

# Decarbonising Heat with Ground Source Heat Pumps

APSE Energy-Scotland

Presented by: Ieman Barmaki – Sustainability Director



# Kensa Group

- We are UK manufacturers of GSHP for domestic applications
- Pioneers of the Shared Ground Loop Ambient systems in social housing
- Market Leader with 45% share in the UK
- Part owned by Legal & General PLC
- Production based in Truro – Cornwall
- Our vision is for a decarbonised heat system using GSHP and ambient heat networks street by street and area based



# The Need to Decarbonise

Figure 2: UK emissions in 2019

Buildings  
Transport  
Industrial and miscellaneous  
Agriculture, land use, land use change and forestry and waste

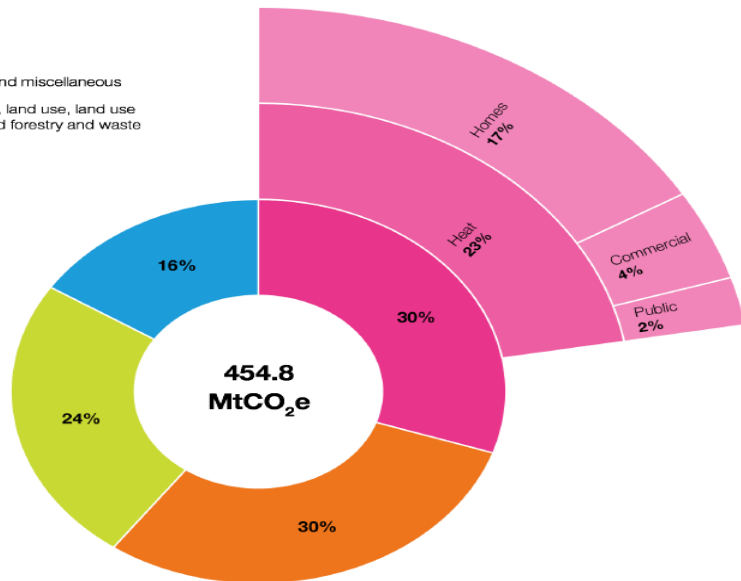
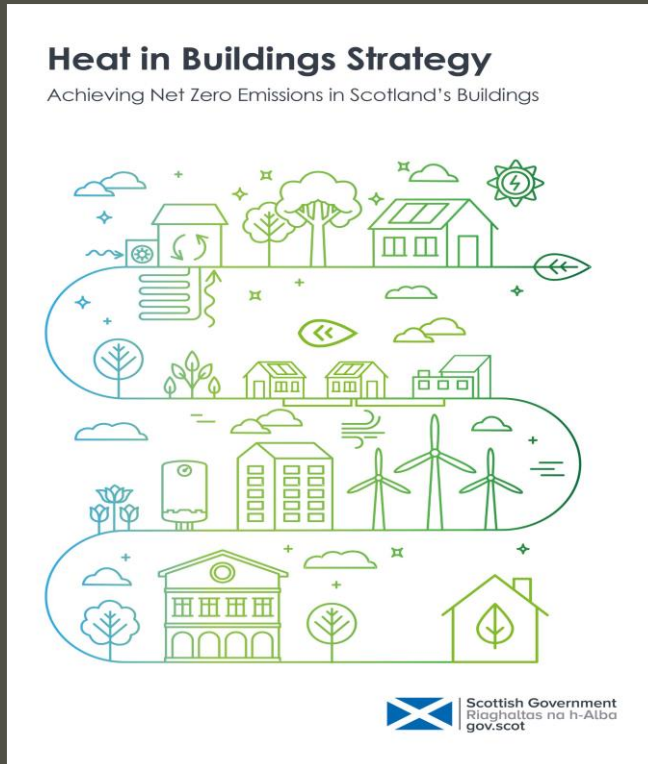


Figure 2 shows the proportion of emissions in 2019 from buildings to the nearest whole number; of the 454.8 mega tonnes of carbon dioxide equivalent (MtCO<sub>2</sub>e) total emissions, 23% were due to heating buildings, with the largest proportion of this stemming from homes.<sup>35</sup>

SOURCE: BEIS <https://www.gov.uk/government/publications/heat-and-buildings-strategy>

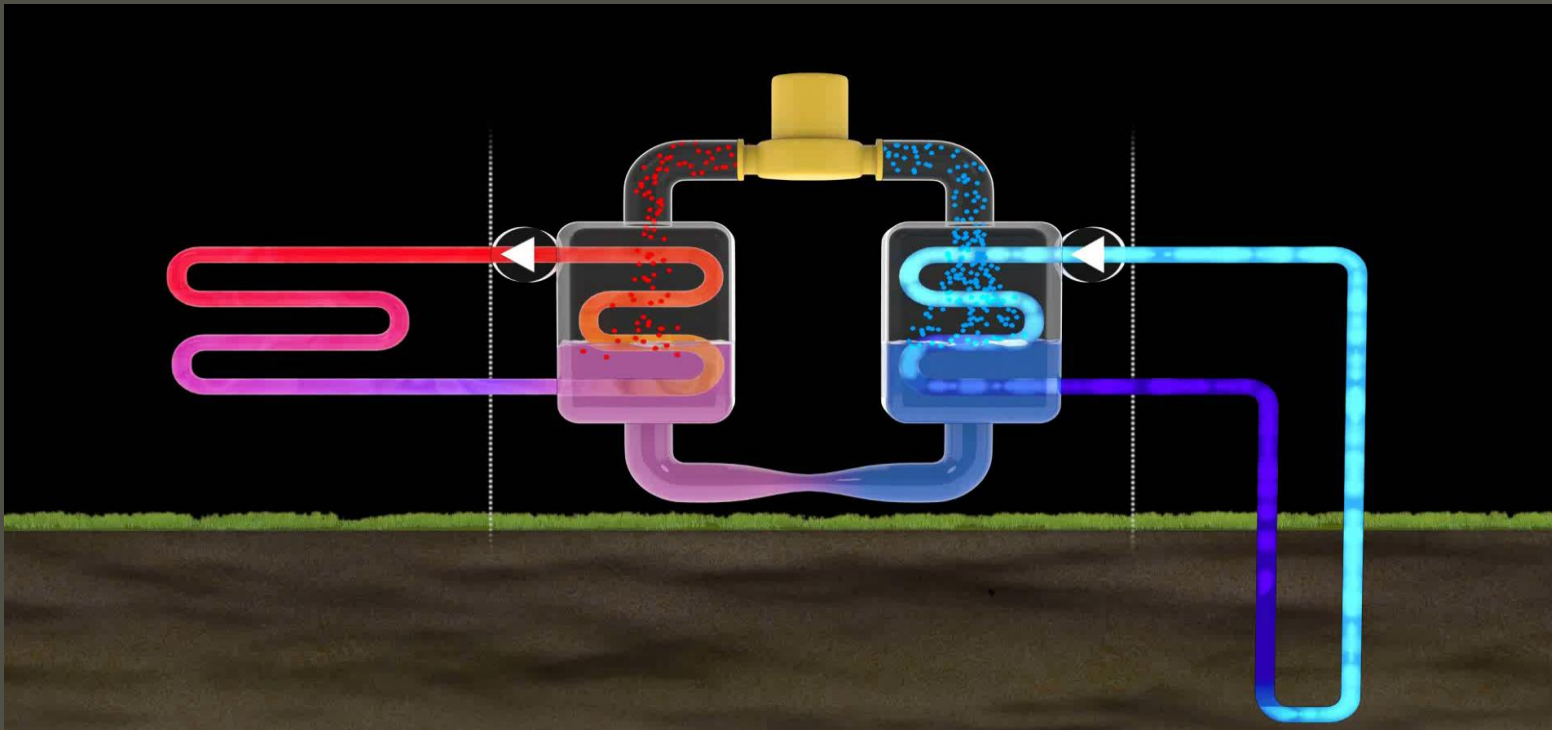
- 80% of existing homes use gas heating
- 30% of UK emissions attributed to heat
- 1.6M boilers sold in the UK every year
- Heat decarbonisation can be achieved through mass roll out of Ground Source Heat Pumps
- Target of 1 million zero emission heating system by 2030 – Scotland
- Massive step change is needed and infrastructure needs to be provided for to access the energy stored in the ground
- With the energy crisis in full flow we need to limit the cost of heat and use as much free energy from renewable sources as possible
- Many heat pump demonstrators have been funded
- Lesson have been learnt and these can be shared
- Lowest running cost and lowest emission heating through GSHP

