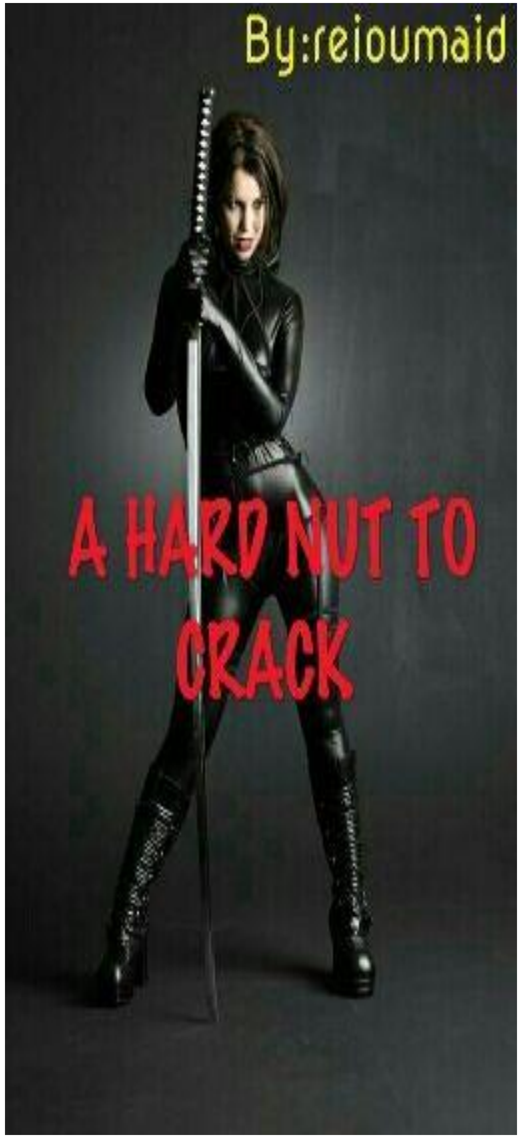
GROUND SOURCE HEAT PUMPS AND SHARED GROUND LOOP ARRAYS

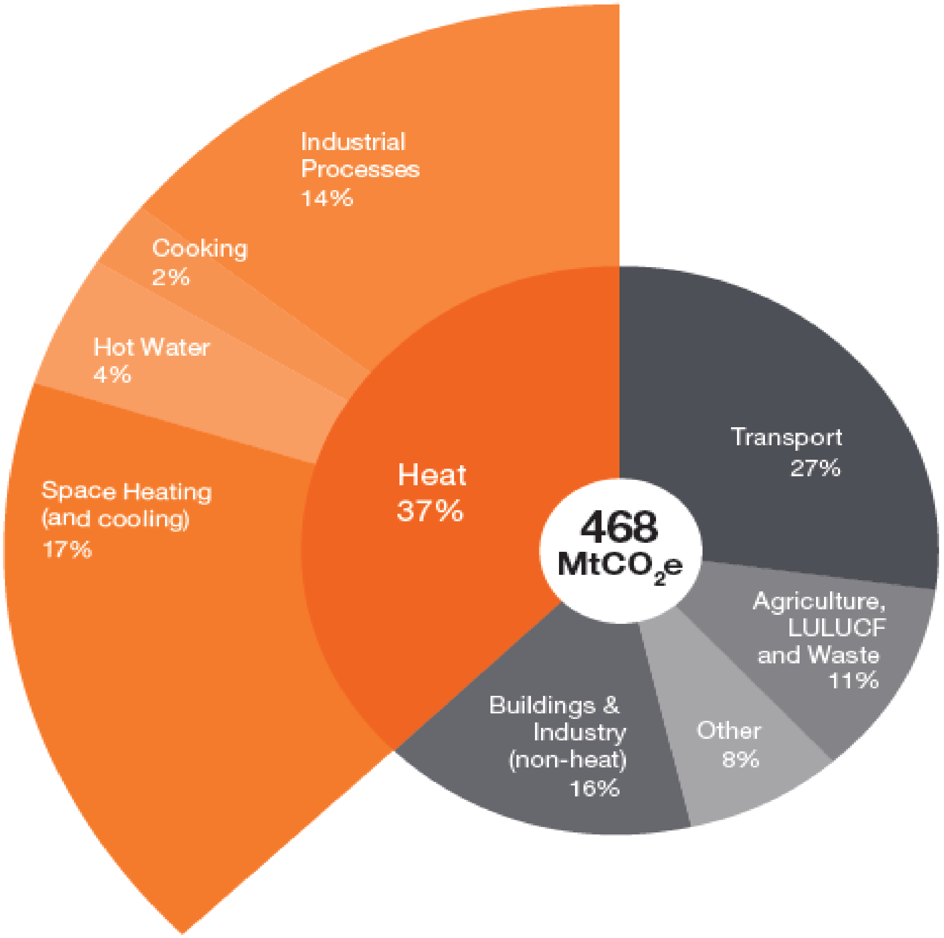
Kensa Contracting
A KENSA GROUP COMPANY

The UK's leading ground source heat pump manufacturer and installation contractor

HEAT- A Hard Nut To Crack



What are the challenges with increasing uptake of Zero Carbon heating in the UK



- 80% of existing homes use gas heating
- UK is the 3rd largest market for gas boilers behind S.Korea and China
- 1.6M boilers sold in the UK every year
- 20K Heat Pumps!
- 6.2% of all heat in the UK is from Renewables
- 4.6% of that are from Heat Pumps
- The CCC suggest we need 2.5 Million heat pumps by 2030!

