Sunnyside Church. Berkhamsted

Buildings Services Engineering

Decarbonisation Report

May 2023

Report Reference: 3237 Decarbonisation Report

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If the document is marked "draft" it is deemed to be uncontrolled and is issued for comment and further development only.

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Executive Summary

The Church of England General Synod has indicated that it would like the portfolio of church properties to be carbon zero by 2030, this is a huge challenge, and as part of this Sunnyside Church have investigated their own carbon reduction initiatives in order to assist in moving towards this target. Within this report a range of low carbon heating solutions as well as potential building fabric improvements have been explored and additional information provided to indicate the extent of on-site PV generation necessary should the Church wish to achieve the net zero-carbon target.

Due to the main church being a Grade II listed building it is not anticipated that significant improvement to the building fabric could be made without causing risk of unnecessary harm to the building operation and aesthetics. There are three passive improvements that were asked to be explored, including insulation to the ceiling/roof, providing secondary glazing to the main church area windows, and providing internal glazed lobby adjacent to the main church entrance door. The newer church hall extension building currently is provided with single glazed windows, rooflights and doors and these could be replaced with double glazed units. The potential energy savings from improving the building fabric in various ways are shown in section 6.1.4, but if all of these were possible then a 45% improvement in energy reduction can be achieved.

There are two main decarbonising opportunities for providing heat to the Sunnyside Church and adjacent buildings in lieu of gas boilers. These are air source heat pump (ASHP) and ground source heat pump (GSHP) systems. Both systems would be effective in providing low carbon heat but would have differing beneficial factors and implications. Domestic hot water usage is minimal on this site, and this is currently provided by local point of use electric water heaters, some of these would benefit from like for like replacement due to their age.

As a result of this study, we note the estimated cost of providing the ASHP option is £195,000 and the estimated cost for the GSHP option is £320,000. We have not included for costs for the fabric interventions as this is outside of our M&E expertise, however if any of these fabric interventions are put in place then the energy savings may mean that less equipment is required, so the costs are likely to reduce depending on which option is taken. Moving to the Heat Pump solution will mean a 78-80% reduction in carbon emissions, although running costs will be 30-40% higher due to the current high price of electricity.

The report also identifies the amount of additional Photovoltaic panels that would be required to offset the carbon usage and achieve a zero-carbon rating under the remaining existing electrical demand. Also, the estimated number of panels for the different heat source options, including the existing boiler solution. Approximate costs for these are also identified, for the heat pump options the typical cost for offsetting carbon by PV would be £30,000. These figures give a current understanding of the wider costs / implications of achieving the net zero carbon target.

To gain an understanding of the use of heat pumps, some common implications for use of these are:

- Larger heating pipework and radiators would be required due to the lower flow and return temperatures of a ground source or air source heat pump type heating system.
- GSHP would require internal plant space to house the heat pump units, circulating pumps and ancillaries and 20 no. bore holes would be required in the surrounding grounds areas, spaced at approximately 8m apart.

- Initial capital cost for a GSHP type system would be considerably higher than that of an ASHP type system.
- ASHP would require an external plant compound to house the main ASHP equipment. This would likely require acoustic treatment due to the noise outbreak from the proposed systems.
- Initial capital cost for a ASHP type system would be considerably lower than that of an GSHP type system.

Both systems would offer significant carbon savings when compared to a traditional gas fired boiler. A GSHP uses approximately 8% less energy than air source heat pump units due to higher SCoP (Seasonal Coefficient of Performance) achievable from the system. This is due to the constant ground temperature of 10°C as opposed to the fluctuating air temperature utilised by an ASHP system.

1 Introduction

This feasibility report has been prepared by SVM Consulting Engineers to assess and indicate the proposals for the decarbonisation of Sunnyside Church, to improve energy efficiency and install low carbon heating measures above and beyond building regulations to better align with the General Synod directives as well as the Government's Net Zero targets. The feasibility report sets out the opportunities to install low carbon heat sources (i.e.: air source and ground source heat pumps) and energy efficient measures which reduce overall energy demand of the building including insulation, air tightness and highly efficient plant supporting the decarbonisation of heat.

The scope of this review is to cover decarbonisation in relation to the heating systems rather than a wider energy study of the buildings. It is however noted that a number of other good practice measures have been already put in place such as LED lighting to some areas. The further application of LED lighting throughout would clearly be of further benefit.

2 Project Description

The proposals relate to Sunnyside Church, Ivy House Lane, Berkhamsted. The site comprises of the main church building, including altar area, organ area, congregation areas and vestries, which was built in 1909, and the entrance foyer lobby and church hall extension building, including kitchen, office, toilets, and stores, which was built in the 1980s.

The 1909 main church area is a Grade II listed building and as such care would need to be taken on any remedial works proposed and avoid any unnecessary harm which may occur as a result of the proposals.

3 Approach

A holistic approach to the building would be considered. The first stage would be energy demand reduction which would include evaluating the feasibility to reduce energy demand by passive means i.e.: insulation, glazing and air permeability. Followed by any energy efficient measure which would reduce the overall energy demand of the building as such support the future heat decarbonisation.

With the heating demand of the building calculated, an options study would identify the low carbon heat strategies available for the project identifying the practicality, implications, energy reduction, carbon savings and indicative capital costs.