# Heat In Buildings Strategy - Scotland

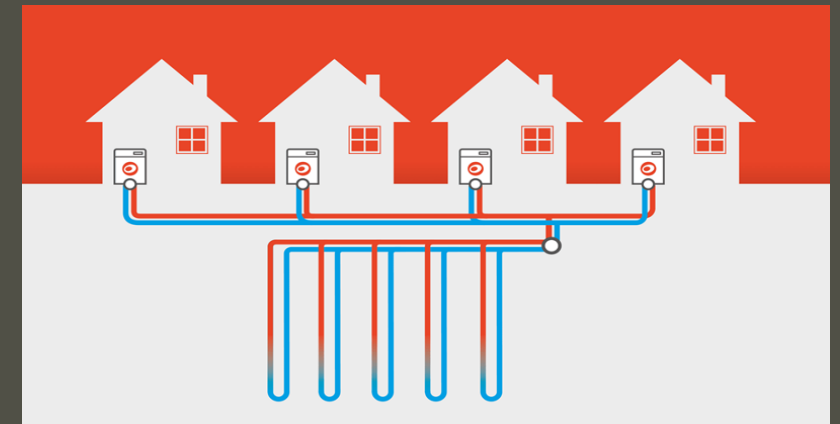


- All homes EPC band C by 2033
- Over 1 million homes with zero emission heat by 2030
- Customer protection and fuel poverty alleviation is high priority
- £1.8 billion for heat and energy efficiency projects
- £200 million Social Housing Net Zero Fund until 2026
- £200 million Green Scottish Public Sector Estates Scheme
- 2024 zero emission heating in all new builds
- 2025 Gas boiler ban in off gas grid
- 2030 Gas boiler ban in other areas
- EESSH2 all Social Housing EPC band B by 2032
- **At least 22% of heat in building from renewable sources by 2030 including “ambient heat supplied heat pumps” Also Known as Ground/Water Source Heat Pumps**

# How Ground Source Heat Pumps Work



- Non combustion heating system with 300%+ efficiency
- Ground provides great amounts of ambient energy
- 2 units free energy + 1 unit of electricity = 3 units of Heat
- Ground is recharged by solar energy and rainfall
- Unaffected by air temperature unlike ASHP
- Lowest running cost heating system
- Lowest carbon heating system



# Kensa's Shoebox Heat Pump

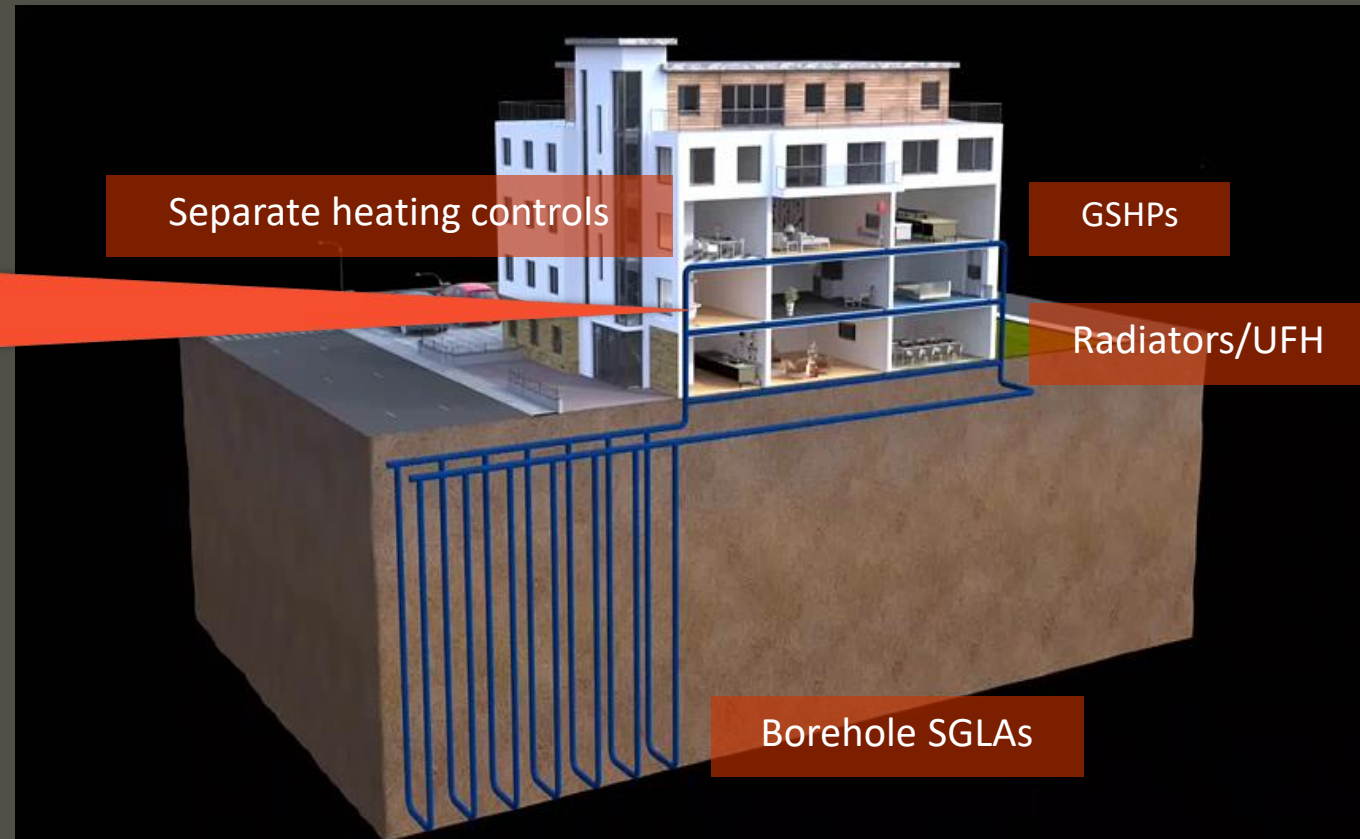
A perfect fit for Shared Ground Loop Arrays:

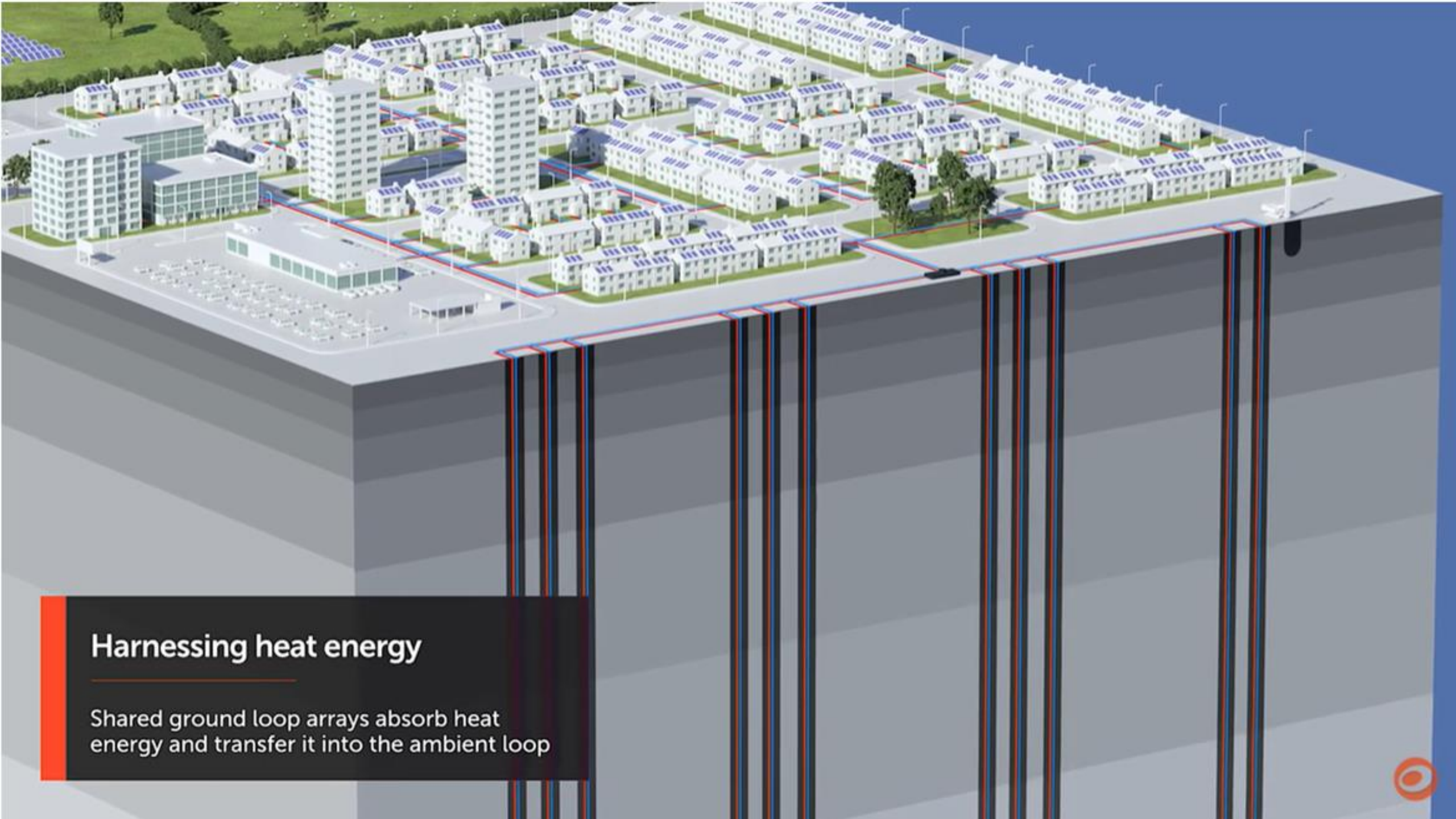
- 3kW and 6kW models
- Smallest and quietest Heat Pump
- Designed for social housing and new build
- Quiet operation: 47 dBA and 52 dBA
- Compact design: 530mm x 475mm x 370mm or 560mm x 605mm x 565mm (H x W x D)
- Integrated ground side circulation pump
- Heating and hot water (above 60°C) using hot water cylinder or heat battery- Sunamp
- Fits in a cupboard or under a sink
- Compatible with all control systems with sensitivity to resident needs



# System Architecture with Ambient Heating

An individual Kensa heat pump inside each dwelling provides independently controllable heat and hot water for each property.





## Harnessing heat energy

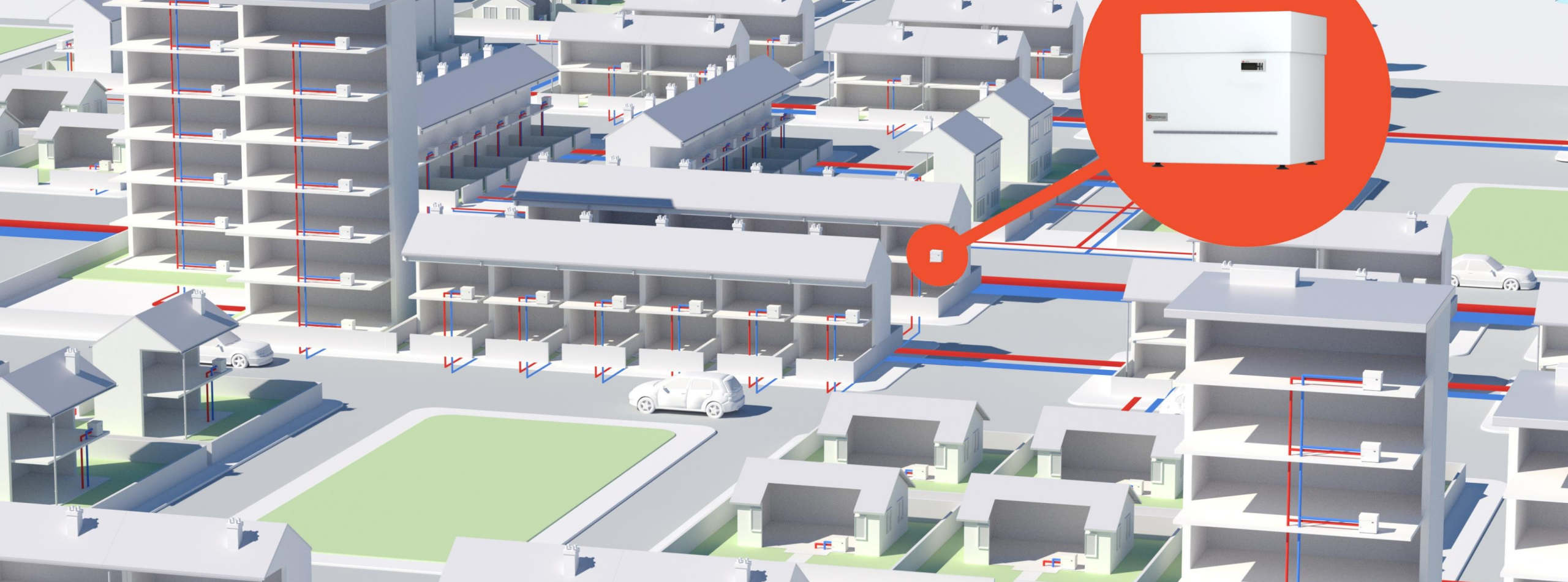
Shared ground loop arrays absorb heat energy and transfer it into the ambient loop



