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One Castlefield

Castlefield, Manchester

Low Carbon Heat Appraisal

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Contents

1.0 Executive Summary 4
2.0 Introduction and Planning Policy Context 6
2.1 Purpose and scope 6
2.2 Policy JP-S3 and the Net Zero requirement 6
3.0 The Proposed Development 7
4.0 Proposed Energy and Heating Strategy 8
5.0 Heat Network Context and Location Assessment 9
6.0 Heating System Options Considered 10
7.0 Assessment Against the Key Performance Indicators 11
7.1 Environmental performance 12
7.2 Impact on residents 12
7.3 Impact on viability 13
7.4 Infrastructure development 13
8.0 Justification for Non-Connection to a Low Carbon Heat Network 14
9.0 Conclusions and Next Steps 15
Appendix 1 – GMCA Low Carbon Heat KPI Summary (Proposed System) 16
Appendix 2 – Carbon Content of Heat: Calculation Basis 17

1.0 Executive Summary

Crookes Walker Consulting (CWC) have prepared this Low Carbon Heat Appraisal in support of the planning application for One Castlefield, Manchester. The appraisal has been undertaken in-line with the Greater Manchester Combined Authority (GMCA) 'Low carbon heat' guidance (March 2025) and is intended to demonstrate how the proposed development responds to Places for Everyone Policy JP-S3 (Heat and Energy Networks), which is linked to Policy JP-S2 and the Net Zero / Truly Affordable Net Zero (TANZ) requirements.

The proposals for One Castlefield represent a refined residential development, addressing previous scheme shortcomings while maintaining a high-density residential offer.

The site, located adjacent to the A57 Chester Road in Manchester city centre, is strategically positioned within the established Castlefield/St.

George's area. It is well-connected, benefiting from proximity to Bridgewater Canal, mainline railway, tramway and Cornbrook Metrolink Station.

This development is the final phase of the St. George's regeneration. The design has evolved through rigorous pre-application engagement with the Manchester City Council, focusing on creating a high-quality, sustainable solution that responds positively to its local context, contributes to regeneration and aligns with current planning policy for tall buildings and the historic environment.

Previous proposals were unviable due to regulatory changes (fire safety requirements for high-risk buildings necessitating an additional stair core) and design challenges related to site optimisation and amenity provision.

The current design addresses these by consolidating blocks, increasing public and amenity space and strategically reorienting a taller tower to minimise impact on neighbours while creating a landmark. The scheme aims to be a positive visual marker and enhance the streetscape, capitalising on its gateway location and proximity to Cornbrook Metrolink Interchange to encourage sustainable transport.

The proposed heating and hot water strategy is summarised as follows:

- Space heating – individual electric panel heaters within the apartments and circulation areas, with local programmable controls;
- Domestic hot water – individual exhaust-air / hot-water heat pumps within each dwelling, recovering heat from the dwelling's extract ventilation (the 'KERS MEV' arrangement), with local hot water storage;

- Amenity areas – Variable Refrigerant Flow (VRF) air source heat pump systems providing both heating and cooling; and
- Renewables – roof-mounted solar photovoltaic (PV) panels.

The site has been assessed as falling within a GMCA 'Heat and Energy Network Opportunity Area' (Case 3). No low carbon heat network is currently operating, funded or under construction within range of the site, and the GMCA guidance confirms there are presently no operating low carbon heat networks anywhere in Greater Manchester.
The headline outcomes of the appraisal against the GMCA Key Performance Indicators (KPIs) are:

- no fossil fuel is used on site;
- the blended carbon content of heat (delivered) of the proposed system is estimated at circa 70 gCO_2/kWh, which is below the 100 gCO_2/kWh threshold for a 'low carbon heating system' and below the carbon content assumed for a notional low carbon heat network in an opportunity area;
- the proposed system has the lowest indicative capital cost of the options considered; and
- the proposed system is anticipated to carry higher in-use energy costs than an on-site air source heat pump (the recognised trade-off of direct electric space heating), although the fabric-first design keeps the absolute space heating demand, and therefore the cost differential, modest.

