Application Support

The following guidance has been collated by the Salix Energy and Carbon Technical Team. The measures found in this document can often aid the delivery of projects and both demonstrating and communicating this effectively in the application submission may aid the assessment process.

1. Project Criteria Section

Measure Definitions	
Measures that save direct carbon	Zero Direct Emission Heating systems that include the following measures: Air source heat pump, water source heat pump, ground source heat pump, electric heating and hot water, solar thermal and a connection to existing district heating.
Other measures that save direct carbon	Measures that contribute to saving direct carbon*; for example, building fabric upgrades (such as roof, wall insulation, draught proofing, double glazing etc.), pipework insulation and mechanical ventilation heat recovery.
Measures that save indirect carbon	Measures that only save indirect carbon* (typically electricity savings) such as solar PV and energy efficient ventilation.

*See section 4.2.3 in Guidance Notes for definitions of Direct and Indirect carbon savings.

1.1. 'Whole building' approach to decarbonising heating

Many public sector buildings are reliant on aged and inefficient fossil fuel heating systems. Scotland's Public Sector Heat Decarbonisation Fund (hereby referred to as 'The Fund') focuses on the following objectives:

- To support projects that will replace existing fossil fuel heating systems with zero direct emissions heating (ZDEH) systems.

- To support energy efficiency projects where they can demonstrate that they are part of a whole building retrofit approach or broader strategy for heat decarbonisation (including connections to heat network).

To implement an efficient and cost-effective zero direct emissions heating (ZDEH) system, the building heating demands should be minimised where possible. Low temperature systems work better in buildings that are suitably insulated and have correctly sized heat emitters and pipework. Heat pump solutions and other low temperature heating systems will achieve the best performance at lower flow temperatures. These lower flow temperatures will generally be between 35-55 °C rather than the 70-80 °C typical of traditional oil/gas boilers. See the **Technologies** section for more information on heat emitters, pipework and flow temperatures.

To meet the 'whole building' approach criteria, applicants must demonstrate that they have lowered flow temperatures as much as possible to optimise the operation of the proposed low carbon system.

1.2. Successful 'whole building' approach

To ensure you have incorporated an extensive whole building approach into your project design, make sure the following have all been checked where applicable and relevant to the technology(ies) you are implementing.

1. Identify energy consumption in the building, for example:
    a. Heating and cooling
    b. Hot water
    c. Electrical loads
    d. Depending on the nature of your organisation and building(s), there may be other energy outputs that do not apply to all buildings. If the system consumers energy, it should be included in the assessment.

2. Identify areas of energy wastage, for example:
    a. Uninsulated walls, roofs and windows
    b. Draughts
    c. Poor/lack of heating control systems
    d. This list is not exhaustive, and it may help to list each area of wastage relevant to each area of energy consumption so that you gain a full picture of energy travel within your building(s).

3. Identify which building fabric improvements and energy efficiency measures can be implemented to reduce the energy wastage
    a. Note that whilst it is good practice and can be illuminating to list all reductions of energy wastage, for the purposes of the Scottish grant scheme, only measures that save direct carbon will count towards the Carbon Cost Ratio.

4. Conduct an options appraisal to select the most appropriate low carbon heating measure, considering:
    a. Is there a local district heat network?
    b. Will the distribution system require upgrading?
    c. Can the electrical capacity be upgraded to support the increased electrical load?
    d. How will hot water demand be met?

5. Size the zero direct emissions heating (ZDEH) system
    a. Calculate the peak heat loss of the building.
    b. Consider the improved thermal capacity of the building fabric and heating system controls.

6. Assess the marginal costs and direct carbon savings of all measures against the CCR
    a. If the value of the measures is higher than this, consider adding further building fabric improvements as these save direct carbon emissions and tend to have longer lifetimes. They can also reduce the overall size of the direct carbon emissions heating plant required.

Supporting commentary and evidence will be required to demonstrate that applicants have taken a 'whole building' approach in planning how to decarbonise their buildings/estates, as outlined in this section. Where applicants are proposing high temperature zero direct emissions heating (ZDEH) systems, without any improvement to building fabric or reduction of flow temperature, applicants need to evidence that this is the only option for this site and that a 'whole building' approach is not possible. If this evidence is not provided, then the 'whole building' approach requirement will not be met, and the application will be less favourable when compared to other projects with similar technologies that have factored in a whole building approach. Applicants will need to demonstrate how they have minimised the energy use onsite to ensure that any heating plant installed is no larger than it needs to be. Applicants will also need to provide an options appraisal to justify why their proposed measures were selected over other decarbonisation measures.