Source: Energy Saving trust https://energysavingtrust.org.uk/blog/decarbonisation-heat-%E2%80%93-crossroads

GSHPs & GOVERNMENT

*"**By 2050, we will…likely need to fully decarbonise how we heat our homes.***

*There are a number of low carbon heating technologies with the potential to support the scale of change needed, including **heat pumps…"***

"Ahead of these decisions, we can take further action to reduce emissions from heating the 850,000 homes currently not connected to the gas grid in England and that use oil for heating.

*"We also need to avoid new homes needing to be retrofitted later and ensure that they can all accommodate low carbon heating. This could involve **all new homes off the gas grid from the mid-2020s being heated by a low carbon system, such as a heat pump**."*

- CLEAN GROWTH STRATEGY – OCTOBER 2017

"The commitment to ***phase out the installation of high carbon fossil fuel heating in buildings off the gas grid*** *is welcome. This should include* ***heat pump deployment****, which, together with installation in new-build properties, would develop heat pump markets and supply chains in order to prepare, if necessary, for potential widespread deployment in buildings connected to the gas grid from the 2030s.*

"Deployment of ***2.5m heat pumps is likely to be the minimum necessary by 2030****…In our scenarios, these 2.5 million are split evenly between properties off the gas grid and new-build properties."*

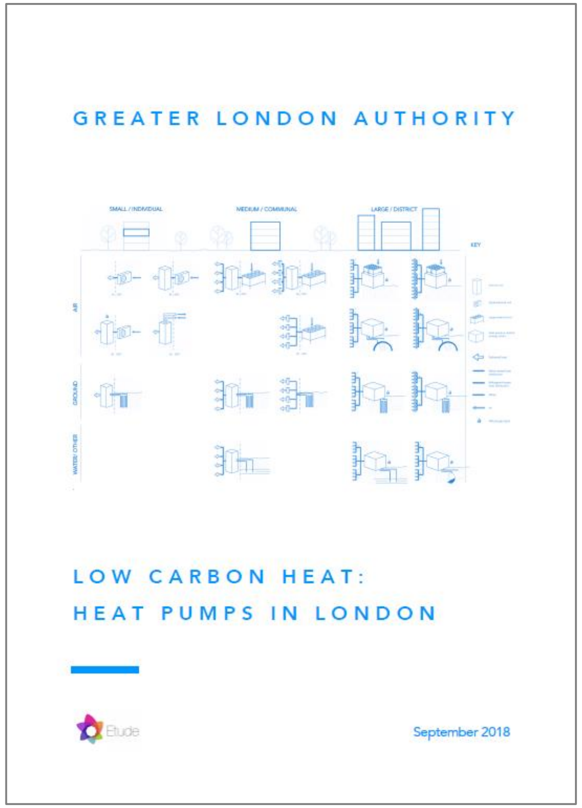
- CCC RESPONSE TO THE CLEAN GROWTH STRATEGY

Committee on
Climate Change

GREATER LONDON AUTHORITY

- London aims to be a zero-carbon city by 2050
- GLA commissioned major report on viability of heat pumps for London
- The report concludes that efficient heat pumps offer a cost competitive form of low carbon heating
- Heat pumps are very likely to play a growing role for the delivery of low carbon heat in the capital
- Staging seminars to support the roll-out of heat pumps in new builds

> “ **Heat pump systems** provide the lowest carbon heat for all case studies, though significant differences exist between the various types of heat pump. The lowest carbon heat is achieved by the residential block using ground source heat pumps coupled to a communal ground loop. This system benefits from very small distribution losses due to the ambient flow temperature and relatively high efficiencies of 380% for space heating at 35°C and 290% for DHW at 60°C offered by ground source heat pumps. ”



LOW CARBON EMISSIONS

GSHP’s & GOVERNMENT

The carbon intensity of electricity generation has fallen significantly with further major reductions forecast for the next few decades.

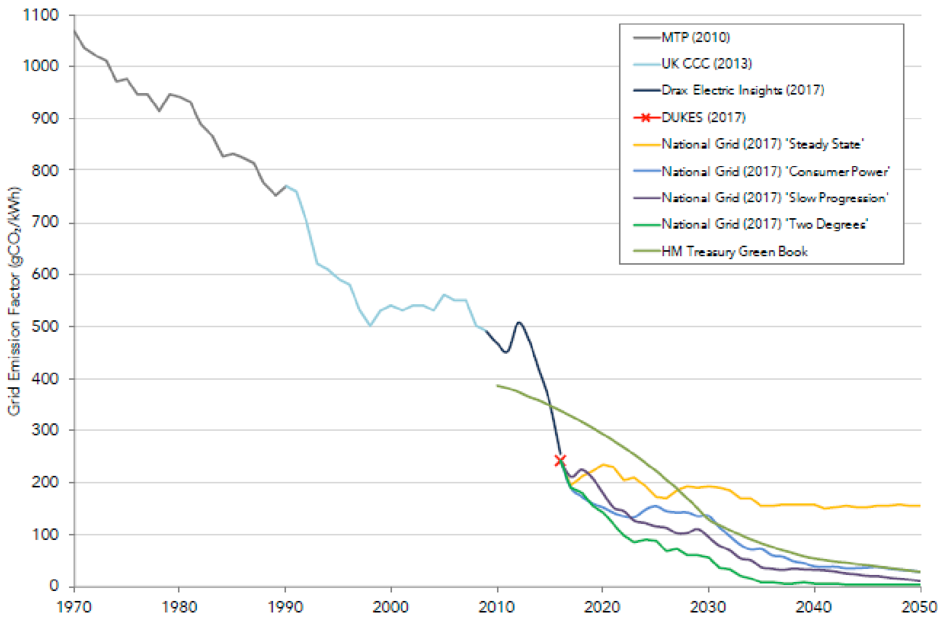


Figure 3.01 – Historic and projected carbon content of electricity

Source: Etude, *Low Carbon Heat: Heat Pumps In London* (September 2018)

