2. Low carbon heat

Guidance for applicants on how to deliver heating systems which are low carbon, cost effective and affordable for residents

March 2025

GMCA GREATER MANCHESTER COMBINED AUTHORITY

Etude

Levitt Bernstein People.Design

Net Zero guidance – A suite of three guides

This document is part of a suite of three Net Zero guidance documents prepared by the Greater Manchester Combined Authority, Levitt Bernstein and Etude.

'Low carbon heat' focuses on low carbon heating systems, providing clarity and guidance to both applicants and development management officers.

Although it can be read independently from the other documents, the reader may find it useful to refer to all three parts as they provide additional guidance.

Three key guidance documents:

1 Design guidance for Net Zero

Design considerations to meet policy JP-S2 and TANZ net zero standard, and linked to JP-S3.

- Definition of net zero
- Net zero operational carbon design (2)
- Designing for low embodied carbon
- Case studies
- Signposts to industry guidance

2 Low carbon heat

Design considerations to meet policy JP-S3, linked to JP-S2.

- Heating systems for net zero (1)
- Examples of low carbon heating solutions
- Heat network opportunity areas/zones
- How to assess heating systems
- Required justification for non-connection

3 Submission guidance

Planning submission guidance influenced by JP-S2, JP-S3 and linked to TANZ.

- Submission requirements – Energy and Carbon Proforma and Energy and Carbon Statements
- Content of energy and carbon statements (1) (2)
- Calculations and results guidance
- Approved compliance routes

Energy and Carbon Proforma

Contents

Interactive navigation

To move through this guide with ease, use the interactive buttons in the top right hand corner of each page. A return to contents button is also available should you lose your way.

Explainer

Guidance context

Low carbon heat is the second of a set of three guidance documents:

1. Design guidance for net zero
2. Low carbon heat
3. Submission guidance

The purpose of this guidance

The purpose of the *Low carbon heat guidance* is to summarise the many types of heating systems at different scales with a focus on the solutions which are likely to be compliant with Net Zero.

A building cannot be Net Zero if its heating and hot water system is not compliant with Net Zero. It is therefore important for applicants and development management officers alike to be able to understand which heating systems are likely to be acceptable.

It is possible that connection to a low carbon heat network could be the lowest carbon and most cost effective solution for applicants. Therefore, this document provides clarity on what applicants should do depending on the scale of the development, its location in Greater Manchester and the level of certainty of a low carbon heat network in the area.

Links to other documents

The low carbon heating systems discussed in this document have been summarised in 'Design Guidance fore Net zero'

Who this guidance is aimed at

This guide is primarily aimed at applicants for full or outline planning permission, to influence the early decision making on low carbon heating systems to meet Net Zero Carbon policy.

How this guidance relates to GMCA policies

Low carbon heat focuses on policy JP-S3 section (2) as well as linking to JP-S2 and Truly Affordable Net Zero (TANZ) requirements.

JP-S2 – Carbon and Energy

- (2) Use of lifecycle carbon tools
- (5) Net zero operational carbon – meeting set targets and following the energy hierarchy:
    - Minimise energy demand;
    - Maximise energy efficiency;
    - Use renewable energy;
    - Use low carbon energy; and
    - Utilise other energy sources.

JP-S3 – Heat and Energy Networks

- (2) Expectation for connection in the 'Heat and Energy Network Opportunity Areas'

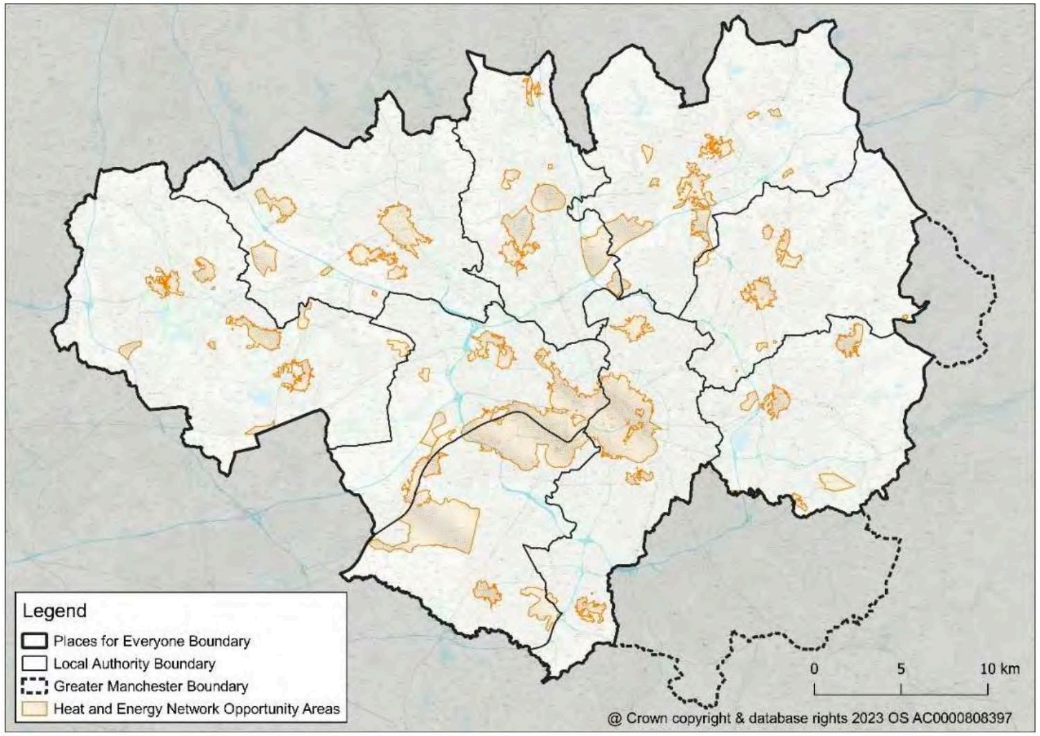
Truly Affordable Net Zero (TANZ)

- Link the requirements of TANZ with planning policy

Places for Everyone - Policy JP-S3: Heat and Energy Networks Policy

1. *Delivery of renewable and low carbon energy schemes will be supported with particular emphasis on the use of decentralised energy networks in areas identified as "Heat and Energy Network Opportunity Areas". These have been identified where:*
   a) *Existing heat/energy networks are operational or have been commissioned;*
   b) *Proposals for new heat networks/energy networks are being progressed, or future opportunities have been identified in city-region master planning;*
   c) *Sufficient density of existing heat demand occurs; and*
   d) *Significant future development is proposed at the strategic development locations.*

2. *Within the identified "Heat and Energy Network Opportunity Areas", unless it can be demonstrated that there are more effective alternatives for minimising carbon emissions or such connection is not practicable or financially viable, it is expected that:*
   a) *New residential developments that are '10 dwellings or more' or other developments over 1,000 m^2 floorspace shall:*
      i. *Connect to an existing or planned heat/energy network or be designed to enable future connection (where within 500m of such a network); and/or*
      ii. *Install a site-wide or communal heat/energy network solution.*
   b) *An expectation that new industrial development will demonstrate that opportunities for using waste heat locally have been fully examined, and included in proposals;*
   c) *An expectation that where publicly-owned buildings and assets adjoin new major development sites, opportunities for these buildings and assets to connect to site-wide proposals will be considered; and*
   d) *An expectation that any site-wide networks will be designed so as to enable future expansion to adjoining buildings or assets as appropriate.*



Map of Energy Network Opportunity Areas from GMCA Places for Everyone Joint Development Plan Document (March 2024)

1

Heating systems for net zero

Heating systems and Net Zero

The importance of heating and hot water

The energy needed to heat our buildings and supply them with hot water accounts for approximately 20% of the UK's total carbon emissions. It is one of the key areas which need to decarbonise in order to enable Greater Manchester to become a carbon neutral city region by 2038.

It is therefore essential that new buildings do not use fossil fuels for heating and hot water and that they are equipped with low carbon heating systems which are compliant with Net Zero.

Heat sources compliant with Net Zero

The most important requirement for a heating system to be compliant with Net Zero is for its heat source to be compliant with Net Zero without relying on any offsetting mechanism.

The adjacent diagram identifies in red the heat sources which are not compatible with Net Zero. In summary, they are those using fossil fuels and those using a process which is not considered to be consistent with Net Zero (e.g. heat recovered from a waste incineration plant not fitted with Carbon Capture and Storage (CCS) or from a high carbon manufacturing process like the current production of cement).

Heat sources considered compliant with Net Zero include those using electricity, including heat pumps, heat recovered from the ground (including minewater) and those using a process which is considered to be consistent with Net Zero (e.g. heat recovered from wastewater heat recover or from an industrial process not using combustion).

Electrification of heat, heat pumps and low carbon heat networks

For the majority of buildings in Greater Manchester, heating and hot water using electricity are likely to be the right solution, whether used on a small scale by individual heat pumps, at a heat network scale by large heat pumps, or used by other electrical heating and hot water systems (see following pages).

Other requirements

A 'Net Zero compliant' heating system should also have other characteristics: it should be energy efficient, reliable and enable residents and building users to be comfortable. It should also be simple for residents to control and supply heat a cost which is affordable.

Heat sources not compatible with net zero

1. **Gas boilers.**
2. **Gas fired combined heat and power** (and other fossil fuel based thermal power generation). These systems usually also have gas boilers to provide a significant part of the heat demand in winter.
3. **Unabated waste to energy*** - these municipal waste incineration plants generate electricity with hot water as waste through incineration.
4. **Industrial processes that release large amounts of greenhouse gases and are not consistent with Net Zero** according to the CCC.
5. **Unabated combustion of biomass.**

Heat sources compatible with net zero

1. **Heat pumps,** due to the decarbonisation of the electricity grid. These can use air, ground, or water as a heat source.
2. **Geothermal energy,** which can be used directly or as a heat source for heat pumps in some locations.
3. **Wastewater,** which can be relatively warm due to discharge of hot water into drains that can provide a heat source for heat pumps.
4. **Minewater,** which can provide a heat source for heat pumps in some locations.
5. **Industrial processes that do not rely on combustion** such as refrigeration, data centres, electricity substations, and subways.

** These terms have been highlighted as they refer to sources of heat/energy which are not currently compliant with Net Zero. However, there may be exceptions/new developments which make them compliant with Net Zero.*

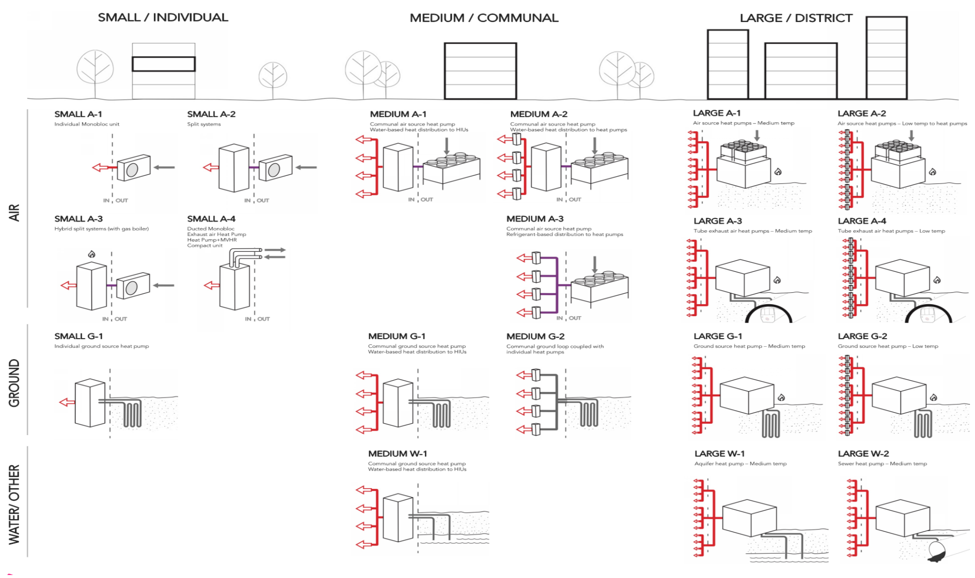
Summary of typical low carbon heating systems

The electrification of heat is one of the key opportunities for delivering Net Zero Carbon buildings. As the electricity grid is decarbonising, heating systems using electricity (e.g. heat pumps) become much lower carbon heating solutions than those using fossil fuels (e.g. natural gas).

It is anticipated that most of the heating systems adopted to meet the GMCA policy requirements will use electricity to deliver low carbon heat.

There is a wide range of low carbon heating systems using electricity

The type of heating system selected will be determined by the size, scale and complexity of the development. This section introduces the three typical scales of heating systems (i.e. individual, building and district) and which systems, at each scale, are likely to be put forward by applicants in order to deliver low carbon heat. The likely suitability of these systems to different scales of development in Greater Manchester is also provided on pages 8 and 9.



Heat pumps are available in many different types and scales, from individual systems to large scale heat pumps (© Etude for the Greater London Authority)

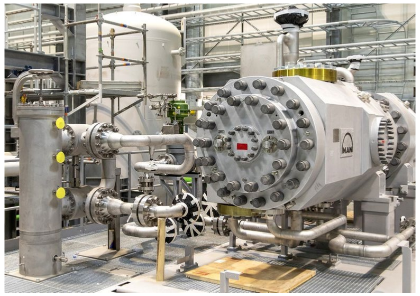
Individual scale

Example: individual Monobloc system

Building scale

Example: communal rooftop air source heat pumps

District scale

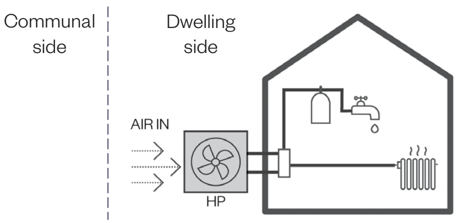


Example: large scale heat pump in an energy centre

Examples of typical low carbon heating systems - individual heating systems

Air source heat pump (ASHP)

Air to water monobloc



Low grade heat is gathered from the external air by the Air Source Heat Pump, which uses electricity efficiently to upgrade the heat to a higher temperature – typically 45°C for space heating and 60°C for hot water. Hot water is stored in an individual hot water tank in each unit.

Pros:

- Low distribution losses
- Low impact on overheating

Cons:

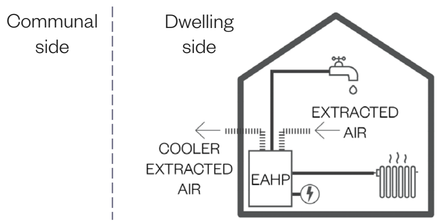
- Visual impact of external unit

TANZ suitability

£ energy bills

Exhaust air heat pump (EAHP)

Compact unit



Combines mechanical ventilation, heat recovery and a heat pump system in one unit. The warm extracted air is passed through a heat exchanger, where heat is transferred to the incoming air. The heat pump uses electricity to upgrade the heat to a higher temperature. Hot water is stored in an integrated hot water tank.

Pros:

- No external unit required
- Low distribution losses
- Low impact on overheating
- Potential for tempered air

Cons:

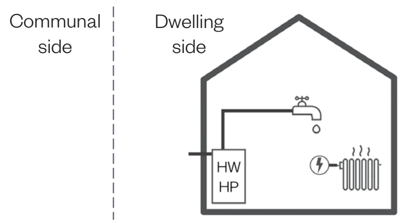
- Potential increased ventilation rates to suit the need of the air source heat pump
- Capital and maintenance costs
- Limited capacity

TANZ suitability

££ energy bills

MVHR included

Hot water heat pump + direct electric



Space heating and domestic hot water are provided separately. Space heating is provided through electric panel heaters and domestic hot water through a packaged hot water heat pump located within the dwelling.

Pros:

- No external units required
- Low distribution losses
- Low impact on overheating

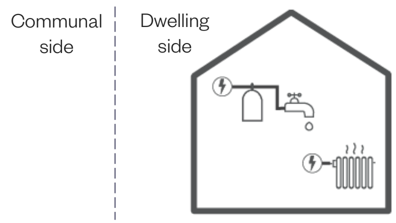
Cons:

- Maintenance costs

TANZ suitability

££ energy bills

Direct electric



Space heating and domestic hot water are both provided by electricity directly. Space heating is provided through electric panel heaters domestic hot water through an immersion heater in the hot water tank. The systems are not connected.

Pros:

- No external unit required
- Low capital cost
- Low embodied carbon
- Low distribution losses
- Low impact on overheating

Cons:

- Energy bills could be very high if not installed within high thermally performing building fabric
- Moderate operational carbon emissions

Due to the risk of high energy bills for residents it is recommended that direct electric heating and hot water is only accepted in ultra-low energy homes (e.g. Passivhaus certified).

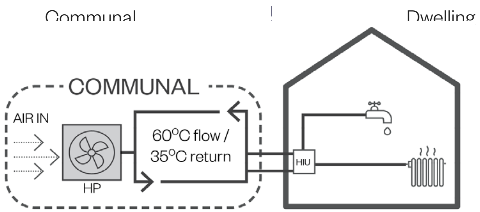
TANZ suitability

£££ energy bills

The use of the word 'dwelling' in the schematics above is only illustrative. These systems can be used on non-domestic buildings.

