Selecting microgeneration technologies: *a process and training programme to increase the uptake of renewable technologies*

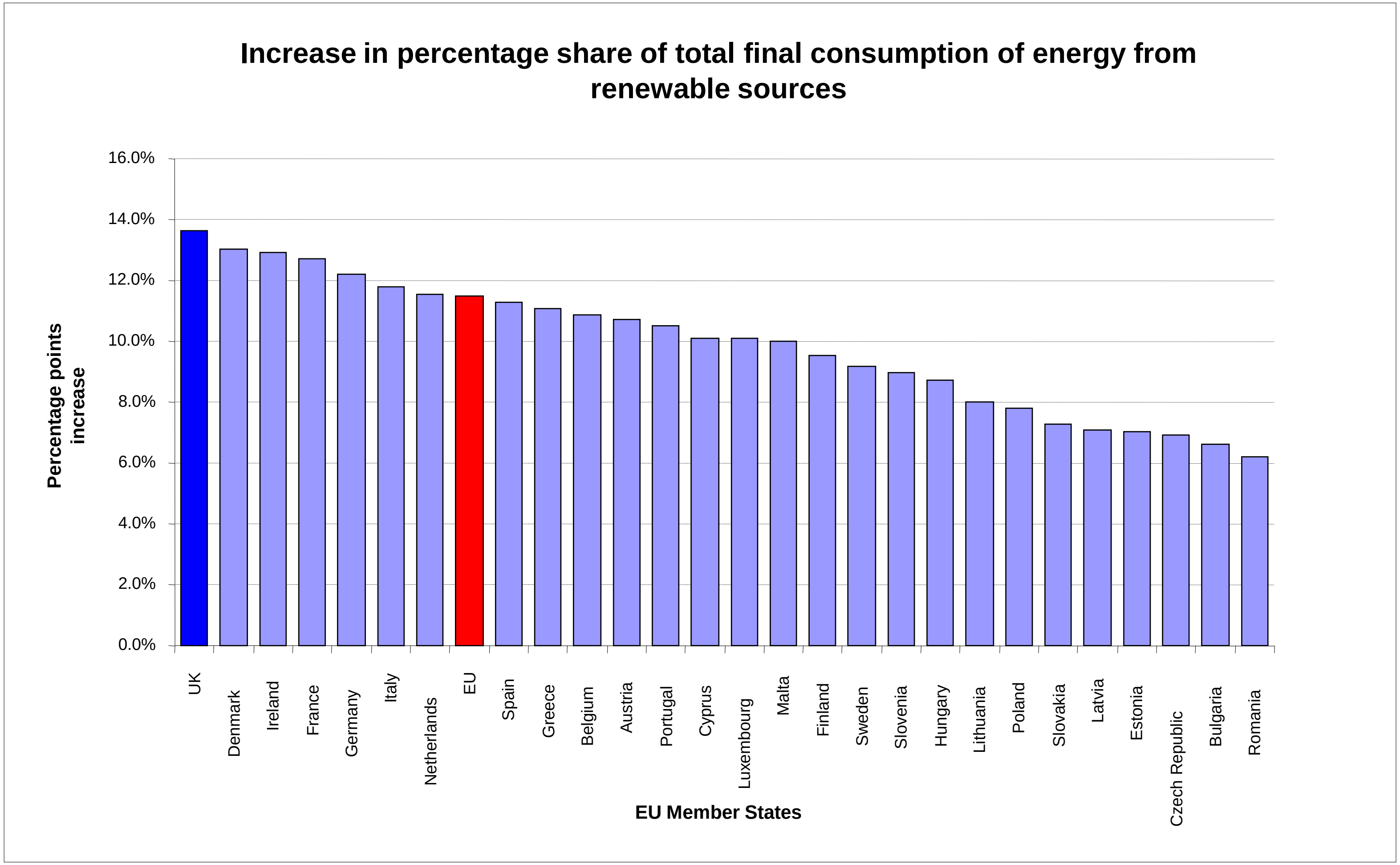
David Matthews, Chief Executive
Ground Source Heat Pump Association

8th June 2011, GS Live, Peterborough

UK 2007

Country	Number installed	Date started
Austria	23 000	
Canada	36 000	
Germany	40 000	1996
Sweden	200 000	1980
Switzerland	25 000	1980
UK	3 000	
USA	600 000	1996

