

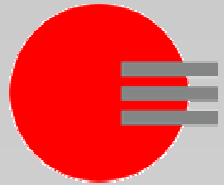
# Ground Source Heat Pumps

Jeremy Rawlings

Consultant in Building Integrated Renewables

**THE NATIONAL ENERGY FOUNDATION**

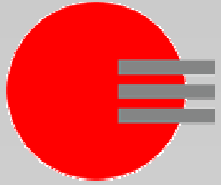
[www.nef.org.uk](http://www.nef.org.uk)



# What this talk will cover

- What do GSHPs do?
- How do they work?
- Can they save Carbon?
- Financial aspects
- Planning
- Questions

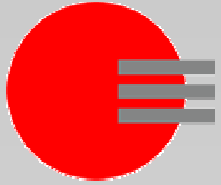




# What do GSHPs do?

- Produce heat at  $\sim 45^{\circ}\text{C}$  – suitable for space heating via under-floor pipes.
  - Work best with low temp difference (input to output).
- Can also give cooling:
  - Gives additional energy saving in commercial buildings.





# Geothermal or Ground Source?

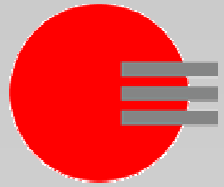
## Geothermal

- Heat from the earth's core.
- Accessible in few locations.
- Requires very deep boreholes (kms).

## Ground Source

- Heat in earth's surface warmed by sun.
- Accessible everywhere.
- Uses trench systems or shallow boreholes (up to 150 m).



