

'The Ground as an Energy Asset'

Energy Now Expo 2018

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Chairman

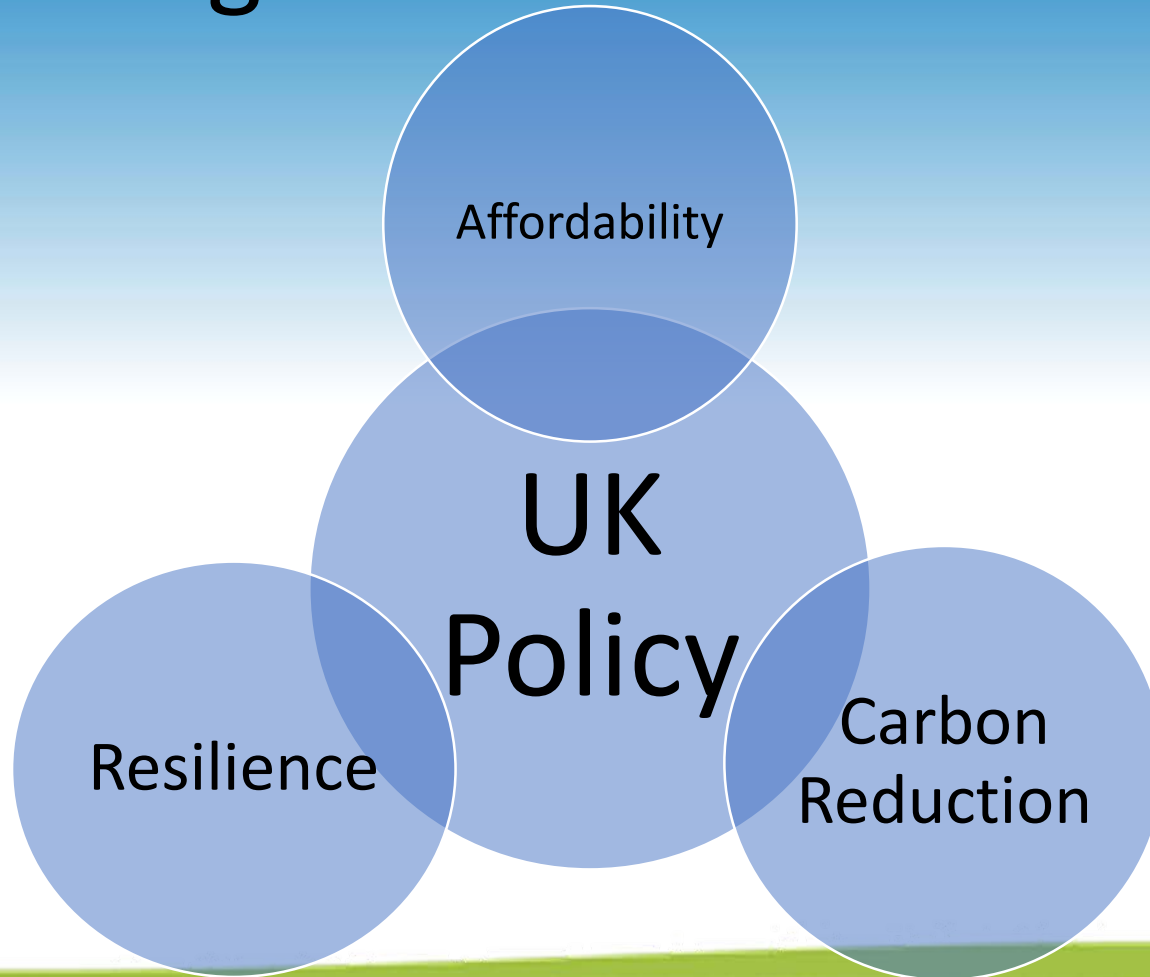
Ground Source Heat Pump Association



Introduction & Agenda

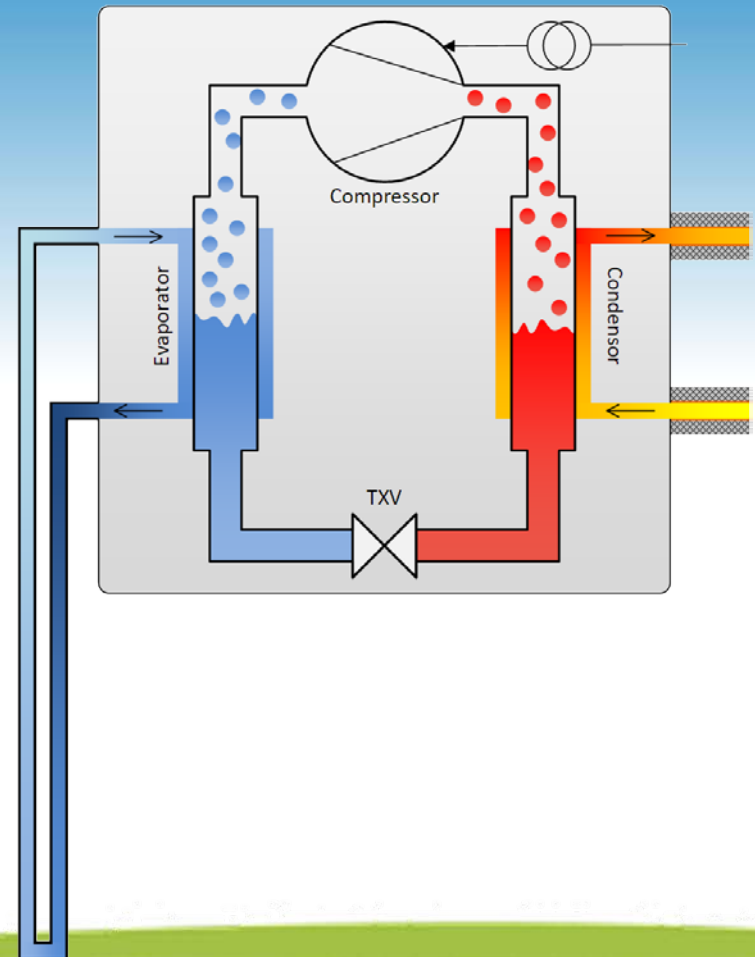
- The Background
- Heat Pumps
- Ground Loops
- Geology & Permissions
- Environment Agency regulation
- Buildings with Ground Source, District heating
- Incentives & Commercial Returns
- Carbon Reduction
- Questions

The Background....

