Reducing Emissions- Low Carbon Guide for Developers

Implementing Decentralised Renewable or Low Carbon Energy Requirements – DM1 and DM2 Guidance Document

Planning Policy 2023

IPSWICH
BOROUGH COUNCIL

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Purpose of this Document

1. This document has been prepared as a guide to adopted Ipswich Local Plan Policies DM1 Sustainable Construction and DM2 Decentralised Renewable or Low Carbon Energy, to challenge and support developers in working towards achieving net zero development. There are multiple drivers for reducing energy use in buildings and switching to renewable and low carbon sources, including national[1], Suffolk County Council[2] and Ipswich Borough Council[3], targets related to climate change, and the cost-of-living crisis.

2. The Government's strategy[4] for delivering a net zero economy by 2050 includes providing a secure, abundant and clean energy supply and reducing demand by increasing energy efficiency for homes and businesses. It should be noted that, as at 28th June 2023, the Committee on Climate Change has published an update to the national progress on Reducing UK Emissions (available here: https://www.theccc.org.uk/publication/2023-progress-report-to-parliament/). Additional action is required for the UK to meet its emission and climate targets. This is important as it re-emphasises the need for Local Government to step up. This means that IBC needs to be prioritising the low carbon agenda in the Borough.

3. This document also provides guidance to support the Low Emissions Supplementary Planning Document (SPD), which was adopted by Ipswich Borough Council on 17th November 2021. The Low Emissions SPD sets out a range of measures developers can adopt to minimise and mitigate air quality impacts that may arise from proposed development. This includes, for example, 'Design measures that make the best use of location and site layout and help reduce trip demand and total emissions generated by a development' and 'Low NOx heating to meet a minimum standard of <40mgNOx/kWh.'

Background and Policy Context

4. Policies DM1 and DM2 have been a feature of the Ipswich Core Strategy and Policies Development Plan Document since 2011. Their inclusion in the Plan was justified because Ipswich needed to address multiple challenges of high growth targets, high vulnerability to sea aand forecasts of water supply stress into the medium to longer term. The policies have evolved through subsequent iterations of the Local Plan in 2017 and 2022 to adapt to changes in the national policy context.

5. The current context is provided by the following national policies and statements.
   a. Future Homes Standard – to ensure that new homes built from 2025 will produce 75-80% less carbon emissions than homes built under the current Building Regulations to help achieve the target of net zero by 2050;
   b. Part L Buildings Regulations - New build homes from the 15 June 2022 are required to produce 31% less carbon than previous Building Regulation limits, with a new metric

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[1] National Government has pledged to cut emissions by 78% by 2035 compared to 1990 levels UK enshrines new target in law to slash emissions by 78% by 2035 - GOV.UK (www.gov.uk) and to achieve net zero for carbon emissions by 2050 Net Zero Strategy: Build Back Greener - GOV.UK (www.gov.uk)

[2] Suffolk County Council aims to be a carbon neutral authority by 2030 – see Our climate emergency declaration - Suffolk County Council

[3] By 2030 IBC's own operations will be cleaner, more efficient and net zero-carbon, whilst also taking a role in enabling the wider Borough to achieve net-zero emissions through demonstrating leadership in the early actions taken to reduce emissions. Climate change and the Council | Ipswich Borough Council

[4] Powering Up Britain, March 2023, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1147340/powering-up-britain-joint-overview.pdf

('primary energy') being used to measure the efficiency of the heating in a building and the energy required to deliver fuel to the building, as well as new minimum efficiency standards and the requirement for new builds to include infrastructure for future electric vehicle charging;

c. The National Planning Policy Framework (NPPF) supports the transition to low a carbon future (e.g. paras 152, 155 (c)); and
d. Emerging legislation: The Energy Bill was given Royal Assent on Thursday 26 October and is now an Act of Parliament (law). Local authorities have been asked by central government to assist in delivering the UK's net zero targets. Examples include the installation of electric vehicle charging points on council land and making council houses more energy efficient with better insulation and installing heat source pumps.