Examples of typical low carbon heating systems - communal systems (building or district)

Communal air source heat pump



A communal bank of air source heat pumps is located on the roof of the building. Heat is distributed to each flat via 'standard' heating pipes to a Heat Interface Unit (HIU).

Pros:

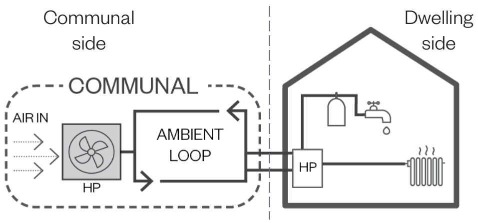
- No individual external units required (only communal ones)
- Communal maintenance

Cons:

- Distribution losses
- Contribution to overheating risk
- Individual metering and billing required

TANZ suitability | ££ energy bills | Overheating risk

Air-source ambient loop



A communal bank of air source heat pumps is located on the roof of the building. Heat is distributed to each flat via a loop flowing at an ambient temperature. Within each dwelling, a heat pump unit uses electricity to upgrade the heat from the communal ambient loop to a higher temperature.

Pros:

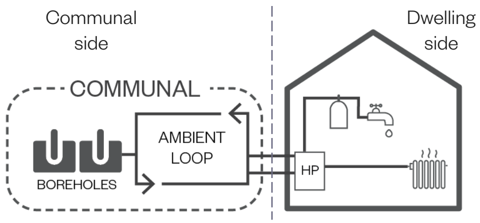
- No individual external units required (only communal ones)
- Low distributions losses
- Low impact on overheating
- Potential for active cooling

Cons:

- High capital cost
- Maintenance
- Individual metering and billing may be required

TANZ suitability | £ energy bills

Ground-source ambient loop



Water is circulated in a large number of boreholes. It is pumped directly into each dwelling via a shared loop flowing at an ambient temperature. Within each dwelling, a heat pump unit uses electricity to upgrade the heat from the communal ambient loop to a higher temperature.

Pros:

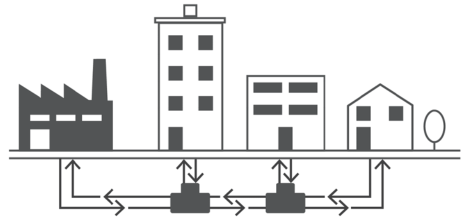
- No external units required
- Low distribution losses
- Low impact on overheating
- High efficiency
- Potential for active cooling

Cons:

- High capital cost
- Individual metering and billing may be required

TANZ suitability | £ energy bills

Heat network (district scale)



District heating uses a singular central heat source to distribute hot water through a network of pipes to multiple dwellings, connecting several buildings together and to a low carbon heat source. This heating system goes beyond the scale of an apartment building.

Pros:

- No external units required
- Does not require individual maintenance

Cons:

- High distribution losses
- Contribution to overheating risk
- Individual metering and billing required

TANZ suitability | ££ energy bills | Overheating risk

The use of the word 'dwelling' in the schematics above is only illustrative. These systems can be used on non-domestic buildings.

Low carbon heat networks - Opportunity areas and heat zoning

Heat and energy network opportunity area

The Places for Everyone Joint Document (adopted March 2024) includes a map identifying the Heat and Energy Network Opportunity Areas in Greater Manchester. This map forms the current basis of Policy JP-S3.

These opportunity areas have been identified based on the following factors: sufficient density of existing heat demand; significant future development at the strategic development locations; presence of existing heat/energy networks; development of new heat networks/energy networks in progress, or identified future opportunities in city-region master planning.

The concept of opportunity areas is however currently being replaced by heat network zones which are more clearly defined.

Heat network zones

A significant amount of work on heat network zones has been undertaken by the Department for Energy Security and Net Zero (DESNZ), the Greater Manchester Combined Authority (GMCA) and AECOM since 2019. A heat network zone is a "*formally designated geographical area where heat networks are expected to provide the lowest cost solution for decarbonising heating*."

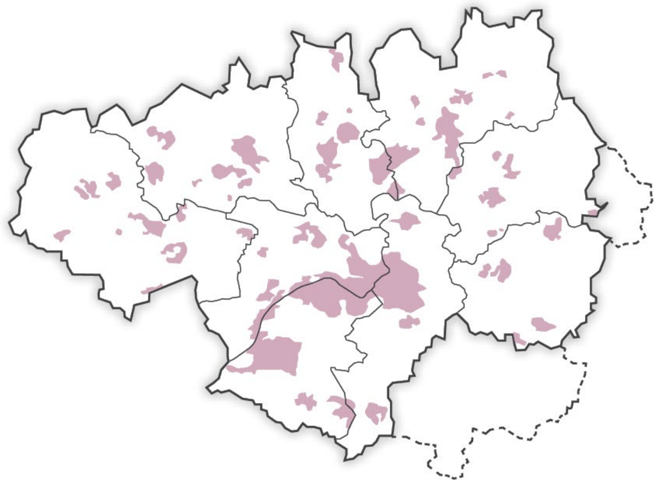
Ten 'utility scale' zones have been identified in Greater Manchester (see adjacent map from DESNZ). There are other smaller heat network zones.

The carbon requirement for heat networks within these zones is currently assumed to be a maximum carbon content of heat (delivered) of 100gCO_2/kWh.

The current assumption is that DESNZ, GMCA and AECOM will finalise the identification of these zones by the end of 2025, and that it will then be each LPA's responsibility, in conjunction with GMCA, to formally designate them as such. A **Zone Coordinator** (at the local authority or GMCA level) will then have significant responsibilities and a key role to develop them.

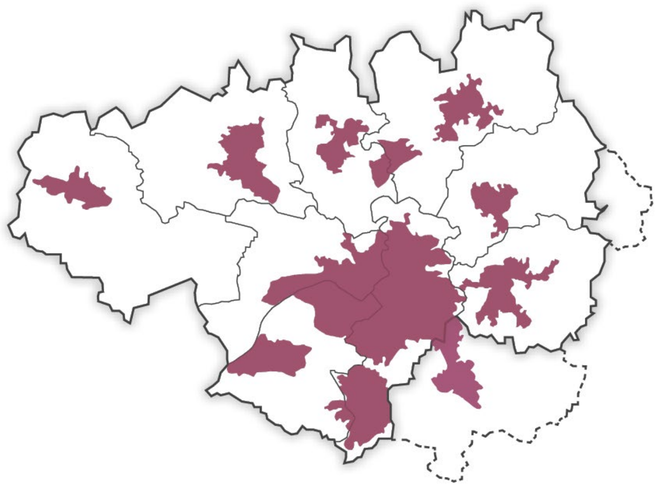
OFGEM is also working with DESNZ on consumer protection and their work is expected to progress further 2025.

The legislative framework for heat zones, the designation of heat zones by the respective LPAs and consumer protection mechanisms are therefore unlikely to be in place before 2026. Until that point it is assumed that heat and energy network opportunity areas will continue to be used in this guidance document. After that point heat network zones are likely to supersede them.



Map of Heat and Energy Network Opportunity Areas

(created from GMCA Places for Everyone Joint Development Plan Document, March 2024)



Map of <u>indicative</u> Heat Network Zones in Greater Manchester

(created from DESNZ indicative heat network zone map for Greater Manchester, September 2024)

The role of planning in the selection of the best low carbon heating system

Planning has a key role to play in the selection of the best low carbon heating system. Applicants can and should carry out their own appraisal and development management officers should check that the selected system meets their requirements. This page summarises what LPAs will be concerned about when evaluating heating systems proposed by applicants.

Environmental performance

Consistency with Net Zero will be a key consideration. The proposed system must not use any fossil fuels. The projected carbon emissions should be lower than 100gCO_2/kWh. It should also aim for a low level of embodied carbon and whole life carbon and have a limited environmental impact locally (e.g. noise, pollution).

Impact on residents

One of the main concerns of LPAs in the Greater Manchester area will be to ensure that the proposed heating system will be affordable to use by residents and that they will be benefit from a clear and regulated level of protection as consumers. The simplicity of use of the system will also be a key consideration to avoid the risk of some residents not being able to heat their home sufficiently. Finally, the system should not contribute to the risk of overheating.

Impact on viability

The cost of heating systems can vary significantly. LPAs will want to ensure that the choice of heating system is not negatively affecting viability and the ability of applicants to deliver housing.

Infrastructure development

When a low carbon heat network infrastructure has been developed or is under development, LPAs will want to ensure that sites located in the vicinity of the infrastructure, especially large major applications (i.e. those delivering more than 150 residential units and/or more than 5,000 m^2 GIA of non-residential floor space) connect to it or commit to connect to it if it is not yet available,, subject to the requirements of Policy JP-S3.

Environmental performance

- Low carbon heat / Consistency with Net Zero
- Decarbonisation at neighbourhood scale / Supporting jobs and growth
- Limited environmental impact locally (pollution, noise, etc.)

Impact on residents

- Affordable warmth
- Health of residents (i.e. heating systems fit for purpose)
- Consumer protection
- No overheating risk
- Public engagement, including with environmental groups and the local community

Impact on viability

- Capital costs of heating system does not constrain the delivery of housing

Infrastructure development

- Facilitating wider development (e.g. grid supply constraints)
- Site allocation for energy generation
- Waste planning – Biogas facilities
- Identification of opportunities for low carbon heat networks

2

The key performance indicators of heating systems and how to assess and compare them

The key performance indicators of heating systems and how to assess them

Selecting the most suitable low carbon heating system

In order to enable applicants to select the most suitable low carbon heating system and to facilitate the LPA's appraisal of their proposal, the following KPIs are recommended:

- **Environmental performance:** whether the system uses fossil fuel or not, its predicted carbon content of heat and whether it will create any local pollution issues. Embodied carbon/whole life carbon as an optional KPI.
- **Impact on residents:** estimated energy, maintenance and replacement costs and additional cost compared to a 'benchmark' low carbon heating system (e.g. (on-site air source heat pump).
- **Impact on viability:** estimated capital costs of selected heating system and additional cost compared to a 'benchmark' low carbon heating system (e.g. (on-site air source heat pump).
- **Infrastructure development:** whether the scheme is proposing to connect to the local low carbon heat network or not with suitable justification for exemption if required.

A 'Low carbon heat appraisal' is recommended for all applications

It is recommended that all planning applications include a Low Carbon Heat Appraisal to demonstrate compliance with Policy JP-S3 and that the most suitable low carbon heating system is proposed . However, the level of analysis and reporting expected will vary depending on the scale and location of the planning application.

Performance area	Key performance indicator	Unit
Environmental performance	1. Fossil fuel use	Yes/no
	2. Carbon content of heat	gCO_2/kWh
	3. Local pollution	Description
Impact on residents/ building users	4. Estimated energy costs for heating and hot water	£/yr
	5. Estimated maintenance costs	£/yr (annualised)
	6. Estimated replacement costs	£/yr (annualised)
	7. Additional operating costs compared with benchmark low carbon heating system	+/- %
Impact on viability	8. Estimated capital cost of heating system	£/unit or £/building
	9. Additional cost compared with benchmark low carbon heating system	+/- %
Infrastructure development	10. Connection to low carbon heat network	yes/no
	11. Scale of application	m^2 GIA

Proposed Key Performance Indicators (KPI) to be assessed in the low carbon heat appraisal

Environmental performance - Focus on fossil fuel use and greenhouse gas emissions

No fossil fuel for heating and hot water

Heating buildings with fossil fuel (e.g. gas, oil) is responsible for most of their carbon emissions and is not compatible with Net Zero. All new buildings must not use fossil fuels for heating and hot water. Refurbishments should ideally avoid replacing an old fossil fuel system with a new one.

The carbon content of heat delivered

Determining the carbon content of heat delivered by different heating systems is an objective way of assessing and comparing them. This key performance indicator combines three considerations:

- the carbon intensity of the fuel used by the heat generation plant (e.g. gas is high carbon, electricity low carbon)
- the efficiency of the heat generation plan (e.g. gas boilers are 80-95% efficient, heat pumps' efficiencies range from 200% to 600%)
- the distribution and storage losses (e.g. a heat network would generally have high distribution losses, an individual heating system low losses).

The adjacent diagram illustrates an indicative comparison between different heating systems.

How to calculate the carbon content of heat?

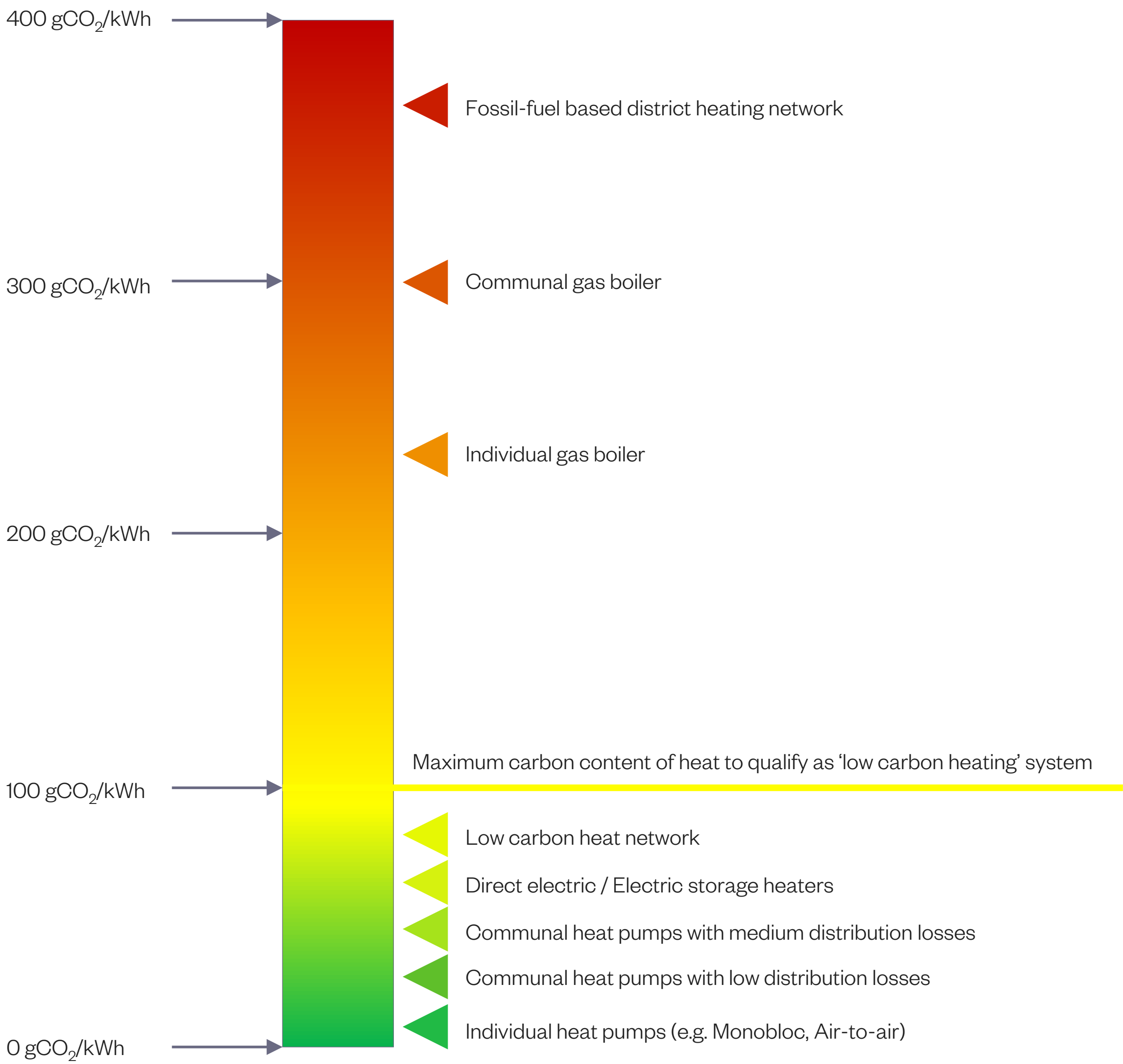
The carbon intensity of the fuel used should be based on average fuel carbon factors in the HM Treasury Green Book. It is recommended to use an average over the first 15 years from the anticipated building completion date (e.g. 2025-40) to represent the average carbon content of the fuel source over the heating system lifetime.

A maximum carbon content of heat (delivered) of 100 gCO_2/kWh

The Green Heat Network Fund (GHNF) from DESNZ sets a carbon content limit of 100 gCO_{2e}/kWh for applications to be accepted. It is proposed to adopt the same limit in Greater Manchester for a heating system to qualify as a 'low carbon heating system'.

Embodied carbon and Whole Life Carbon

The embodied carbon and whole life carbon of heating systems vary substantially. The type and volume of refrigerants is a key parameter. It is recommended that applicants also consider this aspect (see Appendix).



