NVQ Land Drilling
Geothermal Drilling Course
Session 1

Part Funded by

This project has been delivered with support from the CITB Growth Fund, which aims to ensure that the construction industry has the right people, with the right skills, in the right place, at the right time and is equipped to meet the future skills demands of the industry".

Course Objectives

Upskill Land Drilling Personnel

- Geothermal Drilling Subject Knowledge
- Best Practice

Demonstrate Geothermal Potential

- At beginning of large market
- Drilling sector needs to gear up

Encourage NVQ Candidate Recruitment

- BDA Grant Availability
- Need for properly qualified Lead Drillers

Who am I?

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CGD No.201 (AEE – IGSHPA)
IGSHPA – Accredited Installer
IGSHPA – Vertical Loop Installer

Session 1

- Course Objectives
- Projections for growth in the UK
- What is “Geothermal” – How does it work
- Types of Ground Heat Exchangers

Projections for Growth

The Climate Change Act 2008 – What is it?

It's a commitment to reduce carbon levels by 80% from 1990 levels by 2050

Budget	Carbon budget level	% reduction below base year
1st Carbon budget (2008-12)	3,018 MtCO2e	23%
2nd Carbon budget (2013-17)	2,782 MtCO2e	29%
3rd Carbon budget (2018-22)	2,544 MtCO2e	35% by 2020
4th Carbon budget (2023-27)	1,950 MtCO2e	50% by 2025

In Scotland it's the….

The Climate Change (Scotland) Act 2009

Projections for Growth

Why is the UK Government committed to electric heating?

Energy Independence

Produce your own electricity, heat your own properties without Pipe Lines from Russia

Projections for Growth

Heat Pump Growth – Committee for Climate Change

	Installations	TWh
Domestic	30.6m	232
Non-domestic	0.5m	133
Total	31.2m	365

Source: CCC

What does this actually mean for the drilling industry ?

Lets do the maths….

Projections for Growth

Heat Pump Growth – Committee for Climate Change

	Installations	TWh
Domestic	30.6m	232
Non-domestic	0.5m	133
Total	31.2m	365

Source: CCC

Take this number and assume just 10% of these are GSHP's

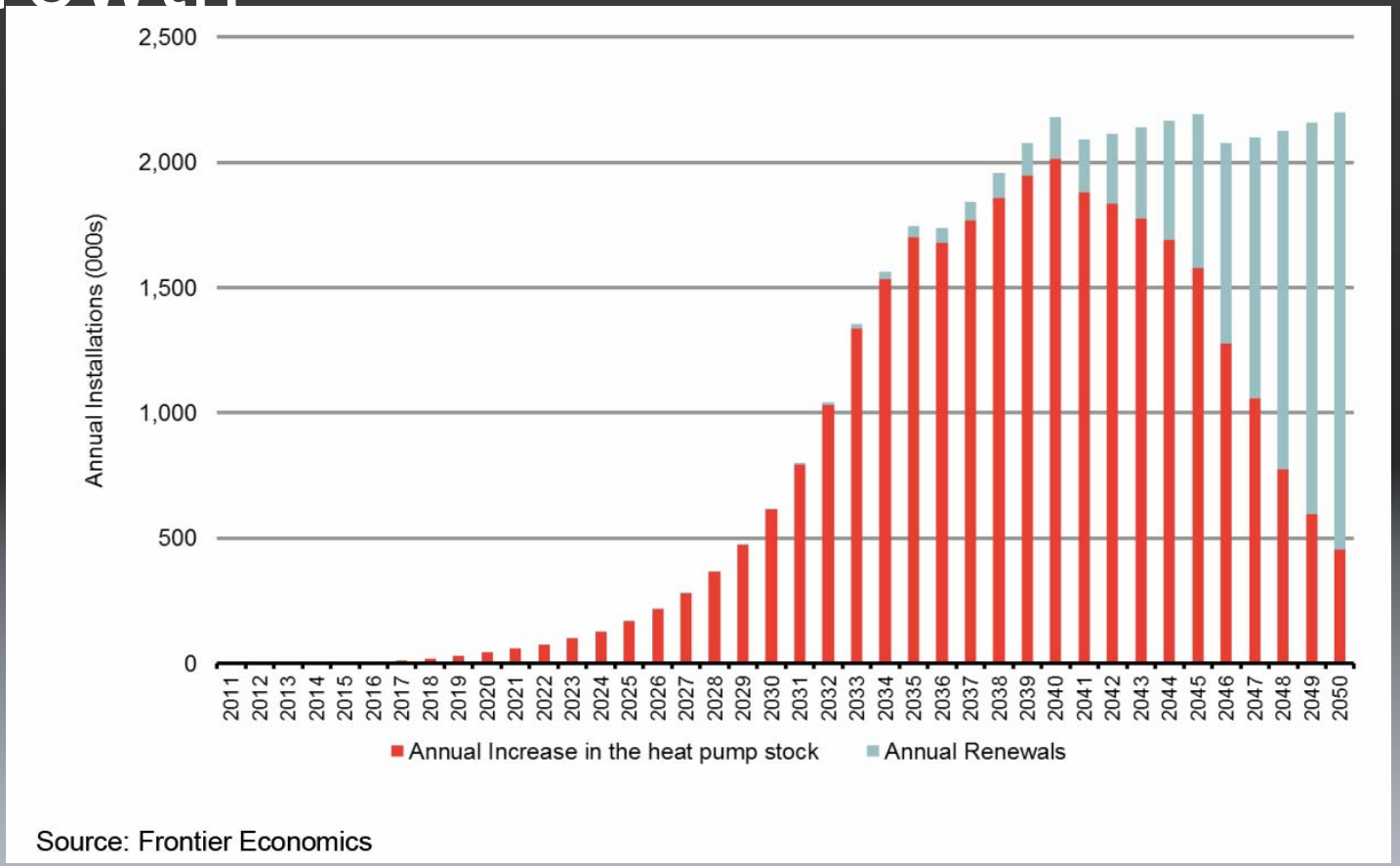
Assume that on average it takes 1.5 boreholes at 80m deep per install

That's 4.5 million boreholes between now and 2050

370 million metres of drilling…

£13 Billion to the industry in just over 35 years

Projections for Growth



This is what it looks like on an annual basis…

We are right at the beginning.