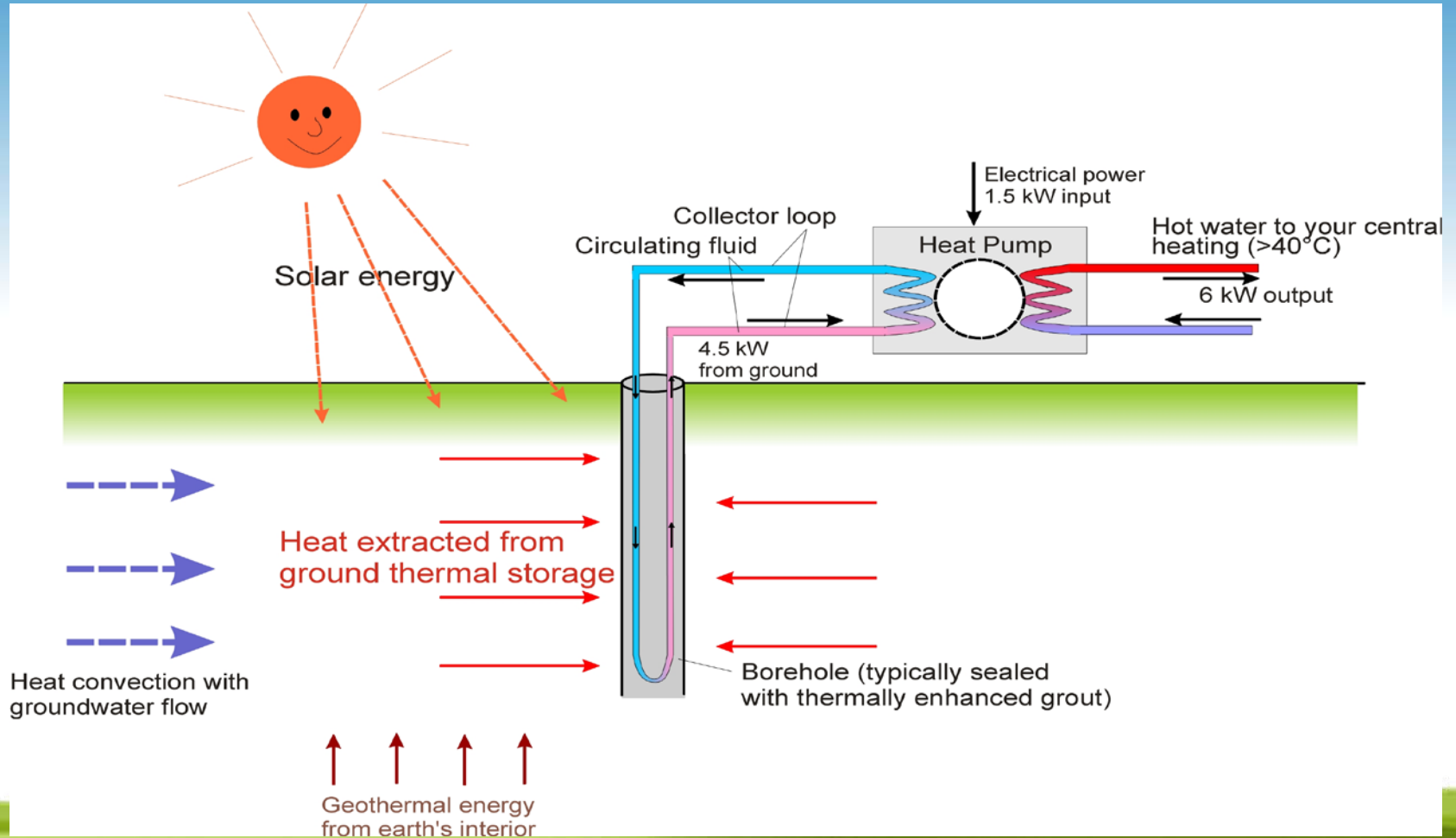


Heat Pumps

- Move heat from a cold place to a hotter place
- Similar technology to the domestic refrigerator
- Mainly electrically driven
- Move much more heat than they consume electrically

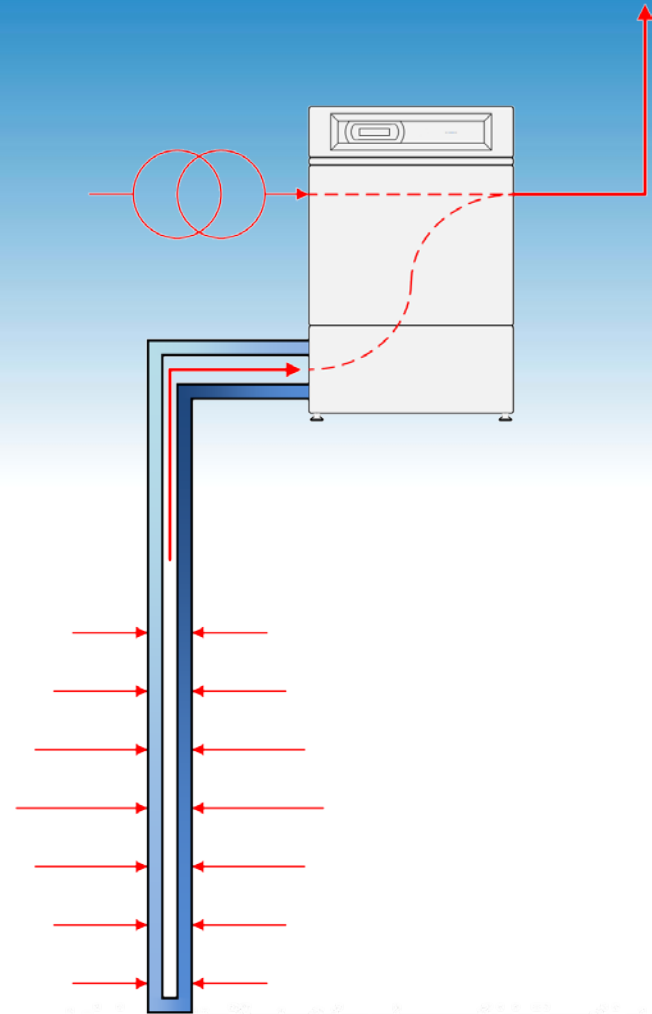


Heat Pumps



Ground Loops

- Are heat exchangers, exchanging heat with the ground
- Come in a variety of geometries
- Form a substantial thermal mass for heat recovery
- They work via temperature difference



Drilling & Geology

- Detailed understanding of the anticipated geological conditions is essential
- There is no statutory permission for closed loop except in coal mining areas
- The EA has published guidance which GSHPA has now adopted
- British Drilling Association Standards are well established
- GSHPA Standards are essential
- Geology can bite – unless you are well prepared!