- One in 4 to 5 of Swedish homes use a GSHP & Mature markets have codes of practice, standards & training



12% Renewable Heat; 29% large scale electricity, 2% small scale electricity, 10% transport

UK HP experience

Restrictions:

- Inconsistent Government policy
- Mixed results from HP field trials

Drivers:

- Renewable Heat Incentive
- Government belief – Professor MacKay

Professionalism:

- MCS
- QCF units

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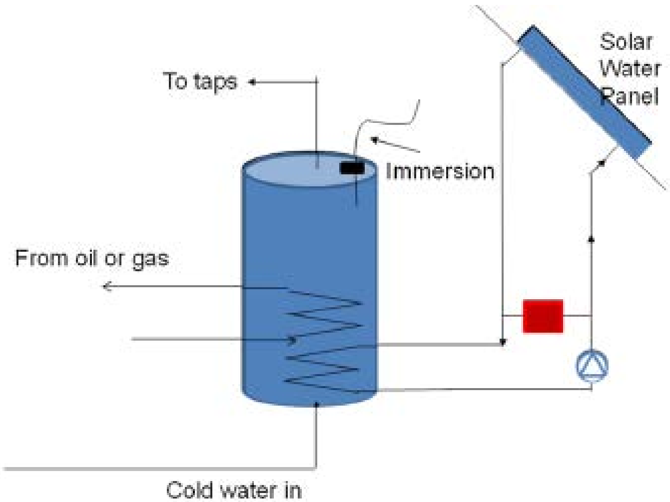
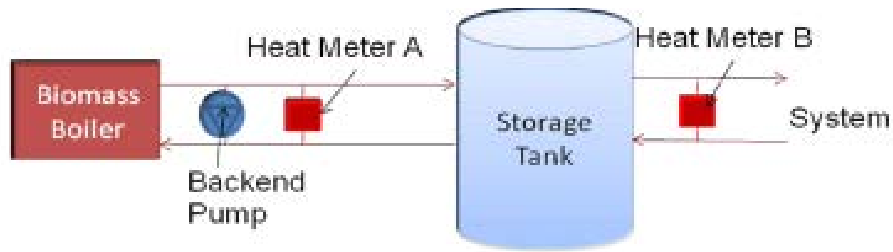
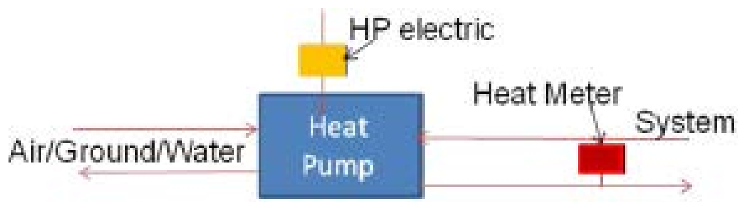
Metering







Heat meter is a flow meter with the temperature difference between flow and return temperature sensors. They have to be Class 2 for RHI.

GSHP	Boiler	Radiant
Underfloor	Radiators	Element
Base load	About 30 mins	Instantaneous
Comfortable	Mild hot spots	Hot skin
Socks on floor	Scalding rads	Burns