Projections for Growth

Drivers for the industry

Previously Low Carbon Buildings Programme & Clear Skies.

Based upon a grant process giving a lump sum to each install

Now there is the Renewable Heat Incentive (Rhi)

The Rhi is a payment for heat produced using a renewable technology

The Rhi has two streams of funding….Domestic and Non-Domestic

Domestic Rhi tariff is 18.2p/kWh paid for 7 years

Non-domestic Tariff is 8.2pkWh paid for 20 years

Eco-Funding

Projections for Growth

Where is the competition coming from for drillers?

It is not other drillers per se

Competition comes from other technologies

Drillers are part of a system that is competing with ASHP's Biomass Boilers, PV Panels and Solar Thermal systems

If the drilling prices are not competitive its not necessarily another driller who will get the work, its more likely another technology will be employed.

What is Geothermal

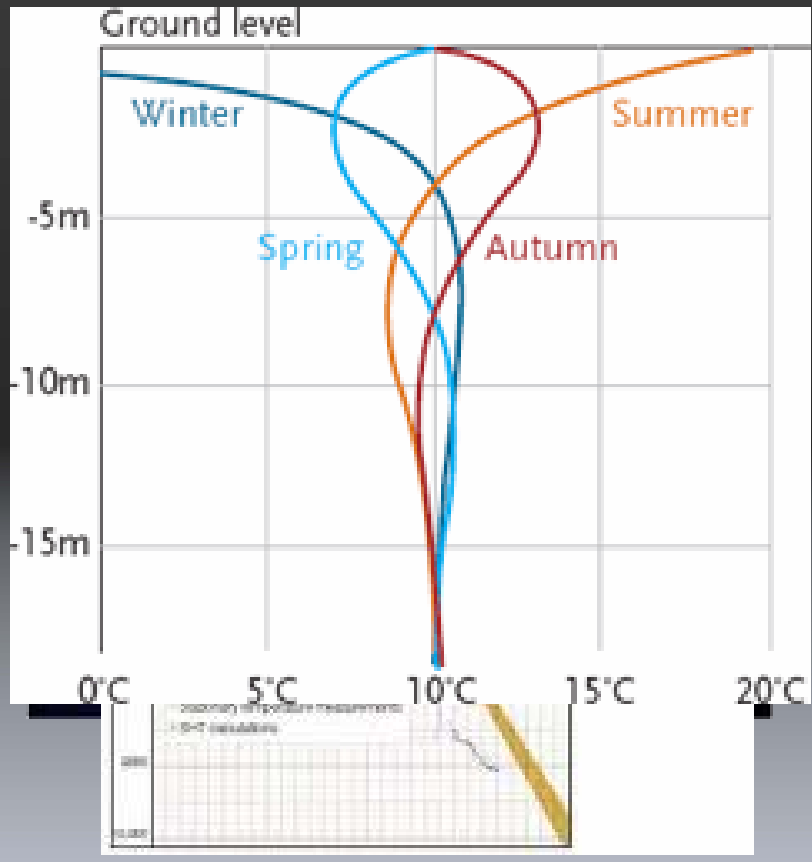
GSHP's work by scratching the surface !

Defined as Shallow Geothermal for depths of up to 400 m

0.004% of the Crust !!

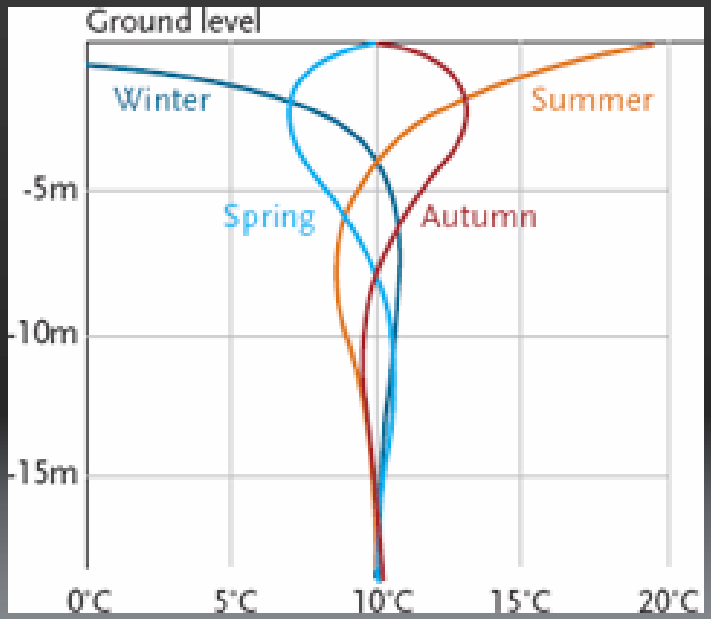
In the upper 15 – 20 m there is an annual temperature swing