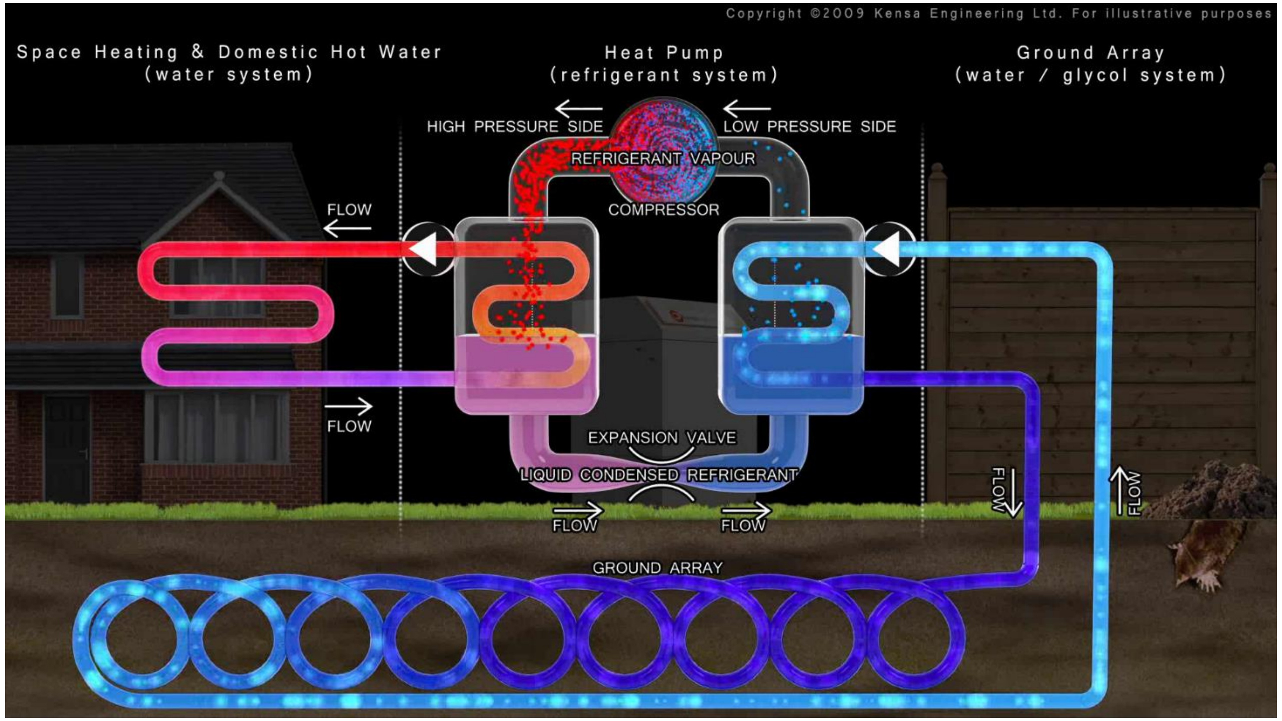
The much-reduced carbon intensity of electricity generation will be reflected in the next edition of SAP.

		Current SAP		Next Generation SAP (SAP 10)		Projected 2030	
Heat Source	Efficiency of Heat Source	Carbon Intensity (kg CO_2 per kWh)	Carbon Emissions (kg CO_2 per kWh)	Carbon Intensity (kg CO_2 per kWh)	Carbon Emissions (kg CO_2 per kWh)	Carbon Intensity (kg CO_2 per kWh)	Carbon Emissions (kg CO_2 per kWh)
Gas Boiler	85%	0.216	0.227	0.208	0.219	0.208	0.219
GSHP	300%	0.519	0.173	0.233	0.078	0.15	0.050
Direct Electric	100%	0.519	0.519	0.233	0.233	0.15	0.150
GSHP Carbon Savings against Gas Combi Boiler			24%		65%		77%

HOW A GSHP WORKS

The basics:

- Non combustion heating system
- Produces up to three times more energy than it consumes
- Ground provides a highly efficient source of heat
- Unaffected by air temperature
- Recharged by solar energy and rainfall
- Ground type (thermal conductivity) needs to be factored into sizing calculations
- Correct sizing is important to avoid over extract