6. The local response has included a revised Local Plan adopted in 2022; IBC declared a Climate Emergency and resolved to start working towards becoming carbon neutral by 2030. The IBC commitment is that by 2030 their own operations will be cleaner, more efficient and net zero-carbon, whilst also taking a role in enabling the wider Borough to achieve net-zero emissions through demonstrating leadership in the early actions taken to reduce emissions. SCC is coordinating work between Suffolk Local Authorities and IBC adopted a Low Emissions Supplementary Planning Document in December 2021 to support implementation of air quality aspects of the Local Plan.

7. Approaches generally have shifted towards carbon reduction goals, providing a more holistic approach than renewable generation and energy efficiency alone. This is encompassed in the newer legislation.

Current Versions of DM1 and DM2

8. **Current DM1 and DM2 requirements explained**
   e. **What we want to see from new development:**

   i. **DM1 –** New Residential development (unless demonstrated it is not feasible or viable) is required to:
      - Achieve a 19% improvement in the reduction of CO2 emissions above the Target Emission Rate of the 2013 Edition of the 2010 Building Regulations (Part L);
      - Achieve water efficiency standards of 110 litres/person/day as set out in Requirement G2, Part G of Schedule 1 and regulation 36 to the Building Regulations 2010, as amended.
      - Incorporate sustainable drainage and water efficiency measures as required by DM4. (SuDs, green or blue roofs, soakaways and permeable paving.)
      - Encourage non-residential development of 500 sq. m and above to achieve a minimum of BREEAM[5] Very Good standard or equivalent.

   ii. **DM2** - All new build development of more than 10 dwellings or in excess of 1,000 sq. m of other residential or non-residential floorspace shall provide at least 15% of their energy requirements from decentralised and renewable or low-carbon sources. Only if it can be clearly demonstrated that this would not be technically feasible or financially viable, then the alternative of reduced provision and/or equivalent carbon reduction in the form of additional energy efficiency measures will be required. The design of development should allow for the development of feed in tariffs.

[5] BREEAM is the Building Research Establishment Environmental Assessment Method: https://bregroup.com/products/breeam/how-breeam-works/

f. **Policy assessment –** DM1 has not materially changed since the previous version of the Local Plan, and, as has been discussed above, has been overtaken somewhat by the tightening up of national policy and regulation. The reference point for emission calculations for CO2 reduction and water efficiency standards relates to the 2013 update of the Building Regulations, and this is still how planning applications for development are assessed against DM1. This doesn't mean that the policy is not fit for purpose, as will be explored below, only that developers face a slightly more complex environment in which to demonstrate compliance. Similarly, DM2 was also carried over from the previous Local Plan, with only minor adjustment.

g. **How does the 19% required by DM1 relate to the updated building regulations requirements?** DM1 looks at ensuring that development achieves a 19% improvement in the reduction of CO2 emissions above the Target Emission Rate of the 2013 Building Regulations. The updated Building Regulations Part L (2021, with updates in 2023), significantly increased this requirement from 19% to 31% [6], meaning that the requirements of 19% above the 2013 rate as stated in Policy DM1 are achieved through compliance with the updated Building Regulations requirement. Detailed guidelines for calculation are included in SAP 10.2 – The Government's Standard Assessment Procedure for Energy Rating of Dwellings (see also appendix): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1133079/Approved_Document_L__Conservation_of_fuel_and_power__Volume_1_Dwellings__2021_edition_incorporating_2023_amendments.pdf [i]

h. **How do we calculate the 15%** Current guidance in place to calculate energy ratings of buildings is underpinned by the Government's Standard Assessment Procedure for the Energy Rating of Dwellings SAP 10.2[7]. In practice, calculating the 15% of energy in development required from decentralised and renewable or low-carbon sources, has been undertaken for the Grafton Way housing development (up to 173 houses), ref: 19/00148/OUT and this can be used as an example of good practice. The energy assessment and strategy for this development[8] prioritised the Energy Hierarchy with a focus on sustainable building design, provision of energy efficiency measures and installation of building-integrated Low and Zero Carbon technologies. The measures proposed included passive design measures, super insulated and airtight building fabric and space and water heating provided by a combination of high efficiency gas fired boilers with flue gas heat recovery. The additional renewable energy requirements were supplied through the provision of roof mounted PV arrays. The study calculated the average building regulations (2013) baseline for building energy consumption DER/BER at 19.97 kgCO2/m^2/year.