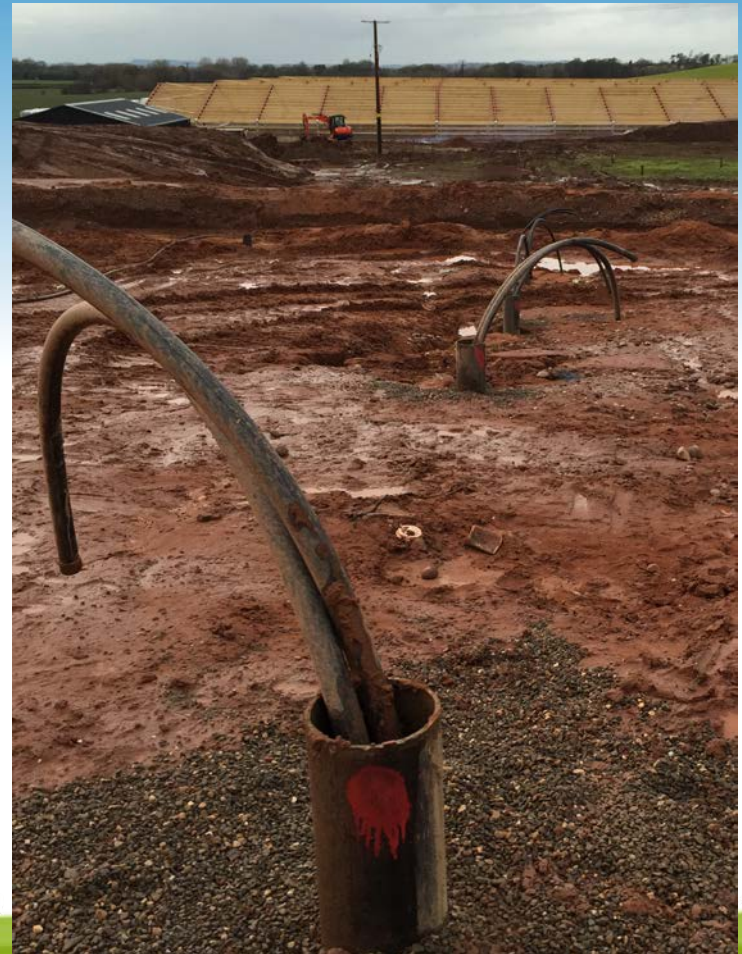


Closed Loop – Vertical

- Bores at 150mm Diameter
- Spaced 5 to 15m apart
- Contain U-Tubes of Polyethylene Pipe
- Installed to depths of up to 250m
- Geology impacts installation depth, drilling method & cost and borehole thermal performance



Closed loop boreholes



Closed Loop – Horizontal

- Trenches 1 to 2m Deep
- Typically 1m Wide
- Various pipe geometries to suit space & application
- Collect solar energy
- Don't store energy in same manner as boreholes
- Domestic (≈ 10 s of kilowatts to multi-megawatt systems)



Open Loop – Borehole

- Uses groundwater directly at around 11°C
- Most systems are non-consumptive (water returned to the aquifer) and so no impact on water resource
- Requires a different set of design skills to locate suitable aquifer and for borehole design



Closed Loop – Surface Water

- Can be used in Sea, Lakes, Canals or Rivers
- Pipe coils or heat exchanger plates can be used
- The main concern is where to anchor the loops or plates in moving water
- In still water it is relatively simple