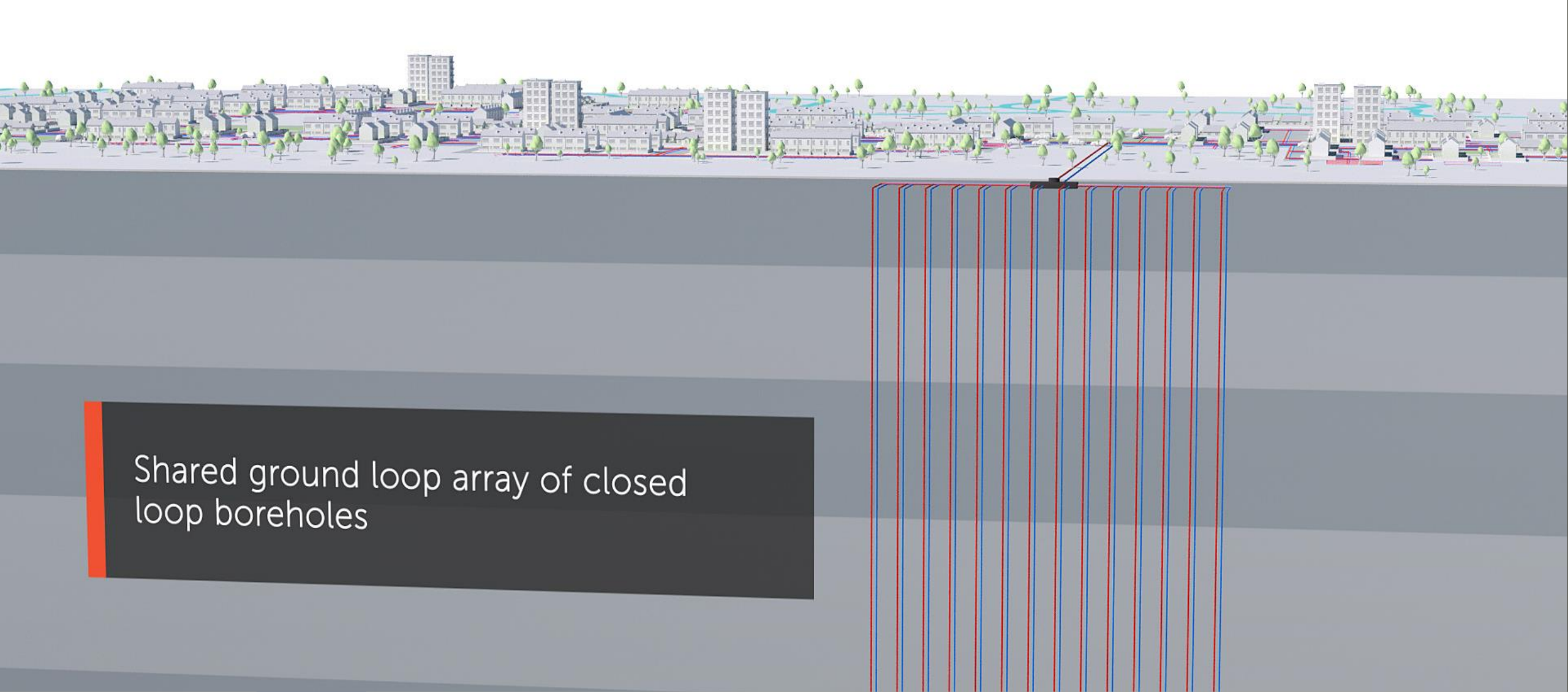


The background features a solid orange color with a fine, repeating diagonal line pattern. On the right side, there are three large, overlapping, semi-transparent orange circles of varying sizes, creating a sense of depth and movement.

**Future Vision:  
Mass Roll Out of Networked Heat Pumps**

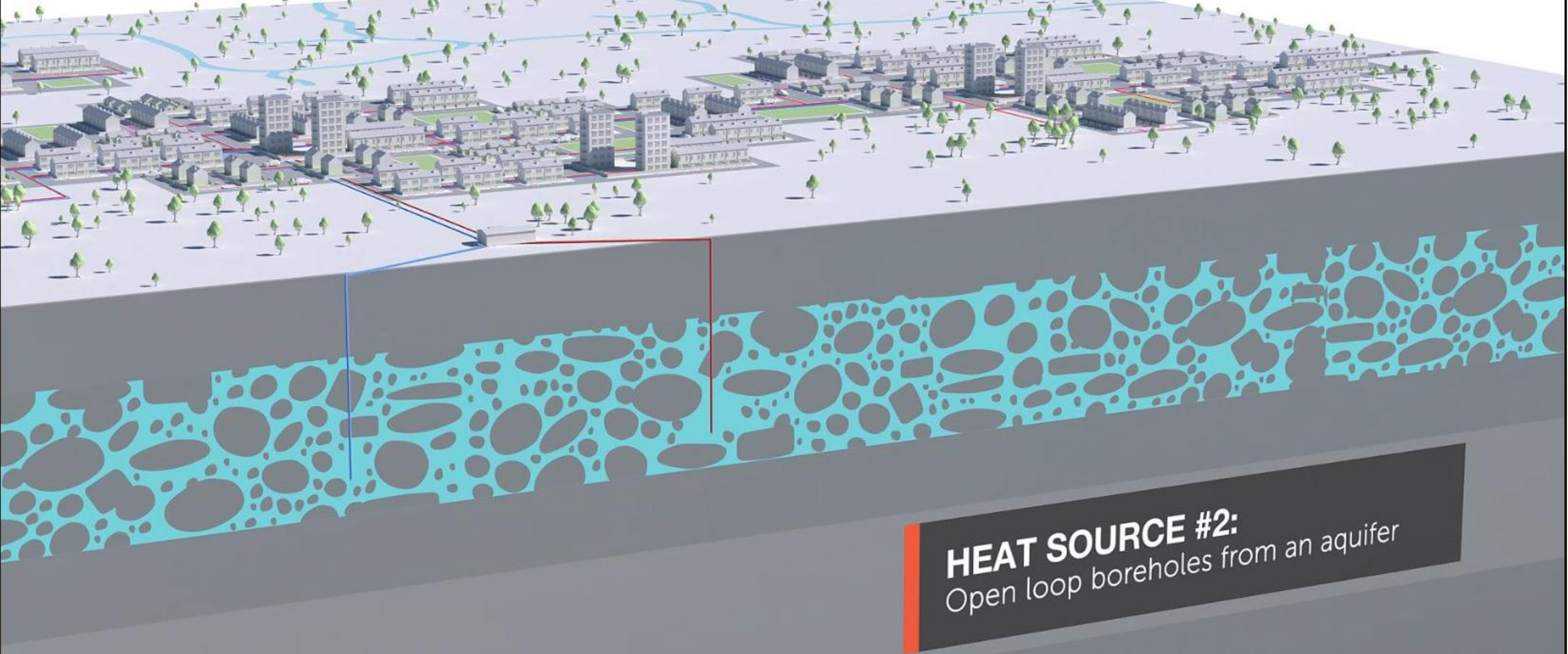


A network of pipes connecting every property  
Temperatures range from 0 – 20°C  
Individual heat pumps in each property to produce space heating and DHW  
Passive and active cooling from the same network  
Waste heat and cold is recycled into the network  
User pays for their energy via their electricity bill