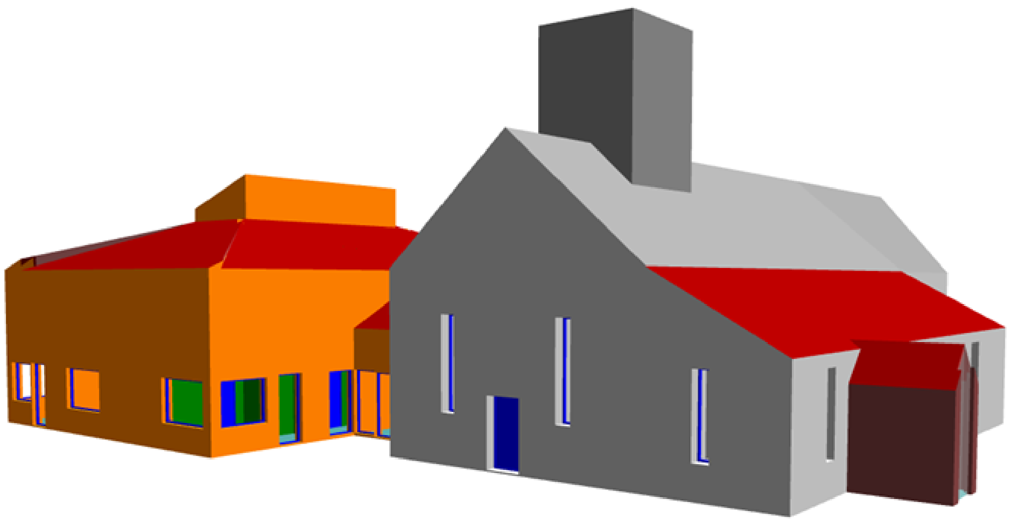
The church buildings were modelled using the licensed and accredited dynamic simulation program EDSL TAS version 9.5.4. These calculations were carried out to identify the energy consumption of the buildings, including for the existing building fabric and for various options for fabric improvements. The building was modelled based on a site survey and reference to building construction information on typical buildings of this nature. Estimates were made on air leakage from the existing buildings. Due to settings in the software, the programme calculates energy use based on the building being heated all day / night without a time schedule, so changes will be apparent in energy use and comfort if the heating is timed off for extended periods.

A number of iterations in the software for the different building fabric interventions were run to include:

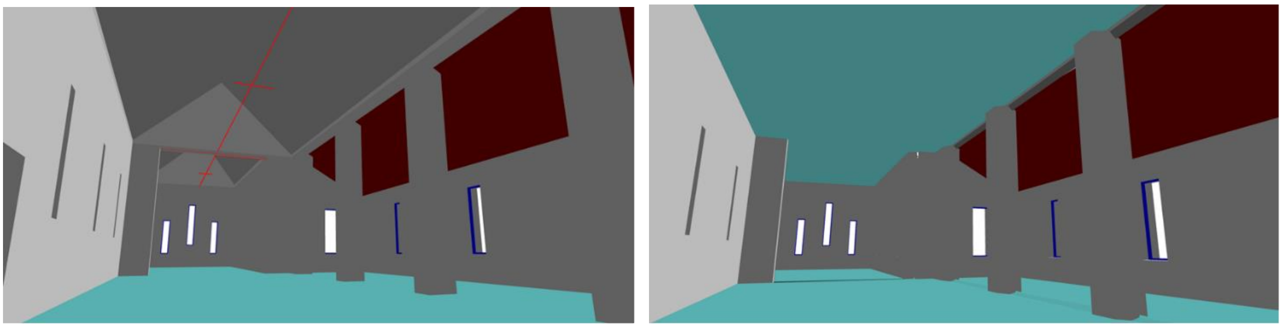
- Existing building
- The addition of an internal porch to the main church entrance to reduce heat loss

- The addition of secondary glazing to the existing stained-glass windows in the main church
- The addition of heavy curtains to the west door of the main church
- The addition of a hypothetical false ceiling to the whole main church area with 300mm of insulation above it
- The replacement of the existing single glazing in the newer church hall and adjacent areas for double glazing

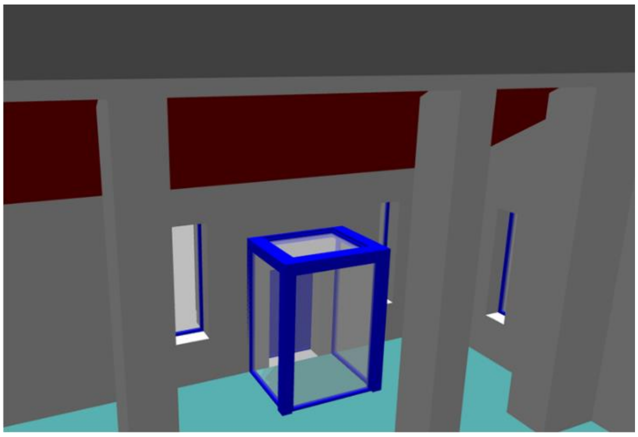
The representation of the thermal model created is as below:



External view of main church from the West of the building



Internal view of the Main Church, LHS without ceiling, RHS with false ceiling



Internal view of the Main Church showing a glass lobby internally to demonstrate the effect of a lobby to this main door

4 Existing Heating Systems

The heating system comprises 2 no. gas fired condensing boilers (Ideal Concord C Series 4 and newer Ideal Concord CXA/A) of approximate heating duty 58kW each which normally individually serve the main church area and church hall area, providing heating via wall mounted column and panel type radiators, some fitted with TRVs, and also to some fan convector units. The existing boilers appear to be in reasonable condition for their age, but likely approaching end of their economic life expectancy There are zone/frost thermostats in the boiler room for each circuit. These boilers are capable of providing for part load situations and allow for a partial reasonable heating capacity if one boiler fails. There is a piped flow and return interlink between the two circuits, which can be manually opened by valves, to allow one boiler to partially feed the heating load on both circuits if the other boiler fails or is being maintained. These boilers most likely operate at an 82 / 71^{0}C flow and return temperature, due to their age and the period of time when they were installed. This results in higher water flow rate and pump size due to flow and return temperature difference.

The Flues are individual and flue liners are installed within the chimney. The main church heating circuit is provided with heating circulation by an older belt driven pump set, The church hall circuit is provided with a relatively modern inverter driven pump which appears to have been a fairly recent replacement and unlikely to require replacement. The heating distribution appears to be an open vented system, as there is no pressurisation unit or pressure vessels installed in the plant room. The systems are controlled via a relatively old analogue control panel. The majority of existing heating pipework and valves are un-insulated.