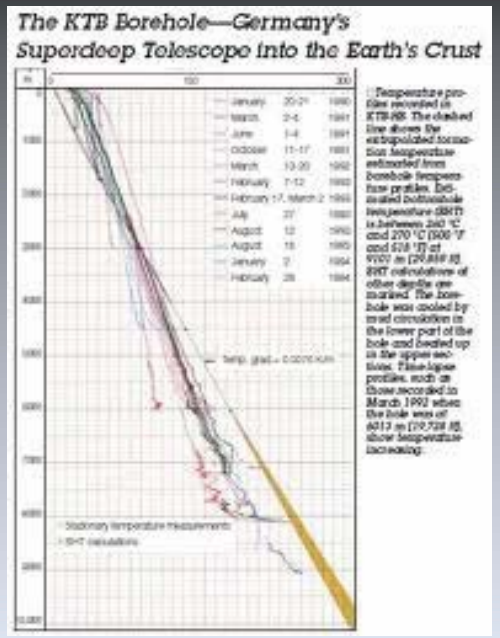
Below 20 m the ground temperature stabilises but still increases at a rate of approximately 1C - 3˚C per 100 m



What is Geothermal

This annual temperature swing is solar.. Without doubt




The KTB Borehole—Germany's Superdeep Telescope into the Earth's Crust

The gradient is natural radioactive decay of the Earths core and millennia of solar and atmospheric influence

What is Geothermal

Heat Map of the UK

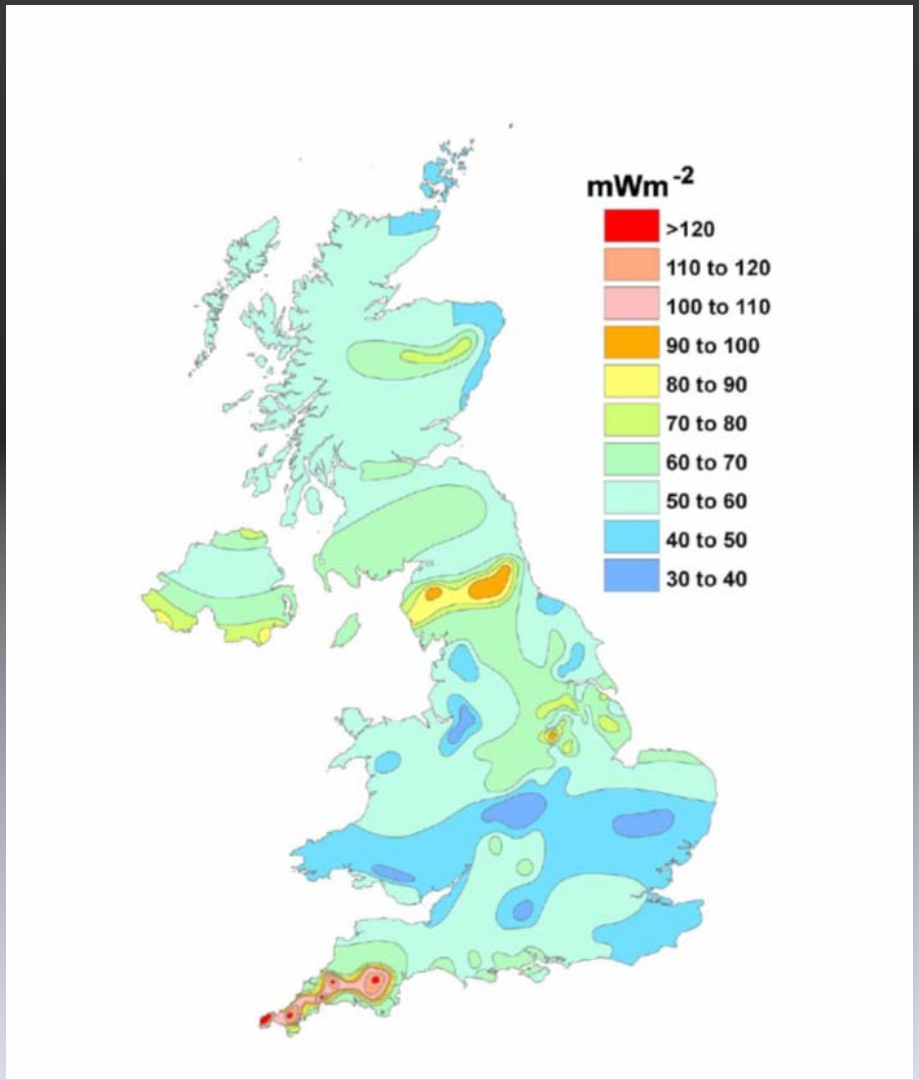
Measured in milliwatts/m^{-2}

Varies across the UK and is **not** related to the climate or solar.

The average across the world is 87 mW/m^{-2}

That is barely enough energy to boil a thimble full of water in 2 years

But it has been on trickle charge for billions of years !!



