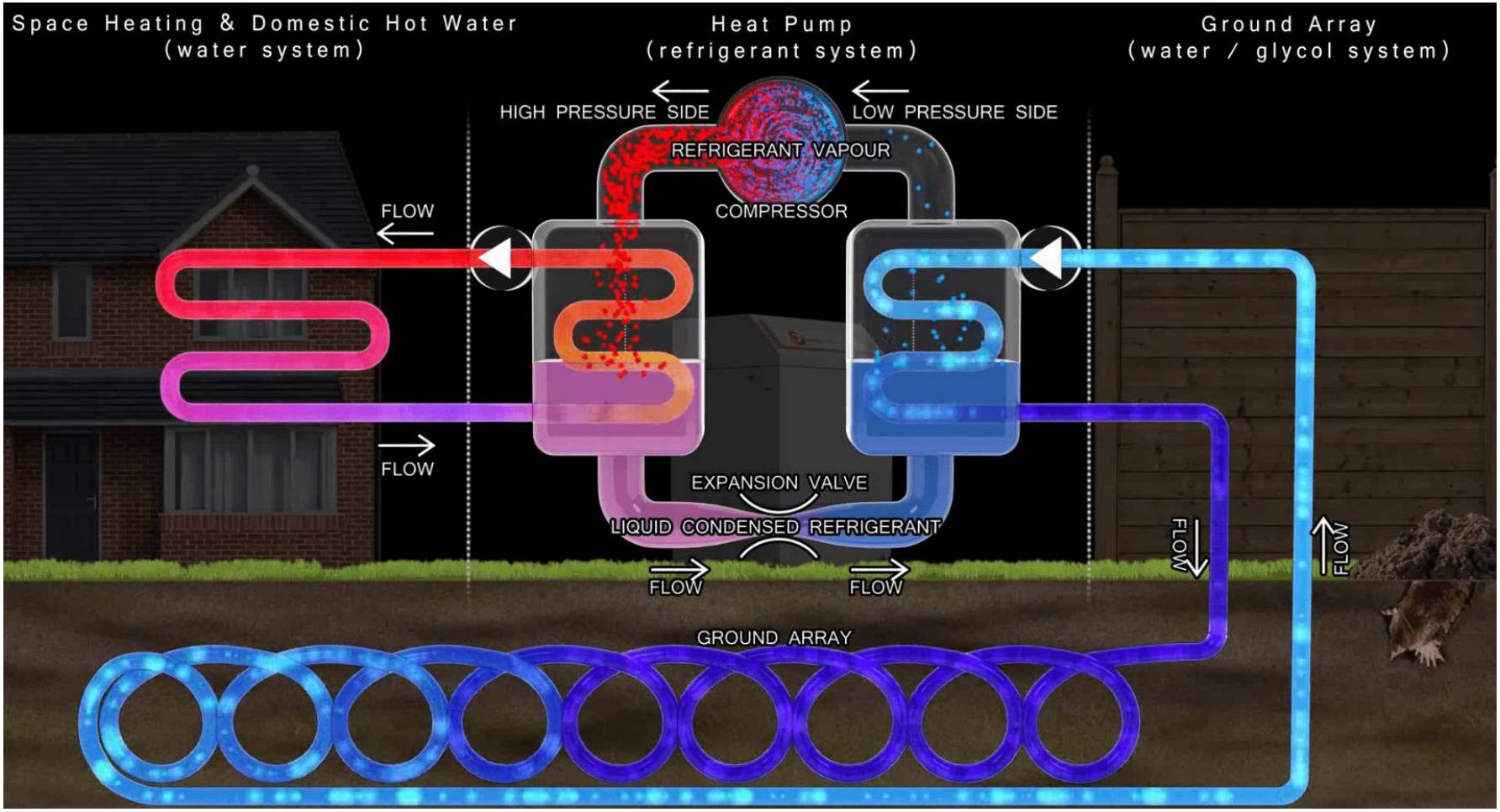
APPENDIX 1 – HEAT PUMP EXPLANATION AND OPTIONS APPRAISAL

The below diagram demonstrates how a ground source heat pump system works. An air source system works in the same way, with the exception that the heat is extracted from the air, rather than the ground array shown below.