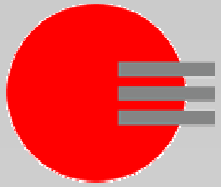


## Two heat pumps:

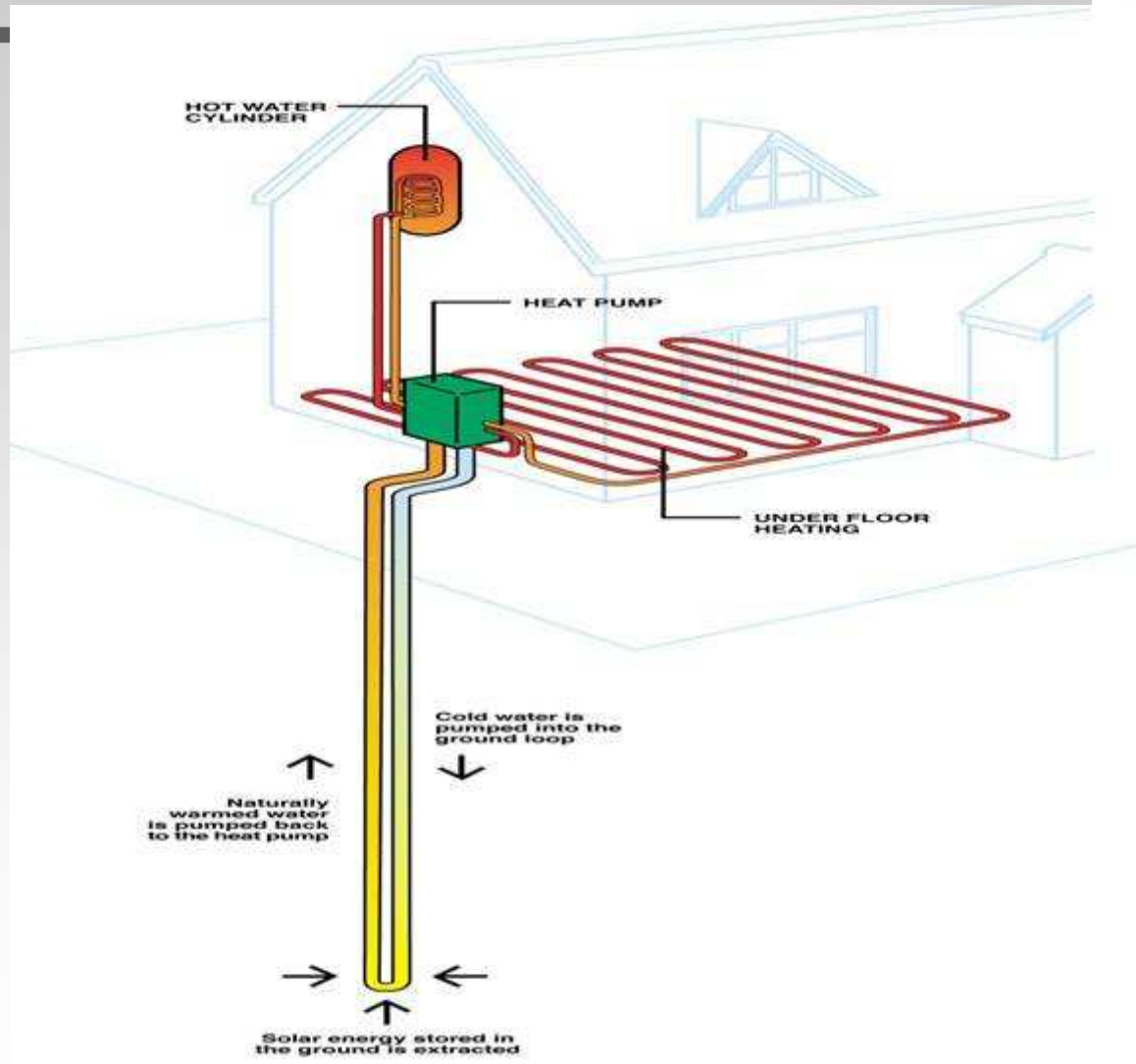


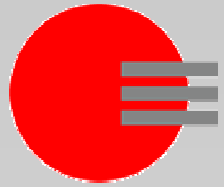
One cools food and the other heats the house.  
Both transfer heat energy from A to B.





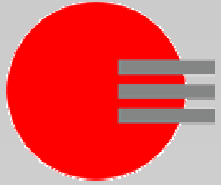
# Heat Plant





# System Components

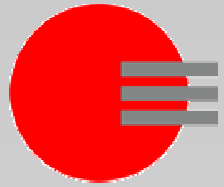




# Ground Source Heat Pumps

- Extract heat from underground
  - Trench systems (1 m to 2 m deep)
  - Borehole systems (up to 150 m deep)
  - Air and water source options also exist.
- COP varies between 1 and 8 to 1
  - @ 8 to 1, 8 kW heat energy for 1 kW electricity
  - Typically between 3 to 1 and 4 to 1
- Overall CO<sub>2</sub> savings depend on electricity source being used.





