BUROHAPPOLD ENGINEERING

Somerstown Decarbonisation of Heat

Summary Report

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author	**Aaron Powell**
date	**01/11/19**
approved	**JE**
signature	
date	**01/11/19**

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Glossary

Term	Definition
ASHP	Air Source Heat Pump
CHP	Combined Heat and Power
DHN	District Heat Network
GLA	Greater London Authority
HIU	Heat Interface Unit
LBC	London Borough of Camden

1 Executive Summary

This study has found that there are two leading contenders for full decarbonisation of heating at the Somerstown Estate. Having reviewed the potential to use carbon offsetting for decarbonisation it finds that although it is possible to offset emissions, it is not a long term solution to decarbonisation and using this as a primary means of emission reduction is not advisable if the problem in question can be tackled directly.

For the two proposed cases it is assumed that internal heat distribution systems are replaced and upgraded with 'low temperature' radiators – supported by the thermal modelling in this study.

Block by block heat pump installation

Decarbonisation is achieved by supplementing the existing gas boilers with electrified air source heat pumps and solar PV. Green electricity is purchased to offset power associated emissions and carbon offset for gas associated residual emissions – the capital cost is ~£2.3m. Long term decommissioning of gas boilers upon life end and replacement with a full electric solution is recommended to achieve full decarbonisation.

In this scenario there is an increase of approximately 10-15% in operational costs of the system vs the gas boiler counterfactual, over the system lifetime. This could translate into increased resident bills however resident heat consumption behaviour is likely to change once they are metered on consumption.

DHN connection with DHN decarbonisation

Connection of the blocks to the Somerstown DHN network will replace the gas boilers onsite at a cost of ~£0.7m. Decarbonisation is however dependent on the greening of the heat network (currently CHP supplied). The reduced capital cost of connection could enable a more cost-effective deployment of a large ASHP onto the DHN network which could have a larger impact than the discrete block by block approach.

If connection to the network is pursued it should be done with a full and credible decarbonisation plan for the DHN in place. LBC could consider offsetting the emissions associated with the estate in the short term until the decarbonisation plan is implemented.

2 Introduction

The Somerstown Decarbonisation of Heat Project is a study into how best the fully decarbonise the heating supply of the Estate, which consists of six blocks containing a total of146 residential units. At the time of the study the estate was heated by gas boilers, centralised a block level.

The scope of the study was to carry out the evaluation using a four step approach, which is summarised below:

Task 1 – Site visits to the estate including plant rooms and access to a unit. Review of site context to establish potential heat supply options.

Task 2 – Building modelling to establish potential heating temperature reduction measures and potential heat demand reduction measures.

Task 3 – Longlist evaluation of decarbonisation options available to the estate to establish the most feasible course of action at different intervention levels.

Task 4 – High level technical designs of most promising options including a techno-economic analysis to establish the most viable solution for full decarbonisation of the heating.

The critical things to be understood through the study were:

1. What is the most technically feasible option for decarbonisation?
2. How much disruption will the option cause residents?
3. How much of an operational cost increase will there be vs the gas boiler counterfactual, as this could translate into increased resident bills?
4. What role can the Somerstown DHN play as the model for the DHN has allowed for connection of the Estate?

Figure 2—1 Somerstown Estate

3 Task Summaries

3.1 Task 1 – Site Visit and Context

The full report for Task 1 can be found in Appendix A.

The site visits and context evaluation revealed the following things about the Estate ():

- The site is in close proximity to the Somerstown District Heating Network (DHN), ~100m away.
- Each block contains 3 to 4 boilers, in small roof level plant rooms.
- Each unit is operating on assumed 1960's heating systems, with poor emitters and multiple pipework entries into the unit.
- The estate is majority tenant occupied.

The task concluded with a SWOT analysis, shown in Table 3—1

Table 3—1 Site SWOT Analysis in regards to potential for action

Strengths	**Opportunities**
Council controlled site meaning maximum influence Majority tenants, not leaseholders should ease implementation Some space on site for plant Close proximity to Somerstown DHN There is a single point of heat connection within the blocks	There is potential for deep retrofit to reduce temperatures and demand There is potential for temperature reductions with minimal intervention (no deep retrofit) Roof space could be used for solar technology Good potential for heat pump deployment Residents should buy in to reducing on site emissions
Weaknesses	**Threats**
Resident decant coordination will be required for retrofit / temperature reduction (however it is understood this will have to happen) No obvious place for large thermal storage if required No obvious place to implement a centralised plantroom on site	Proximity to Somerstown DHN - could stall decarbonisation progress of site if CHP network is used Could be restrained local electricity network capacity Small number of leaseholders could resist change hampering implementation Cost of heat implications of any proposed solution could be prohibitive and penalise vulnerable residents

3.2 Task 2 – Building Modelling

Through a building simulation model Task 2 reviewed the impacts of:

- Replacing the old heat distribution systems with new highly insulated systems.
- Installing improved glazing.
- Installing external wall insulation.
- Increasing heat emitter size.