Indicative carbon content of heat (delivered) from different heating systems. Due to the decarbonisation of the electricity grid and their efficiency, heat pumps (at different scales) are expected to be the main technical solution for many applications in Greater Manchester. Heat networks can qualify as 'low carbon heat solutions' provided their carbon content of heat (delivered) is below 100 gCO_2/kWh.

Impact on residents - Focus on affordability of heat

A growing concern

Energy costs have always been a concern for those affected by fuel poverty and it is now a major issue for many residents in Greater Manchester.

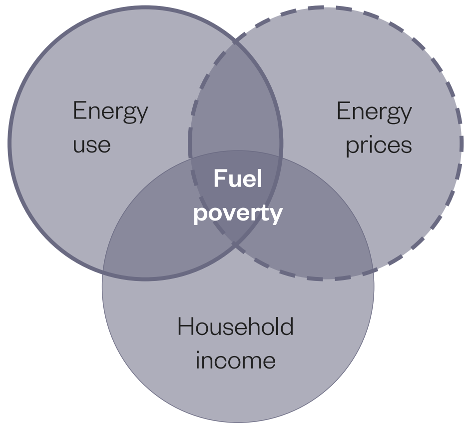
The impact of the choice of heating systems on residents

There are three factors contributing to fuel poverty: the household income, the dwelling's energy demand and energy prices (set by the market/energy suppliers). The choice of heating system will affect the level of energy use, energy prices, the possibility to change supplier and the servicing costs.

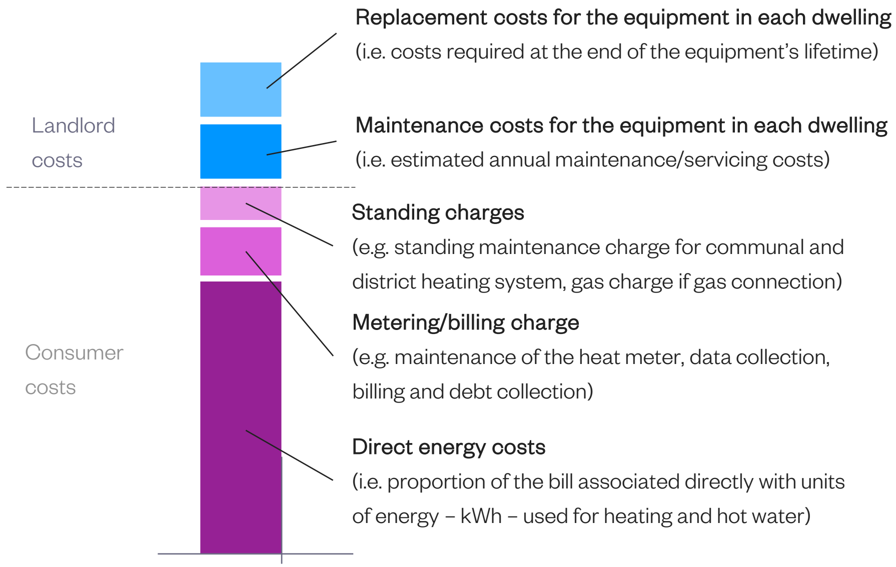
- **Energy efficiency.** Heating systems which generate and distribute heat efficiently will use less units of energy.
- **Energy prices.** The unit cost of electricity is still much more expensive than natural gas, creating a risk of high energy bills for the residents. Although this risk may change in the future with environmental taxes shifting gradually away from 'clean' electricity towards 'dirty' fossil fuels, this change and its timescales are not certain. The unit cost of heat networks is generally specific to the network. It should also be noted that a significant difference between the unit cost of electricity and the unit cost of heat supplied by a communal, site-wide or heat network is that electricity prices can vary significantly during the day from one half hourly period to another as the UK's generation mix changes. During times of high wind or solar generation, prices often drop and can even become negative. Conversely, prices are usually higher when there is less wind and sun.
- **Ability to change supplier and consumer protection.** Some heating systems do not allow the consumers to change suppliers. This is introducing a risk in terms of consumer protection which must be considered.
- **Maintenance and replacement.** Beyond the unit cost of energy, the cost of maintenance and replacement will also affect residents, building owners and tenants.

The need to estimate energy costs

It is recommended that energy costs of the proposed heating system are estimated by the applicant at the planning stage, and, ideally, compared to alternatives. The adjacent diagram illustrates the different components of heating costs which should be assessed.



The dwelling's energy use and the energy prices associated with the heating system could be two key factors contributing to fuel poverty. Net Zero Carbon buildings should help to the sustainable reduction in fuel poverty.



The cost of using a heating system can be broken down into different elements, some of which are paid by the residents and some by the property owner (which may seek to recover them from residents in the service charge). This breakdown can be significantly different for heating systems, depending how much communal equipment is used.

Impact on viability - Focus on capital costs

A wide range of costs

The capital costs of heating systems can vary substantially, generally between £4,000 to more than £20,000 per unit, i.e. by a factor of 5. Therefore, the capital costs are one of the key performance indicators considered in the Low Carbon Heat Appraisal.

A key criterion for low carbon heat networks for DESNZ and GMCA

Cost effectiveness is one of the key criteria in the work currently being carried out by DESNZ and GMCA on heat network zones. The very definition of a 'heat network zone' is a formally designated geographical area "*where heat networks are expected to provide the lowest cost solution for decarbonising heating*."

Policy JP-S3

Policy JP-S3 also identifies cost effectiveness as a key criterion: applicants are required to connect to a low carbon heat network '*unless it can be demonstrated that there are more effective alternatives for minimising carbon emissions or such connection is not practicable or financially viable'*.

Recommendation for planning stage cost assessment

The assessment of the heating system costs at planning stage will generally be done at a high level. In order to make this assessment as practical as possible for applicants. The following guidelines should be followed:

- Costs should include installation.
- All options can exclude heat emitters (unless they are not the same in all options being considered).
- Allowance for cold water distribution can be excluded (unless it is not the same in all options being considered).
- Costs should include main contractor allowances.
- Costs should be based on present day cost and should not allow for inflation.

	Heating system options	Capital costs (£/unit)
Individual heating system options	Air source heat pumps	£10,000
	Exhaust air heat pumps	£14,000
	Hot water heat pump + direct electric heating	£7,000
Communal heating system options	Air source heat pumps	£12,000
	Air-source ambient loop	£16,000
	Ground source ambient loop	£17,000

Indicative capital cost comparison between different heating systems.

The costs above are purely illustrative and are based on a mixed use medium scale scheme. A specific assessment of capital costs by the project's cost consultant is recommended.

How to choose between heating systems (and evidence the choice)?

This page summarises the guidelines to be followed by applicants depending on the type of planning application (i.e. minor/major) and where the development site is in Greater Manchester.

Type of application

Policy JP-S3 only applies to major applications (i.e. New developments that include '10 homes or more' and/or '1,000 m^2 of non-residential floor area:

- **Small Minor /Minor applications** will only be expected to provide a simple statement in DAS, confirming that a compliant system is proposed (no fossil fuel will be used on site with heat provided by a heat pump, providing heating and hot water, with a a minimum SCOP of 3.5). If the efficiency requirement is not met then a short low carbon heat appraisal shall be submitted.
- **Major applications** will be expected to submit a summary Low Carbon Heat Appraisal (e.g. 1-2 pages), reporting predicted performance of the proposed system against the KPIs. See page 20 for more information.
- **Large Major applications** will be expected to submit a detailed summary Low Carbon Heat Appraisal (e.g. 5-10 pages) reporting predicted performance of the system against the adjacent KPIs and comparing them to a few relevant alternatives. See page 27 for more information.

Location (major applications only)

All major applications for which cases 1, 2 or 3 below apply will be required to include a comparison of the proposed system against selected alternatives, including a low carbon heat network and an on-site communal heating system.

- **Case 1:** the site is within 500m of an existing low carbon heat network
- **Case 2:** the site is within 500m of a planned low carbon heat network
- **Case 3:** the site is within a low carbon heat network opportunity area
- **Case 4:** any other location

Although each application will be judged in its own merits, major applications in cases 1 or 2 above, and particularly those of a large scale (i.e. more than 150 homes and/or more than 5,000 m^2 GIA) will be expected to install a communal heating system and connect or commit to connect to the low carbon heat network '*unless it can be demonstrated that there are more effective alternatives for minimising carbon emissions or such connection is not practicable or financially viable'* in line with Policy JP-S3.

Minor application

Energy/carbon requirements

- 1. No fossil fuel based system proposed ✓
- 2. The heating and hot water system is a heat pump and achieves a minimum SCOP of 3.5 ✓

Evidence required*

Simple statement in DAS confirming a compliant system proposed (e.g. monobloc heat pump).

** A Low Carbon Heat Appraisal is not required for this scale of development unless both requirements are not met. In this case a short low carbon heat appraisal shall be submitted.*

Major applications

Energy/carbon requirements

- 1. Non fossil fuel based system proposed ✓
- 2. The carbon content of heat (delivered) is less than 100gCO_2/kWh ✓

Evidence required**

A Low Carbon Heat Appraisal** comparing different heating systems and and identifying the proposed system.

*** The detail and extent of this appraisal will depend on the location and scale of the development. Further details are provided on the following pages.*

3

Low carbon heating solutions for minor developments

< 10 homes and/or
< 1000 m^2 non-residential

Heating solutions for minor developments | Guidance for planning application

It is important to ensure that the heating systems installed in all developments, including minor applications, are low carbon, cost effective and affordable for the residents. It is expected that most heating systems in minor applications will be using electricity and there is a wide range of solutions available.

A simple process to deliver low carbon heat

It is likely that most new homes will have a heat pump installed to deliver low carbon heat for heating and hot water, and where it can be demonstrated the minimum COP is at least 3.5, this will be deemed acceptable and compliant. The applicant will therefore only be required to confirm that no fossil fuel will be used on site and that the seasonal coefficient of performance of the system will be at least 3.5.

1. No fossil fuel based system proposed

2. The heating and hot water system is a heat pump and achieves a minimum SCOP of 3.5

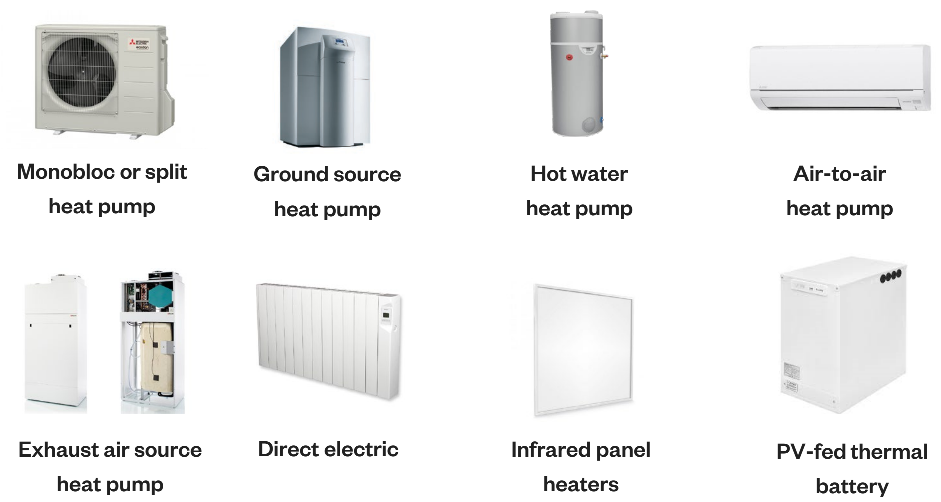
Simple statement in DAS confirming a compliant system proposed (e.g. monobloc heat pump).

A Low Carbon Heat Appraisal is not required for this scale of development unless the requirements above are not met. In this case a simple low carbon heat appraisal

If the above requirements are met a separate report is not required and a paragraph in the Design and Access statement should suffice. Suitable evidence (e.g. drawings, proposed manufacturer's literature) should also be provided.

If the requirements above are not met, a short Low Carbon Heat Appraisal shall be submitted to justify the applicant's choice.

Where technologies that rely on the direct use of electricity are proposed, there is a risk of high energy bills for residents. The applicant will be required to estimate annual heating energy costs and explain how the risk of high bills will be mitigated.



A wide range of individual heating systems using electricity can be installed in new homes (Sources: Valliant, Mitsubishi Electric, Nilan, Dimplex, Ducas, Surya, Daikin, Sunamp)

R-32 BLUEVOLUTION

EDLA

Daikin Altherma 3 High Capacity Monobloc

Outdoor Unit			Single Phase				Three Phase			
			EDLA09D3V3	EDLA11D3V3	EDLA14D3V3	EDLA16D3V3	EDLA09D3W1	EDLA11D3W1	EDLA14D3W1	EDLA16D3W1
Description			Class 9	Class 11	Class 14	Class 16	Class 9	Class 11	Class 14	Class 16
Function			Heating Only	Heating Only	Heating Only	Heating Only	Heating Only	Heating Only	Heating Only	Heating Only
Dimensions [1]	Height x Width x Depth	mm	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460	870 x 1380 x 460
Weight		kg	149	149	149	149	149	149	149	149
Nominal capacity	Heating (a/b)	kW	9.37/9.00	10.6/9.82	12.0/12.5	16.0/16.0	9.37/9.00	10.6/9.82	12.0/12.5	16.0/16.0
	Cooling	kW	-	-	-	-	-	-	-	-
Nominal input	Heating (a/b)	kW	1.91/2.43	2.18/2.68	2.46/3.42	3.53/4.56	1.91/2.43	2.18/2.68	2.46/3.42	3.53/4.56
COP	Heating (a/b)		4.91/3.71	4.83/3.66	4.87/3.64	4.53/3.51	4.91/3.72	4.83/3.66	4.87/3.64	5.43/3.51
Seasonal space heating efficiency	Space heating (Average climate) 35°C	Class	A+++	A+++	A+++	A+++	A+++	A+++	A+++	A+++
		Efficiency	186	182	182	182	186	182	182	182
		SCOP	4.72	4.64	4.62	4.62	4.72	4.64	4.62	4.62
	Space heating (Average climate) 55°C	Class	A++	A++	A++	A++	A++	A++	A++	A++
		Efficiency	133	130	132	130	133	130	132	130
		SCOP	3.39	3.32	3.37	3.33	3.39	3.32	3.37	3.33
EER	Cooling		-	-	-	-	-	-	-	-
Operation range	Heating	°C	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35
	Cooling	°C	-	-	-	-	-	-	-	-
	Hot water	°C	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35	-25 ~ 35
Sound power level	Heating	dBA	62	62	62	62	62	62	62	62
Refrigerant charge (factory)	R32	kg	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Power supply			1-phase / 230V / 50Hz	1-phase / 230V / 50Hz	1-phase / 230V / 50Hz	1-phase / 230V / 50Hz	3-Phase / 400V / 50Hz	3-Phase / 400V / 50Hz	3-Phase / 400V / 50Hz	3-Phase / 400V / 50Hz
Recommended fuses	Outdoor unit	A	32	32	32	32	13	13	13	13
Pump	No. of speeds		Inverter controller	Inverter controller	Inverter controller	Inverter controller	Inverter controller	Inverter controller	Inverter controller	Inverter controller
Expansion vessel volume		litres	8	8	8	8	8	8	8	8
Water connections (diameter)		inch	1″ (male)	1″ (male)	1″ (male)	1″ (male)	1″ (male)	1″ (male)	1″ (male)	1″ (male)
Minimum water volume		litres	20	20	20	20	20	20	20	20
Minimum flow rate	Cooling/Heating above 5°C	l/min	20	20	20	20	20	20	20	20
	Heating below -5°C	l/min	22	22	22	22	22	22	22	22
	Hot water	l/min	28	28	28	28	28	28	28	28
Maximum piping distance to tank		m	10	10	10	10	10	10	10	10
Maximum level difference		m	5	5	5	5	5	5	5	5

Nominal capacity and nominal input tested according to EN 14511 at the following conditions:
Heating a: Ambient air temperature 7°C and leaving water temperature 35°C (A7 W35)
Heating b: Ambient air temperature 7°C and leaving water temperature 45°C (A7 W45)
Cooling: Ambient air temperature 35°C and leaving water temperature 7°C (A35 W7)
Sound pressure level measured at 1m from the unit
[1] Excludes aesthetic grill

Technical data sheet for a suitable ASHP system (Sources: Daikin)

What should be included in a Low Carbon Heat Appraisal for a minor scheme?

For a small minor and a minor applications, a low carbon heat appraisal only has to be undertaken if a heat pump is not used for the heating and hot water system or the system does not achieve a minimum SCOP of 3.5.

If a low carbon heating appraisal is required, then it is expected that a short 1 page assessment is submitted, reporting the predicted performance of the proposed heating system options against various criteria outlined in the table aside.

Although not expected that further information is presented in the low carbon heating appraisal, it is suggested that the following is considered when selecting the most appropriate system:

Local electrical capacity

- What the electrical supply/capacity is, is there sufficient current and projected capacity for the development or are new sub stations required.