# Heat Pump efficiency / high CoP

Earth

Boiler Room

Building

**Ground**

Warmer  
the better



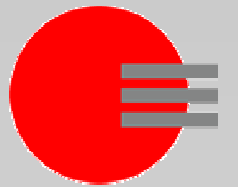
**Heat Pump**

High quality  
compressor



**Distribution**

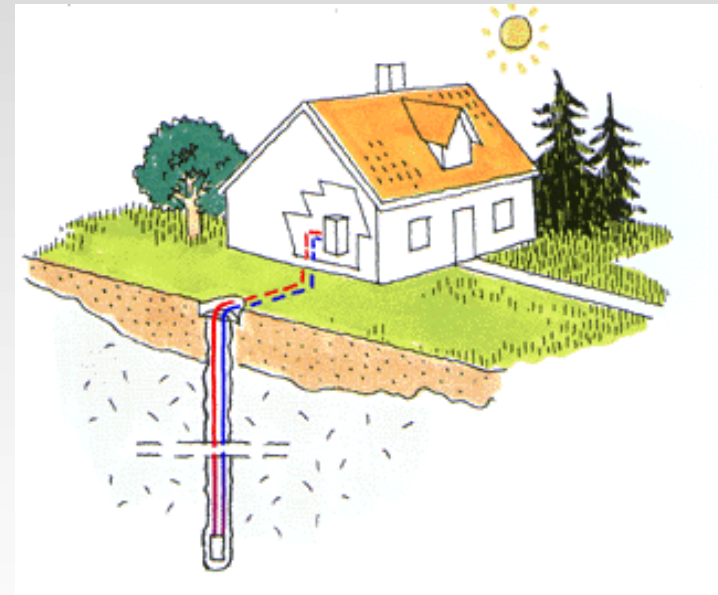
Low temp.  
underfloor  
or radiators

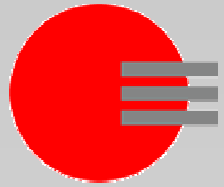


# Types of Collector

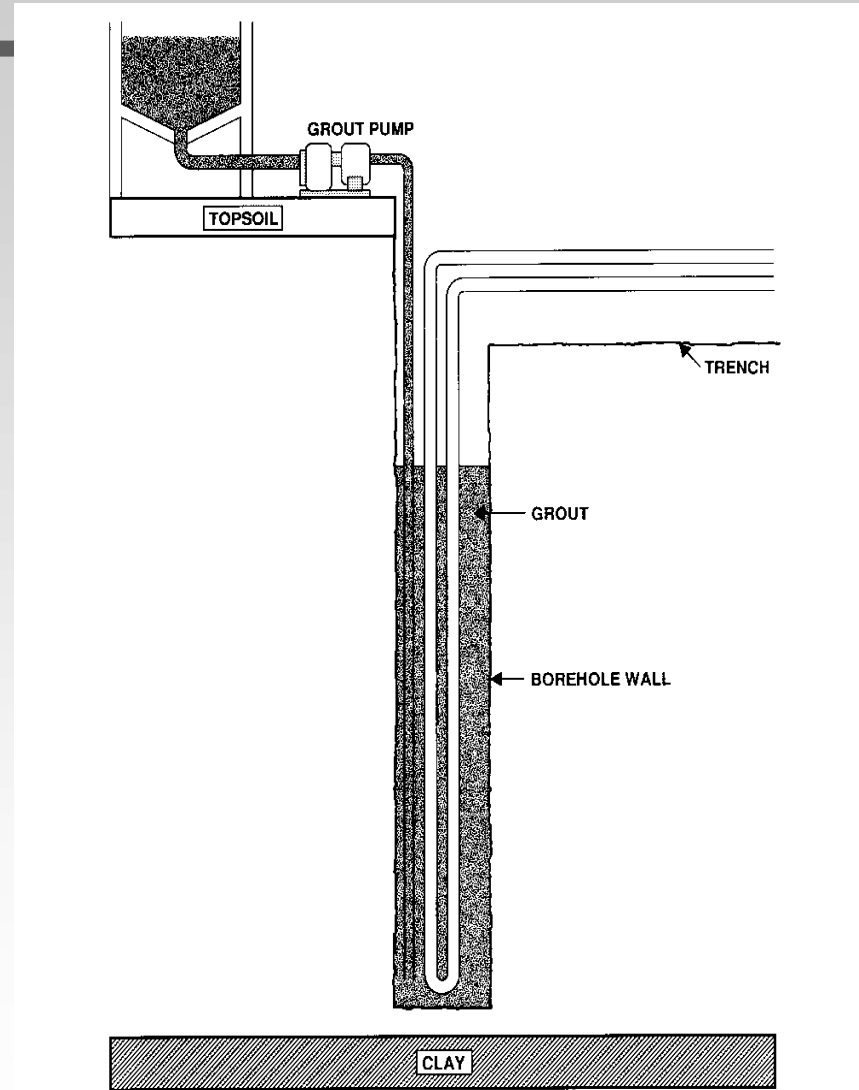
## 1. Vertical Borehole

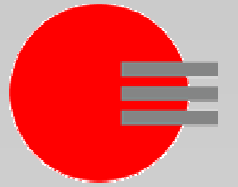
- Space is at a premium
- Loops installed to 150m
- Commercial projects dominate





# Borehole



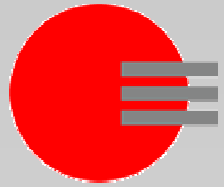


# Types of Collector

## 2. Horizontal loop

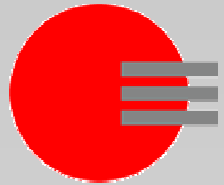
- Loop buried 1-2m deep
- Can be narrow or wide
- Slinky or straight pipes