The purpose of this evaluation was to establish which measures best allowed for reduction in heating temperatures to enable heat pump deployment, and which measures could reduce demand effectively if required. The analysis found that:

- External wall insulation provides a greater benefit in terms of demand reduction than glazing upgrades.
- Combining external wall insulation and glazing upgrades provides only marginal benefit over insulation alone.
- Estate heating temperatures can be reduced to 60℃ by increasing emitter size without any fabric upgrades.

At this point in the study it was agreed with LBC that they would install new heat distribution, including heat interface units and resident metering, no matter what the wider strategy for the estate. Therefore this was removed as an option for further analysis and was taken to be the new baseline for evaluation.

The full report for Task 2 can be found in Appendix B.

3.3 Task 3 – Decarbonisation Options Longlist

The longlist assessment used a matrix evaluation to assess a total of 41 options for decarbonisation of heat at the Somerstown estate.

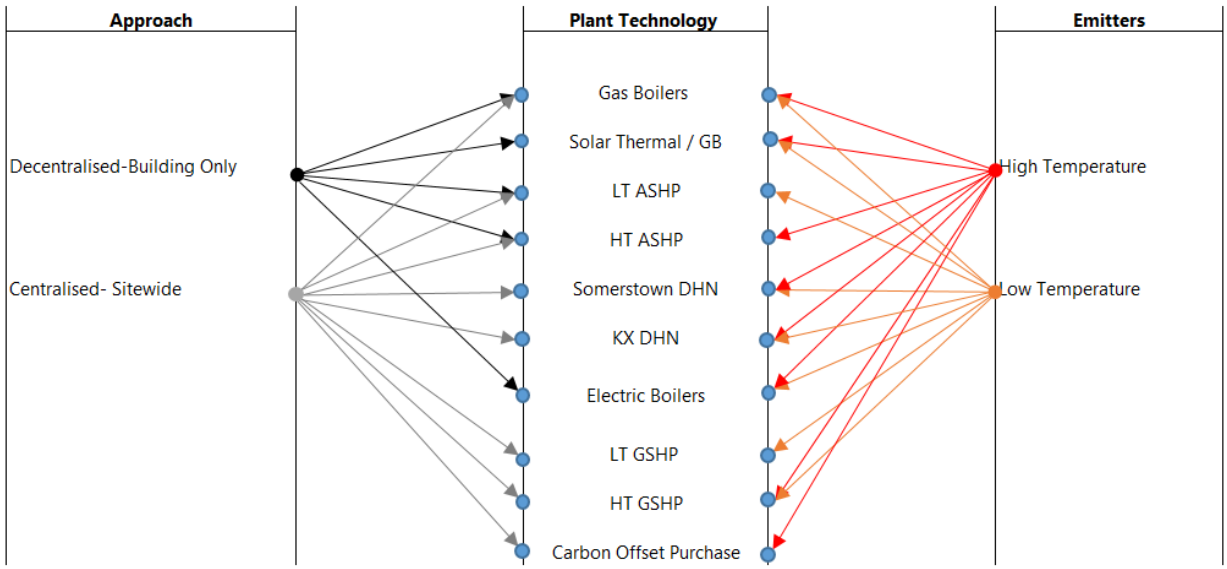

Figure 3—1 Decarbonisation Options

The task recommended that three options be taken forward to the more detailed evaluation in Task 4. These option were based upon varying levels of intervention at the estate. They were:

1. **Decentralised**
   Low temperature Air Source Heat Pumps (ASHP), building by building deployment, green electricity purchased by LBC to serve heat pumps. Should this option be found to be favourable, it will be widely deployable across the LBC portfolio as it does not rely on a constrained energy resource.
2. **No Physical Intervention**
   Business as usual approach with LBC purchasing carbon offsets to mitigate the emissions caused on site. This option ranked second in the analysis and although this option will not require any design but it is proposed to provide a review of the mechanisms that LBC could use to achieve the carbon offsetting, and the costs associated.
3. **Centralised**
   It is also proposed that connection to the Somerstown DHN using low temperature emitters is explored. Note, that this connection would be contingent on there being a concrete plan for decarbonisation of the network in place.