To achieve a >19% reduction in CO2 emissions compared to Part L 2013 including a >15% reduction in CO2 emissions through the installation of Low and Zero Carbon/ renewable technologies (as required by the Local Authority), the following measures were prescribed:

- High performance super insulated building fabric u-values
  - External Walls – 0.15 W/m2K[9]

[6] Confirmed in the Government response to the Future Homes Standard consultation. See page 5 of: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/956094/Government_response_to_Future_Homes_Standard_consultation.pdf

[7] https://files.bregroup.com/SAP/SAP%2010.2%20-%2017-12-2021.pdf

[8] Undertaken by Sol Environment Ltd.

[9] W/m2K relates to the 'U Value' - a measure of the ability of a building element or component to conduct heat from a warmer environment to a cooler environment. It is expressed as the quantity of heat (in watts) that will flow through 1m2 of area divided by the difference in temperature (in degrees K) between the internal and external environment.

- Floors – 0.09 W/m2K
- Roof – 0.11 W/m2K
- Door & Windows – 1.3 W/m2K
- Party Walls – 0.0 W/m2K

- Air Tightness – 4.0 m3/(h.m2)
- Thermal Bridging y value – 0.08 W/m2K (Accredited Construction Details assumed)
- Space and Water Heating – a >90% efficiency gas boiler with flue gas heat recovery
- Low and Zero Carbon Technology – to achieve the >15% reduction in energy use and CO2 emissions the development is required to achieve a saving of ~45 tonnes of CO2; this can be achieved through a ~113kWp roof mounted PV array which equates to approx. 790m2 area of PV panels distributed across the flat roofed terraces in the western edge of the site and the commercial building and/or other unshaded SE, S, & SW facing roofs.

i. **How does DM2 relate to the Building Regulations requirements:** The Building regulations requirement is a calculation based on the overall carbon footprint of the dwelling, and the DM2 requirement is a calculation based on the amount of energy to be used by the dwelling when operational. Developers will need to achieve this 15% generation requirement independent of the Building Regulations requirements, although presumably this DM2 provision would aid in meeting Building Regulations requirements (see SAP 10.2) so the two are compatible and some overlap in measurement would be expected.

9. **Technology readily available to achieve the DM1 and DM2 requirements and the planning pre-application process.** Developers and people planning works on existing buildings are encouraged to submit pre-application enquiries and as part of these may need guidance relating to the types of technology that should be considered in residential development of various scales including change of use to residential. Please note that many of the systems used for energy generation and thermal efficiency would not be permitted development if installed retrospectively (i.e. would need their own planning consent) and this may add an extra level of planning assessment if they are included as part of a planning application for residential development. This is because they may result in noise or amenity impacts that would need consideration against planning policies in the Local Plan. In some cases, a consultation with the Council's Environmental Health Department may be required to ensure any impacts are suitably mitigated. Developers are however actively encouraged to explore the following green energy generation measures and include them in proposed development as appropriate in order to meet the requirements of DM1 and DM2. Types of cleaner/greener energy systems could include:

j. **Air source heat pumps** (ASHPs) - absorb heat from the outside air and convert that into heat and hot water for your home. Heat pumps use reverse refrigeration technology to deliver an energy 'multiplier effect' and come in 'air to water' (hot water) and 'air to air' (air conditioning) types. Investment in ASHPs as a replacement for a gas boiler is increasing in popularity in the UK, but these systems work best in well insulated homes. These systems use small units sited adjacent to the buildings they serve with fan components which could have noise impacts on surrounding dwellings/uses if not mitigated correctly (estimated system cost in 2022: £10-12 000.00).