# Trench



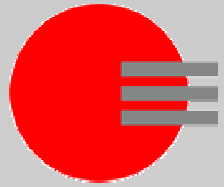


# Domestic Installation

- New property

Mid terrace	Semi- detached	Detached
(2-bed)	(3-bed)	(3 / 4-bed)
6 kW	8 kW	10 kW

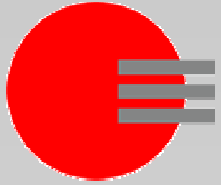
12kW max on single phase supply



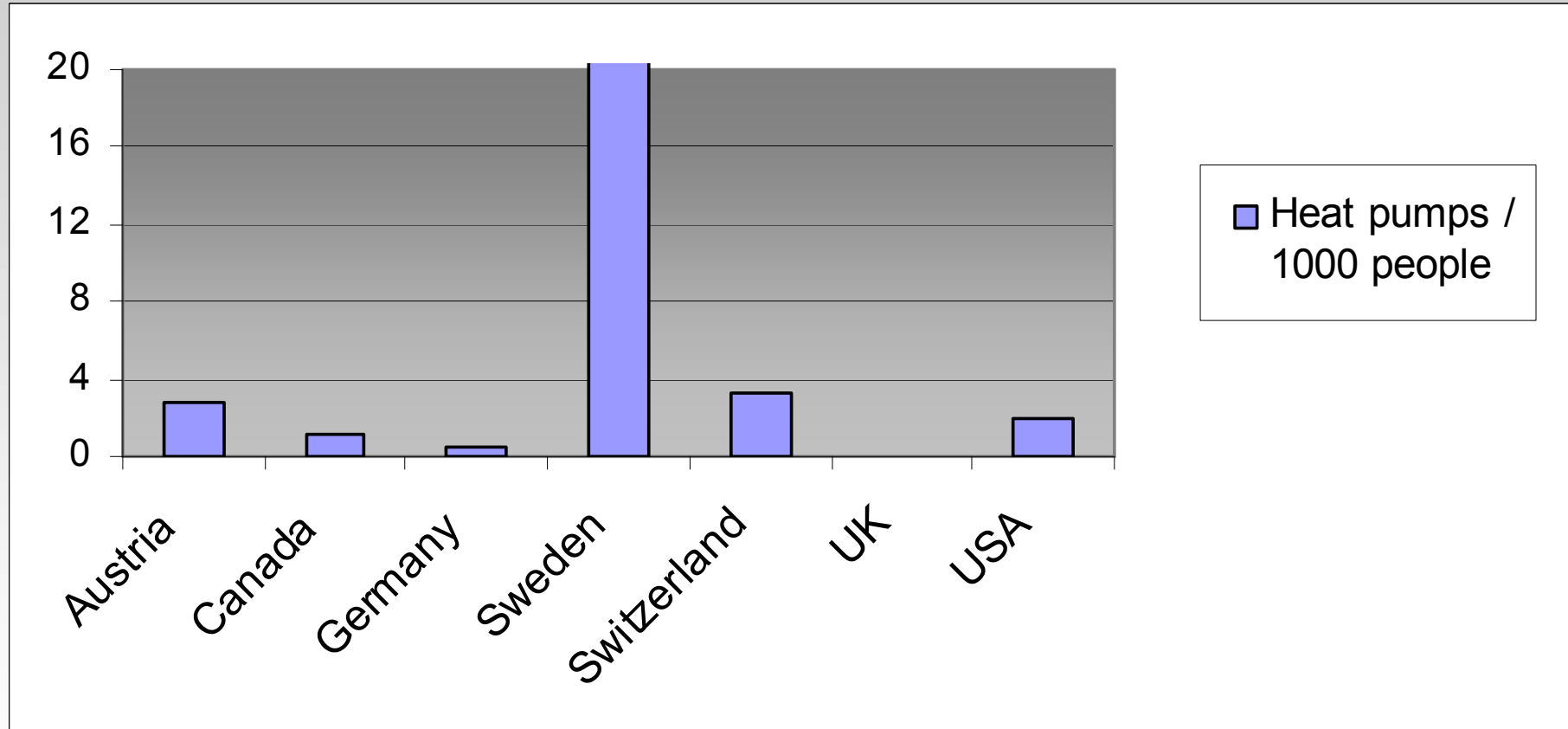
# Ground Source Heat Pumps

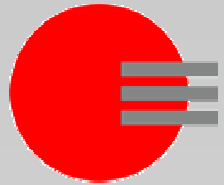
- In UK, emerging market:
  - Few thousand installations
- Hundreds of thousands in Europe & USA
- Heat pumps can supply heating & cooling
- Trend to avoid cooling in domestic households.





# Installation data



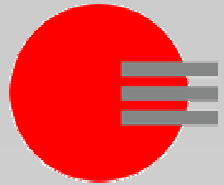


# Capital Costs

- Indicative costs, excluding underfloor heating:

	<b>Rating</b>	<b>CapEx</b>	<b>Annual saving</b>	<b>CO<sub>2</sub> saving (t/yr)</b>
EST	6 - 8kW	£6.5k - £11.5k	£650 - £750	4.5 - 5.5
NEF	13kW	£21.5k	£338	1.36

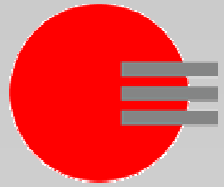
- Grants may be available to support GSHP installation...



# Cost Comparison Table

- GSHP: 25% - 33% cost of electrical heating.

	<b>GSHP</b>	<b>Gas</b>	<b>Electricity</b>
Price / unit	2.91	3.07	7
Annual fuel price	£524	£553	£1,260
CO2 (t)	1.94	3.42	7.74



# Key Points

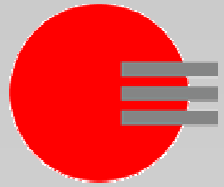
- Heat Pumps:
  - move **heat energy**:

Earth, Water  
or Air



Underfloor or low  
temp Radiators

- High CoPs with:
  - Warm Earth
  - high performance heat pump
  - Low temperature distribution system



**Thank you for listening**

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Any questions?