1.3 'Whole building' approach-eligible mitigation FAQs

Technical feasibility

How low can the flow temperatures go with existing infrastructure?

- Review the building fabric and existing heat demand (*suitable evidence: heat decarbonisation plan/options appraisal/building survey/peak heat loss calculations).*

- Review existing emitter sizing (*suitable evidence: emitter survey/feasibility study).*

- Determine what the lowest flow temperature that could be achieved in your existing buildings (*suitable evidence: feasibility study)*

- Determine what plant equipment would be most suitable for the lowest achievable flow temperature (*suitable evidence: options appraisal)*

Cost-effectiveness

How much would it cost to drop flow temperature to 35-55 °C?

This is changeable depending on several factors; consider the below points in order to form as accurate an estimation as possible:

- Identify both the opportunities to improve the building fabric and how much this would cost (*suitable evidence: feasibility study/ tender report/ Quantity Surveyor estimate*)

- Establish what the new heat demand is/will be (*suitable evidence: peak heat loss calculations*)

- Indicative future energy bills and maintenance costs if flow temperatures were lowered *(suitable evidence: energy saving calculations/energy modelling)*

Scenarios in support of a high temperature system

- Assess whether or not it is feasible to implement building fabric improvements or energy efficiency measures and drop flow temperatures. This can be heavily impacted by the nature of operations in the building.

- Bear in mind the restrictions that come from the costs to implement building fabric improvements or energy efficiency measures to facilitate low flow temperatures.

- Identify where specific ZDEH technologies work more efficiently at higher temperatures, e.g., CO_2 heat pumps.

2. Technologies

2.1. Zero Direct Emissions Heating (ZDEH) Systems

Air-to-air heat pumps

Air-to-air systems use refrigerant pipework to transfer heat from an external unit to an internal unit and then directly to the air inside the space being heated. Air-to-air systems are appropriate low carbon heating solutions in some cases and can be implemented through Scotland's Public Sector Heat Decarbonisation Fund provided that the project meets eligibility and assessment criteria.

Eligible scenarios include:

1. A detailed feasibility study and/or options appraisal show that alternative technologies are not viable.

2. The building is currently air conditioned and both heating & cooling systems are being replaced by the Air-to-Air heat pump.

3. The predominant use of the technology is for heating.

Zero direct emissions heating (ZDEH) system sizing

The proposed zero direct emissions heating (ZDEH) system must be sized to ensure that the heating and domestic hot water (DHW) demand for the building is satisfied and that the heating requirements of the old, end of life heating plant are met.

As applicants are expected to adhere to the 'whole building' approach and reduce the heat demand within a building as far as practical and cost-effective before installing a new heating system, the proposed zero direct emissions heating (ZDEH) system should not be oversized. Potential risks of oversizing a heat pump system are that it can result in higher capital and maintenance costs, losses in efficiency, and require more complex design requirements.

For this reason, the size of the zero direct emissions heating (ZDEH) system (in terms of total output load) should not be larger than the fossil fuel plant being replaced or the post-improvement peak heat loss of the building. Applications for a zero direct emissions heating (ZDEH) system with a higher total output load than the plant being replaced, or the peak heat loss of the building, will be refused unless a clear, technically sound justification is provided. This will be considered at the discretion of Salix.

To size the zero direct emissions heating (ZDEH) system, the applicant should demonstrate how they have followed best practice design principles. This includes submitting either yearly heat load profiles and/or peak heat loss calculations. These calculations must be provided to support the sizing approach taken.

Peak heat loss should be calculated by:

- Measuring fabric and ventilation/infiltration heat losses for the coldest day of the year based on geographic location.

- Using realistic air change rates to estimate ventilation losses.

- Using the area and U-values (thermal transmittance) of the walls, floors, roof, windows, and doors.

The Salix peak heat loss tool can be found here.