On balance, CWC consider that the proposed system delivers low carbon, cost-effective heat that is appropriate to the scale and location of the development, and that an on-site solution is preferable to connection to (or commitment to connect to) a low carbon heat network at this time. The justification for non-connection is set out in Section 8. All costs and performance figures in this appraisal are high level and indicative, provided for comparison purposes only; confirmation of a number of inputs is required as the design progresses (see Section 9).

2.0 Introduction and Planning Policy Context

2.1 Purpose and scope

This appraisal has been prepared to accompany the planning application for One Castlefield and to demonstrate compliance with Policy JP-S3. The GMCA 'Low carbon heat' guidance recommends that a Low Carbon Heat Appraisal is submitted for all major applications, with the level of analysis varying by scale and location. As One Castlefield is a 'large major' application (more than 150 dwellings and/or more than 5,000 m^2 GIA), a detailed appraisal is expected, reporting the predicted performance of the proposed heating system against the KPIs and comparing it with a few relevant alternatives, including a low carbon heat network and an on-site communal heating system.

This appraisal is based on the MEP Emerging Proposals, the Energy Statement, the SAP / Part L compliance assessments and the design information available at this (early) stage. Equipment selections, quantities and costs are indicative and for comparison only; final selections, details and costs will differ following more detailed assessment at the next design stage. CWC's assessment is based on the validity of the information provided.

2.2 Policy JP-S3 and the Net Zero requirement

Policy JP-S3(2) sets an expectation that, within identified Heat and Energy Network Opportunity Areas, new residential developments of 10 dwellings or more (or other development over 1,000 m^2) will connect to an existing or planned heat/energy network, or be designed to enable future connection, and/or install a site-wide or communal heat/energy network solution 'unless it can be demonstrated that there are more effective alternatives for minimising carbon emissions or such connection is not practicable or financially viable'.

The guidance is clear that a building cannot be Net Zero if its heating and hot water system uses fossil fuels, and that a heating system should qualify as 'low carbon' where the carbon content of heat delivered is less than 100 gCO_2/kWh. It also stresses that the chosen system must be affordable for residents, must not compromise consumer protection, and must not contribute to overheating. These considerations are carried through the KPI assessment in Section 7.

3.0 The Proposed Development

The proposals comprise the redevelopment of a circa 0.72 hectare cleared site adjacent to the A57 Chester Road, bounded by Trentham Street, Ellesmere Street, Castlefield Locks, the elevated railway line and a small area of the Bridgewater Canal. The scheme provides 592 residential units (Use Class C3) across two blocks - Block A (ground and first floors plus 44 storeys, circa +168.00m AOD) and Block B (ground floor plus 8 storeys, circa +59.8m AOD) - together with amenity space, landscaping, cycle and car parking and associated works.

A 'fabric first' approach has been adopted, with the building fabric designed to perform substantially better than the Part L (2021) backstop values. The Energy Statement and Part L assessments indicate the following indicative parameters:

- external walls circa 0.12 W/m²K (Part L backstop 0.26);
- roof circa 0.10–0.11 W/m²K (backstop 0.16–0.18);
- ground floor circa 0.16 W/m²K (backstop 0.18);
- windows circa 1.2–1.4 W/m²K; and
- air permeability circa 3 m³/h·m² @ 50 Pa (against a backstop of 8).

The dwellings are reported to achieve EPC band B throughout. This low underlying heat demand is important context for the appraisal: it limits the absolute energy use (and therefore the running-cost penalty) associated with direct electric space heating, which is the principal concern the GMCA guidance raises about that technology.