Technical Design

- The system design, heat emitters, vectors for delivering heat and primary flow and return temperatures.
- Space constraints on site, or within the development itself that impact the heating system selection.
- Whether the system can be integrated and coupled with energy demand reduction technology (batteries), dynamic tariff pricing, electrical self-consumption (i.e. through integration with user owned PV systems).

Ease of operation and maintenance

- System controls and ease of use.
- Operation and maintenance (Owner-occupier, build-to-rent, speculative development, council managed, contracted third party maintenance programmes.) Also consider supply chain of replacement equipment

Carbon emissions

- The likely embodied carbon and whole life carbon impacts of the system (see CIBSE TM65.1).
- The GWP of the refrigerant type, considering emerging regulations.

Performance area	Key performance indicator	Unit
Environmental performance	1. Fossil fuel use	Yes/no
	2. Carbon content of heat	gCO_2/kWh
	3. Local pollution	Description
Impact on residents/ building users	4. Estimated energy costs for heating and hot water	£/yr
	5. Estimated maintenance costs	£/yr (annualised)
	6. Estimated replacement costs	£/yr (annualised)
	7. Additional operating costs compared with benchmark low carbon heating system	+/- %
Impact on viability	8. Estimated capital cost of heating system	£/unit or £/building
	9. Additional cost compared with benchmark low carbon heating system	+/- %
Infrastructure development	10. Connection to low carbon heat network	yes/no
	11. Scale of application	m^2 GIA

Proposed Key Performance Indicators (KPI) to be assessed in the low carbon heat appraisal

4

Low carbon heating solutions for major developments

> 10 homes and/or
> 1000 m^2 non-residential

Is your site located in the vicinity of a low carbon heat network?

Major developments are likely to be located in four different types of locations, which will affect how they should apply Policy JP-S3:

- **Case 1:** the site is within 500m of an existing low carbon* heat network
- **Case 2:** the site is within 500m of a planned low carbon* heat network
- **Case 3:** the site is within a low carbon heat network opportunity area
- **Case 4:** any other location in Greater Manchester

* A heat network is deemed to be 'low carbon' when the carbon content of heat it delivers to each unit is less than 100 gCO_2/kWh.

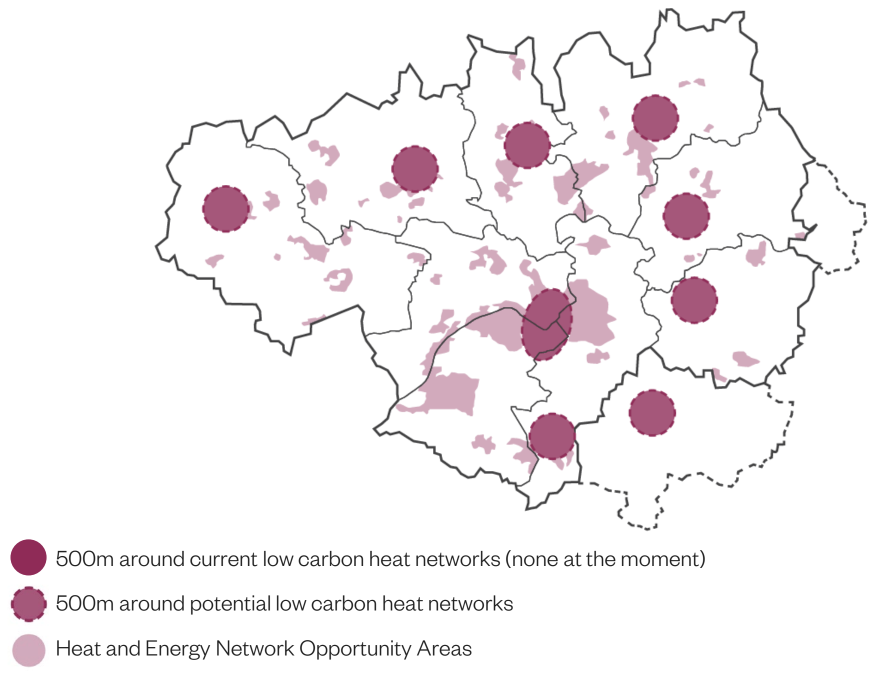
A low carbon heat appraisal in all cases

The applicant should submit a low carbon heat appraisal in each case as choosing the best possible heating system is important. The rationale for the selection of the preferred heating system should be checked by the LPA, particularly in terms of carbon emissions and affordability for residents.

The range of options to consider will vary

Depending on the case above, the range of options to consider will vary, particularly in terms of low carbon heat network:

- **Case 1:** the existing low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered. Unless the applicant provides suitable justification, the expectation is that the scheme will connect to the low carbon heat network.
- **Case 2:** the planned low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered. The applicant should liaise with the LPA to enquire about the likely development programme of the planned low carbon heat network. Unless the applicant provides suitable justification, the expectation is that the scheme will install a communal heating system and enable future connection to the planned low carbon heat network.
- **Case 3:** the site is within a low carbon heat network opportunity area. A notional low carbon heat network with a carbon content of heat (delivered) of 100 gCO_2/kWh should be one of the options being assessed. The applicant should then liaise with the LPA to enquire about the likelihood of a low carbon heat network being installed in the medium to long term.
- **Case 4:** the applicant does not have to include any heat network option in their Low Carbon Heat Appraisal.



Map of Greater Manchester showing the three different types of heat network areas (as of December 2024)

Energy/carbon requirements

1. Non fossil fuel based system proposed

2. The carbon content of heat (delivered) is less than 100gCO_2/kWh

Evidence required*

A Low Carbon Heat Appraisal** comparing different heating systems and and identifying the proposed system.

*** The detail and extent of this appraisal will depend on the location and scale of the development. Further details are provided on the following pages.*

Case 1 | When the site is within 500m of an existing low carbon heat network

This page summarises the expected process an applicant of a major application should follow when it **is located within 500m of an existing low carbon heat network.** A major application is defined as one with more than 10 units or 1,000m^2 of development floor area. 500m represents the maximum distance between the site boundary and the heat network.

Steps to take

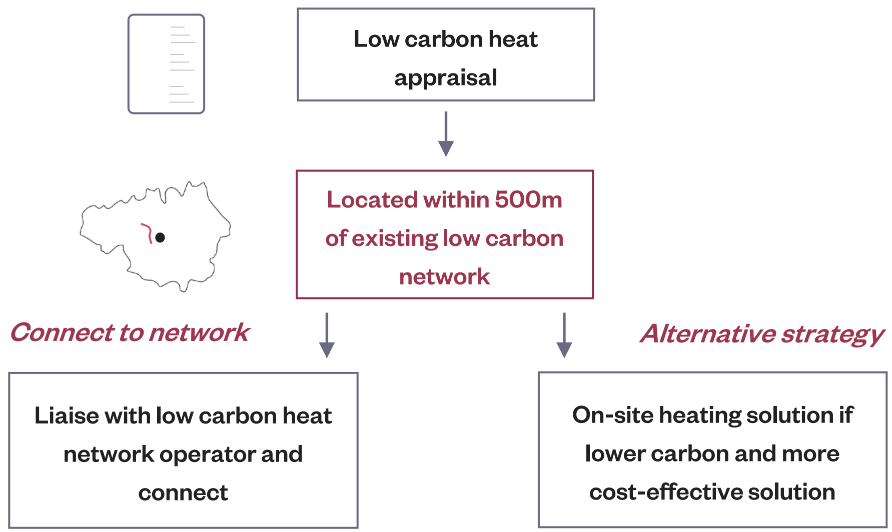
1. The applicant should undertake a low carbon appraisal and review various heating options. The existing low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered.
2. The applicant should liaise with the heat network operator and enquire about the carbon performance of the network, the cost of connection and the cost to residents.

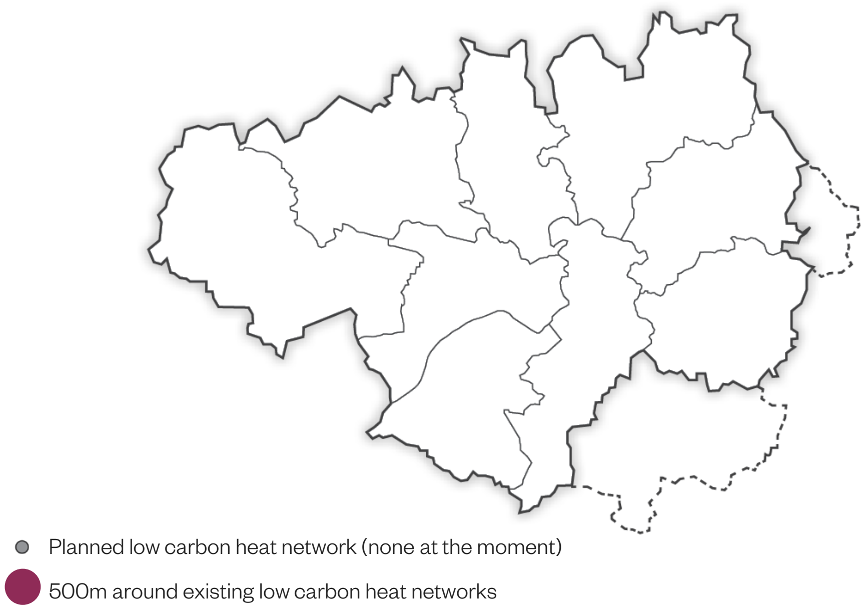
Expected outcome

Unless the applicant provides suitable justification, the expected outcome is that the scheme will connect to the existing low carbon heat network. This is particularly the case for strategic large scale developments located close to the heat generation plant of the existing low carbon heat network.

Exemption

In accordance with JP-S3, an applicant can be exempted to connect where it is demonstrated that an on-site heating solution is lower carbon and more cost effective. It is important to note that the applicant will be expected to provide the evidence required to justify the exemption, and that the scale of development will require a particularly robust evidence. See section 5 for more details.





Map of Greater Manchester showing all existing low carbon heat networks (as of December 2024)

Please note that there are currently no operating low carbon heat networks.

Case 2 | When the site is within 500m of a planned low carbon heat network

This page summarises the expected process an applicant of a major application should follow when it **is located within 500m of a planned low carbon heat network.** A major application is defined as one with more than 10 units or 1,000m^2 of development floor area.

Steps to take

1. The applicant should undertake a low carbon appraisal and review various heating options. The planned low carbon heat network should be one of the options being assessed. Its specific carbon content of heat (delivered) should be considered.
2. The applicant should liaise with the LPA to enquire about the likelihood of the planned low carbon heat network being installed in the short to medium term. The applicant should enquire about the likely carbon performance of the network as well as the likely cost of connection and likely cost to residents (if known).

Expected outcome

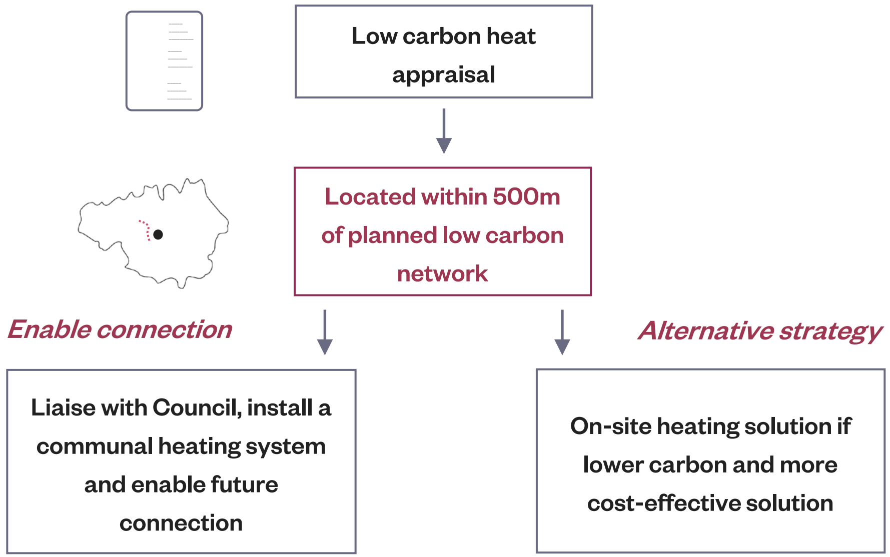
Unless the applicant provides suitable justification, the expected outcome is that the scheme will install an interim communal heating system and enable future connection to the planned low carbon heat network. This is particularly the case for strategic large scale developments located close to the future heat generation plant of the existing low carbon heat network.

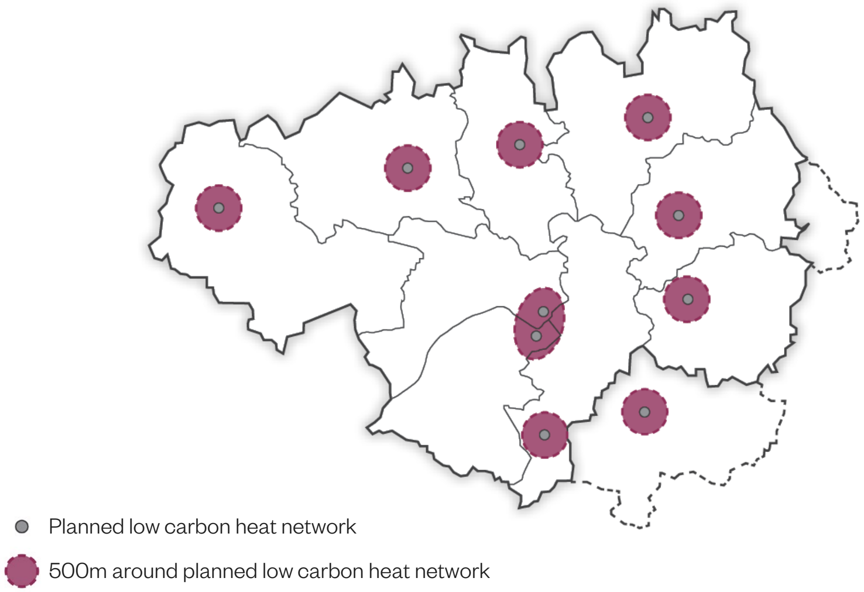
Important note on the 'interim' communal heating system

Where an 'interim' heating system is proposed before the development can connect to the low carbon heat network, this system should not be a fossil fuel based heating system. This is due to the risk of the temporary solution becoming permanent which would lead to significant excessive carbon in the delivery of the low carbon heat network is changes, delayed or cancelled.

Exemption

In accordance with JP-S3, an applicant can be exempted to install a communal heating system and commit to future connection where it is demonstrated that an on-site heating solution is lower carbon and more cost effective. It is important to note that the applicant will be expected to provide the evidence required to justify the exemption, and that the scale of development will require a particularly robust evidence. See section 5 for more details.





Map showing the 10 planned low carbon heat networks in Greater Manchester (as of September 2024)

Please note that these networks are at different stages of development, ranging from feasibility to commercialisation. Construction has not started yet on any of these networks.

Case 3 | When the site is in a low carbon heat network opportunity area

This page summarises the expected process an applicant of a major application should follow when it **is located within a Heat and Energy Network Opportunity Area.** A major application is defined as one with more than 10 units or 1,000m^2 of development floor area.

Steps to take

1. The applicant should undertake a low carbon appraisal and review various heating options. A notional low carbon heat network with a carbon content of heat delivered of 100 gCO_2/kWh should be one of the options being assessed as there may be such a network coming forward in the future.
2. LPA should liaise with the applicant to indicate whether the site is now part of a formally designated heat network zone or not. (Designations unlikely to happen before 2027)

Expected outcome

The applicant should select the best heating option in order to deliver low carbon heat which is affordable to residents and cost effective.

The applicant may decide to enable future connection to a low carbon heat network and install an interim communal heating system, but this will not be required by the Local Authority, unless the area has been formally designated as a 'heat network zone', which is unlikely to happen before 2027.

Dealing with uncertainty

The reason why the LPA will not require the applicant to install a communal heating system and commit to connecting to a future heat network is the level of uncertainty. Until a more formal plan is established by the LPA in the form of a formal designation of the area as a heat network zone, it is not considered appropriate to constrain applicants to this particular solution.

Important note on the 'interim' communal heating system

If an 'interim' heating system is proposed, this system should not be a fossil fuel based heating system. This is due to the risk of the temporary solution becoming permanent given that no formal plan of a low carbon heat network has been developed yet.