Heating system resilience requirement

Certain sectors require backup heating systems which are fed from a separate fuel type to the main system. For example, an organisation may have existing gas fired boilers and a backup oil fired system based on demand. Scotland's Public Sector Heat Decarbonisation Scheme funding cannot be used to pay for the installation of any fossil fuel-based heating plant, even to meet N+1 redundancy or backup requirements. While the applicant may remove their primary heat plant as part of the project, the existing backup fossil fuel heating plant can be retained for use provided that applicants sufficiently demonstrate that the existing heating solution is optimised to achieve the maximum carbon benefit through the system's control philosophy.

These projects will be reviewed on a case-by-case basis upon assessment.

Heat emitters and pipework

The lower flow temperatures of heat pumps often require larger heat emitters than traditional fossil fuel heating plants to allow the heating system to provide the set point temperature in the building, particularly if the building fabric and air tightness is not improved. Where the proposed flow temperatures are lower than existing, a survey needs to be completed to deduce whether existing heat emitters are large enough for the proposed flow temperature.

An important element that needs to be considered is the delta T - the difference between the flow temperature of a heating system and the ambient temperature of a room. For example, a heating system with flow temperatures of 70°C would have a delta T of 50°C when the ambient room temperature is 20°C.

Where the delta T of a new zero direct emissions heating (ZDEH) system is significantly greater than that of the existing heating plant, the applicant will also need to evidence that the detailed design has considered the specific requirements of such a heating system. This generally requires but is not limited to the submission of:

- Proposed heating system schematics
- A description of operation
- Piping and instrumentation diagrams (P&ID)

Evidence must also be provided to demonstrate that the supporting infrastructure will be able to maintain efficient performance of the zero direct emissions heating (ZDEH) system in the long term.

Electrical infrastructure

Applicants are expected to ensure buildings have sufficient electrical infrastructure to support the measures they wish to apply for and install. Applicants seeking to undertake Fabric First + ZDEH and/or Solar PV projects should contact the Distribution Network Operator (DNO) *as early as possible* regarding the connection of their proposed system to the local electricity network if additional electrical capacity is required to accommodate the new ZDEH system and/or PV system. Salix heavily recommends that applicants who need to discuss their proposed system with their Distribution Network Operator (DNO) do so as soon as possible to minimise delays. We have seen through delivering other schemes that costs and timelines on Distribution Network Operator (DNO) upgrades can be a major risk to project delivery, so this should be covered in the applicant's risk register if applicable.

Should no Distribution Network Operator (DNO) works be needed for your project(s), it is part of your responsibility to ensure the equipment is run safely and is in line with

standard practice. Salix also advises that applicants inform their Distribution Network Operator (DNO) about the connection of new assets to ensure that any future decisions on the network are based on the latest information. Please note that, in line with the scheme criteria, Distribution Network Operator (DNO) costs can only be included in the 20% client contribution and the related costs cannot be included, under any circumstance, within the 80% grant funding.

Replacement of calorifiers

Within sites where a central plant room feeds multiple buildings, the local interfaces that connect to the heat network (such as plate heat exchangers and calorifiers) can be counted as the buildings' heating plant for the purpose of meeting the scheme criteria. For example, a local calorifier or heat exchanger that is connected to a central plant room can be replaced with a zero direct emissions alternative such as a heat pump (which would be eligible for grant funding), even if the main heating plant in the central plant room is still relatively new or is not being replaced.

2.2. Heat networks

New building connections to district heat networks are eligible for funding if they are connecting up to a zero direct emissions heating (ZDEH) system. The costs eligible for funding include only the portion of the connection that applies to the individual building(s) listed in the application.

'Connect to existing district heating' should be selected in the Application Form within Step 4 Support Tool zero direct emissions heating (ZDEH) for all buildings where a new connection to a district heat network will provide the building's heating or where a connection is made to an existing energy centre on site.

In either case, there is no requirement for changes to be made to the energy centre that supplies the network with heat. Energy efficiency measures can be installed in the newly connected building to meet the 'whole building' approach.