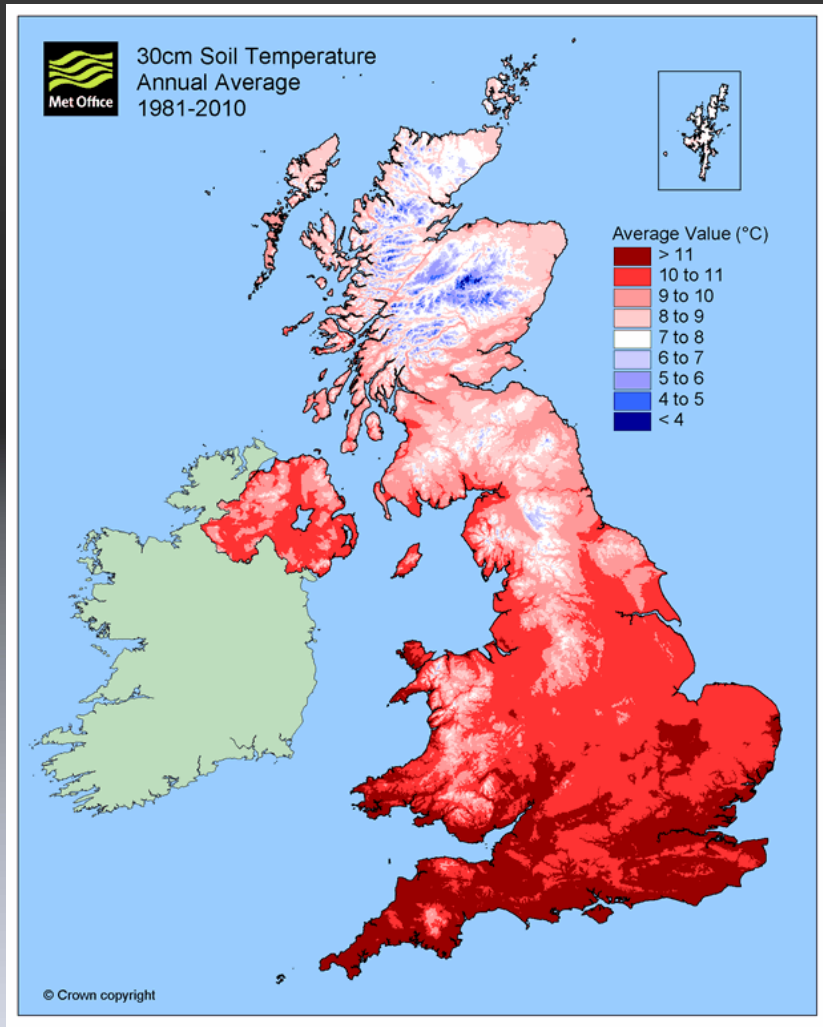
What is Geothermal

Average soil temperatures from the UK show no correlation to the heat flux.

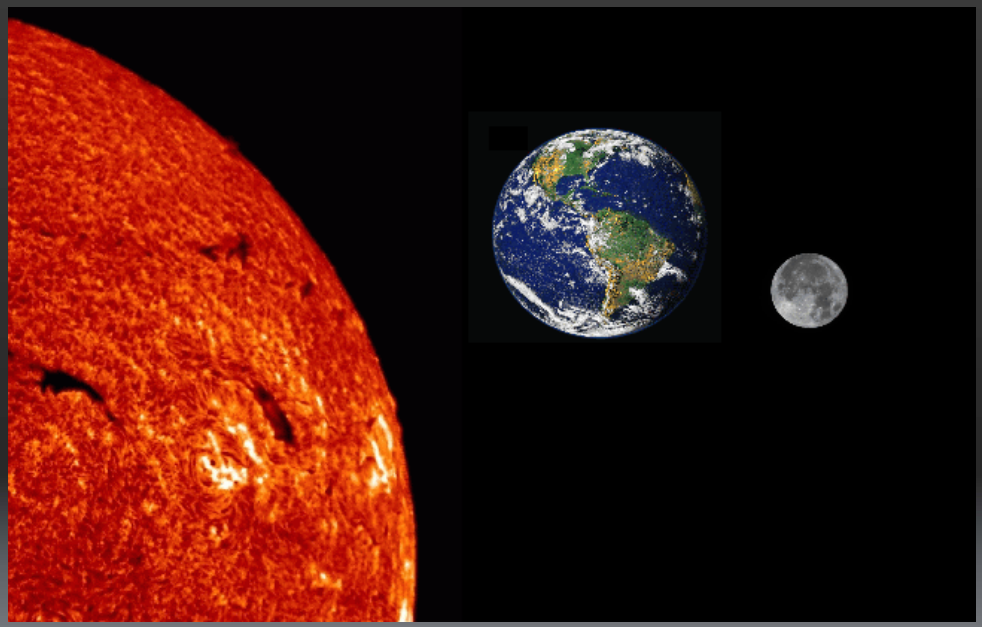
A property with GSHP at height in the North has a lower surface temperature than one at sea level in the South.

This combined with low heat flux can impact the system design

A Designer needs both heat flux and ground/air temperature for design



What is Geothermal



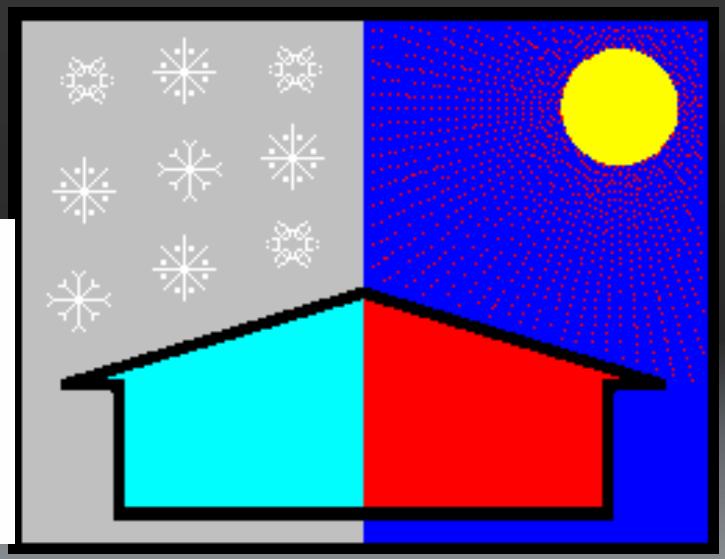
As soon as a GSHP system is turned on it affects the resource that has taken billions of year to get there. This is where the design of the system must be sustainable

Unlike Coal and Oil which is simply removed and burned, shallow geothermal energy is being replenished, just slowly.