In addition to the heating system there are a number of ventilation systems. Most areas are naturally ventilated, utilising openable windows, however small ventilation extract fans are provided for the toilet areas extracting to external and a separate ventilation system for the church hall kitchen, including a cooking extract canopy, is installed and operational.

There is no central domestic hot water provision, and, in any case, hot water requirements are minimal, and are currently provided by local point of use electric water heaters, some of which we would recommend be replaced in due course due to their age.

The following items could be considered for implementation to improve existing plant efficiency in the short term.

- The provision of motorised valves on the pipework interlink, between the two boilers, would improve controllability and could possibly be remotely operated.
- The existing belt driven main church circuit circulating pump could be replaced with a modern inverter driven pump to provide some energy saving and variable heating water flow rate for better temperature control.
- Provide foil back thermal insulation on all heating pipework, valves, and ancillaries, in concealed locations, in locations where pipework is not contributing to heating the space and in boiler plant toom.
- Install new thermostatic radiator valves on all radiators, to improve local temperature control.

5 Existing Electrical System

The existing electrical supply to the building is a 100Amp three phase supply, in addition to this the church has power generation from an existing Photovoltaic system connected to the grid via an import / export meter.

There are approximately 22 existing PV panels and due to their age we estimate these to have an output of approximately 125W each at peak output. Also given that these are occasionally shaded we expect the annual kWh contribution of these will be in the order of 1600 kWh. This represents approximately 12% of the current electrical annual demand of the building based on metering data provided to us by the church, although it is not clear at any instant whether all the power used from these PVs is used within the building or exported to the grid.

Note that with a change to heat pumps the electrical load will increase significantly, so the existing PV will end up being a much smaller proportion of the total electrical demand.

Photo of existing PV installation taken at 3pm on 1 November 2021.

Estimating the current peak load from the existing electrical supply is very difficult from the consumption data provided, as the consumption data is given in months and with potentially sporadic use of the buildings an estimate of this needs to be developed. However, we estimate the existing maximum electrical load is circa 22 kVA or 30 Amps per phase, it would be useful to get the peak loads validated if these heat pump solutions are to be progressed to understand if this is a risk. This provides a spare capacity of circa 50 kVA or 70 Amps as the existing fuses are rated at 100Amps. The actual maximum demand available from the utility service provider would also need to be checked as this could be less than the fuse rating.

6 Low Carbon Heating Solutions

6.1 Reducing Heat Demand

Reducing the energy demand of a building plays a key role for decarbonising heat in buildings. Traditional and historic building are typically referred to as 'breathable construction' due to their ability to absorb and release moisture. Altering the thermal performance of historic buildings does not come without risks and implications. A key implication is increasing the risk of condensation, which can result in a build-up of moisture on surfaces of building components or interstitial condensation. This can result in decay of fabric, mould formation and reducing the air quality within the building, impacting the occupant's health and wellbeing. When considering building fabric improvements, the material and construction methods have been considered to ensure they are appropriate and technically compatible with traditional buildings, thus reducing energy demand and risk of damage from inappropriate interventions.

Reduction of heat demand through passive means ensures operational costs are also reduced. Some proposed measures for Sunnyside Church as noted in the following sections.

6.1.1 Passive Measures (Fabric)

<u>Walls/Glazing</u>

Due to the listed nature of the main church building, it is not anticipated that significant improvements can be made to the external walls without out having an impact on the heritage and architectural significance of the building. The existing wall construction is known to be flint facing to concrete walls with an inner brick skin, Totternhoe stone for internal dressings, Monk's Park and Tisbury stone used for some external dressings on some internal work, brown clay tiled roofs, and boarded and shingled bell-turret and was completed in 1909. The existing glazing is mostly stained glass single glazed windows.

The incorporation of secondary glazing has the potential to reduce energy consumption, however secondary glazing can be visually intrusive externally and internally depending on how it is designed and integrated. Secondary glazing can reduce draughts into the church area, however ventilation provisions, to prevent build-up of moisture within the space between the existing single glazed outside window panels and new internal secondary glazing panels would require very careful consideration.

A new lobby, inside the main entrance door, could be considered and would reduce air infiltration and cold draughts passing through the door into the main church area, thus reducing heat loss further and improving occupant's comfort. This could be glazed to reduce visual impact and to help satisfy the conservation officers. Two options for this solution have been developed, a single glazed internal lobby and a double-glazed internal lobby.

The more recently built church hall and facilities area extension was constructed in the 1980s. This area appears to be built with brick outer skin and concrete block inner skin walls, with cavity insulation. This is not anticipated that this could be significantly improved without major works and the reduction in energy usage effect would be minimal. The extension area has single glazed wooden framed windows and outside doors. Converting these to double glazed windows and door units will improve the thermal efficiency of the extension space significantly, so this has been included as one of the options.

Ceiling/Roof

Historic buildings can typically lose 25% of heat through the roof of a building, in addition much of the heating can often rise to high level in taller areas like the main church, so the benefit of heating is reduced. Where a roof void exists, loft or roof insulation is considered an effective means of improving efficiency. Typically, buildings of this nature use the roof as a ‘cold roof’ with small air vents for air circulation to remove dampness thus an effective method of insulation is to insulate at ceiling level. The extent of insulation, if any, within the roof structure is unknown. However, in the main church there appears to be no roof void, so a proposal of introducing a suspended ceiling in the main church area has been explored on request of the church committee, where insulation is applied above the ceiling, and this helps reduce heat loss as well as avoid heating rising above and beyond the congregation. The addition of a ceiling has been included in the modelling, although this may be somewhat theoretical depending on whether the installation of a ceiling is practically and aesthetically achievable.