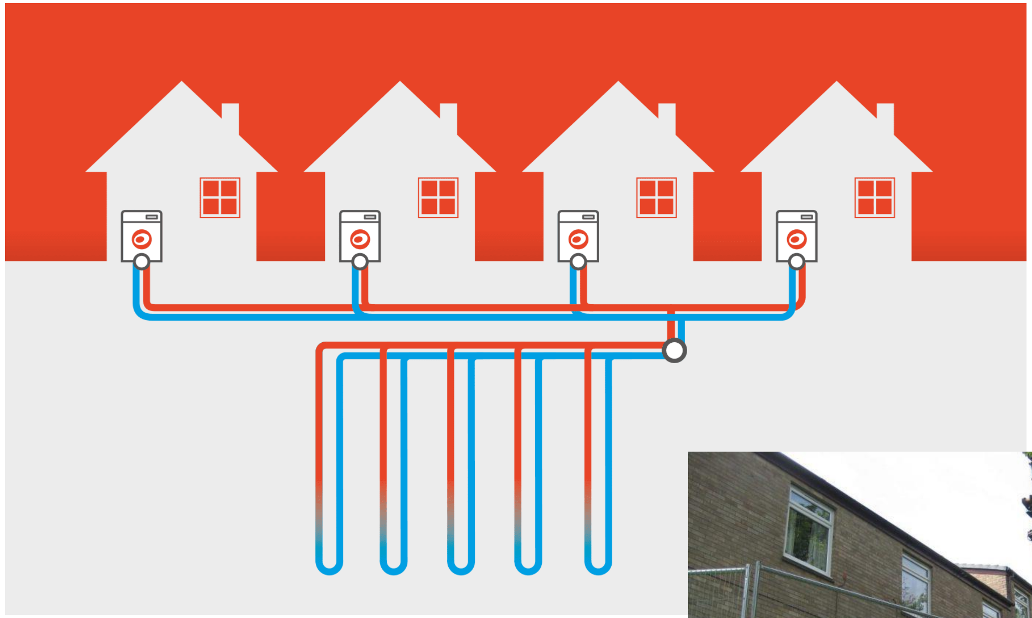
https://www.kensaheatpumps.com/how-a-ground-source-heat-pump-works/

SHARED GROUND LOOP ARRAYS

Shared ground loop arrays are a form of ultra-low temperature heat network connecting Kensa ground source heat pumps inside individual dwellings.

A different approach:

- Link as few as two properties
- Infinitely scalable for large developments
- Suitable for single and multiple occupancy dwellings
- Communal ground array pipework
- Individual heat pump in each dwelling
- Mimics a traditional gas framework

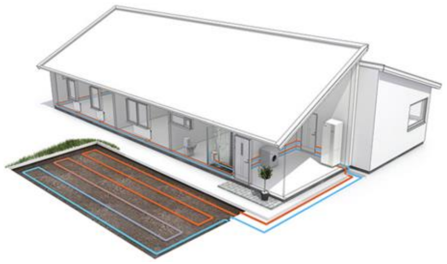


https://www.kensaheatpumps.com/the-technology/heat-sources-collectors/shared-ground-loop-arrays/


SPILL KIT

OTHER METHODS OF HEAT EXTRACTION

Straight pipe



- Collector pipework laid horizontally
- Requires large land area
- Not that sensitive to ground type
- Can be oversized easily
- Cost effective
- Quick to install

Slinkies

- Pre coiled pipework laid in trenches 1-2m below ground
- Requires large land area, but less digging
- Not that sensitive to ground type
- Can be oversized easily
- Cost effective
- Even quicker to install

Surface water (closed loop)

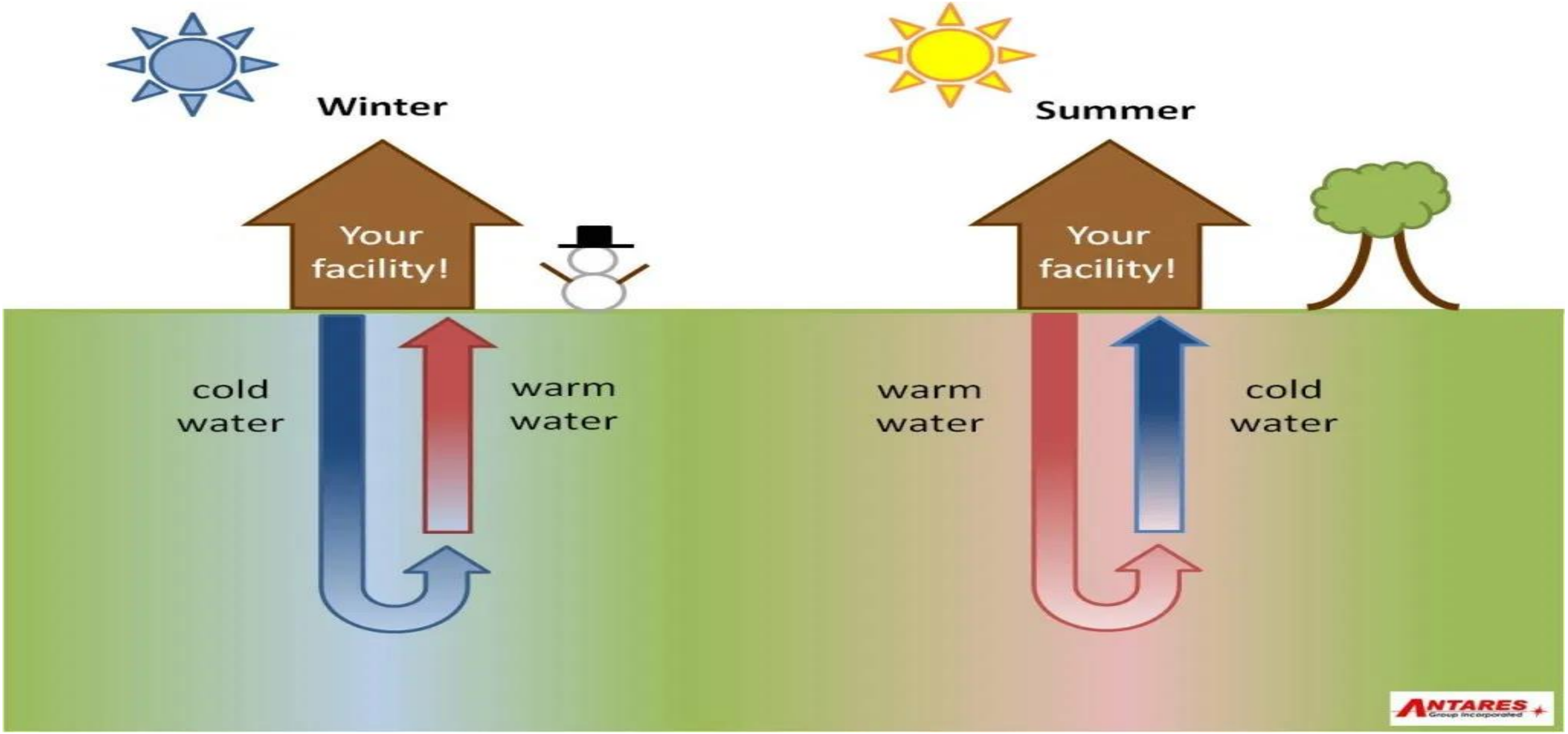
- Ideal solution where surface water (e.g. lake) is available
- Uses pond mats featuring slinky pipe on steel frames
- Extremely efficient
- Cost effective
- Reduced maintenance compared to open loop