Shared ground loop array of closed loop boreholes

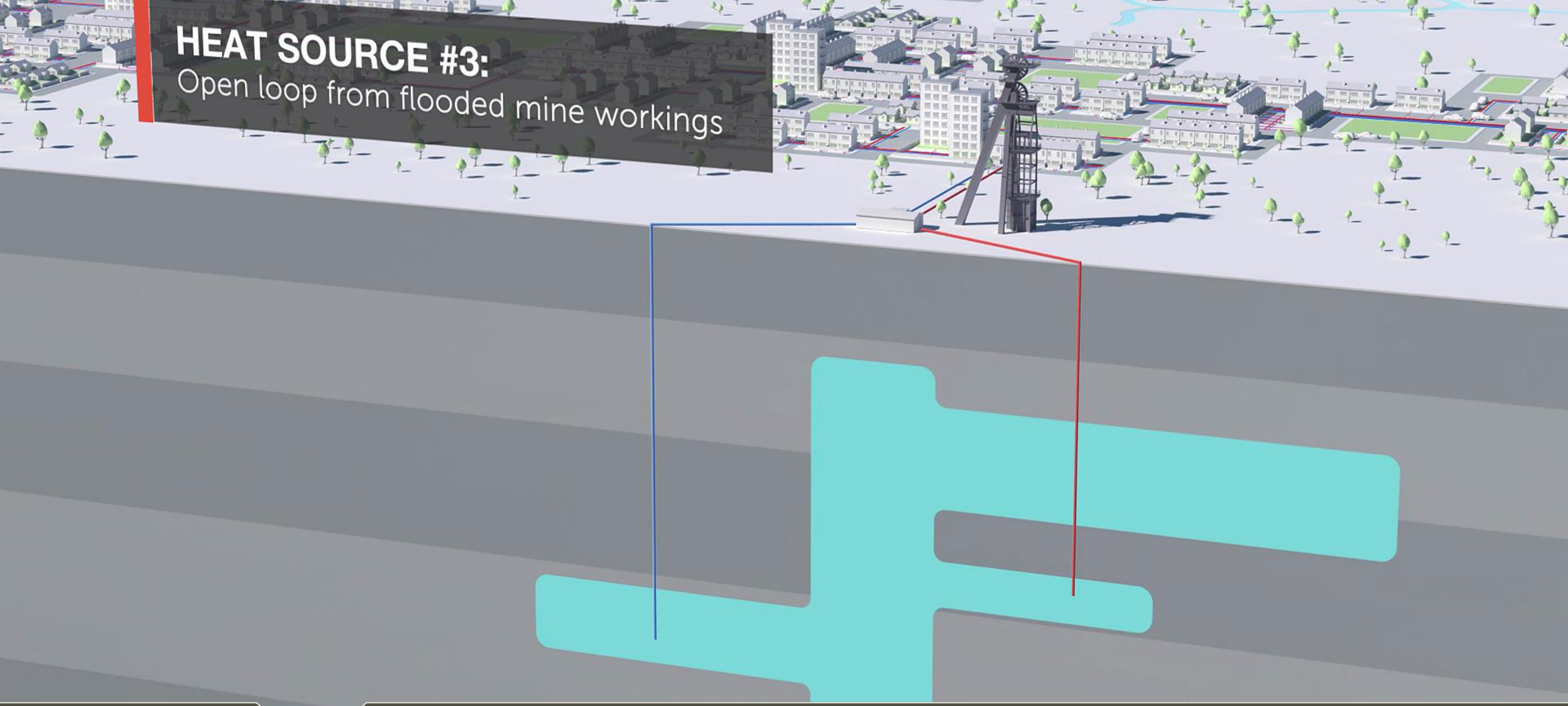
Multiple sources of ambient energy can be used



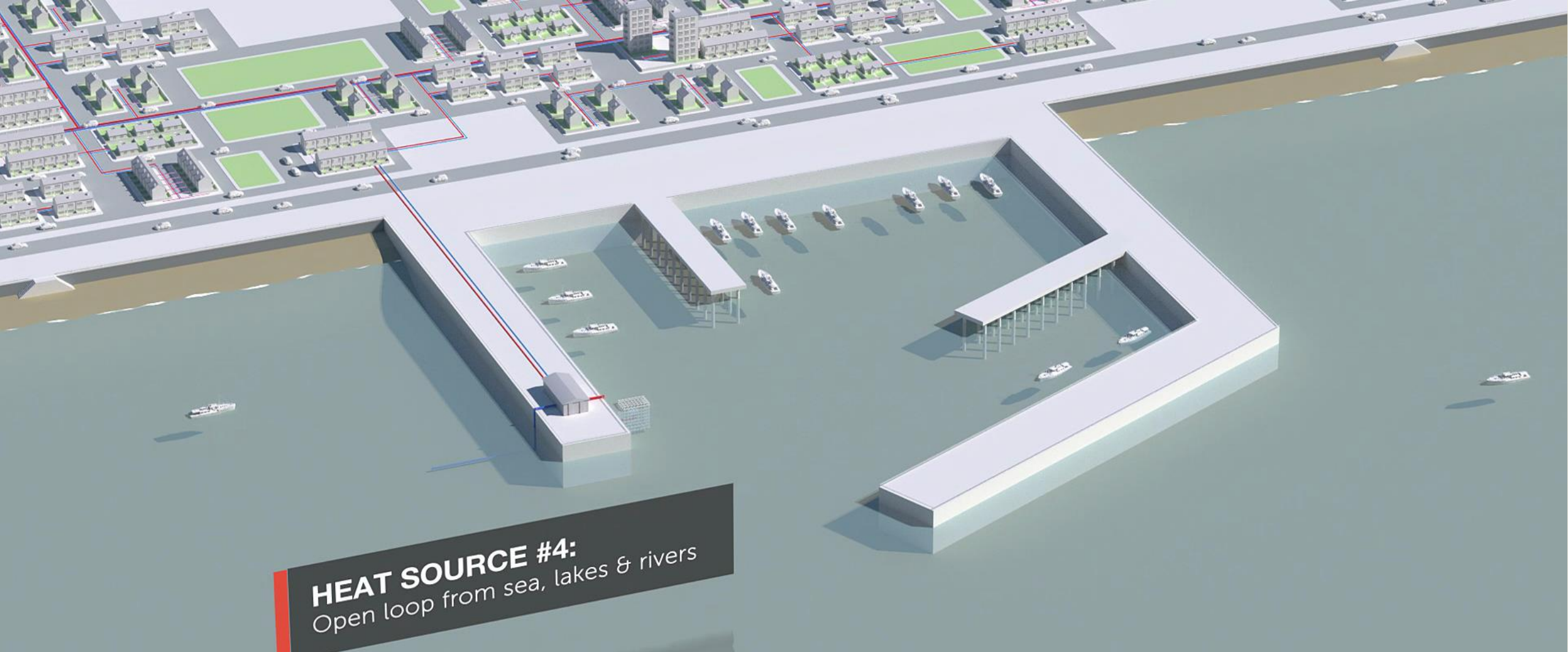
**HEAT SOURCE #2:**  
Open loop boreholes from an aquifer