Combustion

- Flame temperature 600 to 900 °C
- Downgrade heat to 40 to 80 °C

Heat Pump

- Collection temperature – 15 to 15 °C
- Upgrade heat to 30 to 65 °C

n.b. last 2 slides indicative

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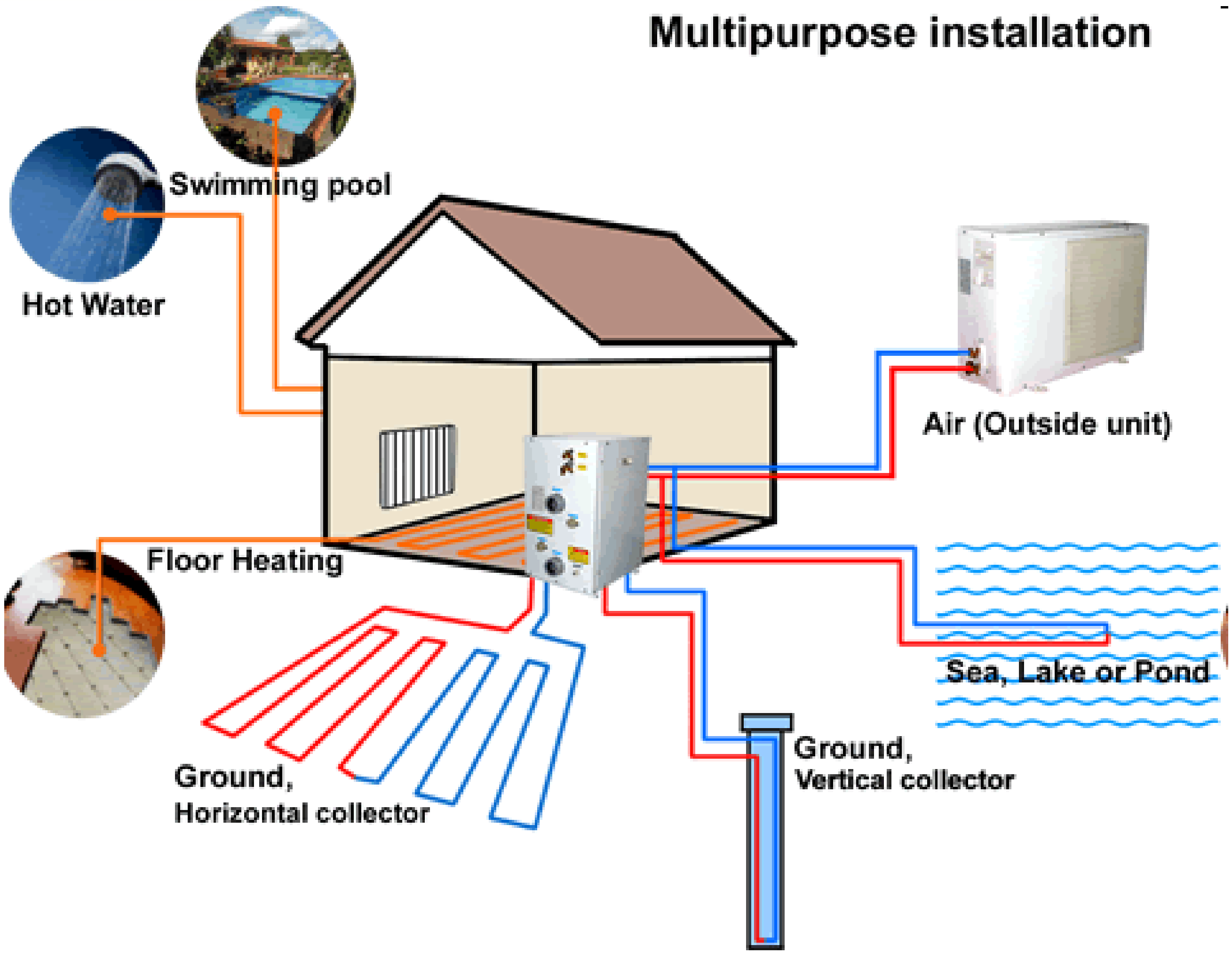
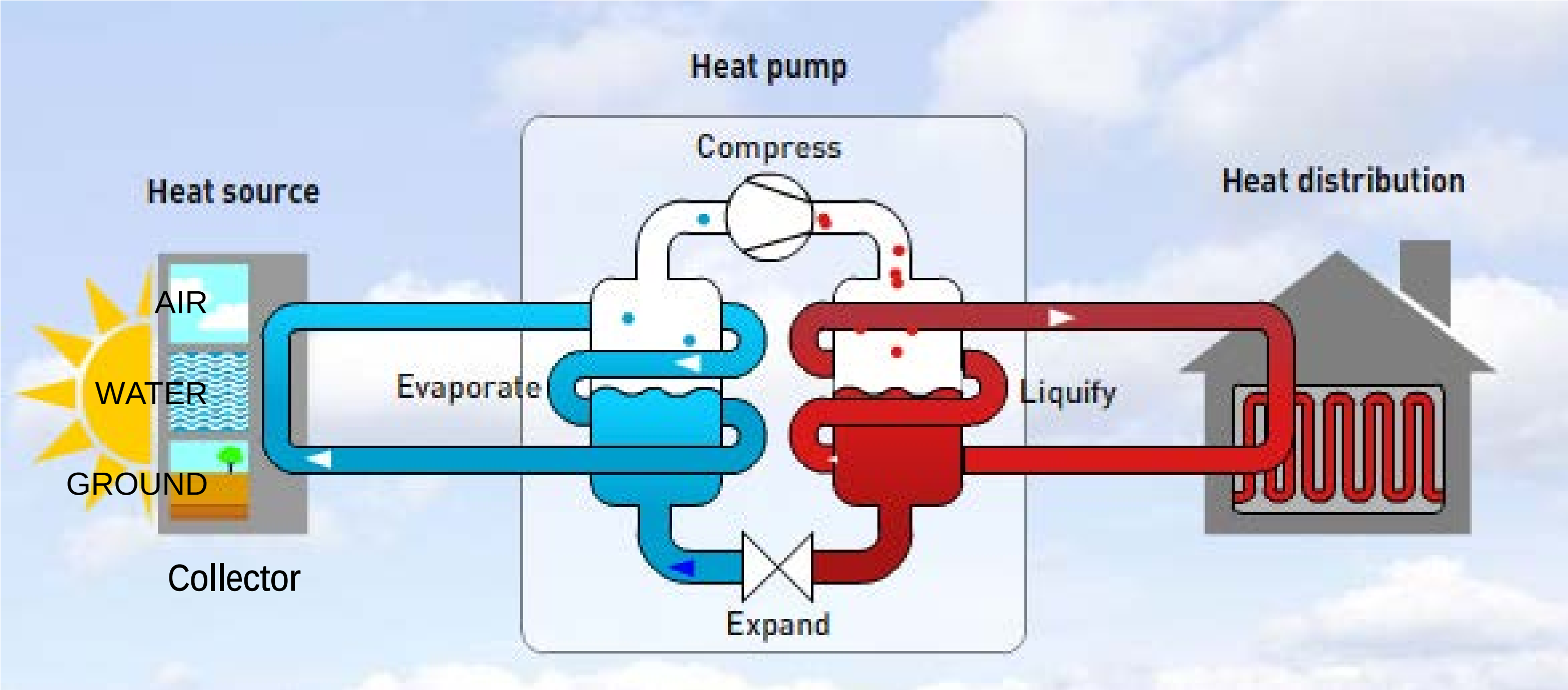
Multipurpose installation