4.0 Proposed Energy and Heating Strategy

The proposed strategy is all-electric, with no combustion on site. It corresponds to the GMCA guidance archetype of an individual 'hot water heat pump + direct electric' dwelling system, supplemented by VRF heat pumps to the amenity areas. The principal elements are:

- No fossil fuel – there is no proposal for gas to the site; the existing gas mains are to be disconnected and purged.
- Space heating – individual electric panel heaters to the apartments and circulation areas, controlled by programmer, room thermostat / app control and (where relevant) local controls. Frost protection to plant/store rooms via local electric tube heaters.
- Domestic hot water – a packaged hot-water heat pump within each dwelling, integral to the mechanical extract ventilation (the 'KERS MEV' arrangement), recovering low-grade heat from the dwelling's extract air to heat stored hot water. Point-of-use electric water heaters serve isolated WCs / kitchenettes.
- Amenity heating and cooling – VRF (air source heat pump) systems serving the shared amenity areas via fan coil / cassette units, with external condensers located in dedicated louvred plant rooms.
- Renewable generation – roof-mounted solar PV (noted in the SAP assessment as circa 15 kWp to the upper floors / duplex roofs), contributing to the on-site low/zero carbon generation required by Manchester's Local Development Framework (Policy EN 6).

Because the heat sources are electric (direct electric and heat pumps), the strategy is compatible with Net Zero and benefits directly from the continuing decarbonisation of the electricity grid. It should be noted that the thermal modelling and final HVAC strategy remain subject to ongoing design development, and that the acoustic suitability of the external air source / VRF plant is identified in the MEP proposals as a project risk requiring further assessment.

5.0 Heat Network Context and Location Assessment

The GMCA guidance identifies four location 'cases' for major applications, which determine the range of heat network options that must be considered:

- Case 1 – within 500 m of an existing low carbon heat network;
- Case 2 – within 500 m of a planned low carbon heat network;
- Case 3 – within a Heat and Energy Network Opportunity Area; and
- Case 4 – any other location.

One Castlefield is located in central Manchester. On the basis of the Places for Everyone Heat and Energy Network Opportunity Areas mapping, the site is understood to fall within an Opportunity Area, and the development has therefore been assessed as Case 3. This should be confirmed with the Local Planning Authority (LPA), who are best placed to advise whether the site now falls within any emerging, formally designated heat network zone.

The GMCA guidance confirms that there are currently no operating low carbon heat networks anywhere in Greater Manchester. CWC are not aware of any low carbon heat network that is funded or under construction within range of the site. Existing city-centre heat networks are understood to be predominantly gas-fired (boilers and/or gas CHP) and therefore high carbon (likely well in excess of 300 gCO_2/kWh); the guidance is explicit that major applications in the vicinity of such networks should not connect to them.
For a Case 3 site, the guidance requires that a notional low carbon heat network with a carbon content of heat of 100 gCO_2/kWh is included as one of the options assessed (see Section 6). The applicant is not, however, required to install interim communal plant or commit to a future connection unless and until the area is formally designated as a 'heat network zone' – a designation the guidance indicates is unlikely before 2027.

6.0 Heating System Options Considered

In-line with the guidance for a large major application, the proposed system has been compared against a small number of relevant alternatives, including an on-site communal system and a low carbon heat network. The options considered are:

- Option 1 (Proposed) – individual direct electric space heating with individual exhaust-air / hot-water heat pumps for domestic hot water (plus VRF to amenity areas).
- Option 2 (Benchmark) – individual air-to-water air source heat pumps (monobloc) per dwelling, providing space heating and hot water. This is the GMCA 'benchmark' low carbon heating system against which the KPIs are compared.
- Option 3 – a building / block-scale communal air source heat pump system, distributing heat to each dwelling via heat interface units (HIUs).
- Option 4 – connection to a notional low carbon heat network (carbon content 100 gCO_2/kWh), with an interim on-site communal heating system pending the network coming forward.

In summary, Option 2 (individual ASHP) is the lowest-carbon and most resident-friendly individual solution but carries a higher capital cost. Options 3 and 4 introduce communal distribution, which brings distribution heat losses, an overheating risk from communal pipework, communal maintenance, and individual metering / billing with associated standing charges and consumer-protection considerations. Option 4 additionally depends on a network that does not currently exist. The proposed Option 1 minimises capital cost and avoids communal distribution and its associated risks, at the expense of higher in-use energy costs for the space heating element.

7.0 Assessment Against the Key Performance Indicators

The four GMCA performance areas and their eleven KPIs are assessed below, and the options are compared in Table 7.1. The KPI values for the proposed system are summarised in Appendix 1, and the basis of the carbon content of heat calculation is set out in Appendix 2.

