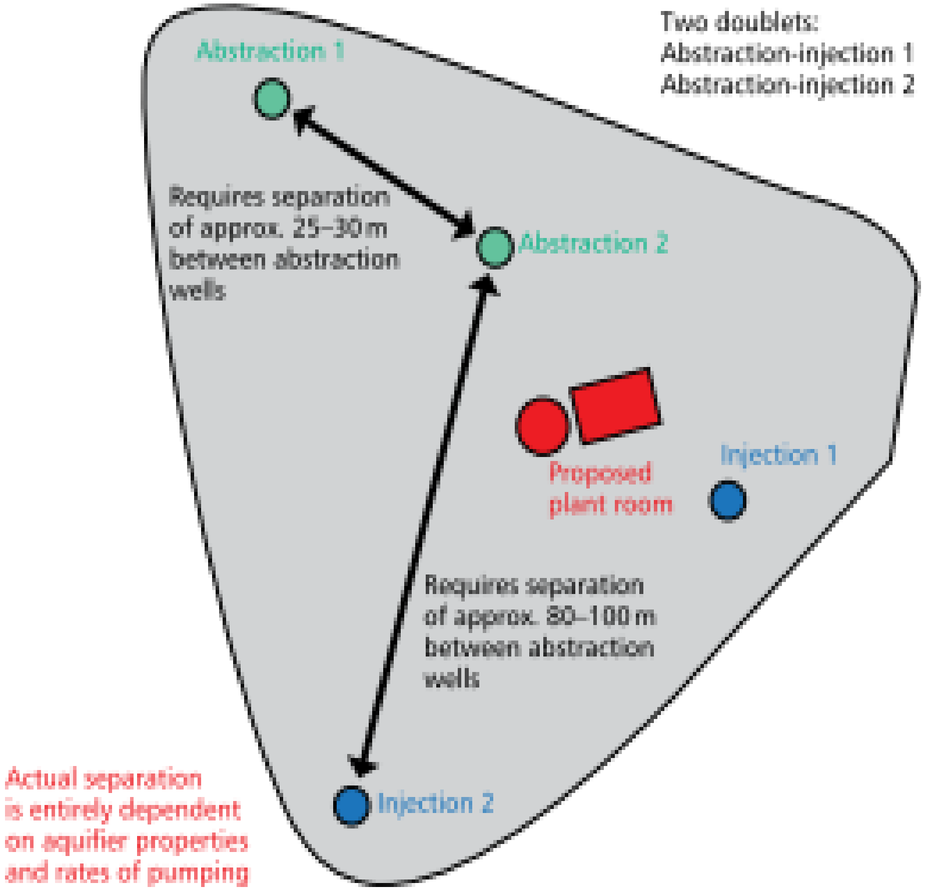
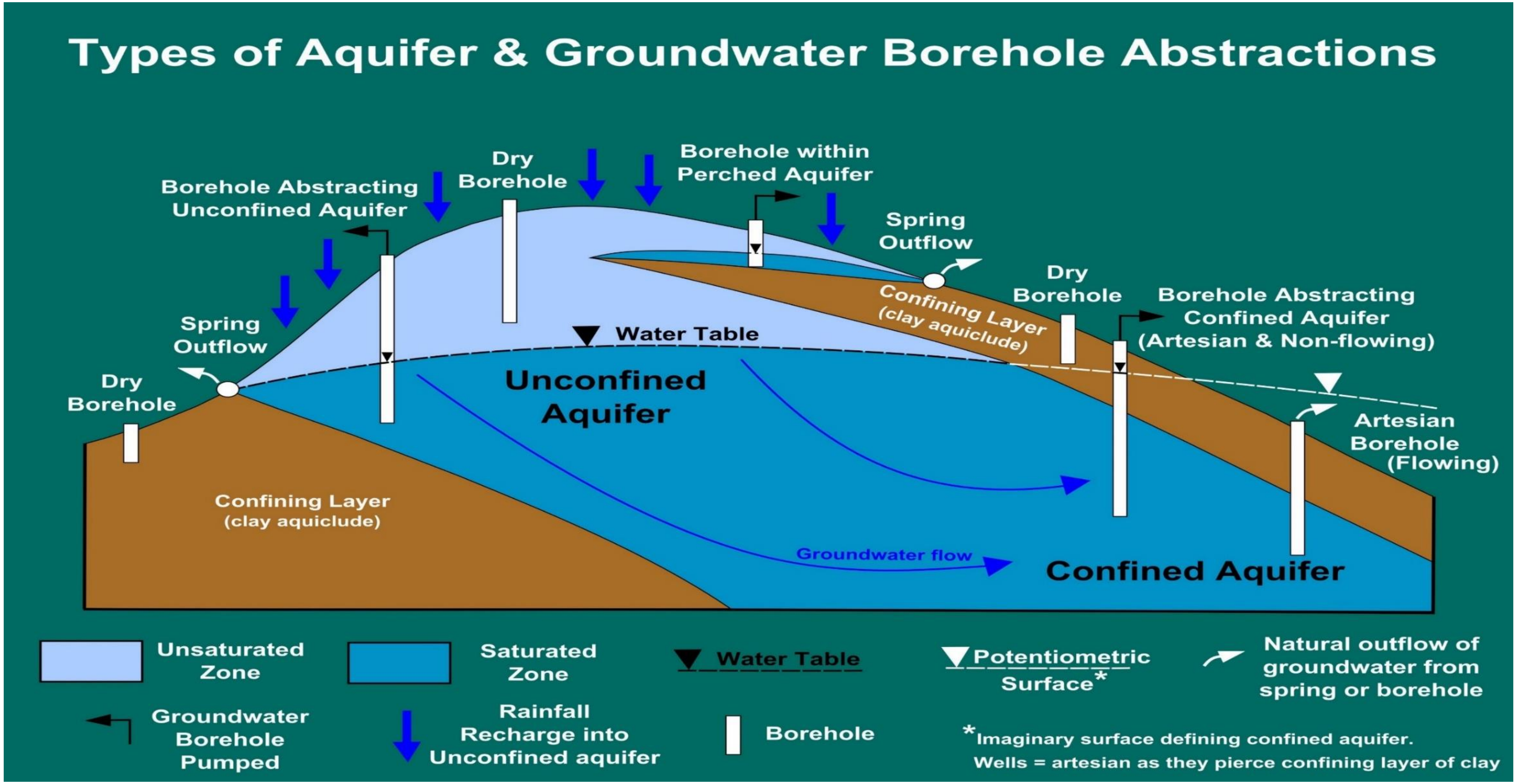