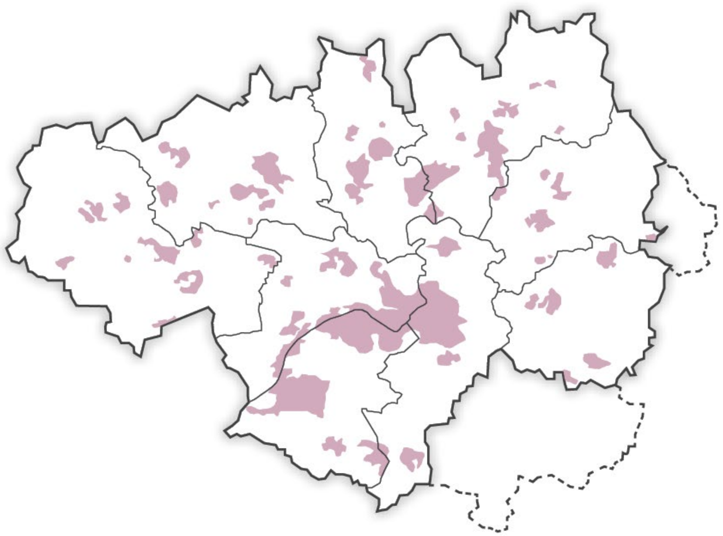
Low carbon heat appraisal

↓

Site is within a within a Heat and Energy Network Opportunity Area

↓ *Choose best option*

Adopt most suitable heating solution



Map of Heat and Energy Network Opportunity Areas

(created from GMCA Places for Everyone Joint Development Plan Document, March 2024)

Case 4 | When the site is in not within 500m of a low carbon network or in an opportunity area

This page summarises the expected process an applicant of a major application should follow when it **is located more than 500m away from any low carbon heat networks (existing or planned) and not within a Heat and Energy Network Opportunity Area.** A major application is defined as one with more than 10 units or 1,000m^2 of development floor area.

Steps to take

The applicant should undertake a low carbon appraisal and review various heating options.

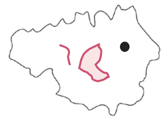
For major large applications (150+ homes and/or > 5,000m^2 non-residential floor area) , the applicant should contact the local authority to ensure there is no planned low carbon heat network in the vicinity.

Expected outcome

The applicant should select the best heating option in order to deliver low carbon heat which is affordable to residents and cost effective.

Low carbon heat appraisal

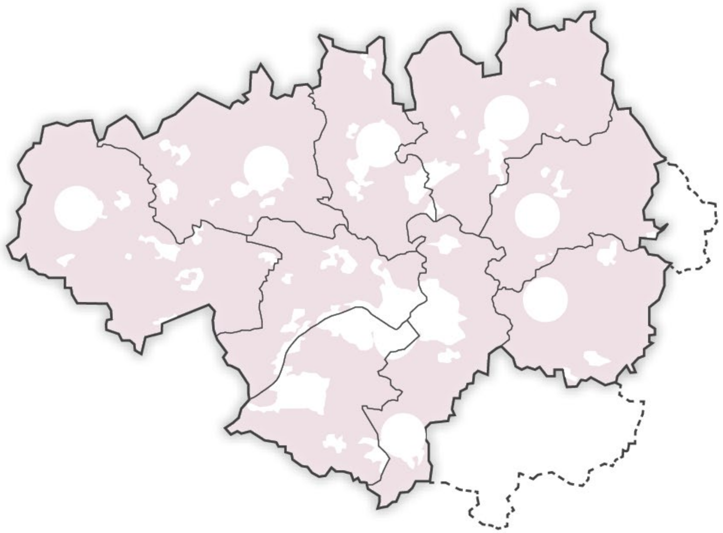
↓



Site is neither in the vicinity of an existing or planned heat network nor in an opportunity area

↓ ***Choose best option***

Adopt most suitable heating solution



Map of Greater Manchester showing all areas which are neither in the vicinity of an existing or planned low carbon heat network nor in a heat and energy network opportunity area (as of October 2024)

Note on existing high carbon heat networks

There is a limited number of existing heat networks in Greater Manchester

According to the Evidence Base Study for Greater Manchester Spatial Energy Plan (2016), the North West had 95 small 'networks' (average of 35 dwellings) and 20 medium and large heat networks (average of 190 and 1,035 dwellings respectively). Source: DECC, now DESNZ, 2013

As small 'networks' could be re-categorised as 'communal heating systems', it appears that the region only has a small number of existing heat networks, serving a fairly small proportion of the population (< 20,000) as well as some non-residential buildings.

Most of these existing heat networks use fossil fuels and are high carbon

Unfortunately most of these heat networks use gas boilers and/or gas Combined Heat and Power (CHP) as their heat generation plant. They also distribute heat at medium to high temperatures (> 70 degrees C) across long distances. Therefore, their carbon content of heat (delivered) is likely to be very high, in excess of 300 gCO_2/kWh, and could be as high as 900 gCO_2/kWh.

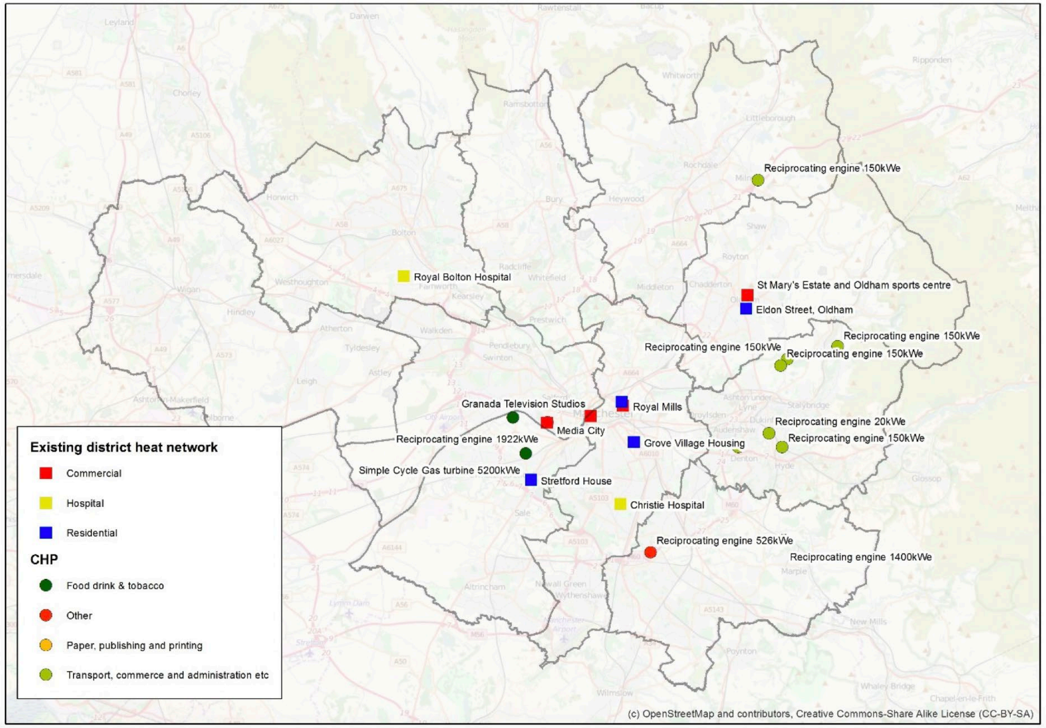
Guidance for major applications in the vicinity of these networks

Given the likelihood of the carbon content of heat of these networks being so much higher than many individual, communal and district scale heating solutions covered in this guidance document, major applications in the vicinity of these networks should not be connecting to them.

Exception for networks with a robust plan to decarbonise:

The exception to this approach is when the specific network can:

1. demonstrate that a decarbonisation plan is available and can be verified by the applicant as well as the Local Authority and/or GMCA;
2. estimate the projected average carbon content of heat for the next 25 years and confirm that it will be less than 100gCO_2/kWh and/or be lower carbon than an on-site communal air source heat pump system.
3. confirm that the decarbonisation plan is funded, at least partially.
4. indicate the implementation programme and key milestones.



Map of existing heat networks in Greater Manchester

(Source: Greater Manchester Spatial Energy Plan, Evidence Study, Energy Technologies Institute, 2016, https://www.greatermanchester-ca.gov.uk/media/1277/spatial-energy-plan-nov-2016.pdf)

What should be included in a Low Carbon Heat Appraisal for a major scheme?

For Major schemes its expected that an assessment is submitted as part of the planning application, reporting the predicted performance of the proposed heating system options against various criteria outlined in the table aside. If the development is located in Case A,B or C the appraisal needs to include a low carbon heating network alongside other options. For major schemes its is expected that the assessment be 1-2 pages long, and for large major schemes 5-10 pages long. In addition to this it is recommended to consider the points below, especially for large major applications.

Electrical capacity

- What the electrical supply/capacity is, is there sufficient current and projected capacity for the development or are new sub stations required.

Technical Design

- The system design, heat emitters, vectors for delivering heat and primary flow and return temperatures.
- Space constraints on site, or within the development itself
- Can the system be integrated and coupled with energy demand reduction technology (batteries), dynamic tariff pricing, electrical self-consumption (i.e. through integration with user owned PV systems).

Ease of operation and maintenance

- System controls and ease of use.
- Operation and maintenance (Owner-occupier, build-to-rent, speculative development, council managed, contracted third party maintenance programmes.) Also consider supply chain of replacement equipment.

Carbon emissions

- As well as the operational carbon outlined in the table, the likely embodied carbon impacts of the system (see CIBSE TM65.1).
- The GWP of the refrigerant type, considering emerging regulations.

Communal systems (Building scale or district)

- The likely heat losses of the network, relative to delivered useful heat.
- The increased potential risk of overheating due to communal pipes.
- Energy / heat metering and billing..

Performance area	Key performance indicator	Unit
Environmental performance	1. Fossil fuel use	Yes/no
	2. Carbon content of heat	gCO_2/kWh
	3. Local pollution	Description
Impact on residents/ building users	4. Estimated energy costs for heating and hot water	£/yr
	5. Estimated maintenance costs	£/yr (annualised)
	6. Estimated replacement costs	£/yr (annualised)
	7. Additional operating costs compared with benchmark low carbon heating system	+/- %
Impact on viability	8. Estimated capital cost of heating system	£/unit or £/building
	9. Additional cost compared with benchmark low carbon heating system	+/- %
Infrastructure development	10. Connection to low carbon heat network	yes/no
	11. Scale of application	m^2 GIA

Proposed Key Performance Indicators (KPI) to be assessed in the low carbon heat appraisal

The additional points should be considered when assessing heat networks

- The distance between heat source in the network and proposed development.
- Geotechnical/below ground conditions, space constraints, capacity constraints, local acoustic implications or air quality issues.
- If the network designed and operated in line with CIBSE CP1 Heat networks: Code of Practice for the UK, the Heat Trust guidance, and if the network is registered.
- Does a minimum heat delivery requirement or concession need to be met or agreed, and is this imposed by the DH / Energy Services Company (ESCO) provider.
- If waste heat is proposed to deliver low carbon heat, what source is proposed (energy from waste as an example).

5

Required justification for non-connection to a low carbon heat network

Justification and evidence required to be granted an exemption

Policy JP-S3

Policy JP-S3 is clear that there is an expectation that connection to a low carbon heat network is proposed '*unless it can be demonstrated that there are more effective alternatives for minimising carbon emissions or such connection is not practicable or financially viable*'.

Grounds for exemption

This section of the report explores the acceptable reasons as to whether or not a scheme could be considered 'exempt' with a reasonable justification.

Where exemption is being sought, in most cases, a robust, evidenced and clearly presented Low Carbon Heat Appraisal that summarises the reasoning for the justification will be required report or design note.

If an exemption is being sought, this should be raised with the case officer.

Important note

This page provides a structured framework for applicants to seek an exemption, in line with Policy JP-S3. It is important to note that the decision to validate the exemption is entirely at the discretion of the local planning authority which may accept it or refuse it.

There are four key grounds for exemption:

1. **Carbon grounds** – An alternative on-site heating system would be lower carbon than the carbon content of heat (delivered) of the low carbon heat network.
2. **Heating costs grounds** - Connection to the low carbon heat network would lead to heating costs for the residents which are more than 10% higher than an on-site heating system with an equal or lower carbon content of heat.
3. **Cost effectiveness grounds** - Connection to the low carbon heat network (and the installation of the on-site interim heating plant if needed) would not be as cost effective as installing an on-site heating system with an equal or lower carbon content of heat.
4. **Technical/practical grounds** – There are significant technical/practical reasons why the development cannot connect.

Summary of the potential grounds for exemption. More detail is provided on the following page.

Justification and evidence required to be granted an exemption

Carbon grounds for exemption

- The heat network has emissions above recognised national standards (currently 100gCO_2/kWh) and does not have a demonstrable decarbonisation plan.
- It is demonstrated that alternative communal or local systems are lower carbon.
- The heat network provider does not provide accurate and robust carbon content of heat calculations.
- The heat network provider uses the sleaving methodology in their carbon content of heat calculations (i.e. when new additional low carbon heating generation plan – e.g. heat pumps – are used as the only heat source, ignoring the carbon emissions of existing high carbon heating plan (e.g. gas boilers, gas CHP, etc).
- Whether a proposed development can determine that the heating loads are extremely low, e.g. Passivhaus certified development.

Cost effectiveness grounds for exemption

- The heating network operator provider does not provide accurate and robust proposed cost for connection.
- Capital costs attributed to the connection are greater in comparison to other on-site systems that deliver similar or improved levels of carbon performance.

Heating costs grounds for exemption

- The heating network operator provider does not provide accurate and robust estimates and commitments in terms of heating costs for the residents and/or building occupants.
- Heating costs for residents and/or building occupants are more than 10% higher than other on-site systems that deliver similar or improved levels of carbon performance.
- The standing charge element of the predicted heating cost for residents is deemed excessive (e.g. more than 50% of the predicted heating cost).
- Customers are not considered to be sufficiently protected against the risk of future unregulated heating price increases.

Technical /practical grounds for exemption

- Connection to a heat network is unlikely to uncertainty over deliverability of the heat network.
- Connection to a heat network is unlikely to due to programme reasons.
- The services distribution and route to connecting to the DH primary pipework is not feasible, either through distance or likely disturbance to existing utilities.
- Geotechnical conditions regarding the site or the expected route do not enable future connection.
- The primary heat losses of the heat network are deemed excessive, leading to a wasteful heat network (e.g. losses are determined to be as high as the expected heat demand of the residents/building occupants).

6

Appendix

6.1

Summary of common low carbon heating options

Residential low carbon heating - Individual dwelling scale - Air-source heat pump

Air source heat pump

Each home has its own Air Source Heat Pump (ASHP) on an external wall. Normally this is a single 'monobloc' unit, but some larger units have both an indoor and an outdoor unit, which together work the same way. Low grade heat is gathered from the external air by the Air Source Heat Pump, which uses electricity efficiently to upgrade the heat to a higher temperature – typically 45°C for space heating and 60°C for hot water. Hot water is stored in an individual hot water tank in each dwelling. Radiators or underfloor heating must be sized for a 45°C flow temperature.

Advantages

- No fossil fuels combusted on site
- Low heating costs
- Low operational carbon emissions
- Low distribution losses
- Low impact on overheating
- Can be used with dynamic tariffs to assist in reducing peak demand

Disadvantages

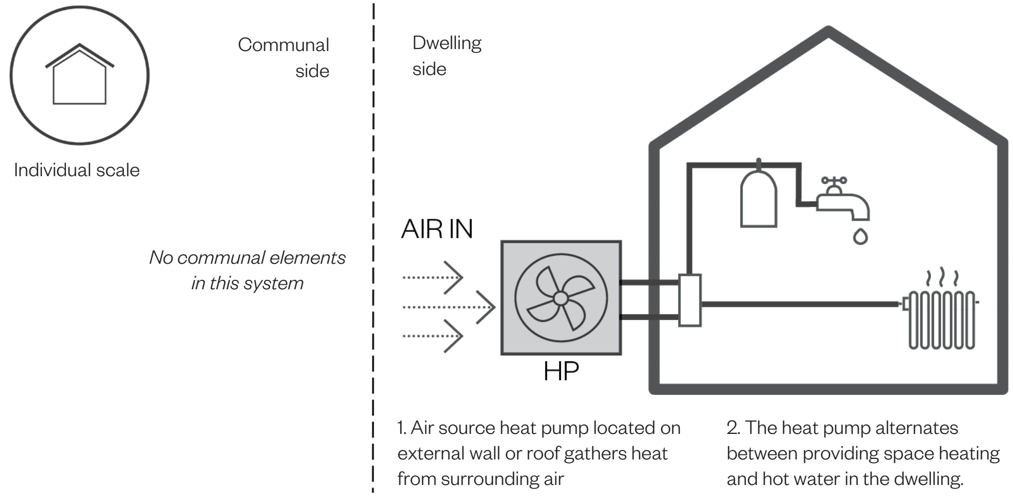
- Visual and acoustic impact of external unit

Key design considerations

- Each dwelling requires an individual external heat pump unit.

Suitability

Individual systems are suitable for bungalows, detached dwellings, terraced dwellings and some individual flats where the connection between the heat pump and the home it serves is less than approximately 12m.



Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
	•		•	•	

Daikin Altherma 3 Monobloc ASHP

Daikin Altherma 3 Monobloc ASHP

LG THERMA Heat Pump and system components

Examples of this system

Residential low carbon heating - Individual dwelling scale - Exhaust air heat pump

Exhaust air heat pump

An Exhaust Air Heat Pump (EAHP) combines mechanical ventilation, heat recovery and a heat pump system in one unit. Air is extracted from occupied spaces (typically “wet spaces” – kitchens and bathrooms) through mechanical ventilation. The warm extracted air is passed over a heat exchanger, where heat is recovered before exhausting used air to the outdoors. The heat pump uses electricity to efficiently upgrade the extracted heat to a higher temperature – typically 45C for space heating and 60C for hot water. Hot water is stored in an individual hot water tank in each unit. Where there is insufficient heat in outgoing ventilation air, the EAHP uses a direct electric top-up to meet demand. Radiators or underfloor heating must be sized for a 45C flow temperature.

Advantages

- No fossil fuels combusted on site
- No external unit required
- Low impact on overheating

Disadvantages

- Potentially challenging to locate quite large internal unit in a suitable location (ideally with 2m of an external wall)
- Potential increased ventilation rates to suit the need of the air source heat pump
- Single point of failure: if the air outlets and/or the filters are not maintained, this would affect both the ventilation and the heating system performance.

Key design considerations

- Suitable location for the unit and associated ductwork to be provided

Suitability

EAHPs are suitable for high density flat blocks where outdoor space is constrained and where the heating loads are low.

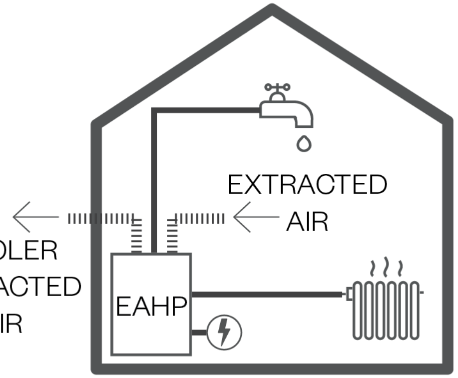
Communal side

Individual scale

No communal elements in this system

Simplified diagram of the system

Dwelling side

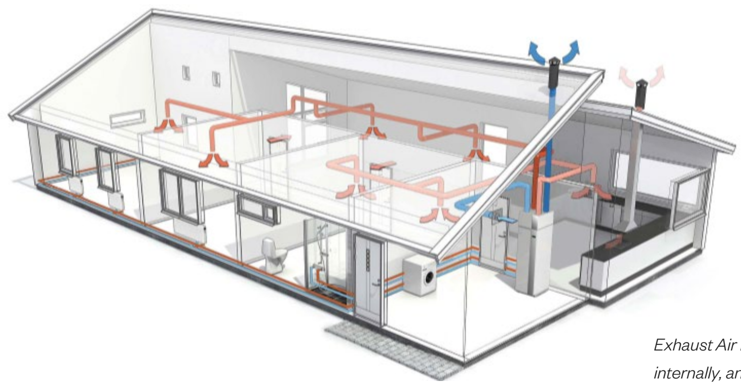


1. The Exhaust Air Source Heat Pump extracts warm air from occupied spaces. Heat is extracted from the outgoing ventilation air and upgraded by a heat pump for use for space heating and hot water.

2. In periods of high demand, the unit supplements heat from exhaust air with a direct electric top-up.

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
			•	•	•



Exhaust Air Heat Pumps are located internally, and use extracted heat from ventilation air as a heat source (NIBE)

Examples of this system

Residential low carbon heating - Individual dwelling scale – Hot Water Heat Pump

Direct Electric + Hot Water Heat Pump

Space heating and domestic hot water are provided separately. Space heating is provided through electric radiators, storage heaters or convectors. Domestic hot water is provided through a packaged hot water heat pump located inside the dwelling. The system is ducted to the outside, from which it draws and expels external air. Low grade heat gathered from the external air is efficiently upgraded using the heat pump element to heat hot water to 60C. Hot water is stored in an individual hot water tank in each unit. The systems are not connected.

Advantages

- No fossil fuels combusted on site
- No external unit
- Low embodied carbon
- Low impact on overheating

Disadvantages

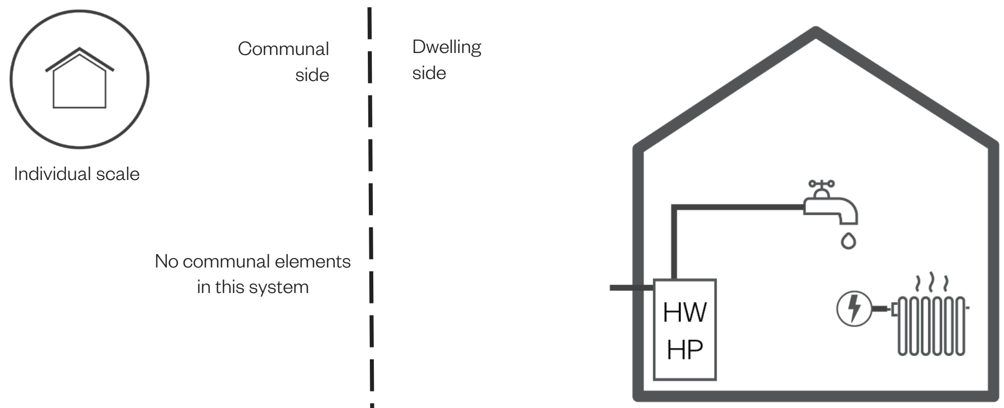
- Space heating costs could be moderate to high depending on efficiency of building fabric and comfort preferences.

Key design considerations

- The hot water heat pump needs to be close to an external wall.
- Additional electrical demand – possible infrastructure impacts.

Suitability

Hot water HPs are suitable for high density flat blocks where outdoor space is constrained and where the heating loads are very low.



1. A hot water heat pump located internally gathers heat from external air and upgrades it for hot water in the dwelling.

2. Space heating is provided by direct electric radiators.

Simplified diagram of the system

Key system characteristics					
Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
			•	•	

Electric radiators can be sourced in a variety of shapes, styles and colours

The hot water heat pump will need to be ducted to outside

Examples of this system

Residential low carbon heating - Individual dwelling scale – Direct Electric

Domestic hot water heat pump + direct electric

Space heating and domestic hot water are both heated by electricity directly. Space heating is provided through electric radiators. Domestic hot water is provided through an electric immersion heater in the hot water tank. The systems are not connected.

Advantages

- No fossil fuels combusted on site
- Low capital cost
- Low embodied carbon
- Low distribution losses
- Low impact on overheating

Disadvantages

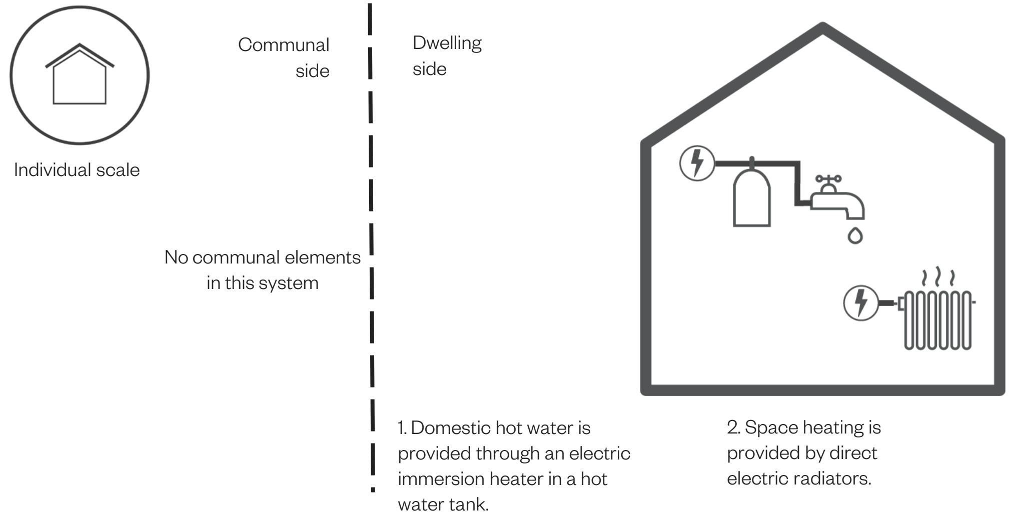
- Moderate heating costs.
- Moderate operational carbon emissions.
- Additional electrical demand

Key design considerations

- Building fabric should be very thermally efficient to reduce space heating demand, to mitigate occupants' heating costs.
- Additional electrical demand – possible infrastructure impacts.

Suitability

Direct electric heating and hot water systems are only suitable for small dwellings where the space heating demand and hot water use are very low.



Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
				•	

Electric radiators can be sourced in a variety of shapes, styles and colours

Hot water cylinder with direct electric heating

Examples of this system

Residential low carbon heating - Individual dwelling scale – Air to air heat pumps

Individual mini split air source heat pumps

Each unit has its own Air Source Heat Pump on an external wall which is connected via refrigerant pipework to wall, floor or ceiling mounted convector units in the main rooms. The convectors can either heat or cool the rooms. Domestic hot water is provided through an electric immersion heater in the hot water tank. The systems are not connected

Advantages

- ➕ No fossil fuels combusted on site
- ➕ Low space heating costs
- ➕ Low distribution losses
- ➕ Low impact on overheating
- ➕ Potential for active cooling.

Disadvantages

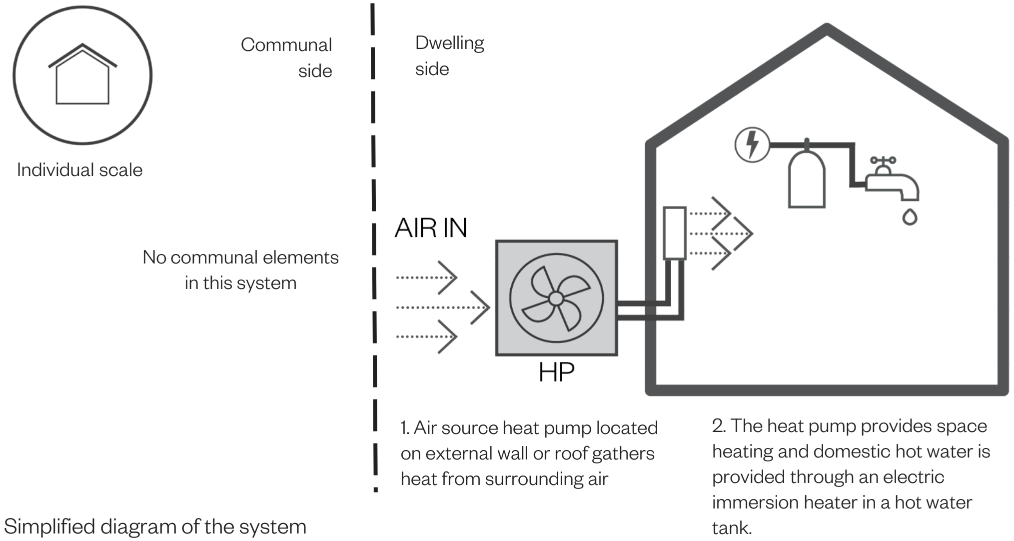
- ➖ Visual and acoustic impact of external unit
- ➖ Moderate hot water costs
- ➖ Moderate operational carbon emissions

Key design considerations

- Each dwelling requires an individual external heat pump unit.

Suitability

Air to air systems are suitable for small dwellings and especially where the risk of overheating is significant.



Simplified diagram of the system

Key system characteristics					
Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
	•		•	•	

External floor mounted heat pump unit

Internal units can be wall, floor or ceiling mounted

Examples of this system

Residential low carbon heating - Building scale – Communal air source heat pump

Communal air source heat pump supplying heat interface units

A communal bank of air source heat pumps is located on the roof of the building. Heat is distributed to each flat via ‘standard’ heating pipes (circa 65ºC). These pipes can lead to significant distribution losses and lead to an overheating risk, so their design needs to be carefully developed and specified. Within each dwelling, a heat interface unit (HIU) gathers heat from these pipes using heat exchangers. The HIUs provide space heating and instantaneous hot water. These HIUs could also be the cause of significant losses and a high overheating risk.

Advantages

- No fossil fuels combusted on site
- Dwellings do not require individual external heat pump units making it suitable for flats and high-density housing.
- Not hot water storage required in flats

Disadvantages

- High capital cost
- Impact on overheating
- Communal distribution and associated riser space
- Communal maintenance

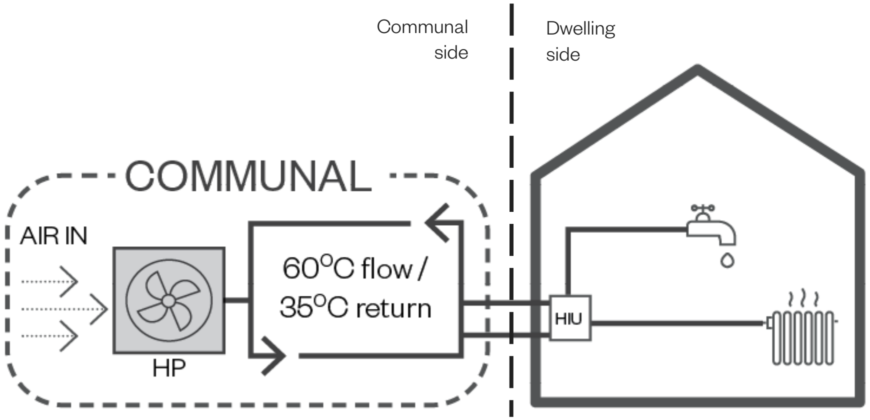
Key design considerations

- Allow enough space on the roof of each building
- Consider acoustic impact of the roof mounted air source heat pumps
- Consider distribution losses carefully

Suitability

Communal heating systems are suitable for high density flat blocks where pipe connections between all units can be reasonably short to limit system heat losses.

Building scale



1. Air source heat pumps located on roof gather heat from surrounding air.

2. Heat pumps deliver heat at a flow temperature of approximately 65ºC.

3. A heat interface unit in each dwelling gathers heat from the incoming heating pipe through a heat exchanger and uses it for space heating and hot water.

Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
	•	•			

Communal rooftop air source heat pumps

Heat Interface Unit

Examples of this system

Residential low carbon heating - Building scale – Communal ambient loop

Communal system supplying individual heat pumps at ambient temperature

A communal bank of air source heat pumps is located on the roof of the building and/or water is circulated in a large number of 150-200m deep boreholes. The water is circulated in a shared loop flowing at an ambient temperature (25 – 30^{o}C). Within each dwelling, a heat pump unit (HP) uses electricity to upgrade the heat from the communal ambient loop to a higher temperature. Hot water is stored in an individual hot water tank in each flat.

Radiators or underfloor heating must be sized for low flow temperature as heat pumps are most efficient when operating at low temperatures.

Advantages

- No fossil fuels combusted on site
- Dwellings do not require individual external heat pump units making it suitable for flats and high-density housing.
- Potential for active cooling.

Disadvantages

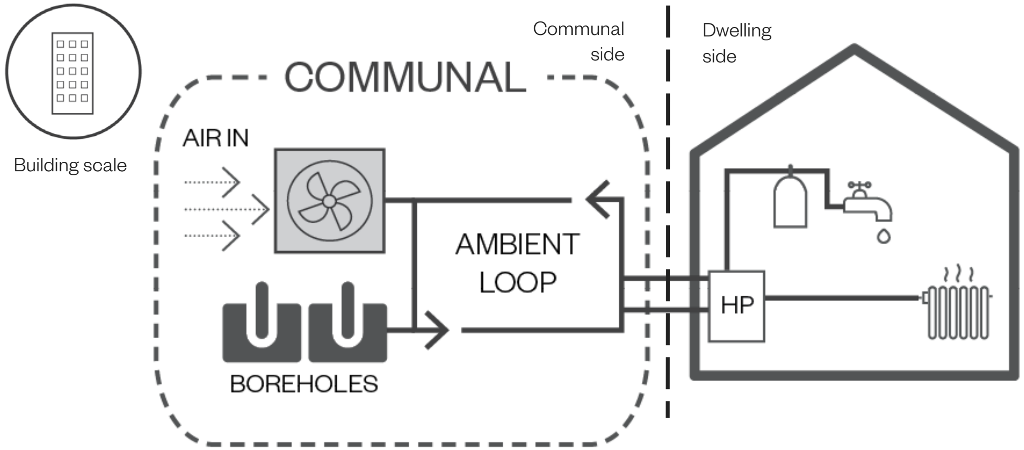
- High capital cost
- Impact on overheating
- Communal distribution and associated riser space
- Communal maintenance

Key design considerations

- Allow enough space on the roof of each building or suitable space and ground conditions for ground array.
- Consider acoustic impact of the roof mounted air source heat pumps

Suitability

Ambient loop systems are suitable for large developments of multiple dwellings, including high rise flats.



1. Either air source heat pumps located on roof gather heat from surrounding air **or** water is circulated through an array of deep boreholes to gather heat from surrounding ground.