k. **Ground source heat pumps** (GSHPs) – as with air source heat pumps, these absorb heat from the surrounding ground using cables buried 1 metre underground in 50 – 100 metre lengths and convert that into heat and hot water. These systems have a higher efficiency and stability than ASHPs but require a substantial outdoor area (approximately half a football pitch) for the pipework (estimated cost in 2022: £20-25 000.00).

l. **Heat Networks** – very location specific and need a substantial nearby generation source – generally best for higher density areas and those close to industrial areas – but can represent a very effective and energy efficient solution for heat and hot water supply to developments - need a minimum of 5,000 MWh (5GWh) annual heat consumption to be viable. To give some idea of annual average consumption:

   i. Academy or school ~0.2GWh typically to ~1GWh if very large
   ii. Family court building ~0.3GWh
   iii. Crown court ~1.5GWh
   iv. Large university campus ~2GWh
   v. Leisure centre ~ 0.5GWh
   vi. Maternity unit ~1.5GWh
   vii. Large Hospital ~ 10GWh
   viii. Library ~0.2GWh
   ix. Police station ~0.3GWh
   x. Community centre ~0.1GWh
   xi. A 400 dwelling residential development ~1GWh

m. **Solar Photovoltaic arrays** – these are widespread across Suffolk and the UK and are generally installed in 2 forms:
   i. individual rooftop installations which can be either installed on top of the tiles on the favourable roof slopes of dwellings, or as solar roof tiles (integrated into the construction of the dwelling)
   ii. Solar Photovoltaic 'Farms' examples in Suffolk/East Anglia such as Stratton Hall Solar Farm, Foxburrow Farm, Toggam Solar Farm and the proposed Sunnica Energy Farm.

n. **Solar Thermal Energy** – these use the energy from the sun for direct water heating and sometimes home heating – not always as popular in the UK as there is decreased viability in the winter months due to lower ambient temperatures.

o. **Wind energy generation** – this technology typically is employed in larger off and increasingly on-shore wind farms making use of large wind turbines for mass generation. There are, however, smaller scale instillations for roofs and residential gardens that are very effective for year-round generation. In many cases, wind turbines do need planning consent and so are not as widespread as they might otherwise be.

p. **Retrofitting** for improvement to thermal efficiency of existing housing stock or through conversion of buildings to residential use. This can take the form of external or internal insulation, window replacement, and any of the renewable energy generation types above. Issues of amenity and visual harm are still relevant to be considered for retrofitting exercises that require planning consent. Care needs to be taken with retrofit to ensure that measures proposed to deal with improving a building's insulation do not impact adversely on air circulation, which otherwise would create its own issues such as black mould.

q. **Biomass Boilers** work the same way as traditional boilers, but burn fuel made from organic materials (such as wood pellets or chippings) to produce heat. Organic materials are fed into a fuel store. If it is an auto-fed model, an auger and agitator will sift the wood fuel from the store to the combustion chamber in the boiler, and if it is hand-fed, biomass fuel will be manually added to the fuel box. Whenever there is a demand for heat, the wood fuel in the combustion chamber is set alight automatically, and secondary combustion occurs when the air is brought into the chamber that mixes with the gases produced. This gas then gets burnt off, generating temperatures of up to 1,200 degrees Celsius. A heat exchanger passes through the hot gases and

heats the water inside. The heated water will then be distributed away from the boiler, providing heat to the building.

This technology can make use of waste timber or agricultural products, making the fuel source fairly sustainable when compared with fossil fuels. If denser materials such as wood pellets are used, more heat per unit of energy will be generated than less dense wood chips.