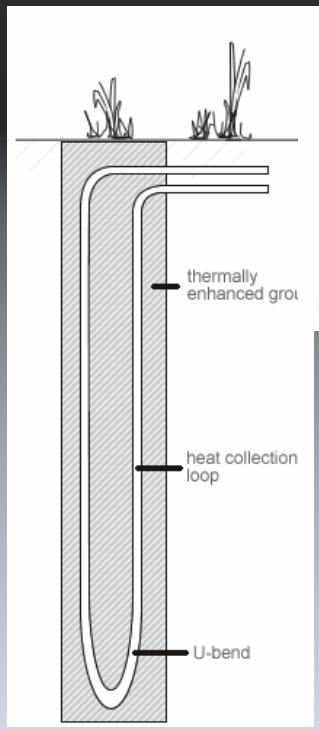
How does it work

Winter Heating

Summer Cooling



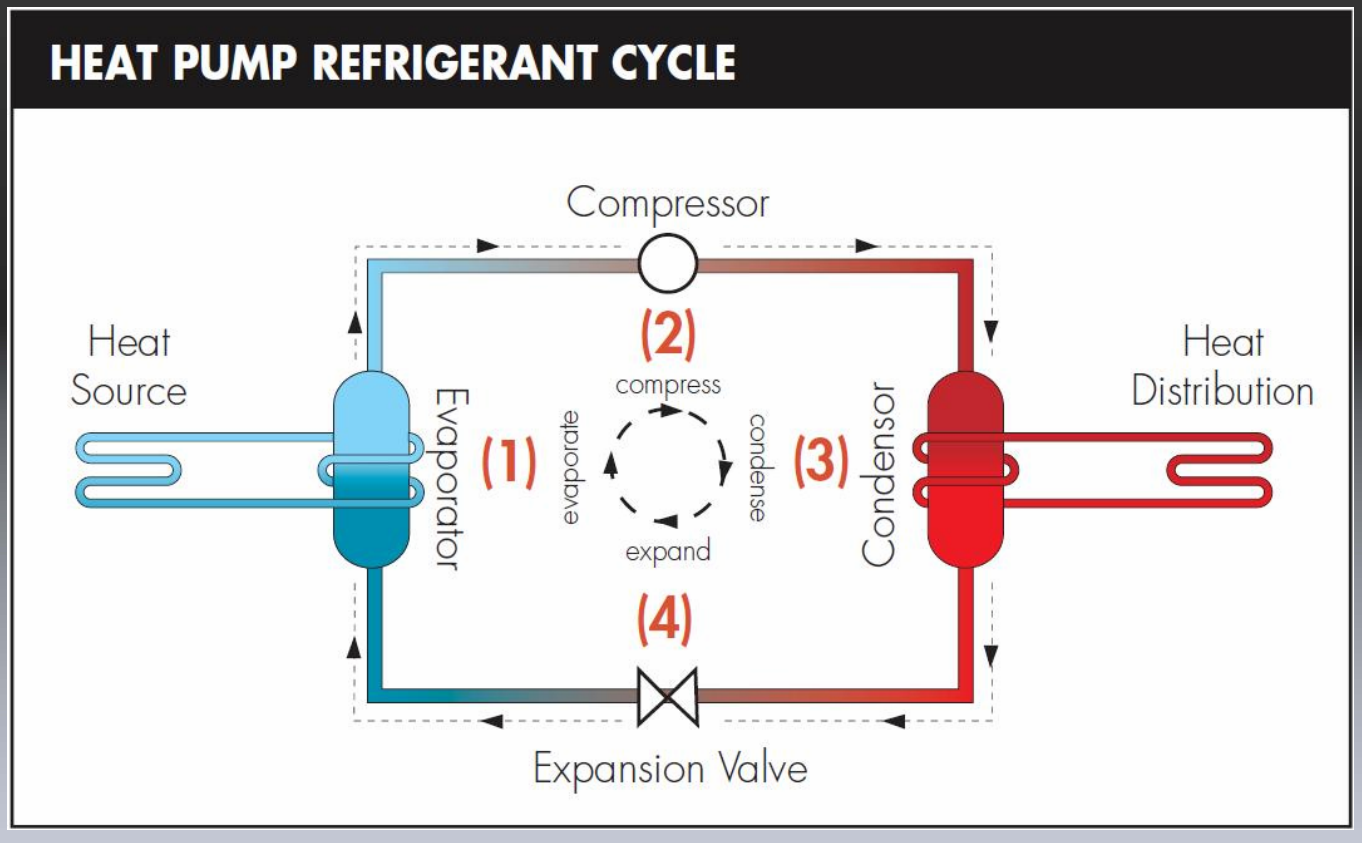
Heat Pump



Ground Source Energy

How does it work

What's Inside the Box ?