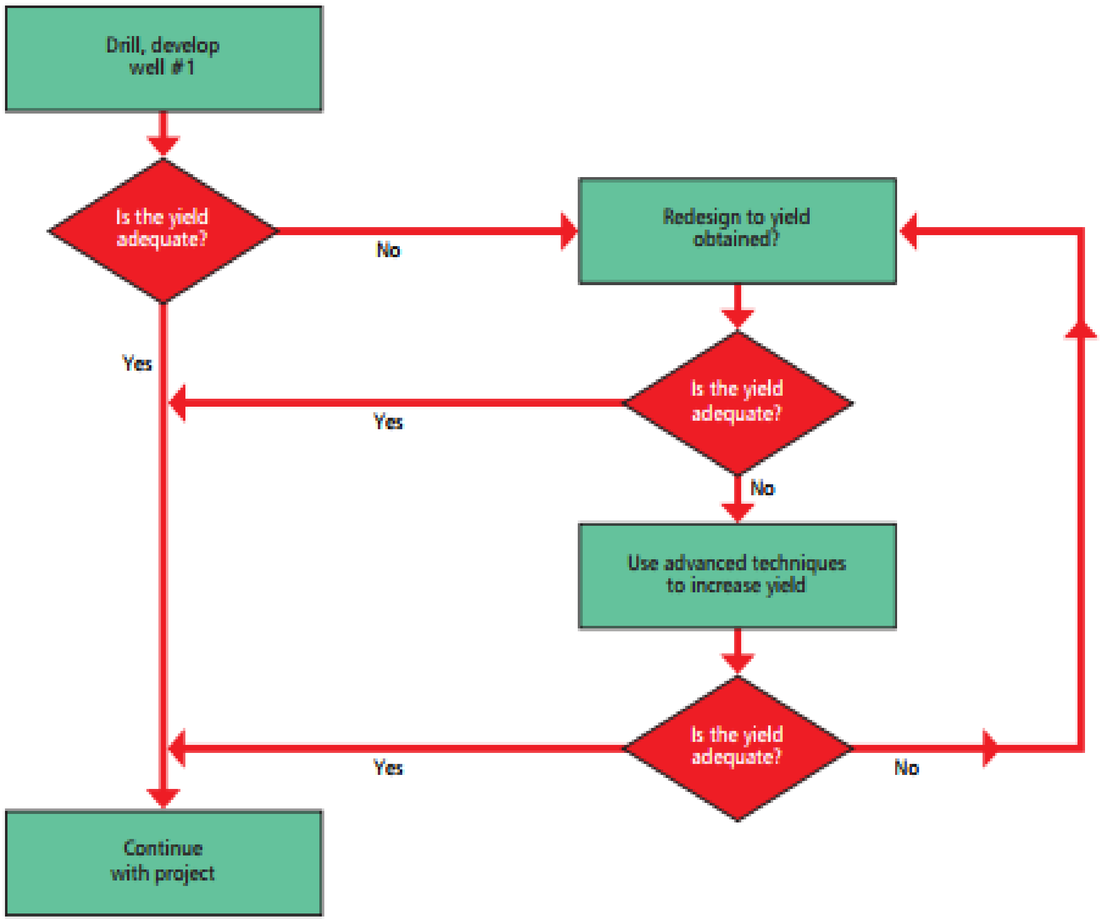
Figure 21 Example of well separation



Please use a professional advisor – Hydrogeologist.

Groundwater yield - Risk Mitigation

Can the design be finalised before the actual Water Well yield is known? How does this influence the construction programme?



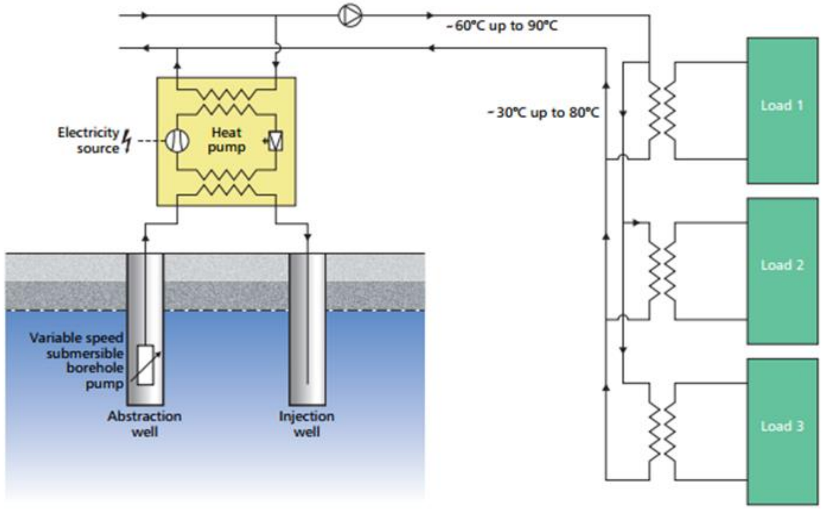
Employ a qualified hydrogeologist if in any doubt.