6.1.2 Air Permeability

Traditional buildings are generally constructed to allow moderate air movement for ventilation. This is typically seen through a series of passive design measures including but not limited to air movement via vents, windows, doors, and chimneys. This form of natural ventilation aids in controlling the build-up of moisture and humid/stale air the building use creates.

Where ventilation is limited, air carrying water vapour cannot escape resulting in increased humidity and condensation build up thus subsequent mould growth, therefore finding a desired balance is challenging.

It is therefore fundamental to consider moisture movement and ventilation when dealing with existing buildings. The air permeability of the existing building is not known but assumed to be in excess of 15 - 20 $m^3/hr.m^2$ @ 50Pa based on the age of the type of building. Reducing air infiltration by sealing unused openings and using caulking or mastic to close gaps between window frames and the external wall, if required, however, not between window sash and jamb, which would prevent the use of openable windows, would improve thermal efficiency of the building, and reduce cold draughts.

The use of caulking and mastic could reduce infiltration; however, it is not recommended that a historic building is too tightly sealed due the implications discussed above. As the current air permeability is unknown, we are unable to quantify the exact savings that could be achieved. Improving the air tightness could, also, result in the incorporation of additional ventilation measures to remove humid stale air from the building. Due to the implications this would have on ceiling voids, plant requirements and Sunnyside Church being categorised as a Grade II listed building, it is not recommended to make significant improvements to the air permeability, but it is advised to seal any areas of prominent air leakage.

6.1.3 Ventilation and Heat Recovery

Sunnyside Church is generally served by natural ventilation in the form of opening windows. The only exception being toilets, some parts of the church/vestry areas, and hall kitchen, which are fitted with extract fans.

There is very little scope to reduce the carbon input required for the ventilation systems, except possibly renewing the fans to those with EC type motors and occupancy controls. In addition, Sunnyside Church is a Grade II listed building so external louvres for intake/discharge would be problematical to accommodate. Installing ductwork, fans and grilles at high level would also affect the internal visual feel of the space to an unacceptable level. It is not proposed to provide heat recovery on the kitchen system due to the possible grease build up and the associated issues.

6.1.4 Potential Carbon Savings Due to Various Fabric Enhancements

A number of fabric improvements have been proposed to reduce heat loss within the building as noted earlier. This section of the report identifies the energy / carbon savings for each iteration of the building model. This is based on traditional gas fired boilers being continued to be used for heating the building. If GSHP or ASHP central heating plant were used there would be further reductions in heating load/carbon due to the greater overall efficiencies of these systems as outlined in later sections of the report.

The table on the following page outlines the improvements. It is interesting to note that based on the data entered into the model and our assumptions on air leakage some of these have a high impact on carbon saving and others a very low impact. A summary of the impact of each of these is as follows:

- Addition of heavy curtains to the main church doors: 0.06% improvement
- Secondary glazing to main church: 2.3% improvement
- Secondary or Double glazing to newer Church Hall: 11.7% improvement
- False ceiling added to main Church: 31.5% improvement
- Internal lobby to main Church: 0.02% improvement
- All fabric improvements: 45.7% improvement

It was surprising that the effect of the internal curtains to the two main external doors had a very small impact, as did the addition of a lobby inside the church door.

The replacement of the glazing in the newer 1980s buildings from single to double or secondary glazing does show a beneficial impact which is not entirely surprising. The biggest single benefit is showing due to the addition of a false ceiling with insulation above it in the main church area and altar area, however how this is physically undertaken in the space given the existing structure is difficult to coordinate. Also, the addition of this would dramatically affect the entire aesthetics of the church, making the space seem smaller and taking away the majesty of the existing church. This would necessitate ventilation to the roof void above and would presumably also require various conservation and Diocese permissions. The further review of this intervention is necessary if this is a serious consideration.

Table of Fabric Improvements and associated energy / carbon saving for the existing gas heating system.

Software Iteration	Description of work	Fabric Intervention	Annual kWhrs Pre-Intervention	Annual kWhrs Post Intervention	Tonnes.CO_{2e} per annum	% Improvement
1	Existing Building Fabric	n/a	155,000	N/A	32.55	N/A
2	Existing plus heavy curtains to external church doors	Heavy duty curtains to two main external church doors	155,000	154,991	32.54	0.06
3	Secondary glazing to Main Church	Secondary glazing to all windows in main church	155,000	151,435	31.8	2.3
4	Secondary glazing to Church Hall Building	Secondary or double glazing to all windows in church hall / 1980 building	155,000	136,865	28.74	11.7
5	Ceiling added to main Church	False ceiling added to main church in nominal location with insulation above	155,000	106,125	22.29	31.5
6	Lobby added to main Church	Internal lobby added to main church entrance	155,000	151,960	31.91	0.02
7	All Parameters Combined Savings	Insulated false ceiling plus internal lobby to main church plus secondary or double glazing throughout.	155,000	84,165	17.67	45.7

These percentage improvements are shown in relation to energy saving based on the existing gas boiler plant. These energy savings can also be expressed in relation to the Heat Pump options, this information can follow if the preferred fabric intervention options can be identified.

6.2 Ground Source Heat Pump (GSHP) System (Option No. 1)

6.2.1 Description of Proposed Solution

Option no. 1 would provide a Ground Source Heat Pump (GSHP) system to replace the gas fired boilers, for the provision of heating to the premises.

The system would comprise 2 No. Ground Source Heat Pump units for heating. Subject to adequate space the Ground Source Heat Pumps would be located within the Basement of the building. The two heating Heat Pump units would serve the entire building including the main church areas and church hall areas.

The system would comprise 10 No. 190m deep bore holes, in suitable locations within the open grounds and/or allotments, surrounding the building, and these would link to a manifold, which would then be connected to the heat pump units. The basement would also house a buffer vessel and all ancillary items such as pumps, pressurisation unit etc.

The bore holes would have an impact on the areas surrounding the building. Typically bore holes would be spaced approximately 8m apart. This would require substantial groundworks to incorporate the bore holes. However, once complete these would be all buried underground and would no longer be visible.