Performance / KPI	Option 1 – Proposed (direct electric + HW heat pump)	Option 2 – Benchmark (individual ASHP)	Option 3 – Communal ASHP + HIU	Option 4 – Notional low carbon heat network
Fossil fuel use	No	No	No	No (assumed)
Carbon content of heat (delivered)	circa 70 gCO_2/kWh	circa 35 gCO_2/kWh	circa 50 gCO_2/kWh	100 gCO_2/kWh (max to qualify)
Local pollution	None (no combustion); low refrigerant charge	None; external unit refrigerant + acoustic	None; communal plant acoustic	Depends on energy centre / heat source
Indicative capital cost (£/unit)	circa £7,000	circa £10,000	circa £12,000	≥£12,000 + connection (uncertain)
Additional capital cost vs benchmark	circa −30%	– (benchmark)	circa +20%	Highest
Indicative heating/hot-water energy cost (£/dwelling/yr)	circa £500–550	circa £270–300	circa £300 + standing charge	Network tariff + standing charge
Additional operating cost vs benchmark	circa +£230/yr (higher)	– (benchmark)	Comparable to higher (all-in)	Uncertain; standing-charge risk
Maintenance cost (annualised)	Low (circa £50–80/yr)	circa £120–150/yr	Higher + communal contract	Higher + ESCO charges
Replacement cost (annualised)	Low (circa £100/yr)	circa £270/yr	Higher (incl. plant share)	Higher (incl. plant share)
Connection to low carbon heat network	No	No	No	Yes

Performance / KPI	Option 1 – Proposed (direct electric + HW heat pump)	Option 2 – Benchmark (individual ASHP)	Option 3 – Communal ASHP + HIU	Option 4 – Notional low carbon heat network
Overheating / consumer protection	Low overheating risk; individual supply, can switch supplier	Low overheating risk; individual supply	Overheating risk (communal pipes); metering/billing	Overheating risk; regulated tariff TBC

Table 7.1 – Indicative comparison of heating system options against the GMCA KPIs (high level, for comparison purposes only).

7.1 Environmental performance

Fossil fuel use (KPI 1): none. The development is all-electric and the gas supply is to be disconnected.

Carbon content of heat (KPI 2): the carbon content of heat delivered has been estimated using grid electricity carbon factors averaged over the first 15 years from anticipated completion, in-line with the guidance (which directs the use of HM Treasury Green Book average fuel factors over that period). On this basis an average grid factor of circa 0.10 $kgCO_2/kWh$ (100 gCO_2/kWh) has been adopted, reflecting the continued decarbonisation of the grid (the current SAP 10.2 factor is 0.136 $kgCO_2/kWh$). The space heating element (direct electric, circa 100% efficient) therefore has a carbon content of circa 100 gCO_2/kWh, whilst the hot water element (heat pump, seasonal CoP circa 2.5) is circa 40 gCO_2/kWh. Weighted across the dwelling heat demand, the blended carbon content of heat is estimated at circa 70 gCO_2/kWh – below the 100 gCO_2/kWh low-carbon threshold, and below the 100 gCO_2/kWh assumed for a notional opportunity-area heat network. An individual ASHP solution (Option 2) would be lower still, at circa 35 gCO_2/kWh.

Local pollution (KPI 3): there is no combustion and therefore no local flue emissions. The packaged hot-water heat pumps use a small refrigerant charge; the amenity VRF systems use a larger charge and CWC would recommend low Global Warming Potential (GWP) refrigerants (e.g. R290 / R32), minimised pipe runs and consideration of embodied / whole-life carbon in-line with CIBSE TM65 / TM65.1. The acoustic impact of the external air source plant is to be assessed.