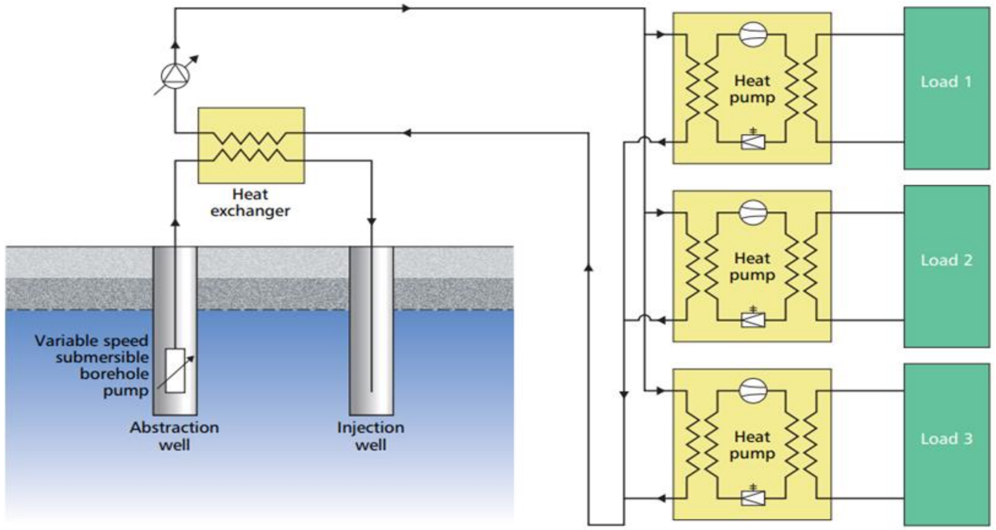
Steps to achieving a viable yield to supply a groundwater source heat pump……..

- Which output enhancement technique(s) to use and in what order will differ with geology and from site to site. Common well development measures may take less than an hour or several days.
- The decisions made will usually be cost-driven although in some cases the critical parameter may be time, reliability or longevity.
- It is often possible to revise the overall system design to work with the quantities available. Low yield designs may increase capacity with bi or multi valent systems incorporating CHP, heat recovery, thermal energy storage, dry air coolers, solar thermal panels etc.

Groundwater Source Heat Pumps are versatile

They can be used with both source and load side networks to provide heating, cooling or both either alternately or simultaneously.

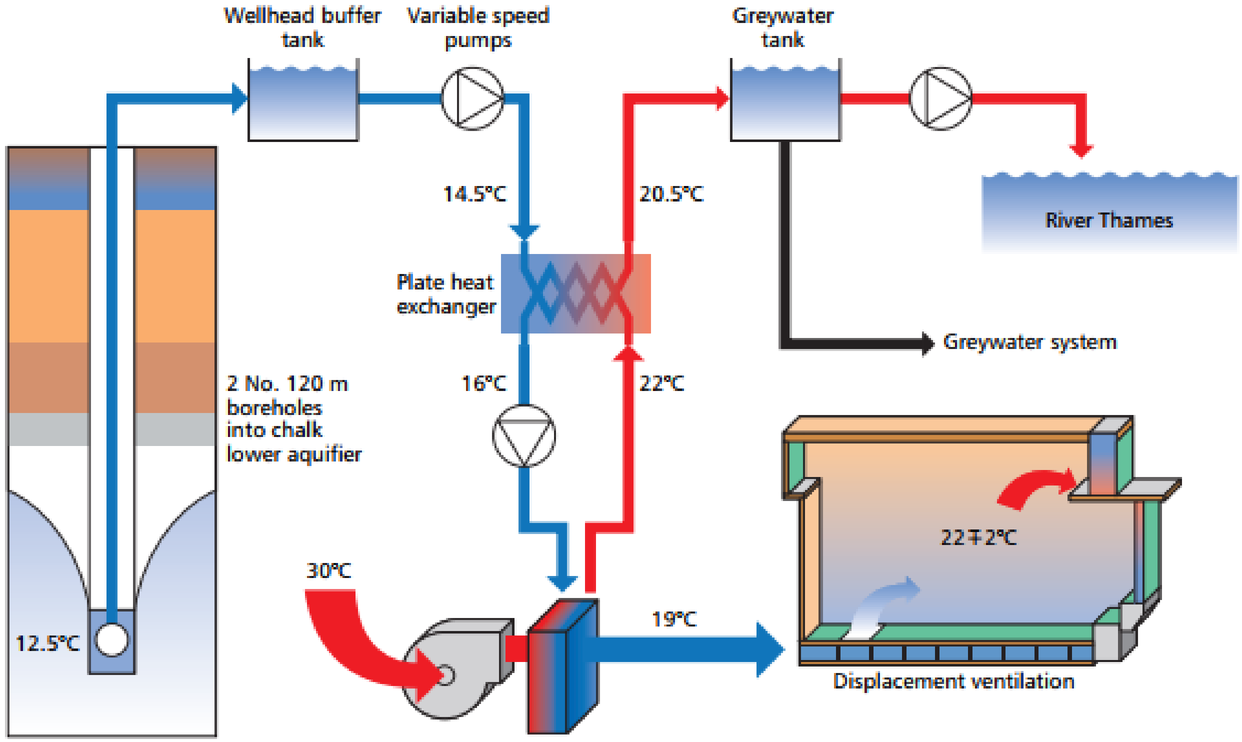




In “traditional” **load side** applications GSHPs are used as the primary generator for heating or cooling networks.

Increasingly **source side networks** (SSNs) allow multiple heat pumps to be attached to a network to collect or reject heat **at or near ambient ground** temperature.