Multiple sources of ambient energy can be used

# HEAT SOURCE #3: Open loop from flooded mine workings

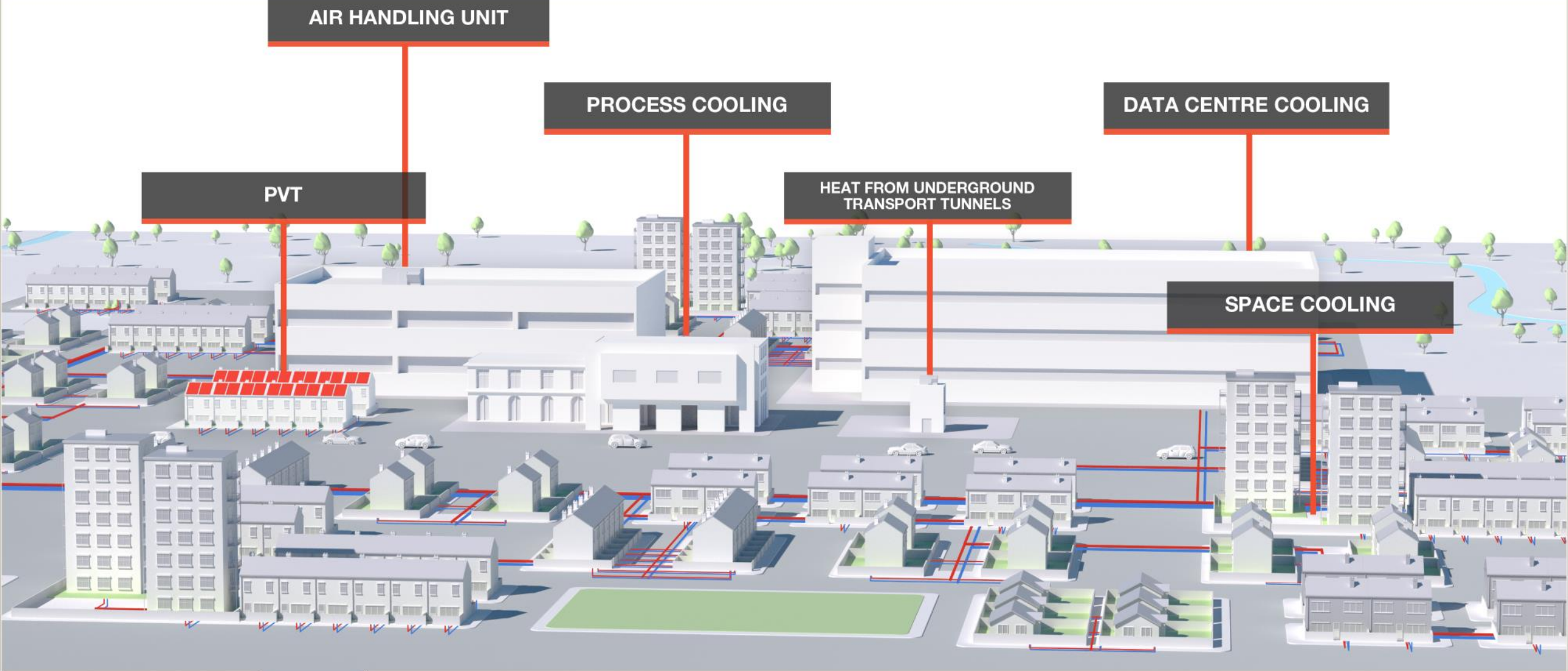


Multiple sources of ambient energy can be used



**HEAT SOURCE #4:**  
Open loop from sea, lakes & rivers

Multiple sources of ambient energy can be used



City scale roll out across all buildings is possible to achieve sustainable and joined up deployment which can help all communities to come together and achieve net zero

# The Appeal of Ground Source Heat Pumps- New Builds

- Contributes towards lowest cost compliance strategy
- 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
- Policy requirements for no fossil fuels from 2024

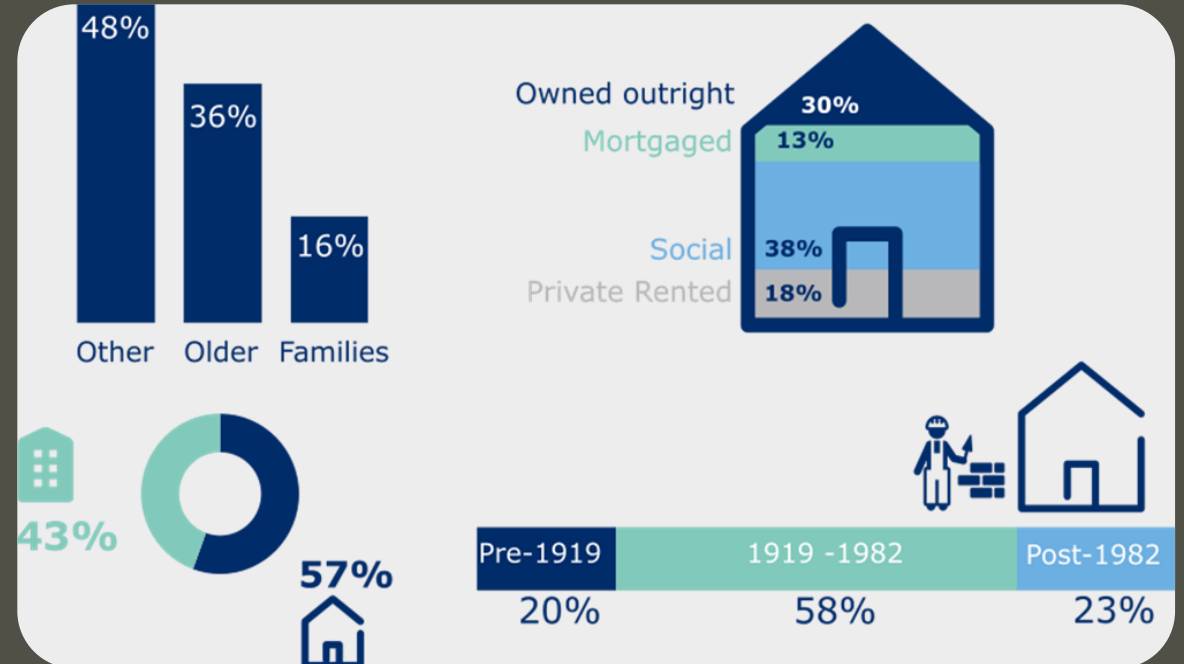




# Why is Social Housing Retrofit Important?

- Social rented sector – 607,929
- 88,000 use electric heating as primary heat source
- 46,530 flats in tower blocks with majority heated with electric storage heaters
  - Running costs in excess of £2,200 pa
- Majority with a weekly income of between £192 to £288
- Average rents of £83.70 a week
- 38% of those in fuel poverty live in social housing
- 43% of those in fuel poverty live in flats
- Huge opportunity for social impact by lifting residents out of Fuel Poverty - saving 66% on heating costs
- Huge opportunity for heat decarbonisation in social housing
- Asset Management is so important