The full report for Task 3 can be found inAppendix B Appendix C.

3.4 Task 4 – Preferred Decarbonisation Options Evaluation

Task 4 developed technical designs for the heat pump and DHN solutions for the estate, including cost estimations. It also provided a review of the potential for carbon offsetting to provide decarbonisation on the estate. It concluded with an evaluation of the operational cost uplift of the heat pump options vs a gas boiler counterfactual in order to provide an understanding of potential impact to resident bills. The evaluations were carried out for Aldenham House only, under the assumption that the results would be transferrable across the estate.

The conclusions of Task 4, and consequently the study as a whole, are as follows:

- It is technically feasible to serve the block with an ASHP system, with one to two units located in a compound outside the block, at 60℃ heating temperature, a rendering of this is shown in Figure 3—2.

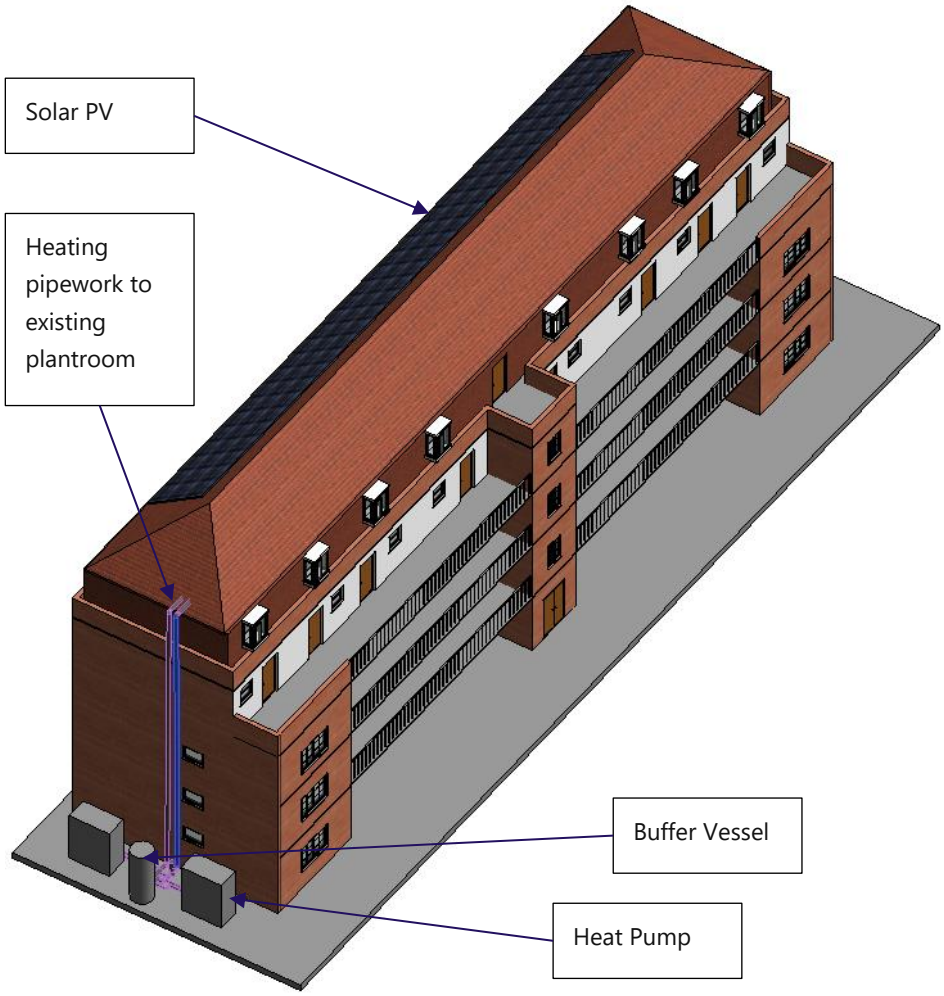

Figure 3—2 Aldenham House Heat Pump Option

- Removing the gas boilers entirely from the system increases the requirement for heat pumps to three units, with a location for the third unit to be identified.
- It is technically feasible to connect the blocks to Somerstown DHN however the option offers less decarbonisation potential, unless the heat supply can be decarbonised centrally.