Types of Ground Heat Exchanger

- Open Loop – Water wells, rivers, lakes & sea

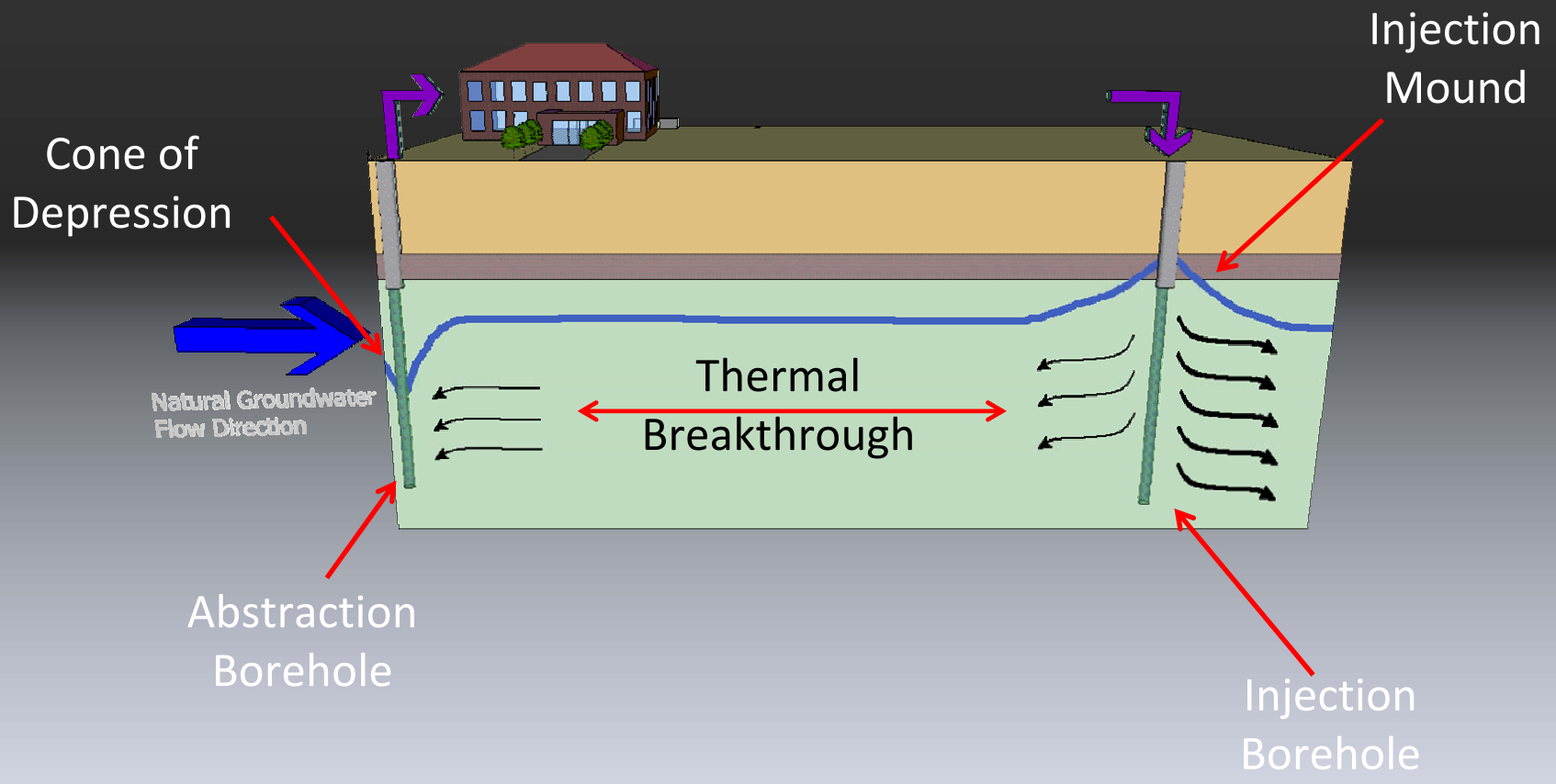
- Closed Loop – Boreholes, trenches, rivers, lakes, sea, process heat recovery, sewage heat recovery, building structures & energy piles

Open Loop Ground Heat Exchangers

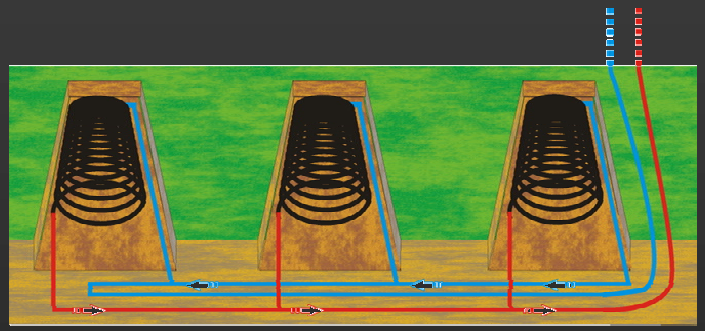
River Extraction filter designed for Open Loop on the Thames