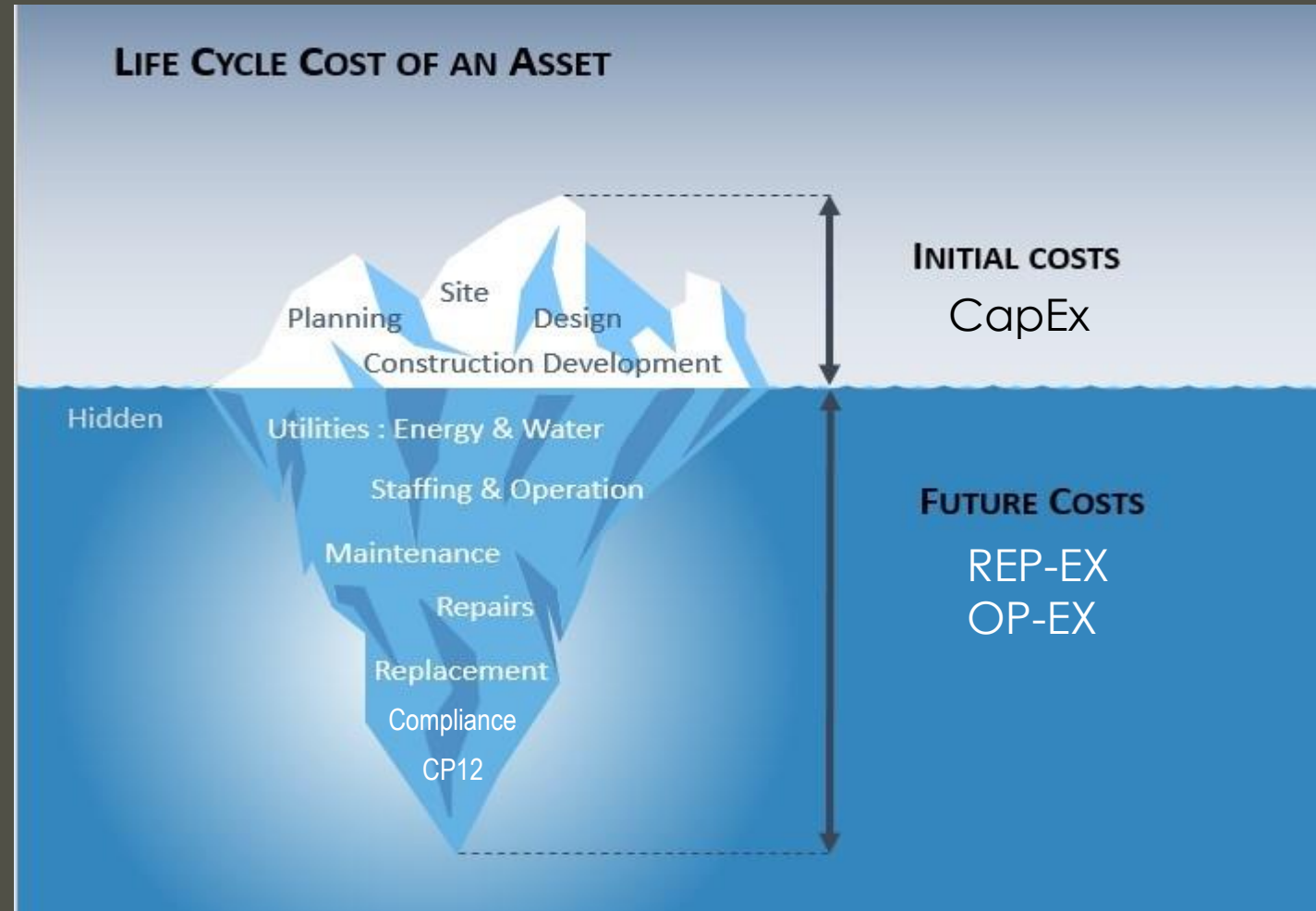
Composition of Fuel Poor Households by Selected Household and Dwelling Characteristics



# Asset Management is Key

- According to Scottish Housing Federation Asset management should ensure :
  - landlord's homes are affordable
  - attractive to tenants
  - financially viable in the medium to long term 30 years (life-cycle)
- As a former asset manager I know that too often decisions are based on initial costs:

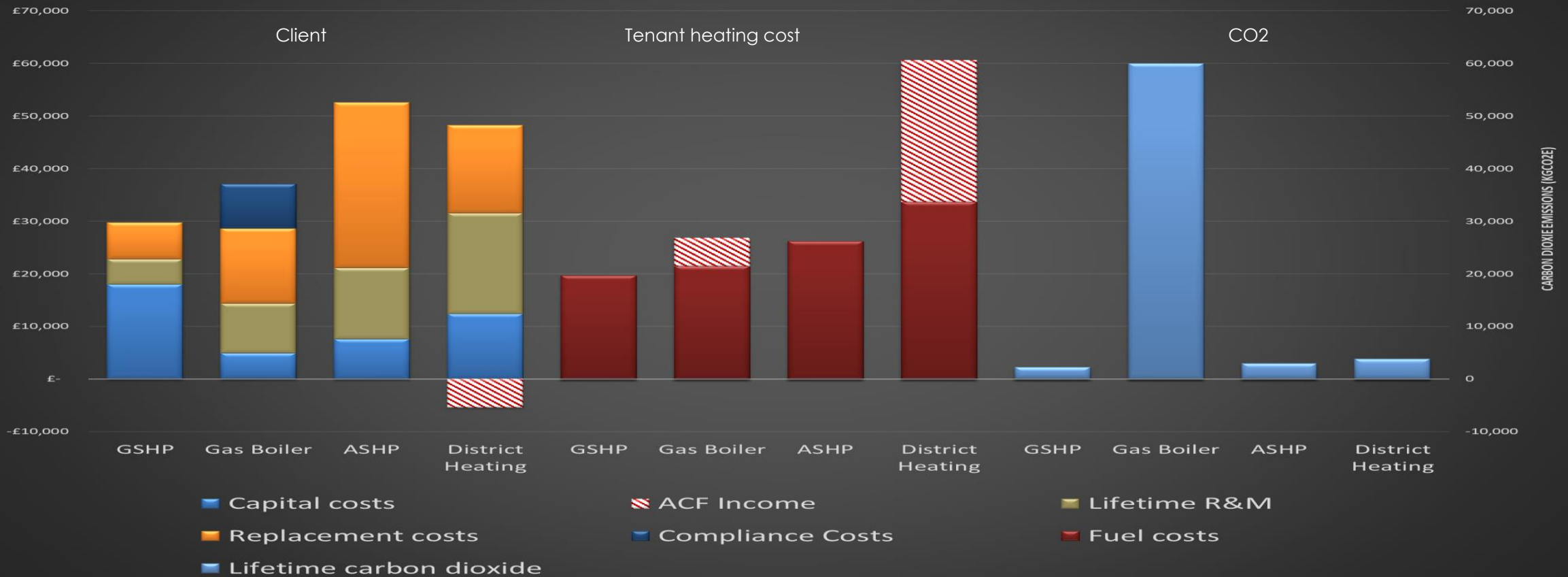
“Tip of the Iceberg thinking”



# Life Cycle Analysis: GSHP has lowest lifecycle cost!

Potential to reduce capital cost by a further 50% through Social Housing Net Zero Fund

System comparison: cost to client, cost to occupier and CO2 emissions per average property



# Support with Building the “GREEN” Business Case

HM Treasury: The Green Book – Central Government Guidance on Appraisals and Evaluation- The Five Case Model

## Strategic Case

- Is there a clear case for change and will it meet aims & objectives?
- Net Zero, EESSH2, Climate Emergency, local and national policy drivers

## Economic Case

- Social value, fuel poverty alleviation, NHS savings, well being of residents
- Protection of residents from high heating charges