- Carbon offsetting as a tool to offset the emissions of the gas boilers on the estate does not tackle the core problem and likely only serves to delay tackling the core issue.
- LBC could pursue off site green electricity generation with a purchasing arrangement to guarantee the estate receives green electricity in a financially beneficial way to the Borough.
- In the initial years of operation a hybrid gas boiler and ASHP system with PV can provide heat at approximately a 10% increase in operating costs, this could be offset by investment in energy efficiency measures such as external wall insulation to minimise the impact on residents.
- If a full ASHP system can be implemented and achieve RHI the system could be approximately operation cost neutral over 40 years vs the counterfactual over its lifetime.
- Integrating rooftop solar into any of the ASHP systems provides a significant operational cost benefit over the scheme lifetime for the southern facing roof spaces.
- Achieving RHI is essential to achieving viability over the lifetime of an ASHP system.
- Given that operational cost is of chief concern as this translates directly into heat price then installing the Solar PV to the maximum extent should be pursued as it provides operational benefit.
- Purchasing green electricity for decarbonisation of residual emissions in electrified scenarios provides significant benefits over using carbon offsetting at the GLA recommended price.
- The estimated capex of the initial ASHP option for the whole estate is ~£2.3m vs ~£0.7m for the Somerstown DHN connection.
- ASHP options provide decarbonisation at a rate of 20-50% higher than the GLA recommended offset price of £95/t (Table 3—2).
- There are two feasible options for decarbonisation:
    - Pursue the ASHP hybrid system with solar PV and retirement of the gas boilers at the end of their useful life.
    - Connect to the Somerstown DHN and use the capital which has been saved to decarbonise the heat supply of the network.

Table 3—2 Cost of Carbon Reduction

Option	Initial Capex (£k)	Extra/Over Operation Cost vs Gas Boiler Counterfactual (£k)	Total Carbon Savings (assuming offset for residual emissions is 100% effective) (t)	Cost of Carbon Saving (£/t)
Counterfactual w/ offsetting	0	319	3,354	95
1no ASHP, GB	228	144	3,354	111
2no ASHP, GB	303	193	3,354	148
3no ASHP	387	-10	3,354	112
3no ASHP w/ green electricity purchase	387	-41	3,354	103
2no ASHP, GB, 20 kW Solar	338	154	3,354	147
2no ASHP, GB, 10 kW Solar	322	166	3,354	145

The full report for Task 4 can be found inAppendix B Appendix D.

4 Next Steps

4.1 ASHP Option

The technical steps to implementation of the heat pump option are as follows:

- Secondary systems refurbishment
    - Decant residents
    - Reconfigure risers and laterals (new installation)
    - Insulate new pipework.
    - Upgrade radiators.
    - Install heat interface units (direct space heating).
- Heat pump installation
    - Retain existing boiler, water treatment, pumping, and pressurisation plant.
    - Create space and install concrete plinth for heat pump installation.
    - Install uprated electrical equipment and cabling to the heat pump area.
    - Install air source heat pumps, pumps, and buffer tank on plinth.
    - Install acoustic enclosure with removable panels around heat pump plinth.
    - Install pipework from heat pumps, up the side of building, through the eaves, into boiler plant room
    - Tie in of heat pump pipework with boiler plant room pipework, likely to a tap in connection.
    - Install necessary BMS equipment to dictate operational priority of heat pump.
    - Fill system from existing fill in boiler room.
    - Commission system.
- Solar PV
    - Install solar PV on rooftop.
    - Connect Solar PV into new distribution board at communal supply point.

4.2 DHN Option

The technical steps to implantation of the DHN option are as follows:

- Identify preferred decarbonisation solution for the network.
- Plan timeline for decarbonisation.
- Confirm budget for future decarbonisation.
- Create space and install concrete plinth for heat substation installation at Aldenham House.
- Install electrical supply to the heat substation area.
- Install heat substation, pumps, associated M&E plant, BMS, and enclosure.
- Commission primary side of substation.
- Decant residents
- Reconfigure risers and laterals (new installation)
- Insulate new pipework.
- Upgrade radiators.
- Install heat interface units (direct space heating).
- Decommission and remove gas boilers.
- Install on site DH network to each block in line with decant programme to tie in with headers in platroom.
- Fill network from existing plantroom filling point.

- Commission new secondary side system in its entirety (heat substation through to heat emitters) with heat supply from the DHN.
- In the medium term implement decarbonisation plan for the DHN.

Aaron Powell
Buro Happold Limited
17 Newman Street
London
W1T 1PD
UK

T: +44 (0)207 927 9700
F: +44 (0)870 787 4145
Email: aaron.powell@burohappold.com