Heat pump
Compress
Heat source
Heat distribution
AIR
WATER
GROUND
Evaporate
Liquify
Collector
Expand

Getting it wrong

Air Collector Systems:

- Noise
- Location (good air flow & connection)
- Defrost cycles
- Undersizing
- Oversizing
- Inaccurate heat loss calculation
- Poor heat distribution design or install
- Inadequate control strategy
- Commissioning, Handover & Maintenance

Getting it wrong

Ground Collector Systems:

- Undersizing
- Oversizing
- Inaccurate heat loss calculation
- Poor heat distribution design or install
- Inadequate control strategy
- Commissioning, Handover & Maintenance
- Inadequate collector design
- Inadequate collector install

Heat Loss of 30 watts per square metre as taken from heat loss calculations per BSEN12831

Efficiency Rating	Flow Temperature To Heating System °C	Return Water Temp °C	GSHP Likely SPF	ASHP Likely SPF	Solid Floor UFH Screeded PS= Max Pipe Spacing	Wood Floor UFH Alu-panel PS = Max Pipe Spacing	Fan Coil Unit (correction factor)	Fan Convector (correction factor)	Fan Assisted Radiator (correction factor)	Standard Radiator (correction factor)
Highest Efficiency, Lowest Running Cost	35	30	4.3	3.6	PS≤200	PS≤150	0.16	0.25	0.25	0.12
	40	35	4.1	3.4	PS≤300	PS≤200	0.25	0.35	0.35	0.21
↑	45	40	3.7	3.0	PS≤300	PS≤300	0.34	0.45	0.45	0.30
	50	45	3.4	2.7	PS≤300	PS≤300	0.42	0.55	0.55	0.41
Lowest Efficiency, Highest Cost	55	50	3.1	2.4	PS≤300	PS≤300	0.51	0.65	0.65	0.51
	60	55	2.8	2.1	PS≤300	PS≤300	0.60	0.75	0.75	0.63