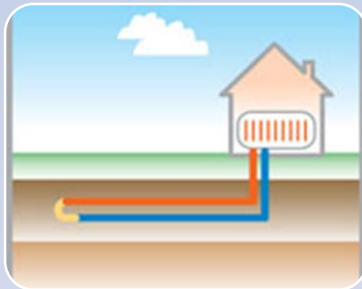


Open Loop – Surface Water

- Often known as Water Source Heat Pumps
- Use water directly from surface bodies like lakes, canals and rivers
- Filtration & maintenance as major consideration

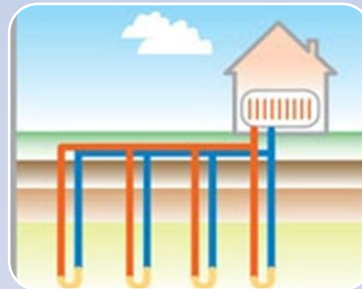


Environment Agency Regulation



EA not involved

Too many and low or no impact



EA not involved

Potential involvement with very large schemes



Regulation of larger schemes

'Standard rules' or 'Bespoke'



Regulation of all schemes

Abstraction and re-injection

Over 20m³/day

In the Building – Domestic

- Can be retrofitted
- Easier with new build
- Distribution system will need to be tailored to lower distribution temperatures
- Underfloor is ideal
- Hot water storage is generally required



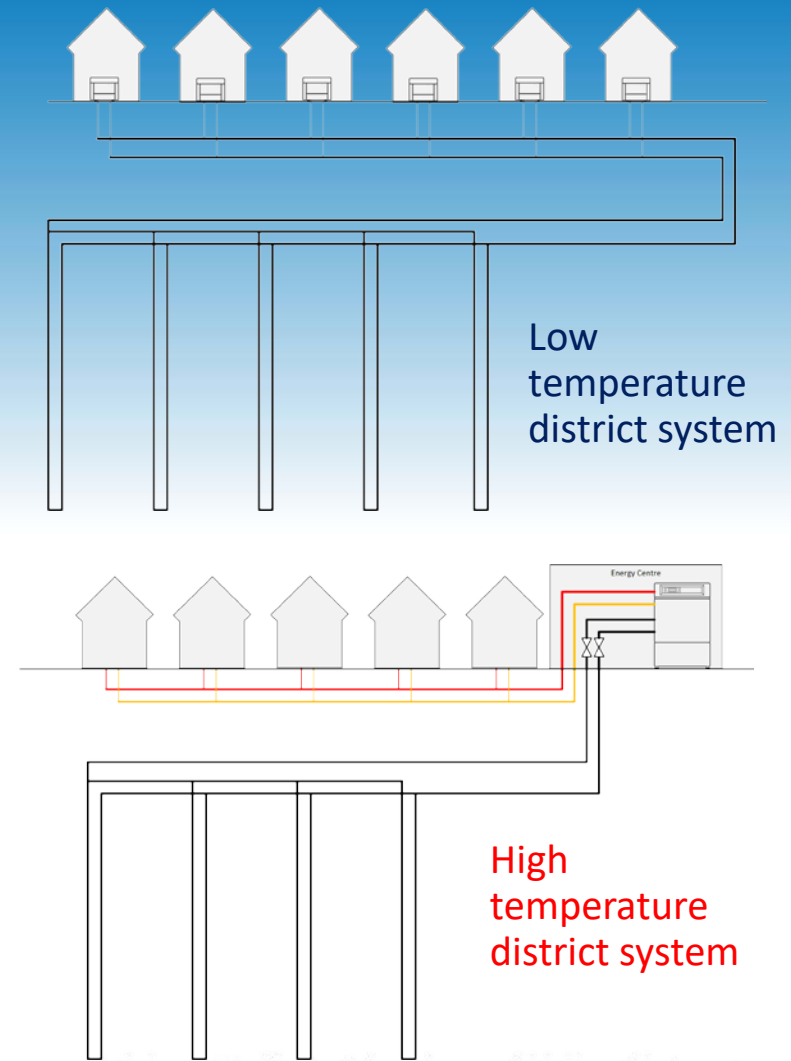
In the Building – Commercial

- Retrofit or new build
- Can interface with all common distribution systems including,
 - 4 pipe fan coils
 - Underfloor
 - Chilled beams
 - Radiators
 - VRF/VRV
- Exceptional cooling performance
- Controls are key!