Innovative groundwater "Free" cooling system

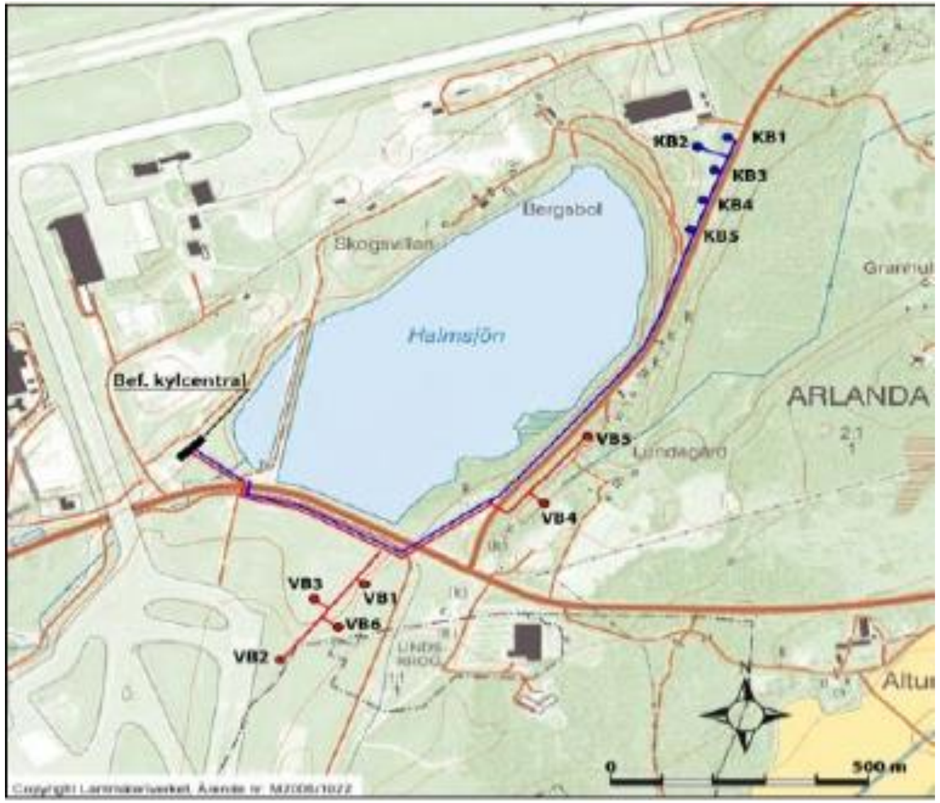


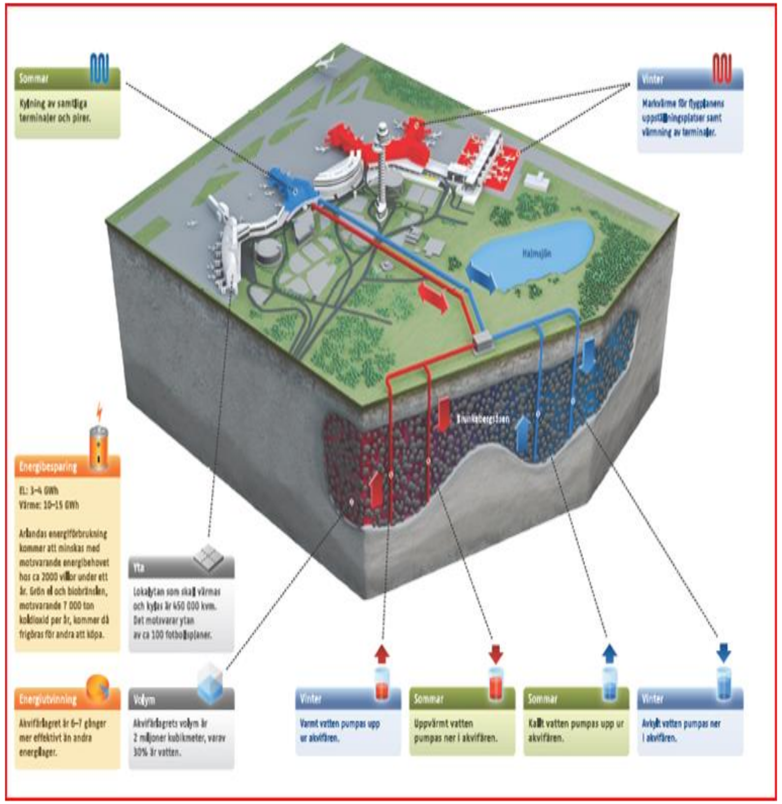
Portcullis House

Free Cooling using groundwater as a low temperature resource without a chiller.