## Commercial Case

- Is it viable? How scalable is this can we all do it together, shall we take the lead?
- In line with 30+year HRA business plans, making use of open spaces and parks, funding, commercial returns

## Financial Case

- Is it affordable over the life of the asset? Can we get funding?
- Financial modelling, divested pension funds, best possible NPVs, better affordability of rents, S106, PWLB

## Management Case

- Is it achievable and are we capable?
- Robust project management in house, asset management skills, large scale deployment, asset infrastructure ownership models

# Case Study - Enfield Council

Largest Installation of SGL GSHP in Social Housing  
Affordable Warmth  
Heat Decarbonisation





60% saving in heating and hot water costs  
23,000 tCO2 saving  
£4 Million funding claimed  
Properties on zero carbon pathway



# Sunderland, Gentoo

- 364 properties
- Replacing gas boiler with GSHP
- Installing sprinklers
- Ambient loop from aquifer 60m
- Smart controls
- 420 tonnes of CO<sub>2</sub>/pa

<https://www.kensacontracting.com/largest-gas-replacement-programme-with-ground-source-heat-pumps-in-tower-blocks-commences-in-sunderland/>





# Together Housing, Lancashire and South & West Yorkshire

- 770 Ground Source Heat Pumps
- Shared ground loop array system
- Borehole drilling of up to 200m
- Up to 45% savings on running costs

<https://www.kensacontracting.com/togetherhousing/>

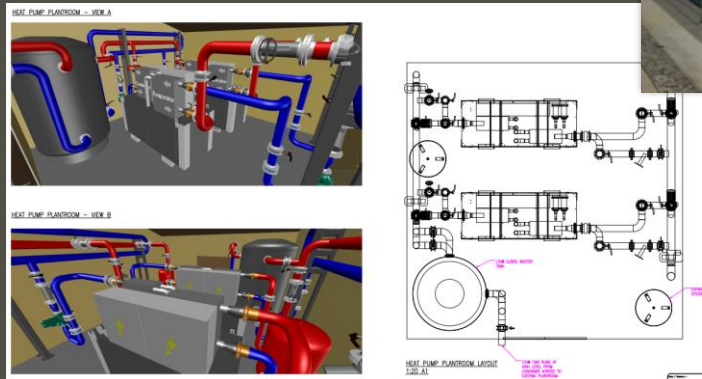


# Non-Domestic Experience

- 62Nr 282m Deep Boreholes all in the car park and land surrounding the building
- Heating the adult and learner pools, 6 air handling units and the DHW for showers
- 700kW of low temperature heat delivered by 2 x 350kW heat pumps in an energy centre
- 100kW high temperature unit, delivering the DHW top up to 65c
- Kensa contracting completed the full design and build of the entire project
- Annual carbon savings of 323 tCO<sub>2</sub>e

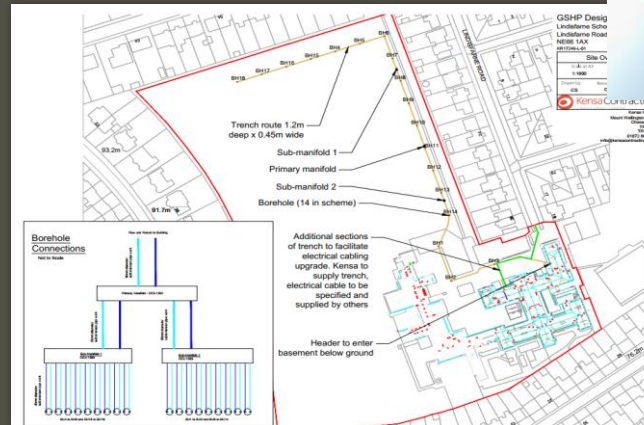


**Willowburn Leisure Centre, Alnwick NCC**



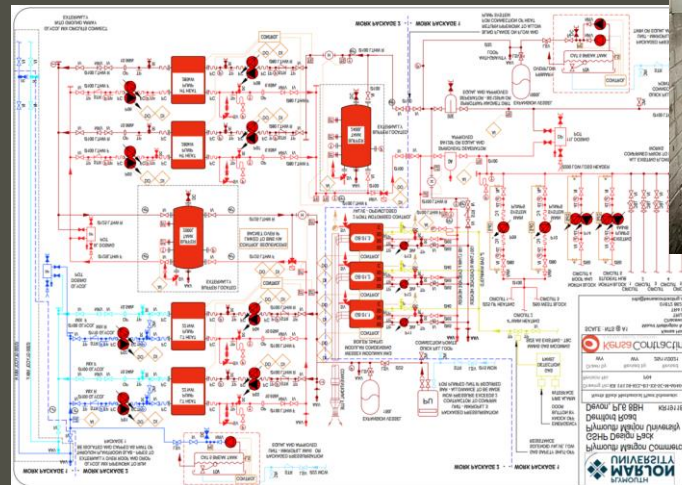
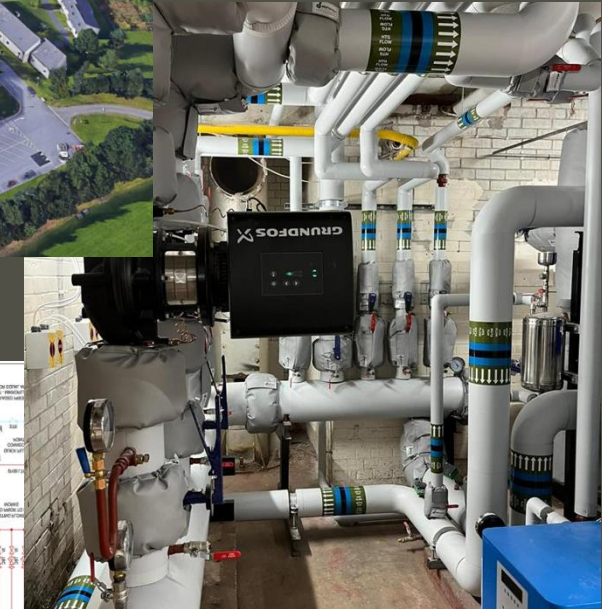
# Lindisfarne Adult Learning Centre

- 18Nr 190m Deep Boreholes all in the border of the playing field
- Heating the entire academic teaching blocks
- 150kW of low temperature heat delivered by a cascade of heat pumps in the main plant room
- Fitted out the entire building with a new two circuit LTHW LST radiator heating system
- Kensa contracting completed the full design and build of the entire project



# Marjon University Plymouth

- North, South and West Academic blocks of the Quad, 46 staff and student accommodation blocks
- Total heating load of 950kW for the entire site
- 84Nr Boreholes at varying depths across the campus
- Installed two centralised plant options with two stage higher temperature and 46 decentralised shared ground array units
- Annual carbon savings of 440 tCO<sub>2</sub>e



# Potential for Innovative Financing Mechanisms

- Ambient loops are similar to gas mains infrastructure
- The Council / Government or a separate entity could invest in the ground array and operate it as a utility
- Charge an Annual Connection Fee (ACF) similar to gas standing charge
- Making third party investment possible
- Asset infrastructure life of 100 years +
- Ideal for pension fund divestment and infrastructure funding
- Reduces capital cost by 50% making projects highly fundable
- Scottish Housing Net Zero Fund could be used for capital contribution
- **“Potential” for no Capital Cost retrofit is an opportunity!!**