District Options

- Heat pumps lend themselves to district and micro district architecture
- Maximise heat recovery & diversity
- *Low temperature* district options are efficient and offer low installation costs
- *Ground array* is a very long term 'utility' asset

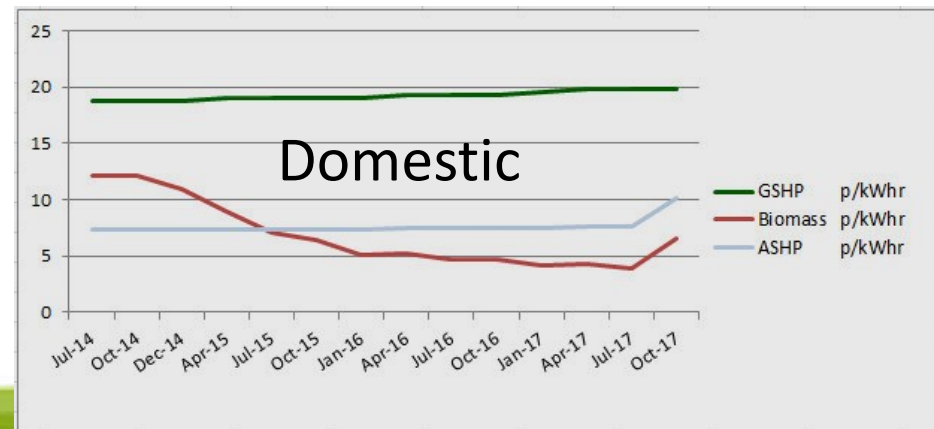
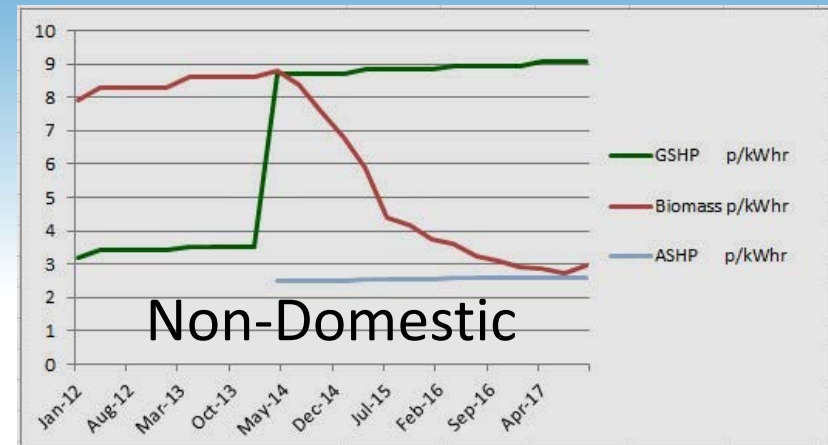


Current District Heating examples

- *'Gateshead Council; to build 2 major low carbon energy schemes, including work across seven high-rise blocks and several public buildings connected to district energy networks in the town, through which they will receive low-cost, clean heat and power'.*
- *400 flats in Enfield retrofitted with heat pumps and connected to "the largest collection of district arrays of its kind." The upgrades are planned to be completed in October 2018 are expected to reduce residents' energy bills by 30-50%.*

The Renewable Heat Incentive

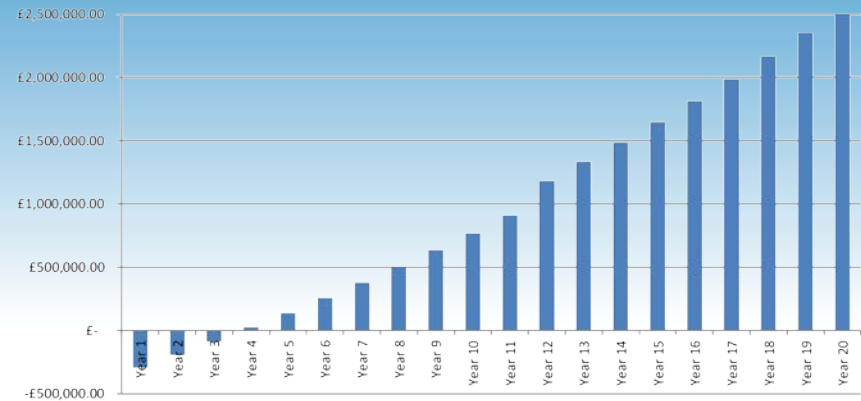
- Major government policy under BEIS
- Pays per unit of heat
- Non-domestic 20 years and is metered
- Domestic stream pays for 7 years and is deemed
- Underpinned by MCS at sub 45kW scale
- Further refinements underway