“Free” pre-heating and cooling

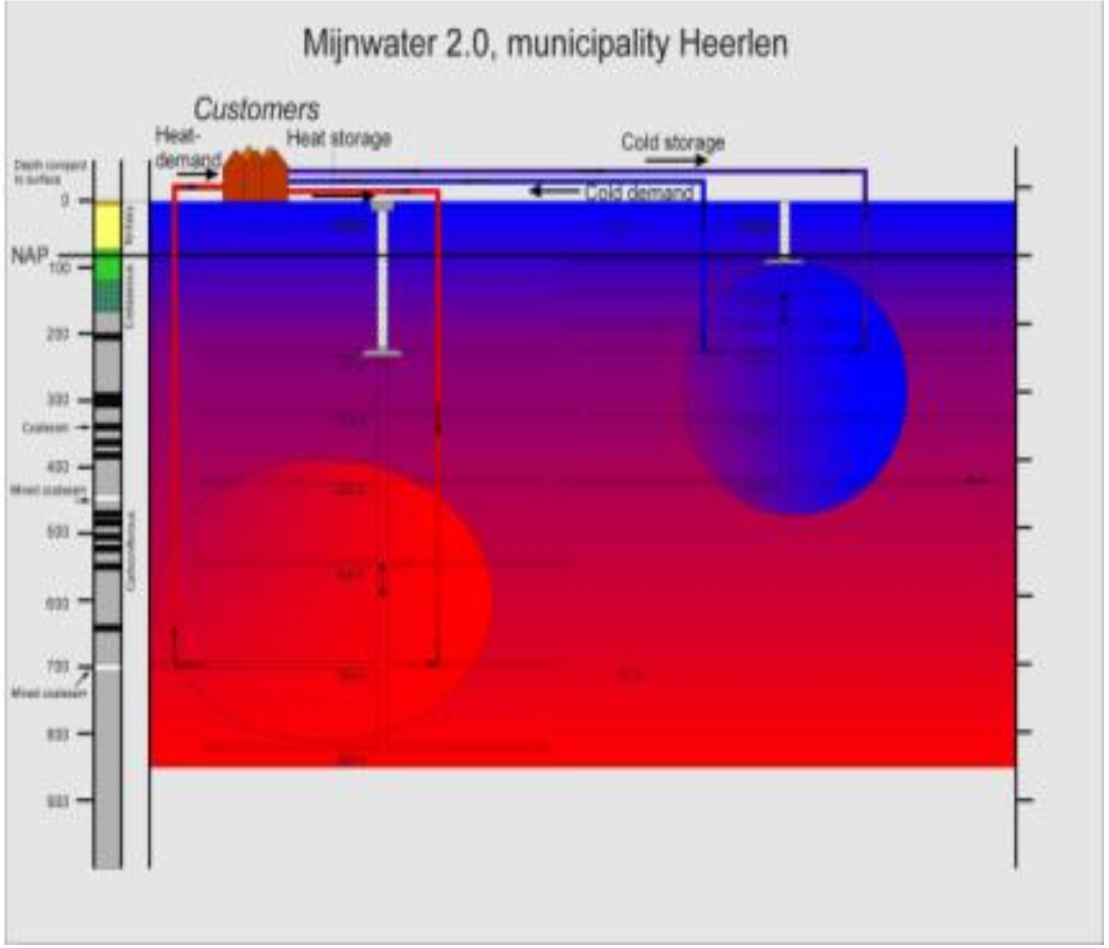
Arlanda Airport – Sweden’s Heathrow

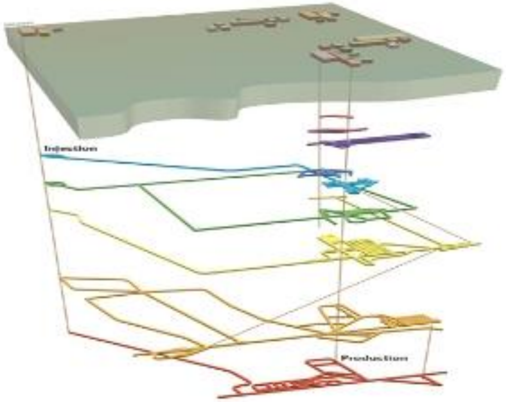


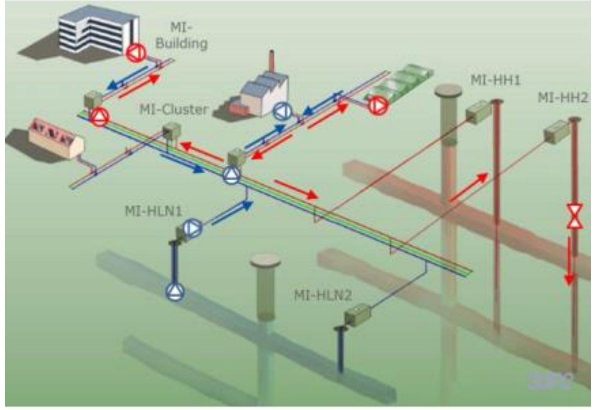


11 high capacity wells (5 Cold and 6 Warm) provide a total flow capacity of 720M^{3}h delivering between 6 and 10MW, a total of around 20GWh is delivered annually. Direct payback was less than 5 years!

Using Minewater as a source of thermal energy



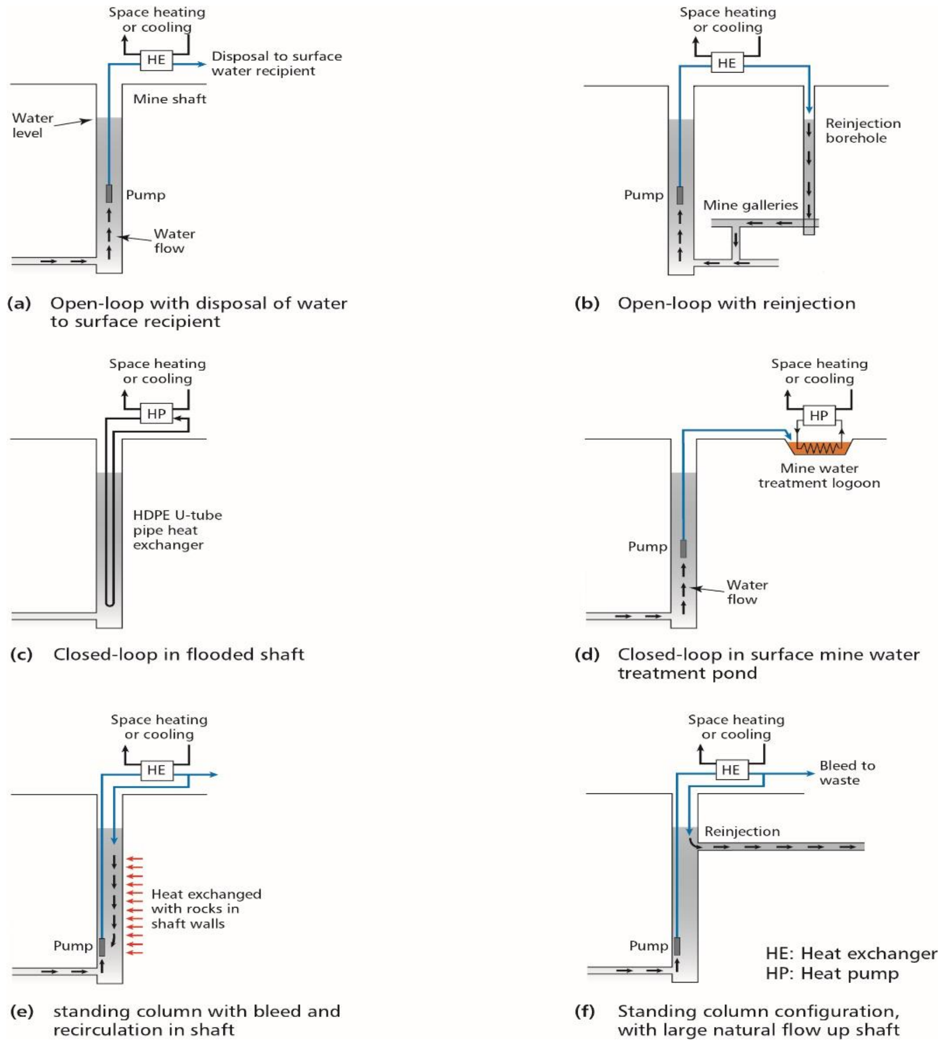




At Heerlen in the Netherlands minewater is pumped to the surface at temperatures reaching 28°C. The system is used to heat and cool, 200,000sq m of commercial and domestic buildings. A further 10,000 renovated homes will be added over the next 5 years. The current capacity is 4MW.