Aquifer or mine water (open loop)

- Extracts ground water from an underground aquifer or mine
- Efficient
- Costly to maintain
- Considerations need to be taken regarding corrosion issues, filtration and extraction

https://www.kensaheatpumps.com/the-technology/heat-sources-collectors/

Can Provide Both Heating and Passive cooling



LOAD SHIFTING

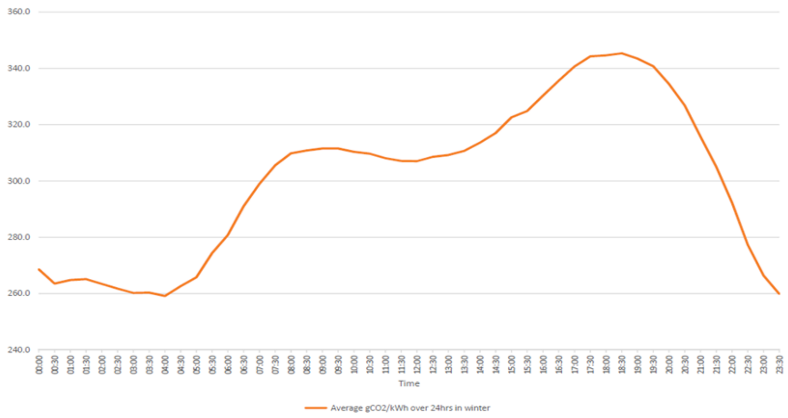
FUTURE-PROOFING

- To further reduce carbon emissions, the operation of the heat pump should be focussed on periods of low carbon electricity generation (i.e. through the night or when the wind is blowing)

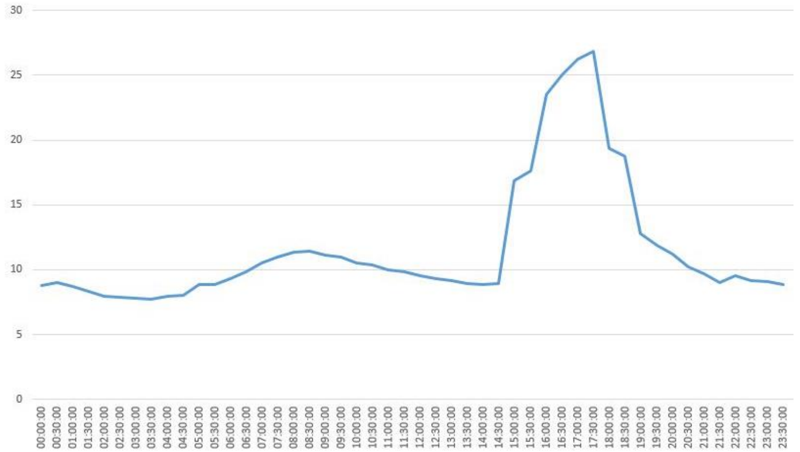
- The ground is a very stable temperature heat source allowing you to run the heat pump at the same efficiency any time of day or night (unlike air source where the efficiency is lower when the outside air temperature is lower at night)

- If you combine this feature with some energy storage local to the heat pump, it would be possible to even further reduce the peak demand by shifting heat production to times when the grid can best accommodate it

Average carbon intensity by half hour (1/11/2017 – 31/3/2018)



Average price by half-hour segment (23/5/2017 – 23/5/2018)



KENSA'S SHOEBOX HEAT PUMP

A perfect fit for Shared Ground Loop Arrays:

- 3kW and 6kW models
- Quiet operation: 47 dBA and 52 dBA
- Compact design: 530mm x 475mm x 370mm
- or 560mm x 605mm x 565mm (H x W x D)

- Integrated ground side circulation pump
- Heating and hot water (above 60°C)
- Fits in a cupboard or under a sink
- Compatible with all control systems

https://www.kensaheatpumps.com/ground-source-heat-pump-products-services/shoebox-ground-source-heat-pump/

BOREHOLE INSTALLATION

For developments with multiple properties, vertical boreholes are typically used to extract heat energy and are linked together to form the shared ground array.