Options Appraisal:

Option 1 – Ground Source Heat Pump (Shared Loop)

This option would see approximately 40 boreholes drilled on site. This work would be staggered in order to minimise disruption to residents' and the parking arrangements. Once completed, each borehole would be capped with a manhole cover, which would seldom need to be accessed for maintenance. No car parking spaces would be lost once the installation is commissioned.

A glycol solution would be circulated through each borehole, absorbing heat from the ground before entering the building. This solution would be transported to each flat via pipework, prior to increasing the temperature of the flow. This minimises heat distribution losses and the risk of overheating in communal areas and is referred to as an 'ambient temperature' system.

Each flat would contain its own, independent heat pump and hot water cylinder, located in existing cupboards and run from the communal electricity supply. Solutions available in the market at present would still permit at least half of the existing cupboard space to be retained for storage, with access only required for infrequent maintenance. The control system would be similar to those for central heating systems installed across the council housing estate. Training will be provided for those tenants who require it.

This system would enable each flat to operate independently. This means if one heat pump were to need maintenance, the remainder of the building will continue to be heated.

The common areas would be heated with a larger, communal ground source heat pump serviced from a centralised plant room in a current void space in the building. Subject to viability, this could be designed to enable cooling in the summer months.

For the individual flat systems, the council would receive fixed, index-linked Renewable Heat Incentive (RHI) payments for a period of 20 years. The amount of heat produced by the communal heating system would be metered and RHI payments made based on actual consumption.

There would be a significant reduction in carbon emissions as the amount of electricity is projected to reduce significantly.

Option 2 – Air Source Heat Pump (ASHP) Centralised

This option would locate a number of large ASHP units external to Elwyn Jones Court. The feasibility study identified the rear of the garages (facing Carden Avenue) as a suitable location. These units would be screened by the existing mature trees and protected from vandalism and leaf drop by cages. An alternative location was proposed by the current bin store, however it is felt that the potential for noise pollution and possible loss of car parking is best avoided.

Electricity, hot and cold water supplies would also need to be installed in a duct under the car park, but no other external works would be required.

Warm water would be circulated round the interior of the building in insulated pipework. Each flat would then require a heat exchanger in order to deliver heat and hot water. This system is identical to that operated across many BHCC housing blocks. The control system would be similar to those for central heating systems installed the BHCC Housing estate. Training will be provided for those tenants who require it.

RHI income would be determined by the heat actually produced, meaning income streams will be more variable than the GSHP option.

Given ASHPs are less efficient that GSHPs, the electricity and carbon emission reductions would be lower, although still considerable.

Option 3 – Electric Heaters

In order to present a 'Business as Usual' scenario, a quotation was sought to cost the full upgrade of all existing storage heaters to modern storage heaters. This would replace each existing storage heater with a *Heatstore Intelirad* Oil Filled Radiator of equivalent heat output to the existing units. These would be very unlikely to deliver any discernible benefit in terms of space heating cost.

Whilst this solution would modernise the system and be maintainable, there is no proposed change in the domestic hot water production method and residents would continue to pay for this through their own electricity bills. There would also only be a negligible reduction in electricity consumption (through improved user controls) and therefore a correspondingly small reduction in carbon emissions.

Summary table

Scenario:	**GSHP Shared Loop**	**ASHP Centralised**	**Electric heaters***
Capital Expenditure	£590,000	£360,000	£90,400
Bill savings (BHCC):	£30 000	£26,381	Negligible
Bill savings (tenants):	£11 880	£11 880	Negligible
RHI income:	£34,966	£12,075	Nil
Annual Operating and & Maintenance Costs:	£7,500	£7,500	Replacement only
Project Payback (BHCC):	Year 9	Year 9	None

Carbon savings (tCO2e/yr):	75	70	Negligible
Heat source:	40-borehole array	Series of heat pumps located by existing garages	Oil filled radiators
Efficiency**:	370%	300%	100%
Distribution temperature:	Ambient	Medium	n/a
Heat pump location:	Individual flat. Small plant room	Twin-plant rooms	n/a
Disruption (internal)	Medium	Medium	Low
Disruption (car park)	High	Very Low	None
Installation timescales	6 months	4 months	1 month

*no POU boiler replacement in this scenario

**these figures are recommended by CIBSE. In practice, it is felt that GSHPs more reliably outperform these figures than ASHPs.