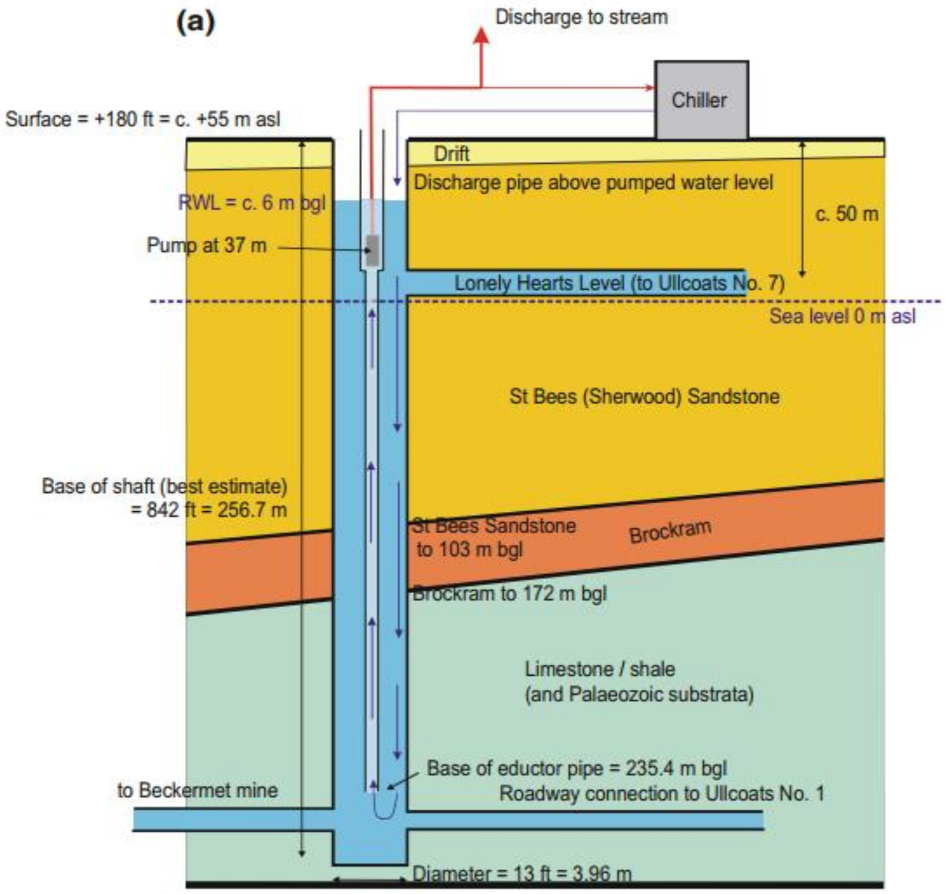
Minewater as a source of thermal energy

Glenalmond Street, Shettlestone, Glasgow

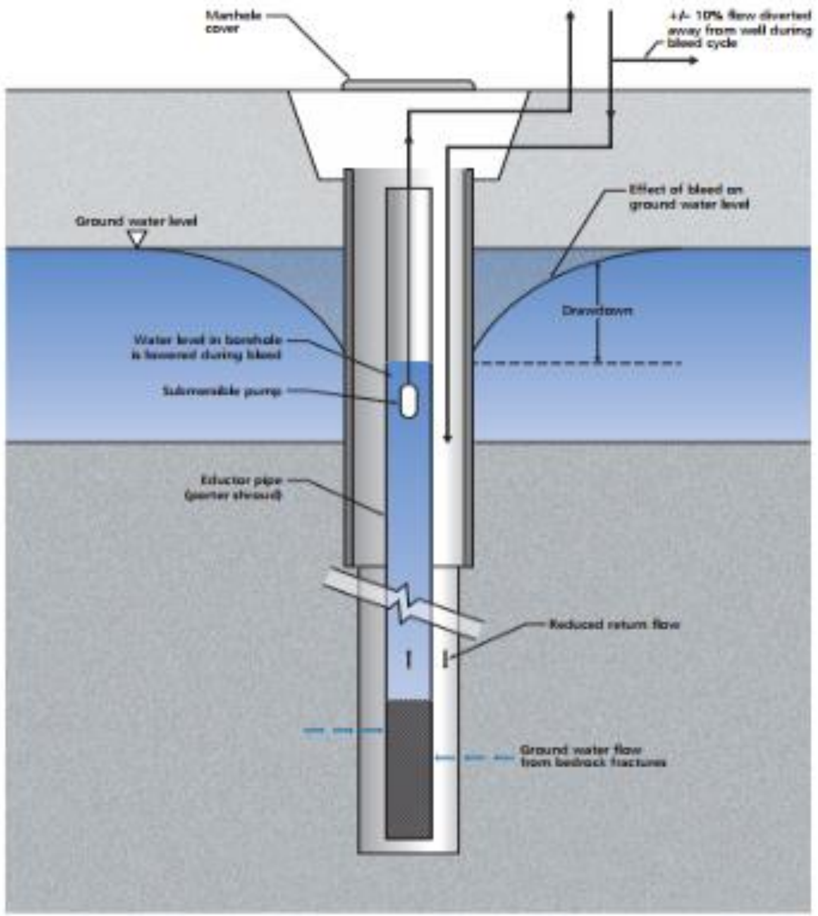


Standing Column Wells (SCW)

Using an Eductor pipe (Porter Shroud)