- Closed loop pipework in vertical hole
- Dependant on site geology
- Requires specialist installation
- Typically 100-150m deep
- Gives 30-60 Watts per metre
- Space efficient and quick
- More expensive than slinkies or water
- Economies of scale can be realised
- >100 year borehole life expectancy

https://www.kensaheatpumps.com/district-ground-source-heat-pumps-installation-in-tower-blocks

Borehole depth
= 210m
4 Tower blocks
10C

DISTRIBUTION SYSTEM & CONTROLS

DISTRICT HEATING vs SGLAs

- Distribution system sized to 45°C flow temperature
- Radiators oversized
- Timeclock
- Central thermostat
- TRV on radiators
- Hot water priority
- 60°C stored hot water
- Local hot water cylinder

GSHPs & HOUSEBUILDERS

THE APPEAL OF HEAT PUMPS

GSHP's & HOUSEBUILDERS

- Contributes towards lowest cost compliance strategy
- Heat pumps may be supplied at no cost to the house builder dependent upon emerging business models
- System architecture is scalable and can be installed as and when required
- No planning permission required
- Installation does not impact the appearance of the property
- Mimics traditional gas boiler arrangements – appliance producing hot water, cylinder, controls

ENFIELD COUNCIL – RETROFIT, FLATS

In brief:

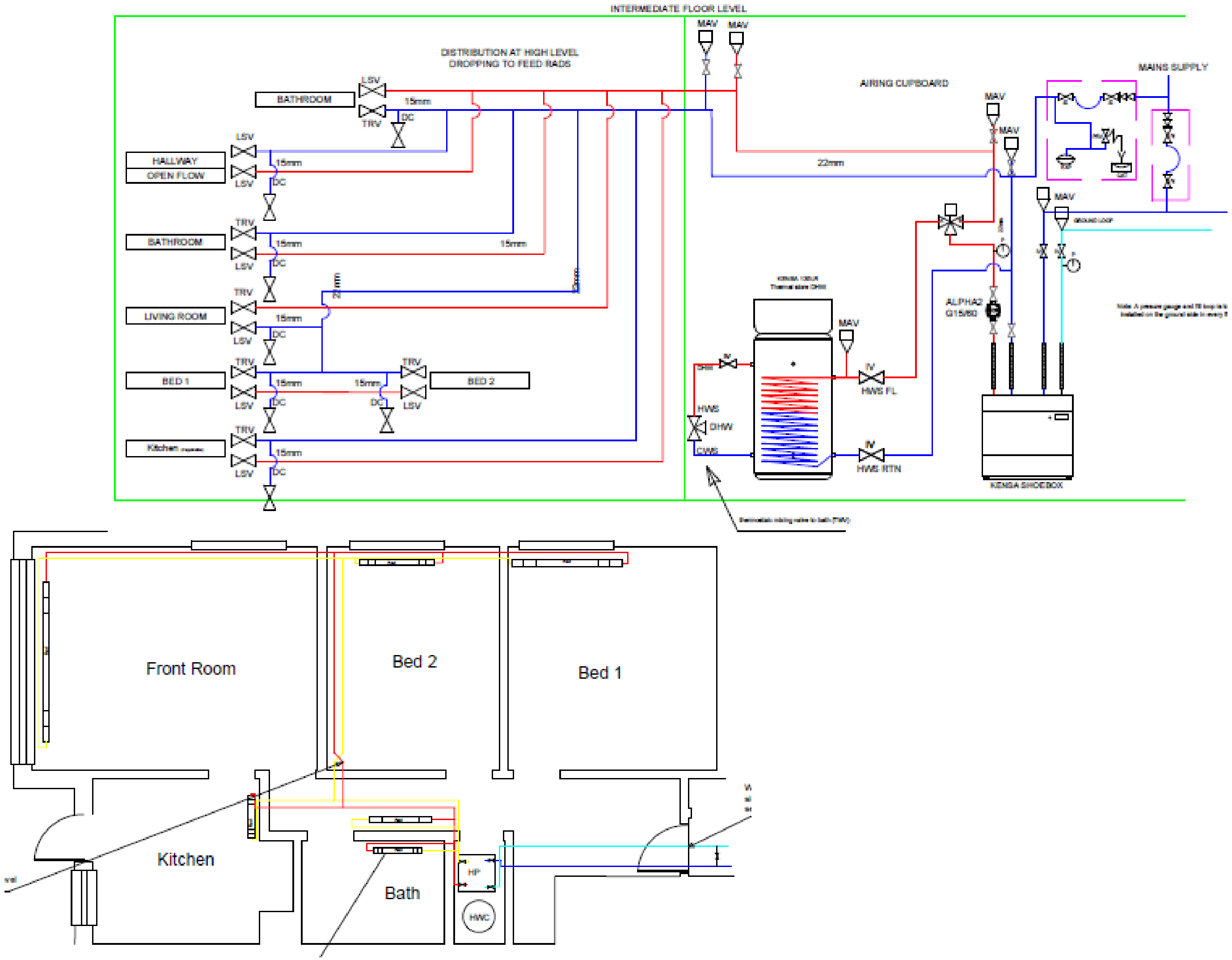
- Retrofit project
- 402 flats
- 8 tower blocks, 13 storey
- 96 boreholes
- 212m typical borehole depth
- £4.6 million project
- £4.3 million RHI return
- 773 tCO_2 saving/yr
- Running costs for residents reduced from £900/yr to £350/yr