Biomass boilers are, in general, more expensive than conventional boilers, they also require regular maintenance, additional storage space (including for fuel storage) and the supply of the fuel can have its own carbon footprint and resource constraints. Importantly, burning organic material emits particulate matter (PM), nitrogen oxides (NOx), carbon monoxide (CO), sulphur dioxide (SO2), lead, mercury, and other hazardous air pollutants (HAPs) that pose health risks to users and make this technology potentially less suitable for more urban environments or large scale use.

New technology is constantly under development, including the recent development of technology which is able to use humidity in the air to generate electrical charge: This New Device Generates Electricity From Thin Air | Smart News| Smithsonian Magazine. This may not be available for use in residential developments yet, but the potential to revolutionise energy supply for the built environment is accelerating and local planners, policy makers and developers will need to stay informed to ensure that innovation is not restricted by the planning system.

The Council's Low Emissions SPD refers to 'Low NOx heating to meet a minimum standard of <40mgnox/ kwh' as a type of mitigation for the air quality impacts of all scales of development. There are modern gas heating systems available which claim to achieve levels below this threshold. However, the Government has announced that, by 2025, all new homes will be banned from installing gas and oil boilers, in order to contribute to achieving net zero carbon targets by 2050[10]. Therefore, for new development, the renewable or low carbon options outlined above present an alternative.

10. Planning approach to installing different renewable technologies –

Note: please see more detailed guidance at: https://www.legislation.gov.uk/uksi/2015/596/schedule/2/part/14 or at the Planning Portal: https://www.planningportal.co.uk/permission/common-projects

r. **Planning approach to Photovoltaic panels –** The installation of solar panels and equipment on residential buildings and land may be 'permitted development' with no need to apply to the Local Planning Authority for planning permission. There are, however, important limits and conditions, detailed on the Planning Portal, which must be met to benefit from these permitted development rights. [11]

s. **Planning approach to Air Source Heat Pumps -** The first installation of an air source heat pump on domestic premises (including residential flats) is considered to be permitted development, not needing an application for planning permission, provided ALL the limits and conditions listed on the Planning Portal are met. These include installation

[10] On 20th September 2023, the Government announced 'an exemption to the phase out of fossil fuel boilers, including gas, in 2035, so that households who will most struggle to make the switch to heat pumps or other low-carbon alternatives won't have to do so'. This is targeted at existing homes rather than new builds.

[11] Permitted development rights are subject to change. It is advisable to check with the Council to ensure consideration of the most up to date position.

compliance with the Microgeneration Certification Scheme Planning Standards (MCS 020) , as well as limits to the total volume of the outdoor compressor unit (not exceed 0.6 cubic metres), that there is no existing heat pump or wind turbine on site, and that all parts of the air source heat pump must be at least one metre from the property boundary, and not placed on pitched roofs. Limits to total noise output also apply (these are at present a limit of 42 decibels, measured from a distance equal to that separating the unit and the next-door property). For information on noise limits please contact Environmental Health on environmental.health@ipswich.gov.uk.

t. **Planning approach to Ground Source Heat Pumps –** Installation of these is usually considered to be permitted development, not needing an application for planning permission.

u. **Planning approach to Wind energy -** Under permitted development rights in some cases it is possible to install domestic wind turbines without the need for an application for planning permission, so long as specified limits and conditions are met.

v. **Planning approach to biomass boilers** (Planning permission - Biomass fuelled appliances - Planning Portal): Planning permission is not normally needed when installing a biomass system in a house if the work is all internal. If the installation requires a flue outside, however, it will normally be permitted development if the following conditions are met:
   i. Flues on the rear or side elevation of the building are allowed to a maximum of one metre above the highest part of the roof.
   ii. If the building is listed or in a designated area even if you enjoy permitted development rights it is advisable to check with your local planning authority before a flue is fitted. Consent is also likely to be needed for internal alterations.
   iii. In a conservation area or in a World Heritage site the flue should not be fitted on the principal or side elevation if it would be visible from a highway.
   iv. If the project also requires an outside building to store fuel or related equipment the same rules apply to that building as for other extensions and garden outbuildings.

w. **Retrofitting of insulation -** Planning permission is not normally required for fitting insulation, provided that there is no change in external appearance. Externally applied insulation may require planning consent if the external building finish is altered or there is a material increase in the projection of the external walls.