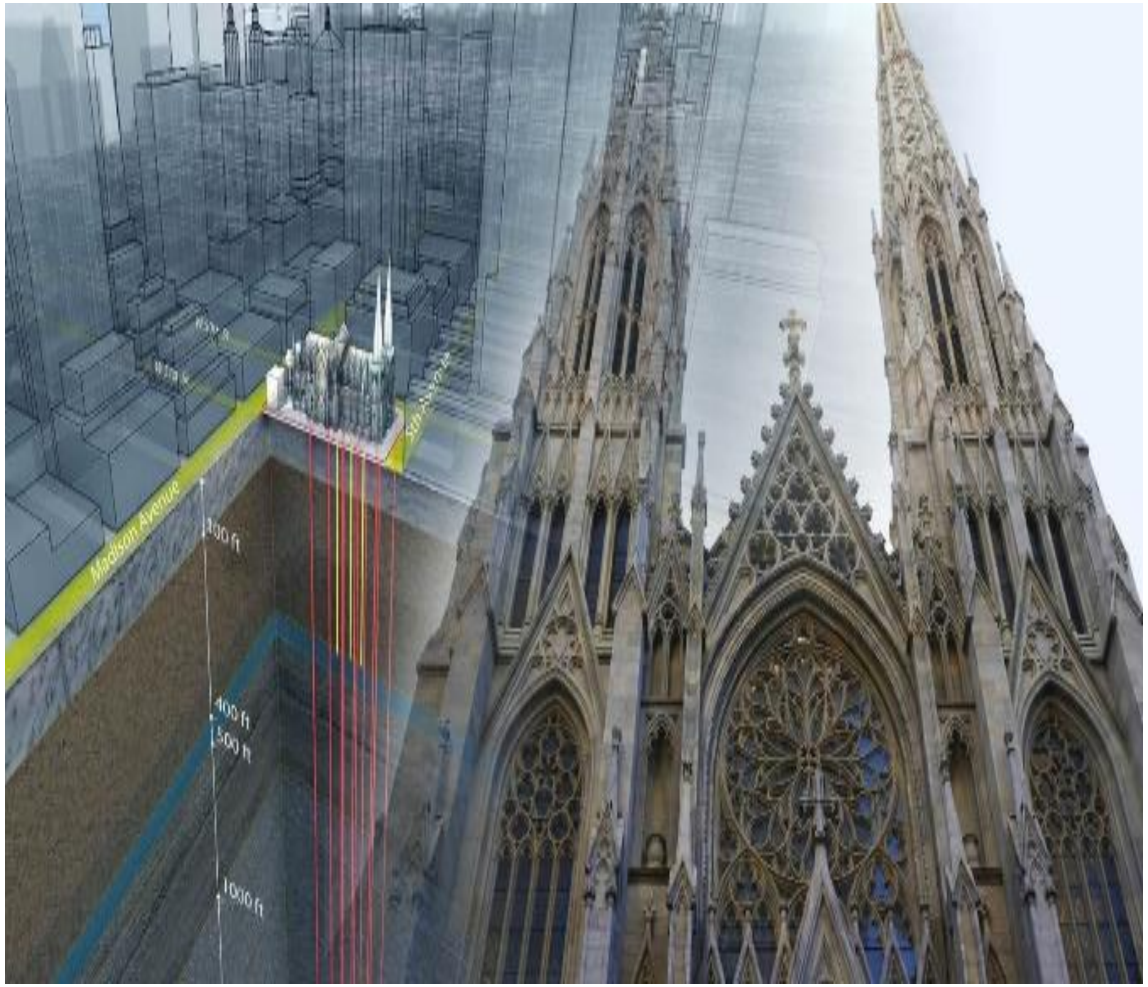
Standing Column Well test at the abandoned haematite mine, Egremont in Cumbria



SCW internals

Standing Column Wells

St. Patrick's Cathedral, 5th Avenue, New York, USA



The 10 ~200mm wells range from ~180M to ~ 675M and feed the system with groundwater at a constant ~13°C to provide ~850kWh of cooling, and/or ~940kWh of heating for the ~7,060M^2 building. It can cool and heat simultaneously.

Operating since February 2017 it saves around 30% of input energy, cuts CO_2 emissions by 94 Tonnes and takes up 60% less space.