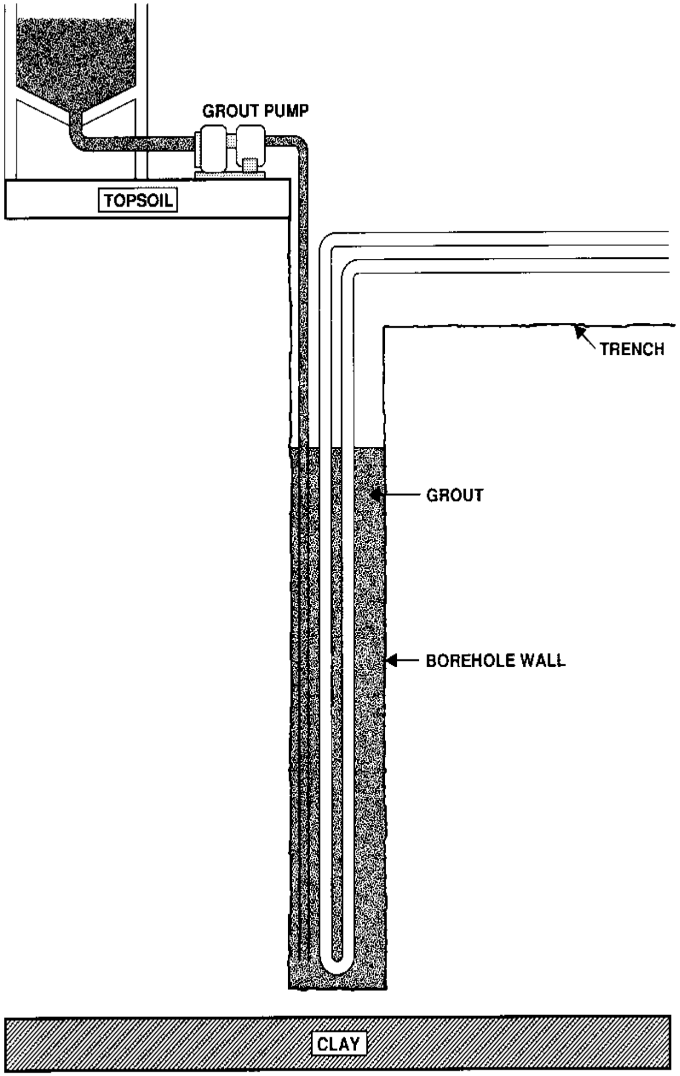
Heat Loss of 50 watts per square metre as taken from heat loss calculations per BSEN12831

Efficiency Rating	Flow Temperature To Heating System °C	Return Water Temp °C	GSHP Likely SPF	ASHP Likely SPF	Solid Floor UFH Screeded PS= Max Pipe Spacing	Wood Floor UFH Alu-panel PS = Max Pipe Spacing	Fan Coil Unit (correction factor)	Fan Convector (correction factor)	Fan Assisted Radiator (correction factor)	Standard Radiator (correction factor)
Highest Efficiency, Lowest Running Cost	35	30	4.3	3.6	PS≤100		0.16	0.25	0.25	0.12
	40	35	4.1	3.4	PS≤150		0.25	0.35	0.35	0.21
↑	45	40	3.7	3.0	PS≤300	PS≤150	0.34	0.45	0.45	0.30
	50	45	3.4	2.7	PS≤300	PS≤200	0.42	0.55	0.55	0.41
Lowest Efficiency, Highest Cost	55	50	3.1	2.4	PS≤300	PS≤200	0.51	0.65	0.65	0.51
	60	55	2.8	2.1	PS≤300	PS≤300	0.60	0.75	0.75	0.63

Heat Loss of 80 watts per square metre as taken from heat loss calculations per BSEN12831

Efficiency Rating	Flow Temperature To Heating System °C	Return Water Temp °C	GSHP Likely SPF	ASHP Likely SPF	Solid Floor UFH Screeded PS= Max Pipe Spacing	Wood Floor UFH Alu-panel PS = Max Pipe Spacing	Fan Coil Unit (correction factor)	Fan Convector (correction factor)	Fan Assisted Radiator (correction factor)	Standard Radiator (correction factor)
Highest Efficiency, Lowest Running Cost	35	30	4.3	3.6			0.16	0.25	0.25	0.12
	40	35	4.1	3.4			0.25	0.35	0.35	0.21
↑	45	40	3.7	3.0	PS≤100		0.34	0.45	0.45	0.30
	50	45	3.4	2.7	PS≤150		0.42	0.55	0.55	0.41
Lowest Efficiency, Highest Cost	55	50	3.1	2.4	PS≤200	PS≤100	0.51	0.65	0.65	0.51
	60	55	2.8	2.1	PS≤300	PS≤150	0.60	0.75	0.75	0.63