In most cases permitted development rights do not apply for installations within the curtilage of a Listed Building or within a site designated as a Scheduled Monument, and additional limits are applied on land within a Conservation Area or World Heritage Site. Applicants would need to contact the Planning Department at development.management@ipswich.gov.uk for more information.

In most cases Building Regulations requirements will also need to be met. Building Control can be contacted on building.control@ipswich.gov.uk and visit: Building control guidance | Ipswich Borough Council.

11. **Links for further information - where developers/householders can go for impartial advice:**

    x. **Greater South East Net Zero Hub:** https://www.gsenetzerohub.org.uk/, The GSENZH is a collaboration of eleven Local Enterprise Partnerships (LEPs). These LEPs are working together to increase the number, scale and quality of local energy projects being delivered across the greater south east region of England. Works with business, education and Local Authorities to support local energy projects, from the development stages to investment readiness. Local partner is the New Anglia LEP: https://newanglia.co.uk/

y. **Green Suffolk:** https://www.greensuffolk.org/ - This site has:
   i. a page on advice for climate friendly action for people to take at home: Low Impact Living – Green Suffolk as well as
   ii. a Community Advice service: https://www.greensuffolk.org/green-communities/communitysupport/.

   Green Suffolk is run by the Suffolk County Council, and incorporates: the Suffolk Climate Change Partnership (which includes all Local Authorities in the county including IBC), the Suffolk Flood Risk Management Partnership / The Suffolk Coast Forum and the Suffolk Waste Partnership

z. **LETI (Low Energy Transformation Initiative):** https://www.leti.uk/ - LETI is a network of over 1,000 built environment professionals, working together to put the UK on the path to a zero carbon future. They provide sustainable architectural and development guidance. The voluntary group is made up of developers, engineers, housing associations, architects, planners, academics, sustainability professionals, contractors and facilities managers. Manuals, webinars, training and general guidance available on this site.

aa. **Centre for Alternative Technology:** https://cat.org.uk/ - CAT is an educational charity dedicated to researching and communicating positive solutions for environmental change. They speak to government and campaigners about policies that would help create a zero carbon Britain; train students and schoolchildren; and give advice to householders on what they can do in their own homes. Their Zero Carbon Britain arm runs training and events for councils, communities and other organisations.

ab. **Historic England provision of advice on the retrofit of Heritage Assets –** https://historicengland.org.uk/advice/technical-advice/retrofit-and-energy-efficiency-in-historic-buildings/

ac. **IBC's own guidance:** https://www.ipswich.gov.uk/content/energy-saving-tips

ad. **National Government guidance:** https://helpforhouseholds.campaign.gov.uk/energy-saving-advice/?gclid=EAIaIQobChMI1Ku28Y7Z_wIVaIdQBh0BNAmgEAAYASAAEgJIFvD_BwE&gclsrc=aw.ds#boiler-upgrade-scheme

12. **Grant funding available** https://www.gsenetzerohub.org.uk/ and Grants and Funding Opportunities – Green Suffolk
    ae. The Government has a Boiler Upgrade Scheme, which provides a grant of £5,000 towards Air Source Heat Pump installation: https://www.gov.uk/apply-boiler-upgrade-scheme?_ga=2.58071850.1056461076.1687514830-3487913.1687514830&_gac=1.39977750.1687514830.EAIaIQobChMI1Ku28Y7Z_wIVaIdQBh0BNAmgEAAYASAAEgJIFvD_BwE