GSHP association HPA HEAT PUMP ASSOCIATION CIBSE

ATES (Aquifer Thermal Energy Storage) system at Wandsworth Riverside

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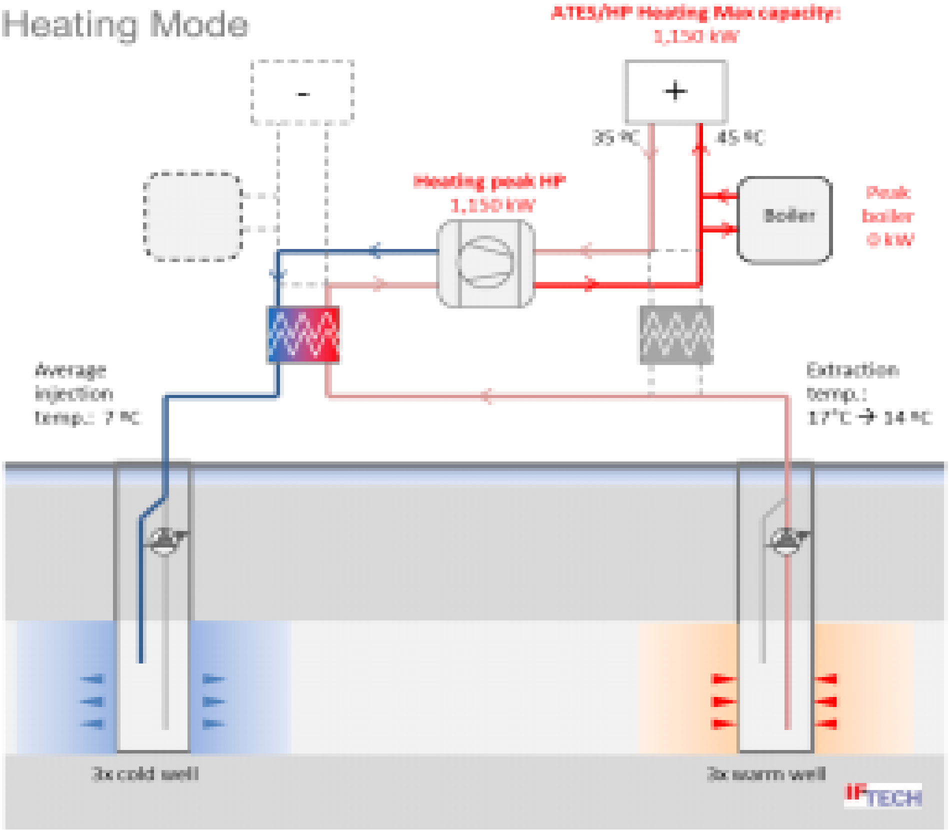
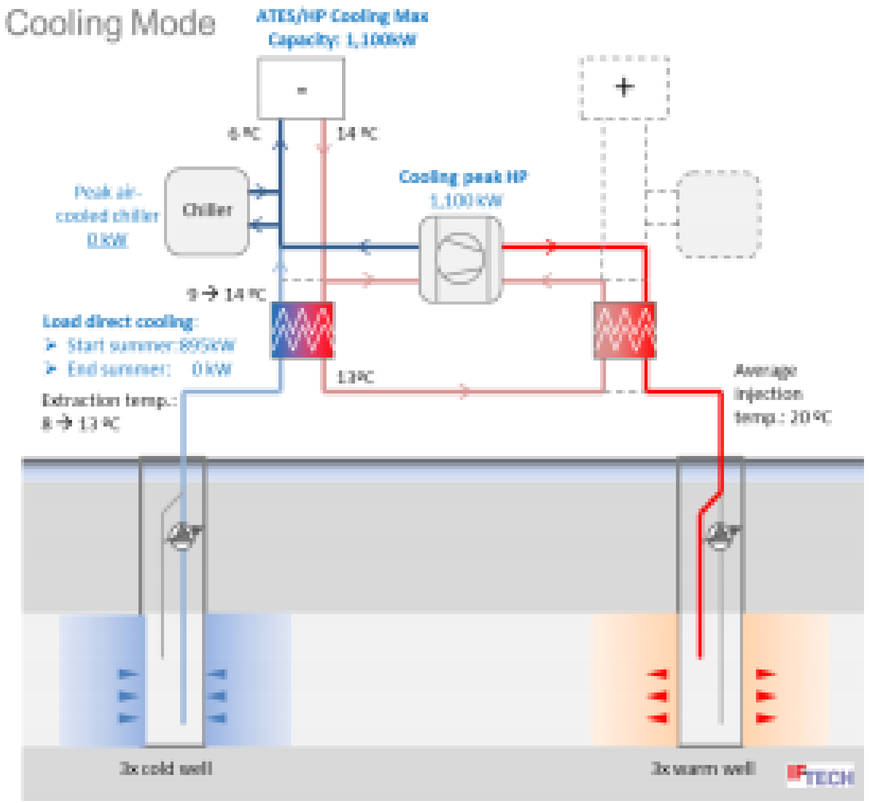
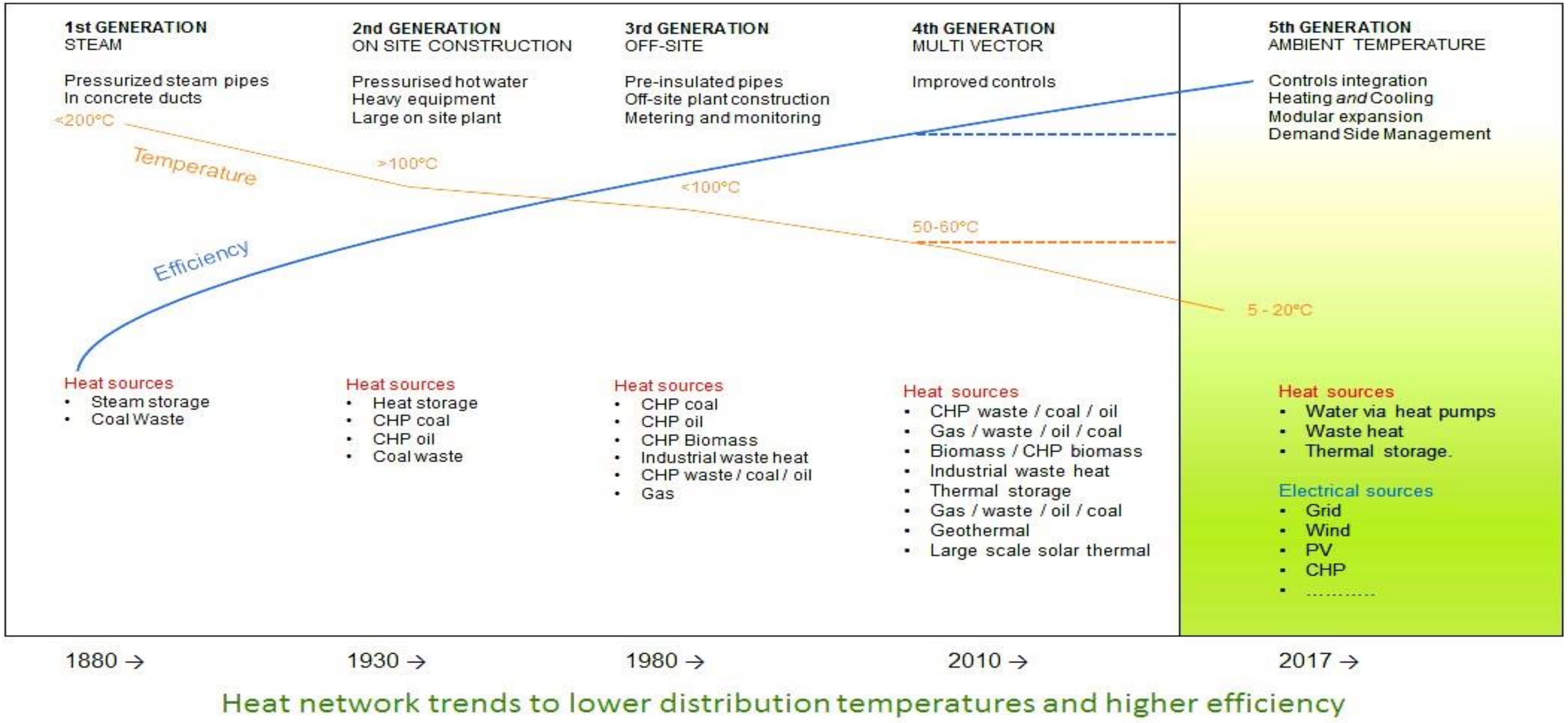




An open-loop system of 8 x 120m boreholes supplies a peak cooling capacity of 2.25 MW and a peak heating output of 1.2 MW. The aquifer provides interseasonal thermal energy storage

5th Generation (Ambient) Networks – Why?



N.B. The closer the source and delivery temperatures of a heat pump the more efficiently it operates – High temperature Cooling, Low temperature Heating

Summary

- Successful CIBSE/GSHPA/HPA partnership
- Input from industry ensuring consensus
- Promotes an under used technology
- Regular review
    - Best practice becomes minimum standard?
- Training pending
- Compliance checking and policing – Under discussion

Thank you for listening

Any Questions?

Nic Wincott: CP2 and CP3 lead author

njwincott@gmail.com

07836 661551