1. Tenant liaison

- Resident remained in occupation throughout the works
- Resident Liaison Officers consulted each family before, during and after works
- Communal meetings held for each block prior to works
- Individual plans agreed to ensure safe delivery of works
- Access to respite area for residents
- Ability to view mock-up for typical flat installation
- Opportunity to ask technical/general questions

2. Survey and Design

- Detailed property surveys to establish heat loads for accurate heat pump sizing and radiator sizing
- Borehole design was a combination of desktop analysis and on-site Thermal Response Test
- Risers designed to ensure no requirement for central circulation pumps
- Surveys carried out to locate all buried services – both externally and internally

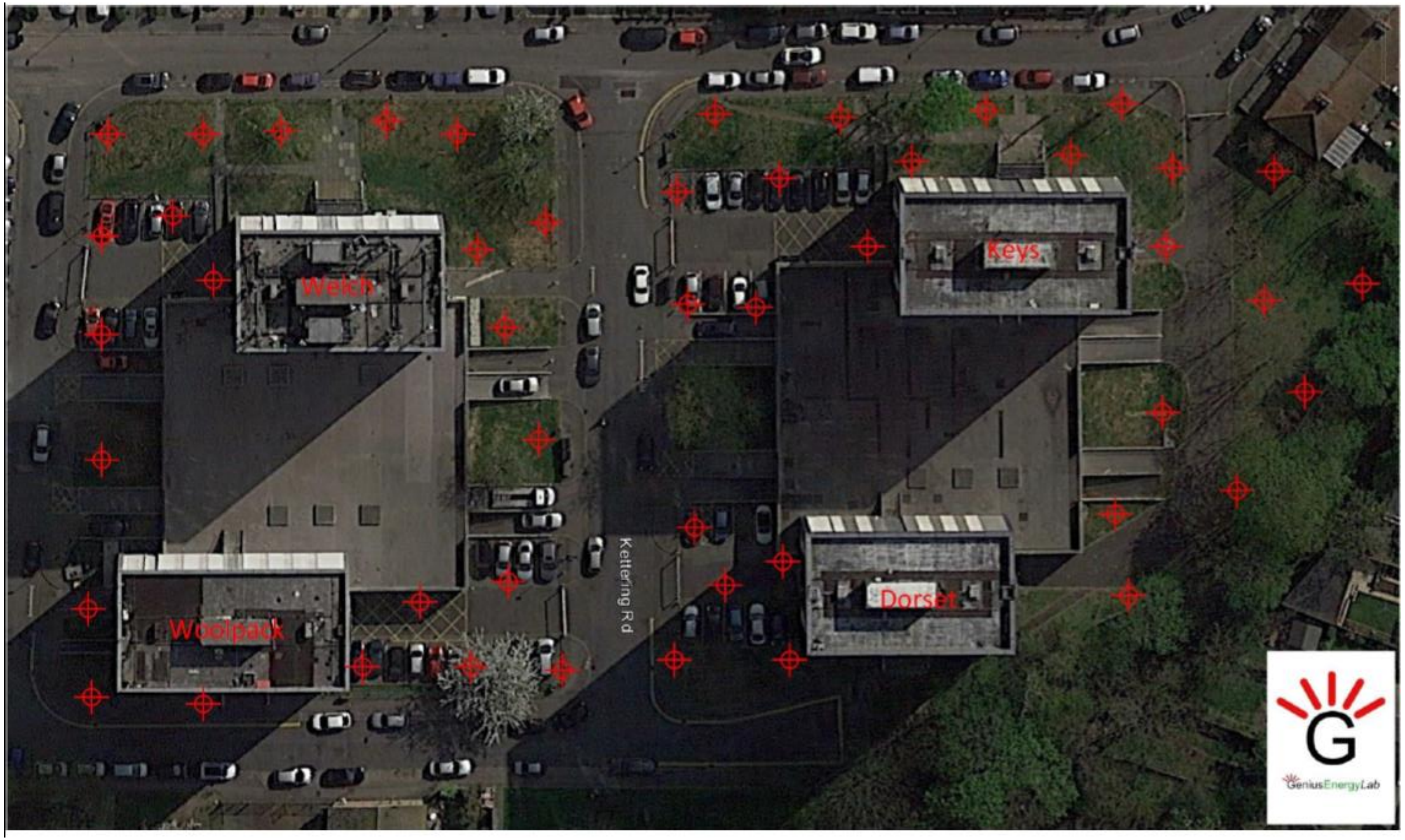


ENFIELD PROJECT – STEP BY STEP

3. Borehole drilling

- Specialist pre-drilling at each borehole location to rule out presence of UXO
- Channel Islands: 52 boreholes, 10,700 metres, 16 arrays
- Each array serves half a tower block – 6 or 7 floors and 24-27 flats
- Channel Islands drilling completed in four months
- Kettering Road: 48 boreholes, 10,000 metres, 16 arrays
- Kettering Road drilling will complete next week

PROJECT OVERVIEW



4. Trenching and headering

- Trenches are dug from each borehole
- Pipework (HDPE) is installed at the bottom of the trench connecting the boreholes to the manifolds
- Manifolds group the boreholes together into two arrays
- Two pairs of pipes run from manifolds into the basement of each tower block
- All ground reinstated at the end to match what was there previously