Open Loop Ground Heat Exchangers

Open Loop borehole system

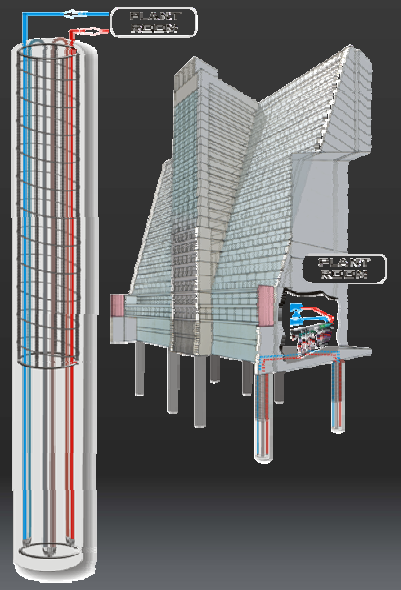


Closed Loop Ground Heat Exchangers

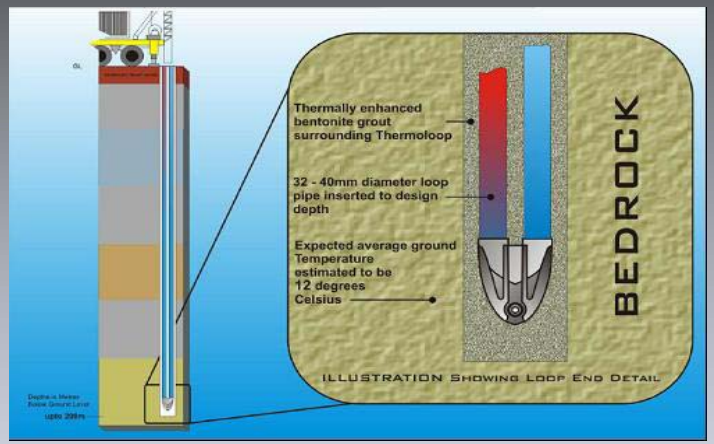


Horizontal loop

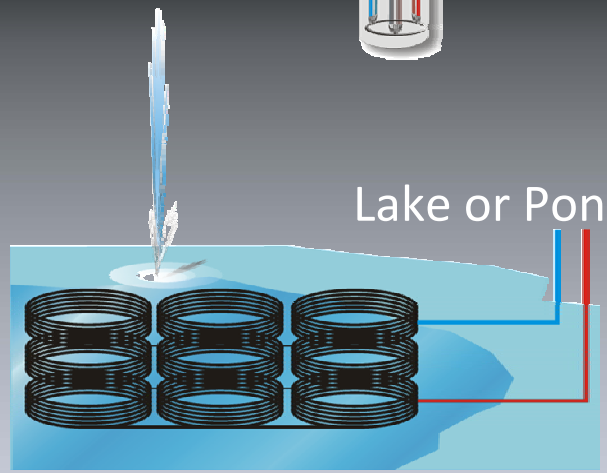
Thermal Pile



Borehole

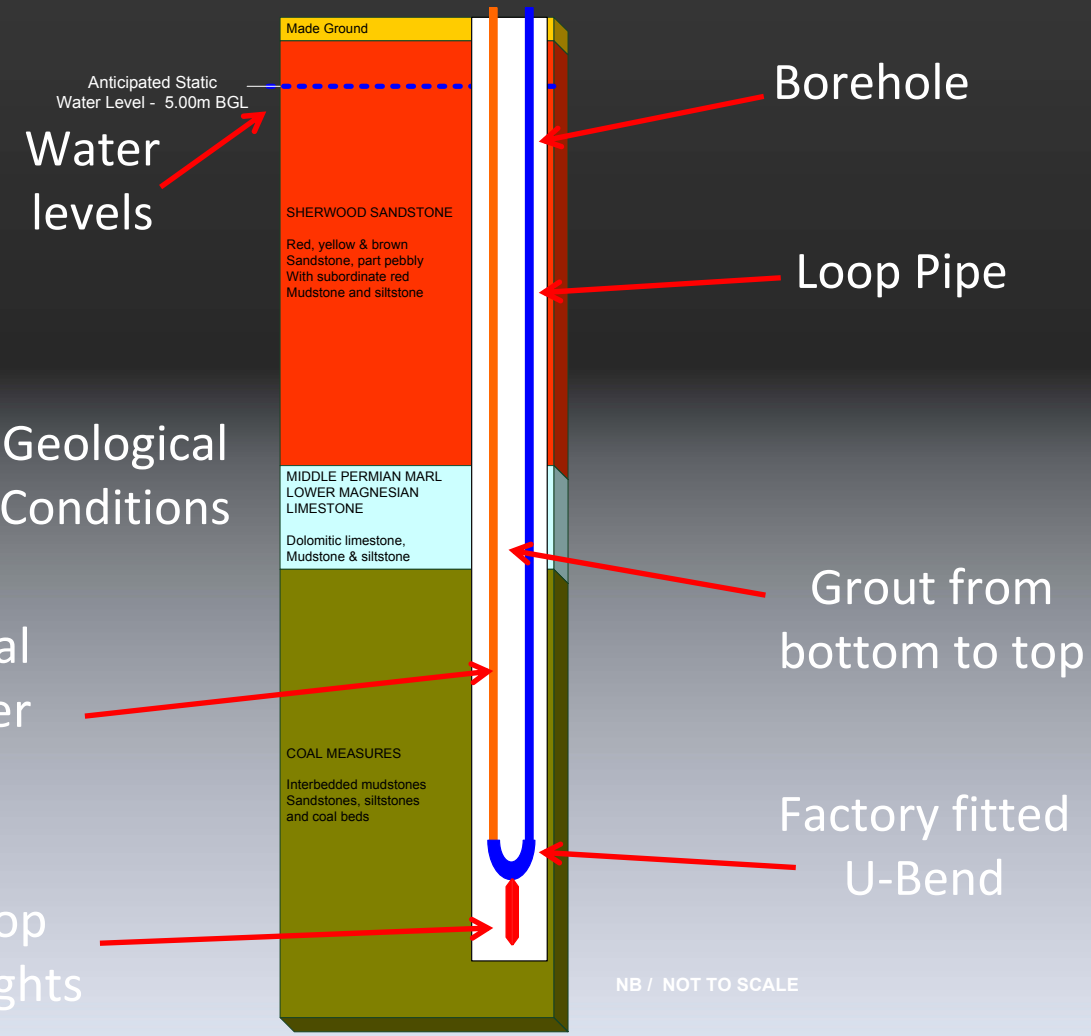


Lake or Pond



Closed Loop Ground Heat Exchangers

What are the main elements of a closed loop borehole?



Closed Loop Ground Heat Exchangers

What are the main loop configurations in the borehole?