The heat pumps would provide hot water at approximately 55^{0}C for heating. These heat pumps would be sized as follows: -

- 2 No @ 50 kW each for heating provision, with Seasonal Co-efficient of Performance (SCoP) of 3.5 each.

From the heat pumps the heating distribution would serve all spaces within the building. The basic heating distribution layout would be similar to the existing but sized for the heat pump lower flow and return temperatures and arranged in two pipe flow and return circuits throughout, instead of the current single pipe heating loops which are located in some parts of the church.

From a maintenance and plant replacement perspective it is more effective and beneficial to have a centralised plant room sized to serve the whole development than having individual plant and equipment for the separate buildings on the site. Thus, the associated loads and quotes have been calculated for the whole development including main church and church hall. This also provides for a level of resilience similar to the existing arrangement with two interlinked boilers.

6.2.2 Implications upon Existing

The heat pumps would be providing water for heating at a lower temperature than the existing boiler system. This would have the following implications.

- Radiators would need to be larger, to cope with the lower flow temperature.
- It may be possible to use fan assisted emitters which would be smaller than radiators, but these would need a power supply and possible noise issues would also need to be considered.
- Pipework would need to be larger due to the lower flow and return temperatures.
  10 No. 190m deep bore holes would be required and, as such, there would be implications of ground works within the church grounds and/or allotment areas. Bore holes would need to be spaced approximately 8m apart.
- Gas would not be required to the site (unless required in church hall kitchen).

- No flues would be required.
- Electrical loads and spare electrical capacity would require careful consideration.
- There are greater efficiencies for GSHP when compared against ASHP (Air Source Heat Pump) system.
- Considerably higher capital costs for GSHP system, when compared against ASHP system.

6.2.3 GSHP Carbon and Cost Considerations

The following figures/loads are based on the existing design fed from gas fired boilers and the proposed changes and associated saving with switching to a centralised GSHP system to provide heating. The savings are those achievable for the main church areas and church hall areas. The further savings from improving the building fabric are shown in section 6.1.4. The project value is the estimated capital costs of the GSHP system, together with cost estimate for new plant, new pipework, new radiators, and new controls. Budget quote has been obtained from G core refer to appendix for further details, but please note the equipment in this quotation is in excess of the final loads required and would also need further updating to suit any fabric improvements that were undertaken.

Description of work	`	Fuel Cost p/kWh	Project Type	Technology	Annual kWhrs Pre project	Annual kWhrs Post project	Carbon Usage (TonnesCO_2)	Project Value (Excluding VAT)	Approximate annual energy costs (Excluding VAT)
Existing gas fired boilers	Gas	8.5	Heating	Gas fired boilers	155,000	0	32.55	0	£13,175
Gas Boilers to Ground Source Heat Pump	Electricity	36	Heating	Ground Source Heat Pump	0	48,000	6.53	£320,000	£17,280

The estimated project value costs for the GSHP have been factored according to the loads to the relevant areas. The total budget cost estimate of a central GSHP system including new plant, new pipework, new controls, and new radiators which will serve the entire premises would be approximately is £320,000.

Note the running costs for this option are currently shown to be higher than the existing boilers, this is due to the current high price of electricity, which is predicted to have a small drop over the next year or so. It should also be noted that whilst the current gas price is more attractive, it is likely in the years to come that this will increase in cost and potentially carbon tax to encourage people and organisations to move to electrical sources heating systems.

This GSHP option, before application of the fabric interventions achieves an 80% carbon saving.

6.3 Air Source Heat Pump (ASHP) system. (Option. No.2)

6.3.1 Description of Proposed Solution

This Option explores providing an Air Source Heat Pump (ASHP) system to replace the Gas fired boilers, for the provision of heating to the premises.

The system would comprise 3 No. Air Source Heat Pump condensing units for the provision of heating. The heat pumps would need to be located within an external compound. The compound would need to be screened with solid walls or acoustic screens to ensure any noise is not transmitted to either the building or the public external spaces. The seven heating Heat Pump units would serve the entire building, including the main church area and the church hall area. Underground connections would be required from the heat pump compound to the building. All ancillary items such as pumps and pressurisation units would be housed within the basement area of the building.

The heat pumps would provide hot water at approximately 50^{0}C for heating. The heat pump units would be sized as follows: -

- 3 No @ 33.4 kW each for the heating system, with Seasonable Co-efficient of Performance (SCoP) of 3.2 each.

From the heat pumps the heating distribution would serve all spaces within the building. The basic heating distribution layout would be similar to the existing but sized and configured for the heat pump flow and return temperatures and two pipe circuits. This also provides for a level of resilience similar to the existing arrangement with two interlinked boilers with multiple ASHPs each contributing to the overall heating demand.

6.3.2 Implications upon Existing

The heat pumps would be providing water for heating at a lower temperature than the boiler system. This will have the following implications.

- Radiators would need to be larger to cope with the lower flow temperature.
- It may be possible to use fan assisted emitters which would be smaller than radiators, but these would need a power supply and possible noise issues would also be required to be considered.
- Pipework would need to be larger to cope with the lower water temperature difference.
- Gas would not be required to the site, unless required in the church hall kitchen,
- No flues would be required.
- An external compound would be needed to be provided to locate the heat pumps. This would result in an external plant space which could require acoustic treatment to minimise noise outbreak. The combined noise level when all units are operational is approximately 77 dBA @ 1m distance. The nearest residential window is estimated to be 25m away from ASHP unit, and using the inverse square law method, a noise level of 49 dBA is estimated. This would need to be checked with the local Planning Authority.
- Planning consent would be required for the external compound.
- Lower efficiency for a ASHP when compared to a GSHP systems due to the fluctuating external air temperature.
- Electrical load and spare capacity would require careful consideration.
- Considerably lower capital costs when compared against a GSHP system.