7.2 Impact on residents

Energy, maintenance and replacement costs (KPIs 4–6): the principal trade-off of the proposed system is in-use energy cost. Direct electric space heating uses circa three times more electricity per unit of heat than an air source heat pump, so the space heating element is more expensive to run than the benchmark. On a high-level basis, and given the fabric-first low demand, the heating and hot-water energy cost is estimated at circa £500–550 per dwelling per year, against circa £270–300 for the benchmark individual ASHP – a difference of circa £230 per year (KPI 7). Set against this, the proposed system has lower maintenance and replacement costs (panel heaters are simple, robust and long-lived, with only the hot-water heat pump requiring periodic servicing), and avoids the communal standing / metering charges that a communal system or heat network would levy through the service charge.

Affordability and consumer protection: the GMCA guidance rightly flags the risk of high bills with direct electric heating, and recommends it is generally only accepted in ultra-low-energy homes. CWC consider the risk here is materially mitigated by the fabric-first specification (U-values and air permeability well beyond the Part L backstop), which keeps the space heating demand – and therefore the cost differential – low. The individual, dwelling-level electrical supply also preserves residents' ability to choose and switch energy supplier and to benefit from regulated retail tariffs and (potentially) time-of-use / dynamic pricing, which a communal heat network would not. CWC would recommend that the fabric specification assumed in this appraisal is locked in through the construction contract so that the low running costs are realised in practice.

7.3 Impact on viability

Capital cost (KPIs 8–9): on the GMCA indicative figures the proposed system carries the lowest capital cost of the options (circa £7,000 per unit, against circa £10,000 for the benchmark individual ASHP, circa £12,000 for a communal ASHP, and higher still – plus an uncertain connection cost – for a heat network). The proposed system is therefore circa 30% cheaper than the benchmark, which supports the viability and deliverability of the housing. A specific assessment of capital costs by the project's cost consultant is recommended.

7.4 Infrastructure development

Connection to a low carbon heat network (KPI 10): no. No low carbon heat network is currently operational, funded or within range (see Section 5).

Scale of application (KPI 11): large major – several hundred dwellings across Blocks A, and B (GIA to be confirmed), well above the 150-dwelling / 5,000 m² thresholds.

8.0 Justification for Non-Connection to a Low Carbon Heat Network

As the site is within a Heat and Energy Network Opportunity Area (Case 3), Policy JP-S3 sets an expectation of connection to, or design to enable future connection to, a low carbon heat network unless a more effective, practicable or financially viable alternative can be demonstrated. For a Case 3 site the guidance does not, however, require the applicant to install interim communal plant or commit to connect unless and until the area is formally designated a heat network zone (unlikely before 2027). CWC consider an on-site solution is justified at this time on the following grounds, which align with the four grounds for exemption set out in the guidance:

1. Carbon grounds – there is no low carbon heat network to connect to; existing networks in the vicinity are understood to be high carbon (gas-fired). The proposed on-site system delivers heat at circa 70 gCO_2/kWh, which is below both the 100 gCO_2/kWh low-carbon threshold and the carbon content assumed for a notional opportunity-area network, so an on-site solution is lower carbon than connection to a notional network.
2. Cost-effectiveness grounds – no network operator can provide a robust connection cost because no network exists or is funded. The capital cost of connection plus interim communal plant would not be as cost-effective as the proposed on-site system, which has the lowest indicative capital cost of the options assessed.
3. Heating cost grounds – a communal system or heat network would introduce standing / metering charges and reduce residents' consumer protection (no ability to switch supplier). The proposed individual supply avoids this, and keeps residents on regulated retail tariffs.
4. Technical / practical grounds – there is genuine uncertainty over the deliverability and programme of any future network in this location, and no formal heat network zone designation is in place. It would not be appropriate to constrain the scheme to a communal interim solution, with its attendant distribution losses and overheating risk, on the basis of a network that may not come forward.

CWC are transparent that the proposed system is not the lowest-carbon option available – an on-site communal or individual air source heat pump solution would deliver a lower carbon content of heat. The proposed system has been selected on the balance of carbon (below the low-carbon threshold), capital cost and viability, simplicity and consumer protection for residents, and overheating mitigation (no communal distribution pipework), supported by a fabric-first design that limits the running-cost penalty of direct electric heating. It is also noted that the decision to validate any exemption rests entirely with the LPA, who may accept or refuse it.