2. Heat pumps deliver heat to a communal loop, which flows at a similar temperature to the inside of the building.

3. A heat pump in each dwelling upgrades heat from the communal loop for use as space heating and hot water in the dwelling.

Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Mechanical ventilation with heat recovery (MVHR) included?
	(●)		●	●	

Individual heat pump and hot water tank in each dwelling

Communal rooftop air source heat pumps

Individual heat pump in each dwelling

Examples of this system

Non-residential low carbon heating - Building scale – Variable Refrigerant Flow System

Variable refrigerant flow (VRF / VRV)

A group of Air Source Heat Pumps usually located on a roof connect via refrigerant pipework to ceiling mounted cassette units throughout the building. The cassette units can either heat or cool and it is possible to have some heating while others are cooling at the same time. In this way, energy can be moved from one part of the building to another, making the system overall very efficient.

Advantages

- No fossil fuels combusted on site
- Low space heating costs
- Low distribution losses
- Combined heating and active cooling system.

Disadvantages

- High volume of refrigerant used in extensive pipework system – risk of leakage
- Moderately high embodied carbon

Key design considerations

- Separate ventilation system required.

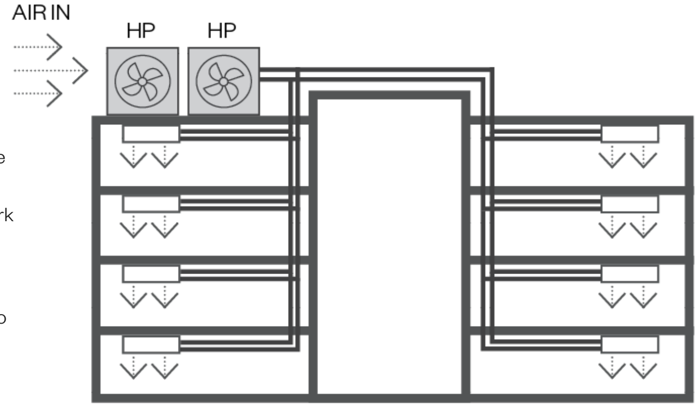
Suitability

VRF systems are suitable for buildings with high internal loads and can be used in most size developments.

Building scale

1. Air source heat pumps located on the roof gather heat from surrounding air

2. The heat pumps connect to a network of pipes carrying refrigerant gas to connect to 'cassette' units in each occupied room or zone. The cassettes blow warm or cool air into each room to provide heating and cooling.



Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Potential for active cooling?
	•	•

External condenser units

Internal units can be wall or ceiling mounted

Examples of this system

Non-residential low carbon heating - Building scale – Air source heat pump heating

Central air source heat pump supplying fan coil units or radiators

A communal bank of air source heat pumps is located on the roof of the building. Heat is distributed via hot water pipework to either ceiling mounted fan coil units or radiators throughout the building.

Advantages

- No fossil fuels combusted on site
- No refrigerant distribution – low risk of leakage
- Fan coils can achieve very high outputs.

Disadvantages

- Separate cooling system required
- Moderately poor energy efficiency

Key design considerations

- Separate ventilation system required
- Acoustic impact of the fan coils
- Filters in fan coil units require regular replacement – access and disruption
- Impact on net lettable area of radiators

Suitability

Fan coil systems are suitable for large buildings with very high internal loads.

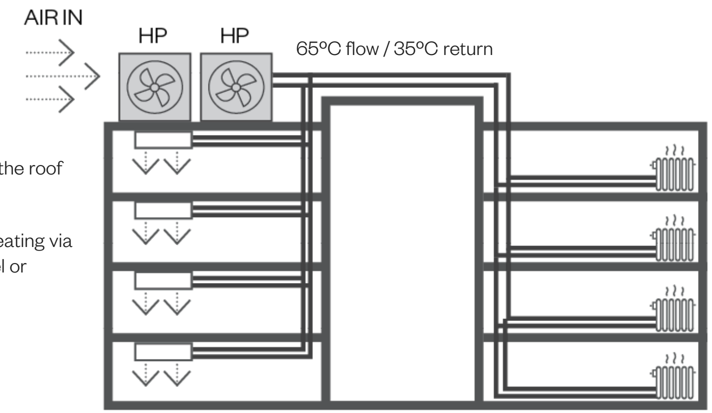
Radiators are suitable for smaller buildings with lower occupancy density.

It is possible to combine the two types of heat emitters in one system with fan coils in high load areas and radiators elsewhere in the same building all served from the central ASHPs.

Building scale

1. Air source heat pumps located on the roof gather heat from surrounding air

2. The heat pump provides space heating via fan coil units mounted at ceiling level or radiators in the occupied areas.



Simplified diagram of the system

Key system characteristics		
Site-wide Energy Centre?	External plant on each building?	Potential for active cooling?
	•	

Roof mounted air source heat pumps

Large surface area radiators

Ceiling mounted fan coil unit

Examples of this system

Non-residential low carbon heating - Building scale – Hybrid / Versatemp system

Manufacturer specific systems

There are systems that have been developed by manufacturers to work in particular applications. Two examples are the Mitsubishi hybrid VRF system and the Clivet Versatemp system. Both use a central heat pump serving a network of pipework to distribute heating and cooling throughout the building. The hybrid system has some refrigerant pipework centrally, connecting to heat exchangers in the building zones from which both heating and cooling water systems distribute to ceiling mounted fan coil units. The Versatemp system distributes ambient temperature water to a network of small heat pumps which can either heat or cool. Both systems allow simultaneous heating and cooling.

Advantages

- No fossil fuels combusted on site
- Combined heating and active cooling systems.
- Good energy efficiency

Disadvantages

- Single supplier systems – capital cost risk
- Versatemp units can be noisy for some applications
- Hybrid system uses more refrigerant than a purely water-based system

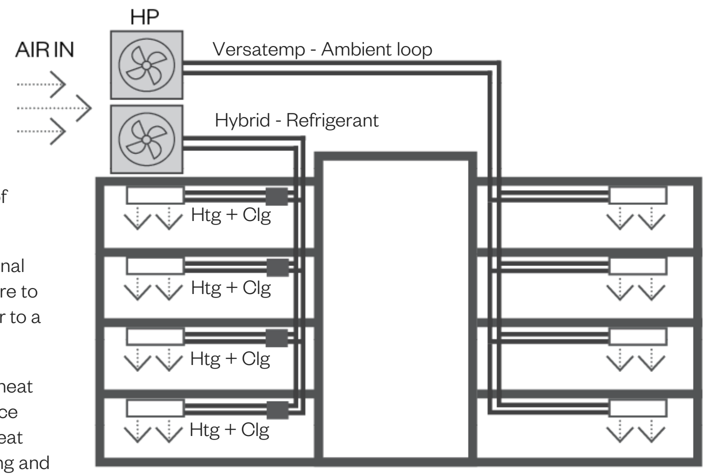
Key design considerations

- Understand manufacturer requirements for optimum operation
- Separate ventilation system required

Suitability

Both systems are good for multi-zone buildings with different users in one building requiring different conditions.

Building scale



1. Air source heat pumps located on roof gather heat from surrounding air.

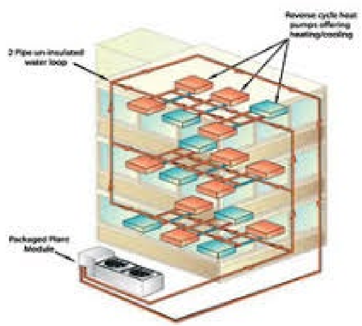
2. Heat pumps deliver heat to a communal loop, which flows at a similar temperature to the inside of the building (Versatemp) or to a network of heat exchangers.

3. A heat pump in each zone upgrades heat from the communal loop for use as space heating and cooling (Versatemp) or a heat exchanger in each zone provides heating and cooling water circuits to serve fan coil units.

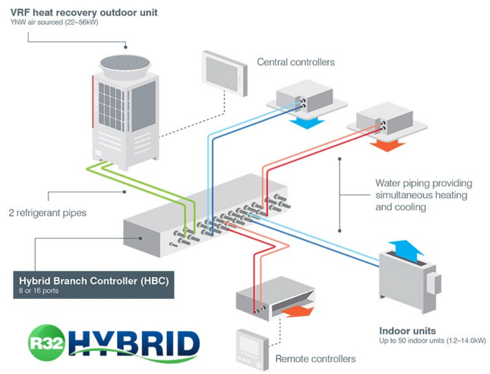
Simplified diagram of the systems

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Potential for active cooling?
	•	•



Versatemp – image source: Clivet UK



Hybrid VRF system – image source: Mitsubishi Electric

Manufacturer diagrams of these systems

Residential and non-residential low carbon heating - District scale (Heat pumps)

District air source heat pump supplying heat exchangers / heat interface units

The heat pumps are located in an energy center. Heat is distributed to each building via a district heating loop with a flow temperature of at least 65°C. For non-domestic buildings, there is a heat exchanger per building. For dwellings, HIUs provide space heating and instantaneous hot water.

Advantages

- Buildings do not require individual external heat pump units making it suitable for high-density developments.
- Buildings do not require individual plant maintenance.
- Potential to provide low carbon heat at a lower cost than the combined individual buildings solutions (this should be demonstrated in each case).
- Reduces the levels of electricity demand, helping to reduce grid constraints.

Disadvantages

- High losses
- Risk of overheating (due to heating pipes in circulation areas)
- Communal distribution and associated riser space (although this will be offset by avoiding individual plant)
- District and communal maintenance (although this will be offset by individual plant maintenance)

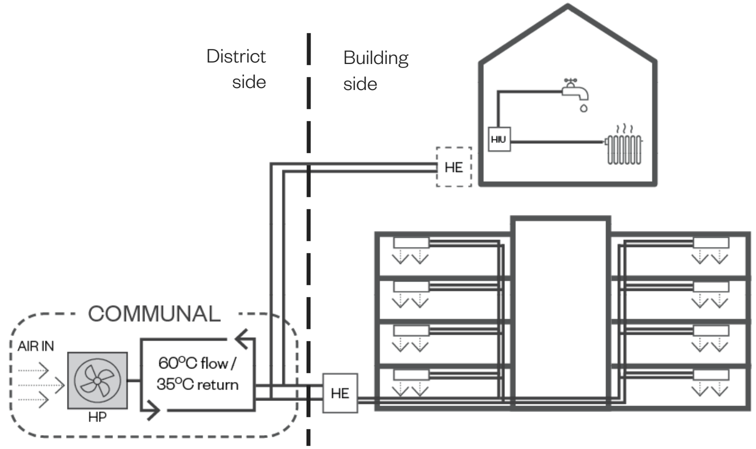
Key design considerations

- Energy centre and extensive buried district heat pipework routes.
- Consider distribution losses carefully.
- Costs to residents should be considered and contracts for heat supply will be required for all residents.

Suitability

District heating systems are suitable for very large masterplan developments where there are enough users to justify the cost of the infrastructure.

District scale



1. Air source heat pumps in an energy centre gather heat from surrounding air.

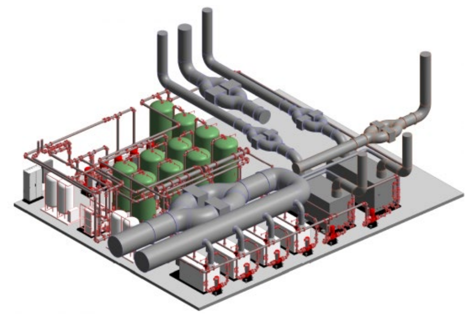
2. Heat pumps heat at a flow temperature of more than 65°C.

3. A heat exchange unit in each building or a heat interface unit in each dwelling gathers heat from the incoming heating pipe and uses it for space heating and hot water.

Simplified diagram of the system

Key system characteristics

Site-wide Energy Centre?	External plant on each building?	Heat interface unit (HIU) in each home?	Heat pump required for each home?	Hot water cylinder required in each home?	Potential for active cooling?
•	(•)	•			



Example energy centre

Heat Exchanger serving a large building

Examples of this system

Residential and non-residential low carbon heating - District scale (other heat sources)

District heating systems have one or more energy centres which utilise different heat sources, all of which feed into the network in varying proportions, depending on how much heat is needed.

There is usually a constant 'base' heat supply which is permanently operating at or close to its maximum output. Traditionally, this has been a 'combined heat and power (CHP) plant. CHP is a fossil fuel powered generator which is generating electricity and producing heat as a waste product. These systems are not compatible with a net zero target because they use fossil fuels. Air source or ground source heat pumps can be used to provide this base load or waste heat sources, such as sewers or high heat processes such as data centres.

There will also be a secondary system which operates when heat demand is higher than the base load can supply. This could be provided by air source heat pumps.

Depending on the secondary system, it may be necessary to have a separate system to cope with high peak loads during very cold weather. Traditionally, this has been provided by gas boilers**, but a net zero compatible system could use electric boilers.**

District heat networks can be based on waste heat sources, heat pumps or fossil fuel plant. Whether or not they are low carbon, or compatible with net zero objectives, depends on the heat sources used. All networks rely on extensive underground pipe systems.

Image sources: Islington Council and UK Gov website

Energy from Waste (EfW)

Industrial processes used to generate electricity from converting and burning municipal waste can be used as the primary heat source. The carbon emissions of these installations are attributed to the electricity they generate so, on paper, they appear to be low carbon heat sources. In reality, there are significant greenhouse gas emissions from the process. There are targets to reduce waste available to process over the medium term, so any heating network based around an EfW plant needs to have a non-fossil fuel back up in place.

The waste hierarchy places energy generation (recovery) quite low – better than landfill but not as good as most other strategies, so EfW plant has a limited place in future planning for heat networks.

Energy from waste plant. Image source: Construction News

6.2

Embodied Carbon & Whole Life Carbon Analysis of heating systems

Embodied Carbon & Whole Life Carbon Analysis of heating systems

It is important that when selecting the appropriate heating system for Net Zero Carbon buildings, the embodied carbon and whole life carbon emissions from MEP system are considered.

The MEP systems are a substantial element in the whole life carbon of any building, driving the operational carbon and also representing, according to CIBSE, between 1% and 25% of the total embodied carbon of a typical home.

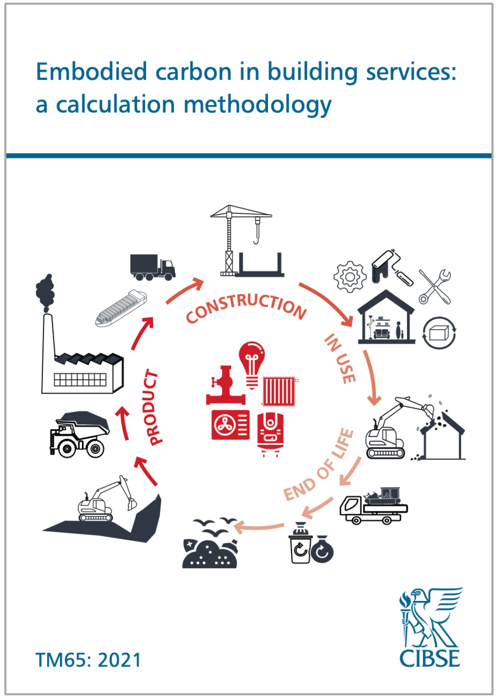
Data sources are limited

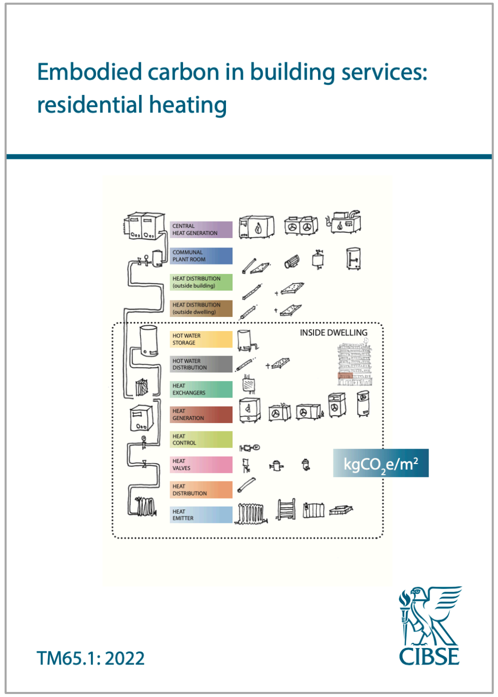
Reliable and consistent data on the embodied carbon of many MEP system components, whilst improving, is scarce at best and unavailable in many cases. The Chartered Institute of Building Services Engineers (CIBSE) has been collecting and collating data to try to provide a better framework for analyses, but it is still quite early in this process.

CIBSE have published a guide, Technical Memorandum 65 (TM 65) which sets out a proposed methodology for assessments and this was followed by TM65.1 which focuses on residential heating and hot water systems that are commonly used in various scale residential projects.