5. Riser installation

- Risers installed in stairwells from basement to top floor
- Core drilling on each floor
- Four pipes from basement to 6th floor
- Two pipes from 7th to 13th floor
- Branches taken off at each floor to serve the four flats
- Pipework insulated to prevent condensation
- Will all be boxed in once completed
- All work approved by Enfield Council's fire safety team

6. Flat installation

- Existing hot water cylinder and storage heaters removed (where fitted)
- New radiators and distribution pipework installed
- Heat pump installed in airing cupboard
- Shelf fitted and hot water tank installed above heat pump
- New controls – dial thermostat and twin channel programmer
- Ground array flushed and filled with anti-freeze
- Heat pump system switched on
- Existing electric UFH system de-commissioned
- Making good and pipework painted
- System handed over to resident

7. Key outcomes

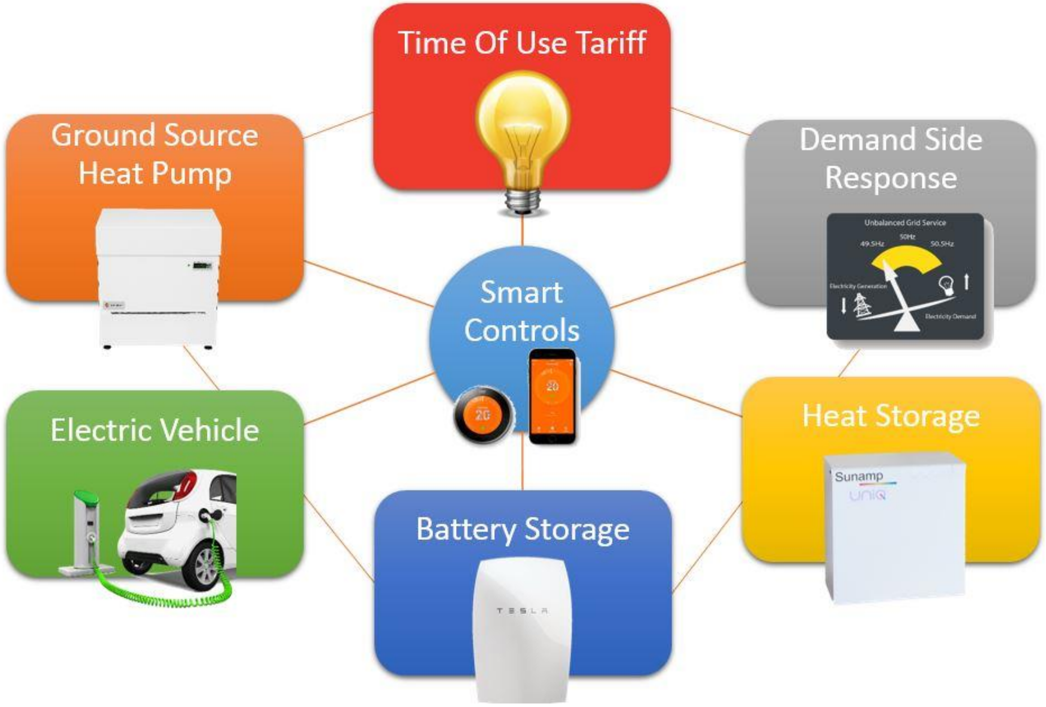
- £4.3 million RHI return
- ECO funding obtained for client
- 773 tCO_2 saving/yr
- Running costs for residents reduced from £900/yr to £350/yr
- Significant reduction in maintenance costs for Enfield Council

HEAT AS A SERVICE

FUTURE-PROOFING

- Potentially energy companies (or other entities) could supply equipment and deliver 'heat as a service' for a fixed (or variable) cost and have the ability to switch on/off the heat pump (and other appliances) to take best advantage of the fluctuating price of electricity and any income available from grid balancing services

- Some entities are speculating that the cost of heat could fall as low as 1p per kilowatt hour (£50 annual cost for typical new build house) although capital costs would need to fall substantially to create the business case



Kensa Group

- Kensa Heat Pumps — A KENSA GROUP COMPANY
- Kensa Contracting — A KENSA GROUP COMPANY
- Kensa Utilities — A KENSA GROUP COMPANY

MADE IN BRITAIN · MCS · BBA · APPROVED INSTALLER · RECC RENEWABLE ENERGY CONSUMER CODE · ISO 9001 UKAS · GSHP association MEMBER

KENSA PRODUCT RANGE

Evo Series

- 7, 9, 13kW and 17kW options (all single phase)
- Small footprint, incredibly quiet
- Suited to retrofit or larger new build
- In-built ground side and heating side circulation pump
- 60°C hot water
- Separate hot water cylinder required
- Compatible with radiators or UFH
- Compatible with all control systems
- New, bespoke refrigeration controls with touchscreen

Twin Compact Series

- 16, 20, 24kW and 30kW with standard temperature
- Single Phase available up to 24kW
- 15 and 21kW “hybrid” to give high temperature DHW
- Installation advised in shed, garage or utility
- Suitable for large domestic properties or small commercial
- In-built ground and heating side circulation pumps
- Compatible with radiators or UFH
- Compatible with all control systems

Plantroom Series

- 25kW to 75kW models
- Three phase electric supply required
- Soft starts fitted to reduce electrical load
- Can be installed in multiples to give higher output
- Ground and heating side circulation pumps to be specified separately
- Compatible with radiators or UFH
- Compatible with BMS
- Normally install a separate high temp heat pump for hot water

CONTACT DETAILS

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Accreditations