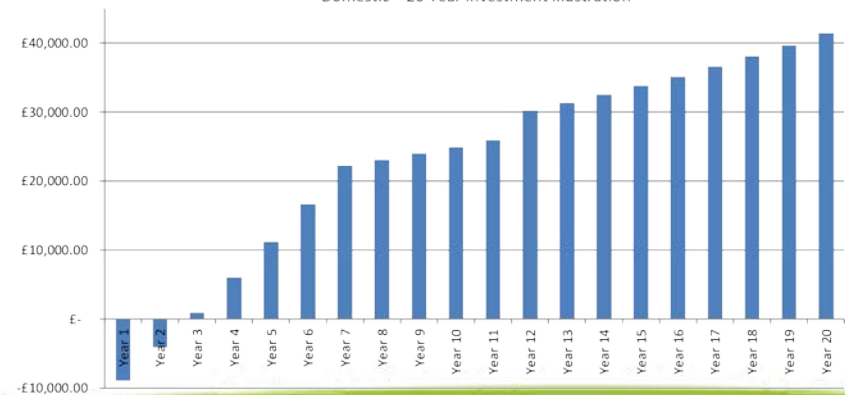
The Business Case

- Outgoings,
 - Installation Cost
 - Maintenance
 - Fuel (Electricity)
- Income,
 - RHI
 - Fuel Savings
- IRR between 10% and 30% with current RHI