Key outcomes

One of the key measures to reduce the potential whole life carbon emissions on a project, is to ensure the volume of refrigerant is reduced by minimising pipe lengths or using mono-block equipment. The use of refrigerants with the lowest Global Warming Potential (GWP) should be adopted wherever possible, for example ammonia, CO_2, water, or propane (R290).





CIBSE in collaboration with Elementa/Introba consulting and several industry experts have released guidance on how to more accurately assess the embodied carbon of building services and in particular the heating systems for residential buildings.

6.3

Glossary, abbreviations and useful links

Glossary of terms

Air permeability – *'The measure of airtightness of the building fabric. It is defined as the air leakage rate per hour per m2 of envelope area at the test reference pressure differential of 50Pa or 4Pa.'* Source: Building Regulations Part L

Airtightness – *The resistance of the building envelope to infiltration when ventilators are closed. The greater the airtightness at a given pressure difference across the envelope, the lower the infiltration.'* Source: Building Regulations Part L

Biogenic/ sequestered carbon – *'Carbon removals associated with carbon sequestration into biomass, as well as any emissions associated with this sequestered carbon. Biogenic carbon must be reported separately if reporting only upfront carbon, but should be included in the total if reporting embodied carbon or whole life carbon.'* Source: *RICS Whole life carbon assessment for the built environment, 2nd edition*

Capacity – The capacity of the system is the maximum power output. It depends on the installation's size and technical capability. The capacity may be in terms of electrical or thermal output.

Carbon sequestration – *'The process by which CO2 is removed from the atmosphere and stored within a material, for example by being stored in biomass as biogenic carbon by plants.'* Source: *RICS Whole life carbon assessment for the built environment, 2nd edition*

Chartered Institute of Building Services Engineers (CIBSE) TM52 - '*This Technical Memorandum (TM) is about predicting overheating in buildings. It is intended to inform designers, developers and others responsible for defining the indoor environment in buildings. It includes the recommendations of the Overheating Task Force, which has sponsored and published this document.'* Source: CIBSE

Chartered Institute of Building Services Engineers (CIBSE) TM59 methodology - *'The application of this technical memorandum, by standardising the assessment methodology, should play a key role in limiting overheating risk in new and refurbished homes.'* Source: CIBSE

Chartered Institute of Building Services Engineers (CIBSE) TM65 methodology - '*A calculation methodology (TM65) outlines the need for assessment of embodied carbon of products linked to building services engineering systems, to increase knowledge and facilitate research related to whole life carbon.'* Source: CIBSE

Combined heat and power – A system which generates electricity whilst also capturing usable heat generated in the process. Typically, when referring to CHP it is inferred that this is gas-fired though this does not necessarily need to be the case.

Deep retrofit – '*Development involving the re-use of as much of the existing building as possible, but may involve substantial demolition and replacement of parts of (but not all of) the façade, core, floor and slab, and which results in significant energy, performance, and climate adaptation upgrades, comparable to those a new building, dramatically reducing carbon emissions from the building and prolonging its usable lifespan.'* Source: *Westminster City Plan Retrofit first Topic Paper, City Plan 2024.*

Demolish and recycle - *'Traditional demolition, with elements and materials processed into new elements, materials and objects for use on the site or on another site.'* Source: *CE Statement 2022.*

Disassemble and reuse - '*Disassemble sections of a building and enable their direct reuse ideally on the site or, where this is not possible, off site (with nearby sites preferred). This approach also includes careful selective deconstruction of the building and material types i.e. taking apart each layer and material type as much as possible, minimising damage to parts and maintaining their value, and then reusing those elements and materials. If reuse is not possible, materials may be carefully and selectively separated for processing and recycling into new elements, materials and objects.'* Source: *CE Statement 2022.*

Embodied carbon – '*The embodied carbon emissions of an asset are the total GHG emissions and removals associated with materials and construction processes, throughout the whole life cycle of an asset (modules A0–A5, B1–B5, C1–C4, with A0[2] assumed to be zero for buildings.'* Source*: RICS Whole life carbon assessment for the built environment, 2nd edition*

Energy Use Intensity (EUI) – *'An annual measure of the total energy consumed in a building … EUI can be expressed in GIA (Gross Internal Area) or NLA (Net Lettable Area). In this document the EUIs are expressed in GIA unless specified.'* Source: *LETI*

Environmental Product Declaration (EPD) – *'A document that clearly shows the environmental performance or impact of any product or material over its lifetime.'* Source: *RICS Whole life carbon assessment for the built environment, 2nd edition*

Form factor – *'Form factor measures how compact a building is and how well it retains heat. It is a ratio of external fabric area to internal area.*

Fossil fuel – *'A natural fuel such as petroleum, coal or gas, formed in the geological past from the remains of living organisms. The burning of fossil fuels by humans is the largest source of emissions of carbon dioxide, which is one of the greenhouse gases that allows radiative forcing and contributes to global warming.'* Source: *LETI*

Glossary of terms

Glazing ratio – *'The proportion of glazing to opaque surface in a wall. Also called window-to-wall ratio, it is a key variable in façade design affecting energy performance in buildings.'* Source: LETI

Global warming potential (GWP) – The Global Warming Potential of a refrigerant is often expressed in carbon dioxide equivalents (CO2e). The timescale the value refers to may be in the order of 50 or 100 years.

Gross Internal Area – *'Broadly speaking the whole enclosed area of a building within the external walls taking each floor into account and excluding the thickness of the external walls.'* Source: gov.uk

G-value – *'Sometimes also called a Solar Factor or Total Solar Energy Transmittance, it is the coefficient commonly used in Europe to measure the solar energy transmittance of windows.'* Source: LETI

Heat Pump – A heat pump is a device that transfers thermal energy from a heat source to a heat sink (e.g. the ground to a house). There are many varieties of heat pump e.g. air, ground and water source heat pumps. The first word in the title refers to the heat source from which the pump draws heat. The pumps run on electricity, however less energy is required for their operation than they generate in heat, hence their status as a renewable technology.

Inventory of carbon & energy (ICE) database – *'The Inventory of Carbon and Energy (also know as the ICE database) is an embodied carbon database for building materials which is available for free on this page. It contains data for over 200 materials, broken down into over 30 main material categories.'* Source: ICE

Kilowatt – Unit of power equivalent to a thousand watts.

Kilowatt hour – Unit of energy. It is equal to the amount of energy a system will generate in an hour whilst running at a kilowatt power output.

Life Cycle embodied carbon – *See 'embodied carbon'*

Major development – *'Major development is: for housing, development where 10 or more homes will be provided, or the site has an area of 0.5 hectares or more [OR] The provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more [OR] Development carried out on a site having an area of 1 hectare or more.'* Source: gov.uk

Major renovation – *'Defined in regulation 35 as the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation.'* Source: Approved Document Part L 2021.

Megawatt – Unit of power equivalent to a million watts

Megawatt hour – Unit of energy. It is equal to the amount of energy a system will generate in an hour whilst running at 1 megawatt power output.

Minor development – *'Minor non-residential extensions (industrial/commercial/leisure etc): extensions with a floorspace not in excess of 250 square metres [OR] Alterations: development that does not increase the size of buildings, e.g. alterations to external appearance [OR] Householder development: for example, sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling (e.g. subdivision of houses into flats) or any other development with a purpose not incidental to the enjoyment of the dwelling.'* Source: gov.uk

Offsetting – *'Payment to receive credit for a certified unit of carbon emission reduction or removal carried out by another actor. Varying levels of accreditation exist for carbon offsets.'* Source: UK Net Zero Carbon Buildings Standard

Operational carbon – *'Operational carbon – energy (module B6) refers to GHG emissions arising from all energy consumed by an asset in use, over its life cycle.'* Source: RICS Whole life carbon assessment for the built environment, 2nd edition

Overheating – *'Refers to discomfort to occupants caused by the accumulation of warmth within a building.'* Source: The Construction Wiki

Partial retention and refurbishment – '*Significant quantities of carbon-heavy aspects of the building are retained in place, such as the floors and substructure, with replacement of some elements of the building, such as walls or roofing. More significant refurbishment can involve adding floors or extensions.'* Source: CE Statement 2022

Passivhaus planning package (PHPP) – Predictive energy modelling tool, typically used for Passivhaus projects, but can be used for any project to better predict performance and deliver outcomes.

Peak demand – *'Refers to the times of day when our electricity consumption is at its highest which, in the UK, occurs between 5-30pm to 6pm each weekday evening.'* Source: LETI

Performance gap – *'This term refers to the discrepancy between energy predictions at design stage, compared to in-use energy consumption of buildings.'* Source: LETI

Photovoltaics (PV) – solar panels converting sunlight into electricity.

Glossary of terms

Post-occupancy evaluation (POE) – *'Post-occupancy evaluation is the process of obtaining feedback on a building's performance in use after it has been built and occupied. By accurately measuring factors such as building use, energy consumption, maintenance costs and user satisfaction, POE allows for a process of continuous improvement in the construction industry.'* Source: RIBA

Regulated energy – *'Regulated energy is building energy consumption resulting from the specification of controlled, fixed building services and fittings, including space heating and cooling, hot water, ventilation, fans, pumps and lighting. Such energy uses are inherent in the design of a building.'* Source: The Construction Wiki

Renewable energy – *'Renewable energy technologies use natural energy sources to generate electricity and/or heating/cooling. Sources include solar, wind, wave, marine, hydro, etc.'* Source: LETI, 2nd edition

Responsible retrofit – *'Responsible retrofitting is an informed and integrated attitude to retrofit in a way that enables people to reduce the operational carbon of a building, improve energy efficiency, and/or improve a building's resilience to the impacts of climate change. Responsible retrofit will take into account the building's location, context, design, construction, materials and use, to ensure retrofit measures perform well and avoid adverse impacts to health, heritage and the natural environment.'* Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Retain and retrofit - *'The vast majority of the building's fabric is retained, with the building refurbished for the same or new uses through restoring, refinishing and future-proofing. This also encompasses retrofitting, where new technology or features are added to existing buildings to make them more efficient and to reduce their environmental impacts.'* Source: Circular Economy (CE) Statement 2022.

Retrofit – *'Development involving the re-use of at least 50% of the existing building in-situ (by mass or volume), retaining as a minimum the foundations, core, and floor slabs, and which results in energy, performance, and climate adaptation upgrades, which will reduce carbon emissions from the building and prolong its usable lifespan.'* Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

RICS Professional Standard (RICS PS v2 2023)– *'Sets requirements or expectations for RICS members and regulated firms about how they provide services or the outcomes of their actions. RICS professional standards are principles-based and focused on outcomes and good practice. Any requirements included set a baseline expectation for competent delivery or ethical behaviour. They include practices and behaviours intended to protect clients and other stakeholders, as well as ensuring their reasonable expectations of ethics, integrity, technical competence and diligence are met. Members must comply with an RICS professional standard.'* Source: RICS Whole life carbon assessment for the built environment, 2nd edition

Substantial demolition – *'Development consisting of the demolition of 50% or more of existing above ground structures, by area or volume, but not constituting total demolition.'* Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Thermal bridge – *'Heat makes its way from the heated space towards the outside. In doing so, it follows the path of least resistance. A thermal bridge is a localised area of the building envelope where the heat flow is different (usually increased) in comparison with adjacent areas (if there is a difference in temperature between the inside and the outside).'* Source: LETI

Total demolition – *'The removal, deconstruction or demolition of an existing building, which will entail the removal of all of its fit out, superstructure, cores, and basement slab(s), but which could involve the retention of parts or all of the façade.'* Source: Westminster City Plan Retrofit first Topic Paper, City Plan 2024.

Unregulated energy – *'Unregulated energy is building energy consumption resulting from a system or process that is not 'controlled', i.e. energy consumption from systems in the building on which the Building Regulations do not impose a requirement. For example, this may include energy consumption from systems integral to the building and its operation, e.g. IT equipment, lifts, escalators, refrigeration systems, external lighting, ducted-fume cupboards, servers, printers, photocopiers, laptops, cooking, audio-visual equipment and other appliances.'* Source: The Construction Wiki

Upfront embodied carbon – *'Upfront carbon emissions are GHG emissions associated with materials and construction processes up to practical completion (modules A0–A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.'* Source: RICS Whole life carbon assessment for the built environment, 2nd edition

U-value – *'The rate of transfer of heat through a structure (which can be a single material or a composite), divided by the difference in temperature across that structure. The units of measurement are W/m²K.'* Source: LETI

Whole life carbon (WLC) - *'Whole life carbon emissions are the sum total of all asset-related GHG emissions and removals, both operational and embodied, over the life cycle of an asset, including its disposal (modules A0–A5, B1–B7, B8 optional, C1–C4, all including biogenic carbon, with A0[2] assumed to be zero for buildings). Overall whole life carbon asset performance includes separately reporting the potential benefits or loads from future energy or material recovery, reuse, and recycling and from exported utilities (modules D1, D2).'* Source: RICS Whole life carbon assessment for the built environment, 2nd edition

Abbreviations

AHU: Air Handling Unit

ASHP: Air Source Heat Pump

CHP: Combined Heat and Power

CIBSE: Chartered Institution of Building Services Engineers

CLT: Cross Laminated Timber

CO_2e: Carbon dioxide equivalent

DHW: Domestic Hot Water

EAHP: Exhaust Air Heat Pump

EC: Embodied Carbon

EPD: Environmental Product Declaration

EUI: Energy Use Intensity

GIA: Gross Internal Area

HP: Heat Pump

GGBS: Ground Granulated Blast-furnace Slag

GHG: Greenhouse gas

GWP: Global warming potential

IPCC: Intergovernmental Panel on Climate Change

IStructE: Institution of Structural Engineers

kW: Kilowatt

kWh: Kilowatt hour

KPI: Key performance indicator

LETI: Low Energy Transformation Initiative

MEP: Mechanical, electrical and plumbing

MVHR: Mechanical Ventilation with Heat Recovery

MW: Megawatt

MWh: Megawatt hour

NZCBS: UK Net Zero Carbon Buildings Standard

PH: Passivhaus

PHPP: Passivhaus Planning Package

POE: Post-Occupancy Evaluation

PV: Photovoltaic

RIBA: Royal Institute of British Architects

RICS: Royal Institute of Chartered Surveyors

RICS PS: RICS Professional Statement

UKGBC: The UK Green Building Council

UPVC: Unplasticized Polyvinyl Chloride

WLC: Whole life carbon OR whole life cycle

Useful links

- BAMB –Building as material passports
- BECD – Built Environment Carbon Database
- Building to net zero: costing carbon in construction: Government Response to the Committee's First Report – Environmental Audit Committee
- CIRCuIT
- Climate action tracker 2023
- Climate Change Committee - the sixth carbon budget
- CWCT– How to calculate embodied carbon of facades
- Easi Guide Passivhaus Design
- European Union's Roadmap for Whole Life Carbon
- Greencore Homes – low carbon offsite construction
- IStructE How to calculate embodied carbon 2nd edition
- IStructE Lean design: 10 things to do now
- LETI Circular economy 1 pager
- LETI Climate emergency design guide
- LETI Embodied Carbon Primer
- LETI opinion piece - Circular economy and carbon in construction
- LETI opinion piece – operational carbon in whole life carbon assessments
- LETI The Whole Life Carbon Alignment paper
- Net Zero Carbon Toolkit
- Net Zero Carbon Building Standard Pilot
- Net Zero: The UK's Contribution to Stopping Global warming
- Part B building Regulations Volume 1: Domestic
- Part Z proposed amendment to building regulations
- Policy paper by Part Z group of experts , January 2024
- Places for Everyone - Joint development plan document for Bolton, Bury, Manchester, Oldham, Rochdale, Salford, Tameside, Trafford and Wigan
- RIBA 2030 climate challenge
- RICS Whole Life Cycle assessment 2017, 1st edition
- RICS Whole Life Cycle Assessment 2023, 2nd edition
- Services Guide - Zero Carbon Hub
- Shading for housing - Design guide for a changing climate
- The concrete centre– Sustainable concrete
- The construction material pyramid
- Thermal Bridging Guide - Zero Carbon Hub
- TM52 - The limits of thermal comfort: avoiding overheating
- TM54 - Evaluating operation energy use at the design stage
- TM59 - Design methodology for the assessment of overheating risk in homes
- TM65 - Embodied carbon in building services
- UK Net Zero Carbon Building Standard - Pilot
- UKGBC - Circular economy guidance for construction clients
- UKGBC - Circular economy metrics for buildings
- UKGBC – Net zero whole life carbon technical study
- Understanding overheating - where to start - NHBC

Accessibility information

GMCA acknowledges that this guidance is not fully accessible as it would be a disproportionate burden to do so, particularly as it is extremely technical, contains a high number of illustrations and tables, and is used by a low number of people.

Please contact planningandhousing@greatermanchester-ca.gov.uk if you require an accessible version of this document. GMCA will consider your request and aim to get back to you within seven working days.

Version 1.02 – March 2025

Authors:

Levitt Bernstein People.Design

Etude

GMCA GREATER MANCHESTER COMBINED AUTHORITY