Single Loops
25, 32 & 40 mm

Double Loops 32 &
40 mm

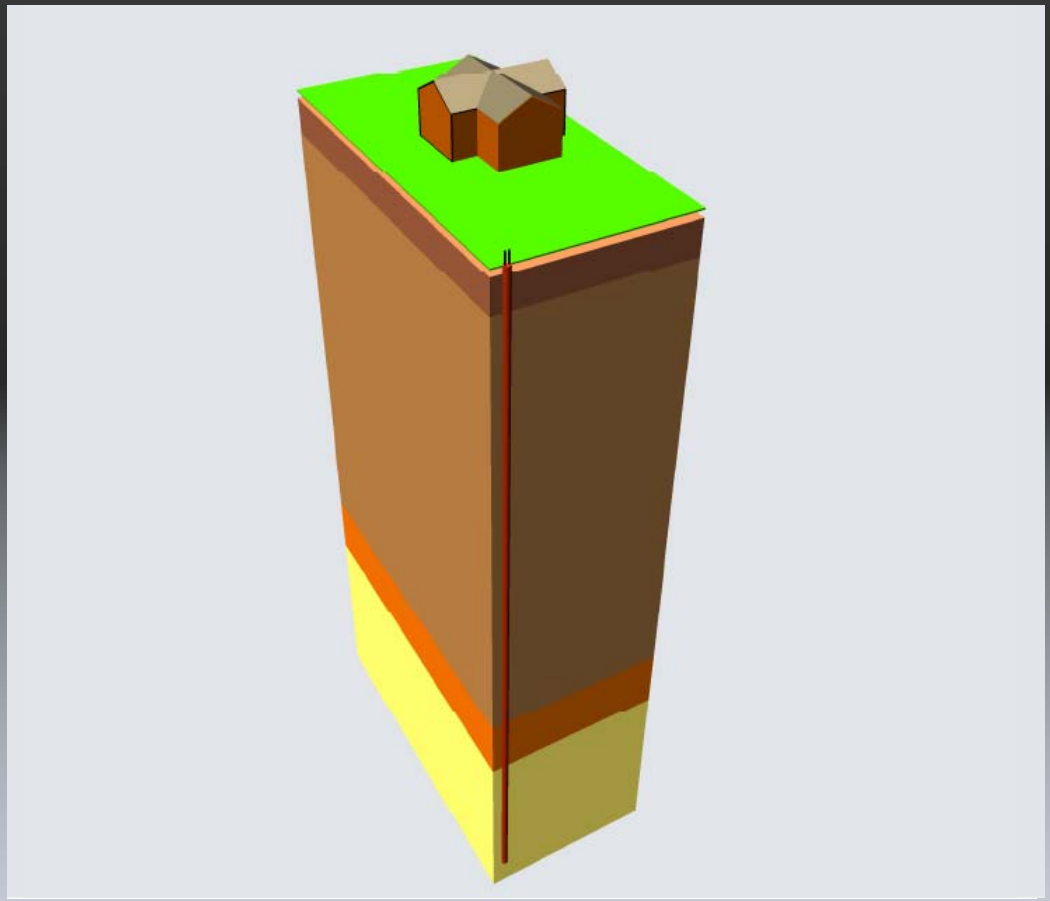
Beware Buoyancy !!

Number of loops per bore	1	nr
Loop Diameter	32	mm
Hole Depth	100	m
Rest Water level	0	m
Bore Fluid Density	1100	kg/m3
Water in loop density	1000	kg/m3
PE100 Density	955	kg/m3

Volume of water displaced	0.161	m^3
Weight of water displaced	176.9	Kg
Weight of water in loop	107.7	Kg
Weight of loop pipe	50.8	Kg
Weight differential	18.5	Kg
Total to be added to have 50% negative buoyancy	27.72	Kg

Closed Loop Vertical Boreholes

Main Components of a ground array



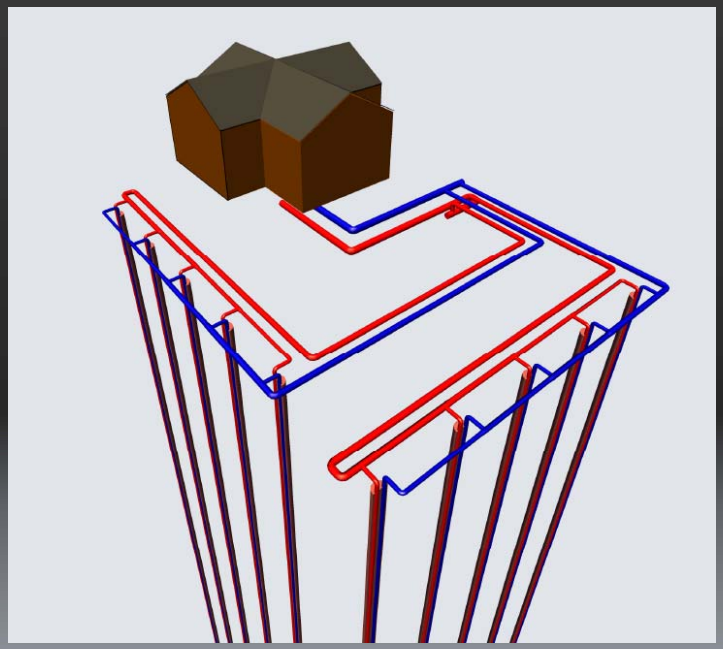
Fluid is warmed

simply repeats

Closed Loop Vertical Boreholes

Thermal Transfer Fluid – Made of…

1 – 2 % Biocide



20 - 25% Antifreeze

73 – 79 %
Potable Water

Q & A on session 1

Any questions….

Any slides you want to go back to?

Break for Coffee