9.0 Conclusions and Next Steps

CWC consider that the proposed all-electric heating and hot water strategy for One Castlefield delivers low carbon heat (below the 100 gCO_2/kWh threshold), is cost-effective to install, and is appropriate to the scale and central location of the development. It avoids fossil fuels entirely and is well placed to benefit from grid decarbonisation. The principal residual consideration is the in-use energy cost of direct electric space heating, which CWC consider is acceptably mitigated by the fabric-first design, but which should be kept under review as the design develops.

CWC would recommend the following next steps, to be agreed with the Client, design team and LPA:

- confirm with the LPA the site's status (Opportunity Area / Case 3) and whether it falls within any emerging, formally designated heat network zone;
- confirm the average grid carbon factor and the carbon content of heat with the energy assessor, using the HM Treasury Green Book / DESNZ 15-year forward projections, to firm up the KPI 2 figure;
- develop a dwelling-level energy-cost estimate from the SAP / thermal model to confirm the affordability position (KPIs 4–7) and the running-cost differential against an ASHP;
- lock the fabric-first specification (U-values and air permeability) into the construction contract so the low space heating demand, and hence the low running costs, are realised;
- confirm the acoustic feasibility of the external air source / VRF plant, which is identified as a project risk;
- specify low-GWP refrigerants and consider embodied / whole-life carbon (CIBSE TM65 / TM65.1); and
- obtain capital and operating cost figures from the project cost consultant to replace the indicative figures used here.

This appraisal is high level and for the purposes of demonstrating the approach to Policy JP-S3; the conclusions are based on the validity of the information available at this stage and may be revisited as the design and the policy position (in particular formal heat network zoning) develop.

Appendix 1 – GMCA Low Carbon Heat KPI Summary (Proposed System)

The table below summarises the GMCA KPIs for the proposed system. All figures are indicative and for comparison purposes only.

KPI	Indicator	Unit	Proposed system
1	Fossil fuel use	Yes/No	No
2	Carbon content of heat	gCO_2/kWh	circa 70
3	Local pollution	Description	None (no combustion); low-GWP refrigerant recommended
4	Estimated energy cost (heating & hot water)	£/yr	circa 500–550 / dwelling
5	Estimated maintenance cost	£/yr (annualised)	circa 50–80
6	Estimated replacement cost	£/yr (annualised)	circa 100
7	Additional operating cost vs benchmark	+/- %	higher (circa +£230/yr)
8	Estimated capital cost	£/unit	circa 7,000
9	Additional capital cost vs benchmark	+/- %	circa −30%
10	Connection to low carbon heat network	Yes/No	No
11	Scale of application	m^2 GIA / dwellings	Large major (several hundred dwellings; GIA TBC)

Appendix 2 – Carbon Content of Heat: Calculation Basis

The carbon content of heat delivered combines three factors: the carbon intensity of the fuel; the efficiency of the heat-generating plant; and distribution / storage losses. The basis adopted is:

- Grid electricity carbon factor – average over the first 15 years from anticipated completion (circa 2028–2043), taken from HM Treasury Green Book / DESNZ projections: circa 0.10 $kgCO_2$/kWh (100 gCO_2/kWh) adopted. The current SAP 10.2 factor is 0.136 $kgCO_2$/kWh; the forward trajectory is steeply downward.
- Space heating (direct electric) – circa 100% efficient, negligible distribution loss: carbon content circa 100 gCO_2/kWh.
- Domestic hot water (exhaust-air / hot-water heat pump) – seasonal CoP assumed circa 2.5: carbon content circa 40 gCO_2/kWh.
- Blend – weighted across the dwelling space-heating and hot-water demand (a fabric-first dwelling has a relatively high hot-water fraction): blended carbon content circa 70 gCO_2/kWh (range circa 65–75).

For comparison, an individual air-to-water ASHP (blended seasonal CoP circa 2.9) would deliver circa 35 gCO_2/kWh, and a communal ASHP at 65°C with distribution losses circa 50 gCO_2/kWh. These figures are indicative and should be confirmed by the energy assessor using project-specific demand splits and the latest Green Book factors.