Under development – distribution temp guide


GROUT PUMP
TOPSOIL
TRENCH
GROUT
BOREHOLE WALL
CLAY

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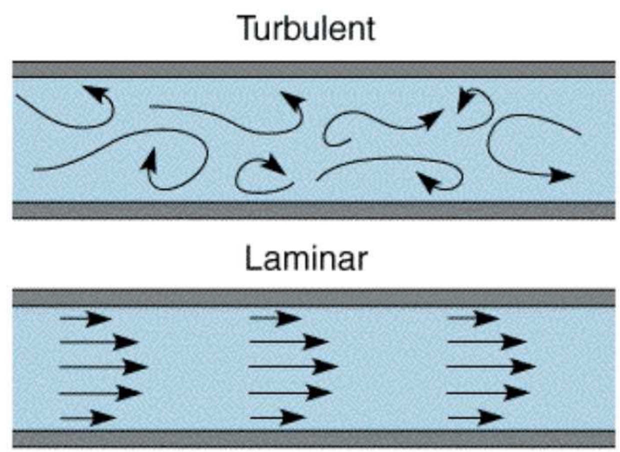
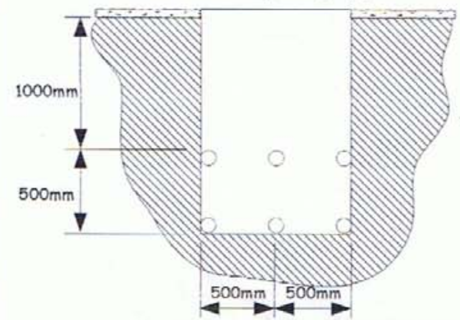


number and lengths of the trenches will depend on the exact load of the system and the properties of the soil. These factors are ESSENTIAL for the proper working of your geothermal installation.

TRENCH CROSS SECTIONS

6 Pipe System, 1000mm wide, 1500mm deep, straight pipe



In a 6 Pipe system, each trench contains 3 U shaped loops of pipe. In the diagram to the left, the upper most pipes are the flow pipes from the house, the lower pipes are the return to the house. The U bends are formed with two 90 degree bends and a vertical, 400mm piece of pipe. These components are sometimes referred to as "the tail".

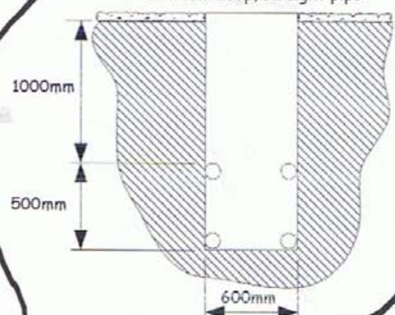
Similarly, in a 4 pipe system, each trench contains 2 U shaped loops of pipe. The upper pipes: the flow; the lower: the return.

The flow and return pipes are brought together in a manifold, referred to as a "Header", which leads to two pipes entering the building.

A Slinky is coiled arrangement of flow and return pipes. Although these can take up less space, they are less efficient heat exchangers; they use more pipe and increase pumping costs.

Please do not arrange for trenches to be dug, or workmen to be present until after you have received your pipe, as delivery times can not be guaranteed.

4 Pipe System, 600mm wide, 1500mm deep, straight pipe



PROPOSED TRENCH LAYOUT

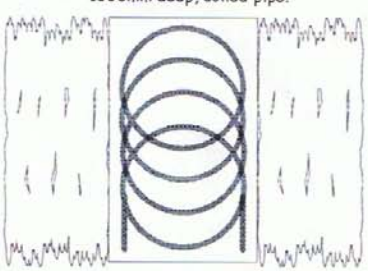
Customer Name:

Quote Number:

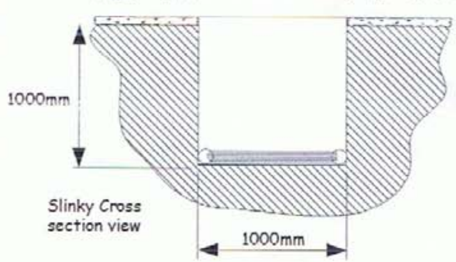
Project Name:

PLEASE SEE ATTACHED SKETCH

"Slinky" System, 1000mm wide, 1000mm deep, coiled pipe.