6.3.3 ASHP Carbon and Cost Considerations

The following figures/loads are based on the existing design fed from gas fired boilers and the proposed changes and associated saving with switching to a centralised ASHP system providing for heating. The savings are achievable for the main church area and church hall area. The further savings from improving the building fabric are shown in section 6.1.4. The project value is the estimated capital costs of the ASHP system, together with cost estimate for new plant, new pipework, new radiators, and new controls. Budget quote obtained from PAC-AIR, refer to appendix for full details, please note this quotation will need to be updated to suit final heating loads and any of the fabric interventions selected.

Description of work	Energy Type	Fuel Cost p/kWh	Project Type	Technology	Annual kWhrs Pre project	Annual kWhrs Post project	Carbon Usage (TonnesCO_2)	Project Value (Excluding VAT).	Approximate annual energy costs (Excluding VAT)
Existing Gas Fired Boilers	Gas	8.5	Heating	Gas fired boilers	155,000	0	32.55	0	£13,175.00
Gas Boilers to Air Source Heat Pump	Electricity	36	Heating	Air Source Heat Pump	0	52,000	7.07	£195,000	£18,720.00

The project value costs for the ASHP have been factored according to the loads to the relevant areas in the main church areas and church hall areas. The preliminary cost of a central ASHP system, including new plant, new pipework, new controls, and new radiators which will serve the entire premises would be approximately £195,000.

Note the running costs for this option are currently shown to be higher than the existing boilers, this is due to the current high price of electricity, which is predicted to have a small drop over the next year or so. It should also be noted that whilst the current gas price is more attractive, it is likely in the years to come that this will increase in cost and potentially carbon tax to encourage people and organisations to move to electrical sources heating systems.

This ASHP option, before application of the fabric interventions achieves a 78% carbon saving.

6.4 Electrical Load Availability

As noted earlier it is estimated that the existing incoming electrical supply has a spare capacity of circa 50kVA. Under these option proposals the expected additional load for the mechanical plant would be as follows:

Ground Source Heat pumps: 30kVA

Air Source Heat Pumps: 45kVA

Therefore, the existing power supply should be available for the needs of the new heat pumps, subject to a peak load check being undertaken of existing equipment.

6.5 Further Decarbonisation

Whilst the change of heat source from gas boilers to heat pumps provides a significant reduction in carbon usage on the site, due to the remaining, but reducing, carbon in the grid supply this does not achieve the General Synod target of net zero carbon emissions. To move towards this some further on-site renewables need to be provided and whilst there does exist some Photovoltaic cell panels on the roof of the Church Hall, these will not provide the necessary provision to achieve this target. For the purposes of understanding the gap between these proposed decarbonisation options and the net zero carbon target, we outline the amount of PV required under each option to give an indication of what would be necessary to achieve net zero carbon. Having noted that, it is likely that the grid electricity will continue to de-carbonise itself, which means over time the carbon usage at the Church will reduce. i.e., fewer PV panels will be required in the future to reach net zero compared to what would be necessary now.

Having noted the above in relation to carbon reduction, the provision of PV panels will reduce the electricity bill and ongoing running costs. What is also useful to note is that whilst many institutions are paying typically 35p - 40p per kWh for their electricity and we understand the current figure being paid by the church is 36p, any excess electricity generated by the PV and not used by the building will be exported to the grid, however the revenue received for this is typically 3p - 5p per kWh. This difference means that a business case quickly develops for the investment in battery storage, so that all power generated by the PV panels is either used at that time, or stored in the batteries and used when the Church does need power. If provision of batteries is of interest, we will be able to provide some indicative costs and payback periods for these.

For the purposes of understanding the amount of PV required to achieve net zero carbon under each option, we note the following quantities overleaf. Please note this is for quantitative purposes only and locations / practicality of where this would be sited is subject to a more practical review of suitable locations. These calculations are based on the existing PV being retained in its current position. In addition, these figures are before application of any fabric improvements so PV can be reduced if some of these measures can be put in place.

Indicative PV to achieve Net zero Carbon, based on no fabric interventions:

Option	Carbon Usage [1] (Tonnes CO_2)	Annual kWh Energy equivalent	No of PV panels of output 550W [2] (1.2m x 1.7m) to achieve net zero carbon	Estimated Cost (excl batteries)
Existing Electricity used	1.53	11,260	21	£5,250
Existing Gas Boilers	32.55	155,000	287	£71,750
Or ASHP	7.07	52,000	97	£24,250
Or GSHP	6.53	48,000	89	£22,250

1. This is based on a carbon factor of 0.136kgCO_2/kWh for Electrical supply and 0.21kgCO_2/kWh for gas.
2. This is in addition to the existing PV panels

The potential locations for the PV do need to be assessed if there is appetite and funding available for these. Potential locations could include the following:

- South side of the main Church roof potentially looking at roof integrated panels. (Optimum location).
- Part of the vicarage garden, subject to shading.
- Create car ports in the car park area where the roof is made of PV panels, again subject to shading.
- Potentially the top part of the steep bank to the north of the church hall, subject to not being shaded.

Note the provision of PV and batteries would also provide some resilience should power cuts occur.

Examples of Roof Mounted PV on Churches & Cathedrals:

Gloucester Cathedral

Chester Cathedral

St John's church, Old Trafford

Church in North London

Examples of Car Port PV:

6.6 Phased Implementation

Programming of the range of potential works is important for a variety of reasons including ongoing church activities, funding availability and seasonal impact such as not undertaking the heating replacement in winter.

A number of the proposed works may have a smaller yet productive benefit by undertaking these first and this would be the case with any fabric improvements, as these will yield benefit almost as soon as they are completed. Also given that the heating system would only want to be as big as is necessary without being oversized, and if this is to be replaced for a lower rated heat pump system on the basis that the fabric improvements are to be put in place then those fabric improvements would need to be done first.