Improvements to the current network will not be eligible unless accompanied by the installation of a zero direct emissions heating (ZDEH) system in the energy centre, replacing a fossil fuel heating source. For example, a whole heat network de-steaming project will require a zero direct emissions heating (ZDEH) system to be installed in the network's energy centre to meet the project eligibility criteria. De-steaming of the rest of the system can then be entered as 'distribution pipework improvements' in the energy efficiency and enabling measures section of the Step 4 Support Tool. Other energy efficiency measures can be combined with the zero direct emissions heating (ZDEH) system in any building connected to the network.

Applicants must provide the following documents to support their application:

- Bespoke carbon factor calculation
- Calculations evidencing the heat loss figures for the primary pipework connecting the building to the energy centre
- Network design drawings clearly demonstrating the pipelines to be funded by the Public Sector Decarbonisation Scheme
- Design considerations for how thermal losses across the network will be minimised
- Evidence that the new connection will be operational by the grant end date.

2.3. Biomass

Scotland's Public Sector Heat Decarbonisation Scheme allows applicants to apply for funding for biomass boilers. Applicants must demonstrate they will be operated in such a way as to be sustainable, as well as mitigating unwanted effects on air quality.

Applicants will need to demonstrate:

- Why biomass is more suitable than other low carbon alternatives, for example, where there is not appropriate infrastructure in place to support a heat pump.

- How they intend to mitigate any potential impacts on air quality particularly on people in the local area. Applications are not encouraged for biomass boilers in heavily built-up areas, unless there is a strong clear justification for the use of biomass boilers in place of another heat source.

- That they will obtain their biomass fuel from sustainable sources. The Biomass Suppliers List, which can be found here, lists suppliers who have demonstrated that their wood fuel meets the sustainability criteria of the Renewable Heat Incentive scheme.

- How they intend to maintain their boilers to ensure the performance over the lifetime of the plant. Note the Microgeneration Certification Scheme has recently published a new Standard for the maintenance of biomass boilers.

3. Additional resources

This section will include technical information to further the applicant's understanding of how technical sections of the assessment are calculate as well as some additional policy information for a deeper strategy context of this grant scheme.

3.1. How the Carbon Cost Ratio (CCR) is calculated:

$$£450\text{tCO2eLT} \geq \frac{£)\ \text{Total Grant Requested}}{\text{Total direct carbon emissions saved over the lifetime of the project (tCO2eLT)}}$$

The results of the CCR is not to determine a threshold for projects, but is an indication of what an efficient project should aim for. There will be nuances in this and we understand that due to the nature of various projects and the operational hours of certain types of public sector organisations, the CCR may vastly vary. This has been accounted for in that no CCR will be deemed insufficient outright, but there must be a detailed explanation to accompany those organisations that have a CCR higher than £450/tCO2eLT.

Calculating the direct carbon savings of a project

Direct carbon savings should be calculated based on the lifetime of each direct carbon emissions saving measure.

Baseline figures for fossil fuel consumption should be based on each building's real-life consumption and evidenced with metered data, the previous year's energy bills and/or the latest EPC (Energy Performance Certificate). Where such data is unavailable or inaccurate, Salix will consider alternative methodologies with reference to industry benchmarks.

It is recognised that while replacing fossil fuel heating plants with zero direct emissions heating (ZDEH) is assumed to decarbonise the heat within a building, the building itself still may not be fully decarbonised, as there may be instances where residual direct emissions from fossil fuels may occur due to catering and other activities. This is why the whole building approach has been implemented and features in the assessment criteria as an expectation of the organisation's overall strategy.

Where boiler efficiency is used as part of the direct carbon saving calculations for the new low carbon heating system, the efficiency must be a close representation of the existing boiler to be replaced or retained for a bivalent solution. As an example, the efficiency of a condensing boiler is greater than 85% in most cases. Salix will assess the efficiency rate used in the calculation as part of the due diligence.

3.2. Resources and Regulations

Throughout the various schemes we have delivered previously and currently, applicants have found the following resources useful.

Resources:

Salix Tools and Resources
Climate Emergency Skills Action Plan 2020-2025
CIBSE (2022) Heat pump installations for large non-domestic buildings CIBSE AM17
EN 17267 (2019) Energy Measurement and Monitoring Plan
Fair Work First guidance
Salix's Scottish case studies

Regulations

HM Government (2021) The Building Regulations 2010: Conservation of fuel and power

Heat in Buildings Strategy 2021

Heat in Buildings Strategy 2022 update