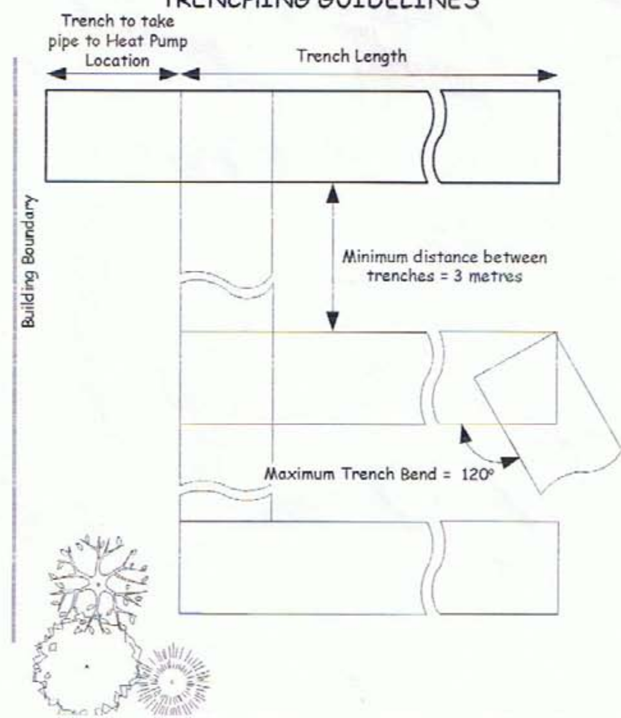


Slinky Plan view



Slinky Cross section view

TRENCHING GUIDELINES



Some Ground Collector Faults:

- Not enough surface area/depth or proximity
- Overlapping pipework
- Poor materials (pipes, antifreeze etc)
- Poor hydraulic design (massive pumps)
- Poor backfilling or grouting
- Poor drilling/trenching practice
- No capping off
- Poor purging and filling
- Inadequate joints

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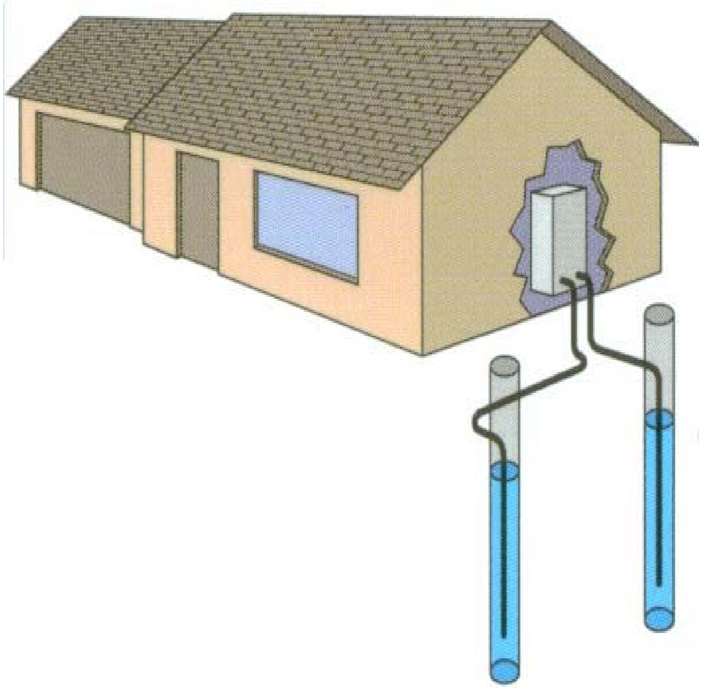
Water Source – Open Loop

- Aquifer required
- Need for abstraction licences
- Need to reject abstracted water



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Training stakeholders

Green Deal October 2012 - Loan of £6000 to spend on Energy interventions

Besides **Solid Wall Insulation**, all measures must payback

RHI payback (besides ASHP on off-gas grid?) doesn’t currently payback

Green Deal **assessed** by DEA or HI via rdSAP

How do we **train DEAs & HIs** on GSHP / RH?

