Case Study: Peabody

Heating New Homes with Heat Networks

The provision of efficient fossil fuel free heating and hot water in the development of new homes is key to decarbonisation. For development projects in urban areas such as London, heating and hot water is typically provided by a scheme or building wide communal heat network.

Heat is generated centrally on the site, typically by air or ground source heat pumps. Electric boilers are often incorporated to boost heat supply on the coldest days and provide resilience if a heat pump is out of action. Water flows around the building at a high temperature (approximately 60 degrees C) and is transferred to each dwelling by a Heat Interface Unit.

Alternatively, heat generated centrally at a lower temperature with water flowing around the building at an ambient temperature (approximately 20 degrees C). The temperature is raised further by a heat pump in each dwelling and stored ready for space heating or hot water use.

Peabody's research demonstrated that there is no 'one size fits all' solution for heat networks: the most suitable system temperature and type of heat pump differs depending on the scale and density of development, the amount of heating and/or cooling required and the heat source available on site.

Peabody has developed a holistic methodology for arriving at the best-balanced heating system for each new development scheme. The methodology is intended to be applied at not later than RIBA Stage 2 and revisited as required through later design stages.

The following hierarchy is based on research and techno-economic analysis of several case study schemes of varying scale and density as well as identification of the organisation's own priorities. The options include ground source and air source heat pump systems with either high or ambient temperature networks.

	Option A (GSHP Shared Loop-ambient)	Option B (Central GSHP/ high)	Option C (Central ASHP/ high)	Option D (Central ASHP/ ambient)	Option E (Block ASHP/ ambient)
Capital Cost	**	**	***	**	*
Operating Cost (Maintenance/replacement)	***	***	***	**	**
Carbon Emissions	*****	*****	****	*****	*****
Resident Bills	****	****	**	**	***
Compliance	*****	*****	*****	*****	*****
System Efficiency	*****	****	***	*****	*****
Management complexity (system, billing)	*****	***	***	**	*
Income generating/saleable	No	Yes	Yes	Portion	Yes
Hierarchy	1	2	3	4	5

Using the hierarchy as a starting point, heat network consultants carry out a project specific options appraisal, testing each option against the drivers.

If a suitable water source is available close to the site, water source heat pumps would be evaluated as part of the project options appraisal.

For ground source heat pump solutions be deemed best value, the additional capital cost must be offset in savings in operational costs and residents' bills over the lifecycle of the heat network.

The scope of the options appraisal is as follows:

SCHEME CONTEXT

Develop options with consideration for:
- Peabody hierarchy of preference
- Number of homes, density and space available
- Asset type (for sale or lease)
- Heat network management strategy

SELECT OPTIONS

For each option note:
- Central/primary heat source, back up/peak heat source, network temperature, dwelling equipment, metering/ billing requirements and provide high level schematic.

PLANNING/COMPLIANCE

Evaluate options against:
- Local authority planning conditions
- Compliance with London Plan/Part L
- Peabody minimum performance requirements

COMMERCIAL

Provide high level life cycle cost analysis over 40 years to include:
- Capital cost (incl. carbon offset)
- Operational cost (broken down into fuel, maintenance, metering/billing, replacement)
- Ability to generate income
- Highlight commercial considerations

TECHNICAL

Provide commentary (advantages and disadvantages) in relation to:
- Technical/design feasibility
- Type of equipment/redundancy
- Network temperature/efficiency
- Operation/maintenance
- Highlight any technical risks.

SUSTAINABILITY

Evaluate:
- Carbon emissions of each option
- Comment on futureproofing/route to net zero

SOCIAL/AFFORDABILITY

Evaluate:
- Running costs for a typical unit
- Ease of use
- Comfort

Summarise evaluation of commercial, technical, social and sustainability considerations for each option and recommend optimum solution

The table below shows the outcome on a residential development of 173 homes.

The consultant appraised six options in accordance with the methodology.

	Description	Plant room requirements	Apartment plant space (incl. MVHR)	Carbon emission (per dwelling)	Percentage reduction from Part L	Estimated energy bills (per	Management complexity	System resilience	Capital cost	Lifecycle cost (40 years)
A ✗	GSHP – Heat pumps with dry air cooler	Medium (internal only)	800mm x 800mm	337	68.20%	£290	Medium	Medium	£1.47m	£4.18m
B	Central GSHP / boiler hybrid	Medium (internal only)	500mm x 300mm	482	N/A	£327	Medium	High	£2.48m	£7.80m
C (i)	Central ASHP / boiler hybrid		500mm x 300mm	499	N/A	£327	Medium	High	£0.65m	£8.50m
C (ii) ✓	Central ASHP		500mm x 300mm	337	61.90%	£353	Medium	Medium	£0.62m	£7.02m
D	Central ASHP / dwelling ASHP		800mm x 800mm	340	N/A	£375	Low	High	£0.97m	£8.57m
E	Central ASHP / Block ASHP		500mm x 300mm (Plus 1000mm x 1000mm block plantroom	338	77.90%	£411	Very High	Low	£0.75m	£13.30m

* Estimated for regulated energy only using SAP calculation methodology. Indicative of relative performance only.
** Day one basis estimates (2021) to inform options appraisal (indicative of relative costs only).

Option A, which adopts a shared group loop array (distributing water through the building at an ambient temperature) with individual heat pumps in each home, appears to be the best value for residents' and for Peabody over the lifecycle of the heat network. Following a desk top study exercise, the consultant verified that the site is not large enough to accommodate the number of boreholes required for the ground source only solution. A hybrid solution was proposed which combined the ground array with roof mounted dry air coolers (similar to air source heat pumps). Due to the new combination of technologies proposed, the limited number of suppliers available in the market and other commercial/management structure considerations this option was not taken forward.

Option C, which adopts air source heat pumps with heat interface units in each home (distributing water through the building at a high temperature) was deemed the best balanced solution for this scheme considering the lifecycle cost analysis in parallel with other organisational drivers.

The options appraisal was carried out after the Concept design had been developed and the scheme had an existing planning permission. This added constraints such as availability of space on the roof that had been committed for roof top amenity and renewable energy generation (photovoltaic panels) and at ground level (e.g. for boilers to provide heat at peak times and provide resilience).

This reinforced that pre-planning (typically RIBA Stage 2) is the best time to balance amenity, plant and energy generation (amongst others) and select the most appropriate heat network system.

In the context of rapidly evolving technology, supply chain maturity and local and national policy and regulation, it is important that the approach to heat network selection is flexible to make the best decision available at a given time.

Each project has a new and different set of opportunities and constraints including scale and density, heating and/or cooling demand, and the heat source available in close proximity. The Peabody Heating New Homes with Heat Networks Brief & Options Appraisal ensures project specific scenarios are considered whilst providing a robust methodology for determining the most suitable option.