The heating system clearly needs to be planned to be undertaken after the heating season has finished, so timing the works to start in May – June and completed before September would be beneficial to avoid the need for temporary heating or user's discomfort. This is subject to ongoing satisfactory operation of the existing boilers.

The provision of more PV panels will achieve instant benefit in terms of reducing electricity bills, so can be undertaken at any time subject to funding, although there is often an independent business case for these to provide a payback over a number of years. The best financial and carbon gain will be to also provide batteries to store the PV generated energy on site and not export this, the batteries could be added at a later date but doing so will lose some of the financial benefit. Subject to any restrictions in the church finance governance there may be mechanisms for financial loan schemes that pay the capital for the works and the repayments are taken from the reductions in energy costs over an agreed number of years.

Note that this feasibility report is not a completed design, so any planned works would need to go through a detailed design process of circa 12 weeks and where relevant local authority Planning Approval secured. These timings would need to be taken into account in developing a programme of works. The design process would also need the services of an Architect, Quantity Surveyor and potentially a Structural Engineer and other professionals in order to provide a proper design for any new works.

7 Appendices

7.1 Photographs

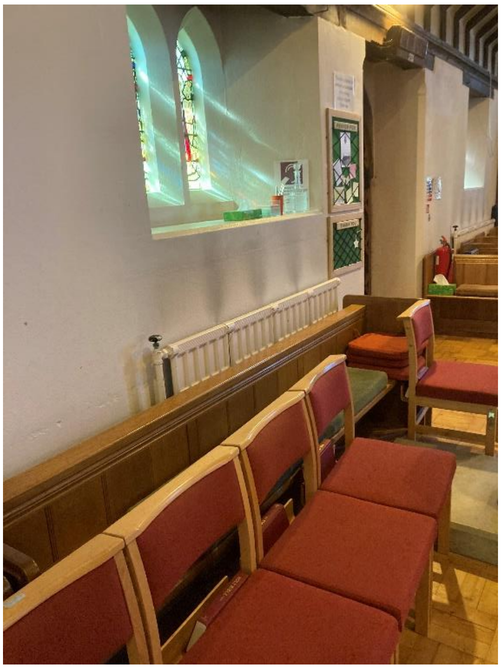
Existing Gas Fired Boilers

Existing Belt Driven Pump

Existing Control Panel

Existing Inverter Driven Pump

Existing Electric Water Heater in Vestry



Existing Single Panel Radiator in Church

Existing Electric Heater and Fan Convector

Existing Column Radiator in Church

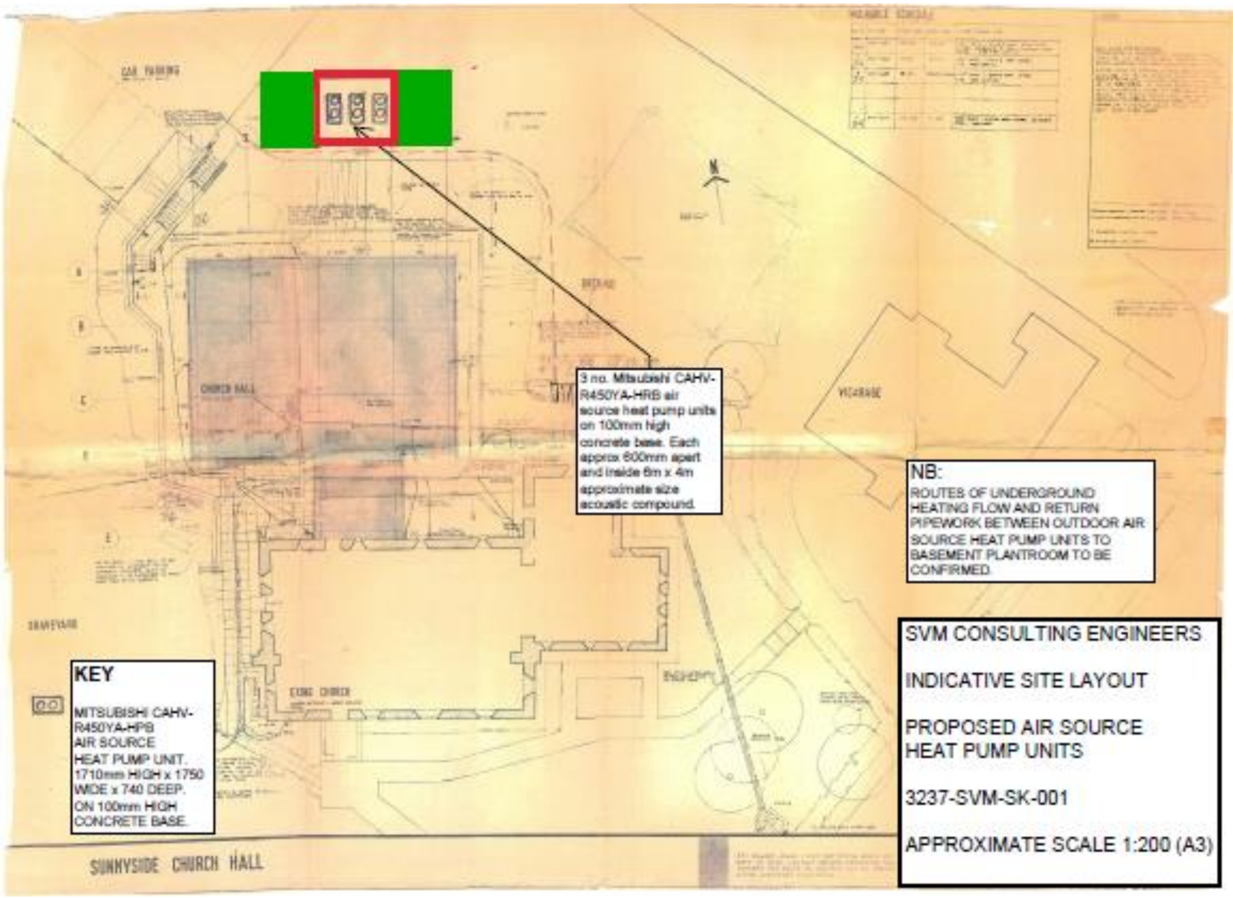
Typical View of Stained Glass Windows

Typical View of Church Hall

Church Grounds. Possible ASHP Location

Church Hall Lobby Entrance

7.2 Indicative Outdoor Air Source Heat Pump Equipment Proposal Sketch Drawing



This indicative sketch shows one potential location for the ASHP option as shown by the red box approximately to scale. The green areas can be vegetation screening or open air to assist in air flow.