How should we train **other stakeholders** e.g. architects, planning permission, etc?

Training stakeholders

Based on 4 different sections:

Energy & Policy Exercise

Zero Carbon Technologies

Low Carbon Heating Technologies

Selection Procedures; Four Case Studies

Interesting and interactive - Team work

1st Exercise Share your energy knowledge

2nd Exercise 4 domestic housing scenarios.

Maximise participant engagement

Evaluate, Audit, Interview
Insulate, Supply, Generate

Selection Principles

External evaluation

Internal audit

Customer interview

Specification Processes

Insulate	(Energy Efficiency)
Supply	(Low Carbon Heating)
Generate	(Renewable Electricity)

Scenarios – Case studies

Refurbished Council House

Victorian Terrace House

Modern Detached House

Leasehold Flat

Selection - External Site Evaluation

Building Type

- Age
- Construction
- Floor area

Building Orientation

- Roof pitch and direction
- Roof shading
- Noise issues?
- Prevailing wind

Outbuildings

- Size
- Construction

Construction

- Walls
- Roof
- Chimneys & flues
- Windows, doors & glazing

Land

- Size
- Terrain
- Access (drilling rigs etc)
- Ground type
- Rivers / Streams

Selection – Internal Audit

Metering

- Gas & Electric
- Location
- Type
- Access for export metering

Cable / Pipe / Flue Runs

Insulation

- Walls
- Roof
- Floors

Hot Water system

- Vented/Unvented/Thermal store
- Power showers
- Instantaneous water heating

Heating system

- Central / distributed
- Gas / oil / electric / wood
- Underfloor / Radiator / Storage
- Controls

Appliances and Lighting

Selection – Customer Interview

- **Budget**
- **Occupancy**
- **Future growth plans?**
  - Obviously handled with due care & consideration
- **Refurbishment plans**
  - Energy Efficiency (insulation, glazing, lighting, draft proofing, appliances, any others)
  - Renewable Energy
  - Appearance (e.g. flooring, look of roof etc)
- **Specific areas of interest**

Energy Assessment Report

Energy efficiency

- Double Glazing
- Cavity Wall
- Loft Insulation
- Low energy lighting
- A rated appliances
- Draft proofing

Renewable Electric

- PV
- WIND
- HYDRO

Renewable part-load heating

- DSHW
- Wood or Pellet stoves

Renewable & low carbon full-loaded heating

- ASHP
- GSHP
- Pellet Boiler
- mCHP
- A rated condensing boiler

Other options

- Does the hot water cylinder need replacing or relocating
- Can underfloor heating be fitted
- Are central heating control adequate
- Are electrical supplies adequate

Use *Heat Pumps* ....

GSHP @ 350% efficiency and 0.54 $kgCO_2/kWh$ electricity = **0.15 $kgCO_2/kWh$**

Gas Condensing @ 80% eff.* and 0.205 $kgCO_2/kWh$ gas = **0.26 $kgCO_2/kWh$**

In this case, GSHP is ***40% CO_2*** improvement and **38% running cost** saving

As national grid decarbonises, **CO_2 savings improve**

* 80% gas condensing system efficiency is based on currently ongoing EST field trials. This figure is yet to be published and might be subject to change. However, our understanding is that it is far more accurate than stated boiler efficiency of 91%. Heat pump system efficiency of 350% equates to a realistically GSHP achievable CoP of 3.5. Costs based on 3.3 p/kWh gas and 8.9 p/kWh electricity-BSRIA and carbon figures-SAP 2005.

A well **designed, installed, commissioned and maintained** GSHP system is:

Cheaper than Gas, Oil, Wood, Coal or Economy 7

Has no Carbon Monoxide or flueing issues

Easily achieves a 10% or much more RE target

Can heat and cool the building

Compatible with Domestic Solar Hot Water


CLIMATE SUMMIT
• ENERGY INDEPENDENCE
• PRESERVE RAINFORESTS
• SUSTAINABILITY
• GREEN JOBS
• LIVABLE CITIES
• RENEWABLES
• CLEAN WATER, AIR
• HEALTHY CHILDREN
• etc. etc.
WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?