13. **Best practice examples:**
    af. Ipswich – Tooks, Bader Close
    ag. Clay Field, Elmswell – Green Suffolk - from the architects website https://www.mikhailriches.com/project/clay-field/
    ah. Deben Fields, East Suffolk Passivhaus scheme in Felixstowe : https://www.passivhaustrust.org.uk/news/detail/?nId=1181
    ai. Stackyard House, Palgrave (large new build) : Stackyard House, Suffolk | RIBAJ and Stackyard House / Mole Architects | ArchDaily
    aj. Hastoe social housing scheme (terrace new build), Rattlesden: https://www.hastoe.

com/about-us/building-homes/recently-completed-homes/middleton-suffolk/

ak. Flagship social housing retrofit, Martlesham

al. Beattie Passive T-Cosy retrofit, Great Yarmouth

am. Energy efficiency retrofit in Greater Manchester The £97m plan to bring energy bills down in social housing - Manchester Evening News

an. 96-home zero bills eco-village planned for Newport, Essex (show home at BRE Innovation Park) Newport | zedfactory and Zero Bills Home | zedfactory

Appendix

SAP definition:

The Standard Assessment Procedure (SAP) is the methodology used by the government to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwellings that are needed to underpin energy and environmental policy initiatives. The Simplified Building Energy Model (SBEM) is the methodology used by the government to assess and compare the energy and environmental performance of non-domestic properties.

The government is committed to increasing the accuracy of SAP. The most recent version of SAP 10 (10.2) came into force with the updated Part L building regulations in June 2022, and incorporated various changes to the methodology. Previous versions of the SAP are now deemed to be out of date and the most recent version will be deemed equivalent for planning policy compliance, given that the requirements of SAP 10.2 for new dwellings exceed the required energy performance within the Ipswich Local Plan Policies DM1 and DM2.

References:

Air Source Heat Pumps: The Ultimate Guide to the Pros & Cons by David Hilton, published 04.10.2022 in https://www.homebuilding.co.uk/advice/air-source-heat-pumps
A Beginner's Guide to Heat Pumps by Chris Delaney, published 08.02.2022 in https://www.greenbuildingrenewables.co.uk/a-beginners-guide-to-heat-pumps/?gclid=EAIaIQobChMIx93xnIrZ_wIVjb7tCh0f4weKEAAYAyAAEgK81_D_BwE

Sources used for Biomass Boilers:
Biomass Energy Systems | Vital Energi
Pollutant emissions from biomass burning: A review on emission characteristics, environmental impacts, and research perspectives - ScienceDirect
Air Pollution from Biomass Energy - Partnership for Policy Integrity (pfpi.net)

Endnotes

[i] From the Updated Building Regulations: 14 CARBON DIOXIDE EMISSIONS AND PRIMARY ENERGY
CO2 emissions attributable to a dwelling are those for space and water heating, ventilation and lighting, less the emissions saved by energy generation technologies. The calculation should proceed by following the appropriate section of the SAP worksheet, designed for calculating carbon dioxide emissions for: a) individual heating systems and heat networks without combined heat and power (CHP); or b) heat network with CHP or utilising waste heat from power stations.
The Environmental Impact Rating (EI rating) is related to the annual CO2 emissions by:
CF = (CO2 emissions) / (TFA + 45)
if CF >= 28.3 EI rating = 200 – 95 log10(CF)
if CF < 28.3 EI rating = 100 – 1.34 CF
where the CO2 emissions are calculated at (272) or (383) and TFA is the total floor area of the dwelling at (4). The EI rating scale has been set so that EI 100 is achieved at zero net emissions. It can rise above 100 if the dwelling is a net exporter of energy. The EI rating is essentially independent of floor area. The EI rating is rounded to the nearest integer. If the result of the calculation is less than 1 the rating should be quoted as 1. Environmental impact rating bands are defined by the EI rating according to Table 14.
The primary energy consumption of the dwelling is calculated in the same way as CO2 emissions, using the primary energy factors in Table 12 in place of the CO2 emission factors. However, this result is not used to create a rating (i.e. equations (10), (11) and (12) are not used for primary energy).'