Non-Domestic – 20 Year Investment Illustration

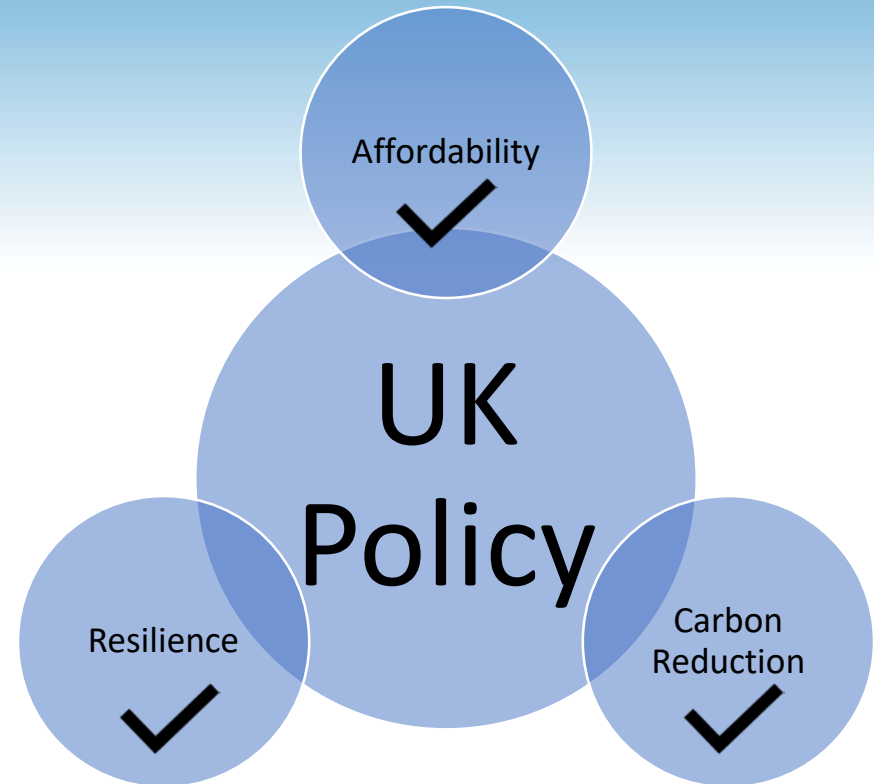


Domestic – 20 Year Investment Illustration



Carbon Reduction

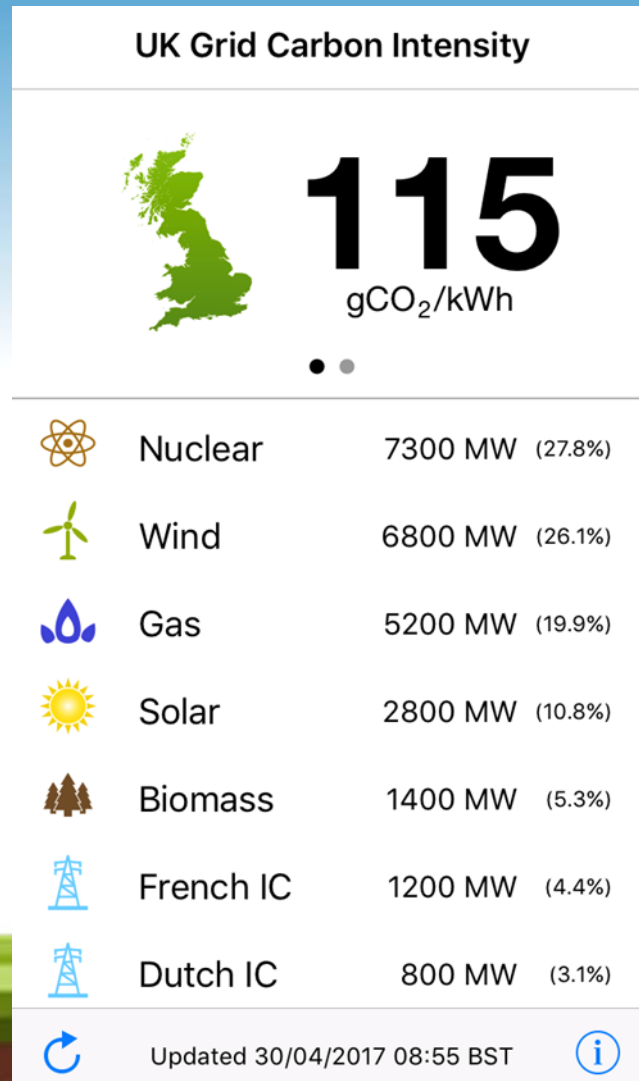
- GSHP Systems Deliver,
 - Reduced run costs
 - Carbon reduction
 - Reduction in gas consumption
- They are a key part of the UK energy future to Carbon Zero in 2050
- As grid carbon falls this only gets better!



Carbon reduction

- Average Grid Carbon ‘intensity’ is far below its value of a few years ago
- Low or no coal use & much higher renewables leads to CO₂ emissions from power producers falling by 70% between 2010 and 2020.
- UK electricity generation (renewables & nuclear generation) projected to rise from 22% in 2010 to 58% in 2020.

UK 'Grid' carbon Intensity



The GSHPA Carbon Calculator

CO₂ from Heating systems

UK grid at : 2018-02-05 13:30

is emitting : 360 grams CO₂ /kWh

Ground Source Heat Pump (400%):	90	grams CO ₂ per kWh delivered heat
Ground Source Heat Pump (320%):	112	
Direct Electric heating (100%):	360	
Gas boiler (85%):	215	
Oil Boiler (85%):	320	
Coal (50%):	630	

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Displaying the CO₂ released from different heating technologies. GSHP values are for 2 typical levels of efficiency; 320% (COP=3.2) & 400% (COP=4). Grid carbon intensity uses real-time data. The value reflects the decline in generation from coal & the growing contribution from renewable power technologies.

Data courtesy of Elexon portal & Sheffield University. Original thinking JCW Parker. Developed & sponsored by GeoScience Ltd. Running on pythonanywhere.

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Grid carbon reduction

- Heat pumps are becoming ever-lower CO₂ emitters. BEIS prediction for 2018 is an average of 205 gCO₂/kWh
- At this carbon intensity; A GSHP would emit 70% less CO₂ than a gas boiler system

Some heat pumps operating today will one day be zero-carbon heating systems



About the GSHPA

- Over 120 members from a variety of sectors concerned and working within the Ground Source Energy Industry
- Has significant influence with government departments on policy development
- Works on the development and issue of technical standards
- Essential point of contact for those within the industry and those considering using the technology

Questions....

and thankyou for listening

www.gshp.org.uk

John Findlay

Carbon Zero Consulting Ltd