7.3 Indicative Ground Source Heat Bore Hole Sketch Layout Drawing

NB:
ROUTES OF UNDERGROUND HEATING FLOW AND RETURN PIPEWORK BETWEEN GROUND SOURCE HEAT PUMP BOREHOLES/MANIFOLD TO BASEMENT PLANTROOM TO BE CONFIRMED.

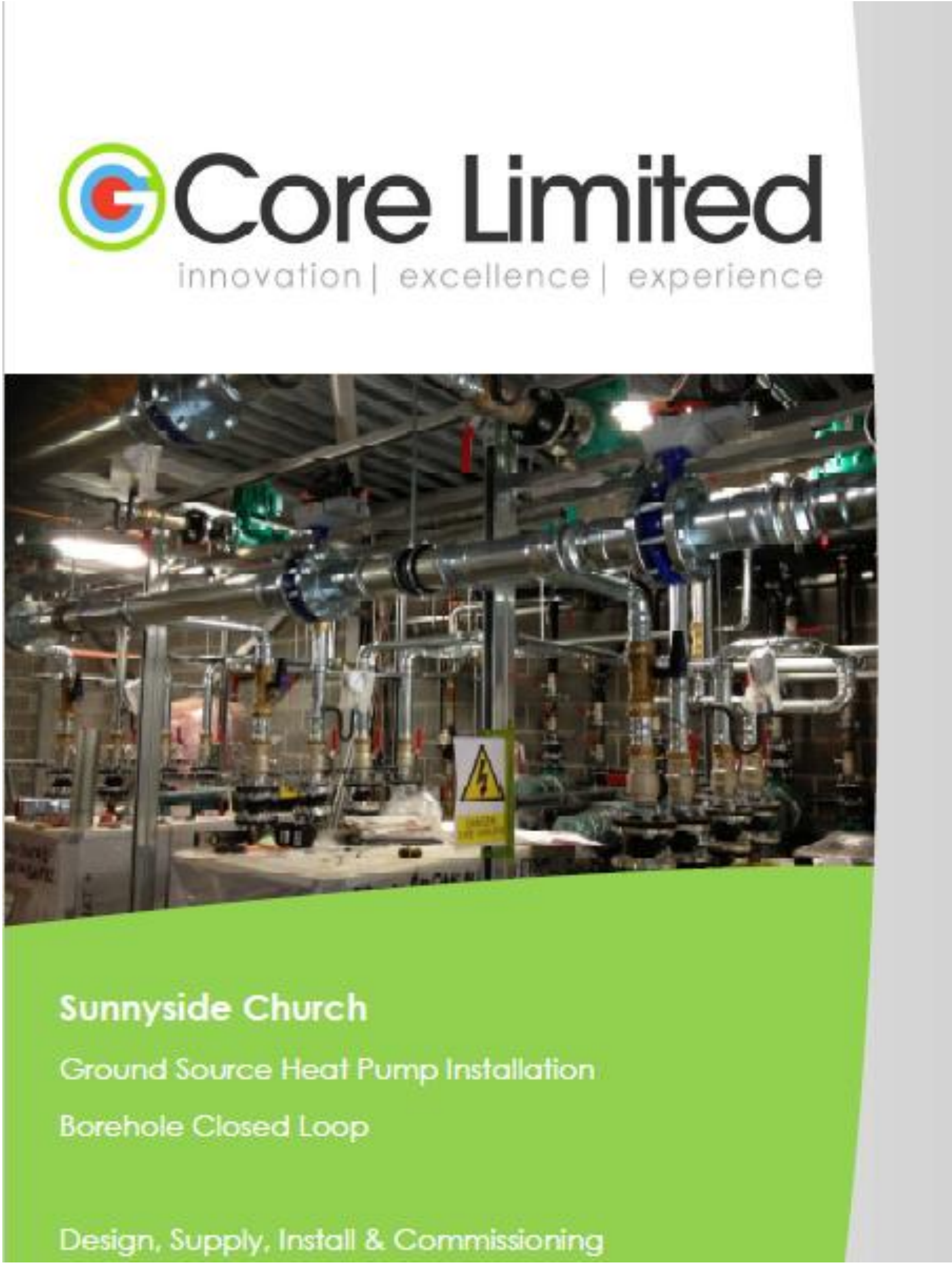
SVM CONSULTING ENGINEERS INDICATIVE SITE LAYOUT

PROPOSED GROUND SOURCE HEAT PUMP BOREHOLES

3237-SVM-SK-002

This indicative sketch shows nominal locations for the boreholes, there is much flexibility in these locations subject to land ownership and no archaeological issues. These are all buried and connected by pipework approx. 2m deep, so can be in allotment or car park areas.

7.4 GSHP Information



Document Reference:	**12231**
Project:	**Sunnyside Church**
Company:	**SVM**
Contact:	**Michael Doyle**
Proposal Type:	**Budget**
Work Type:	**Borehole Closed Loop Ground Source Heat Pump System**

Revision	Description	Issued by	Date	Checked by
00	Budget	Rob Gardiner	09.05.2023	Michael Regis

This document has been prepared for the sole benefit, use and information of the Client for the purposes set out in the proposal. The liability of G-Core Limited in respect of the information contained in the document will not extend to any third party.

G-Core Limited is a full-service ground source and geothermal energy company, specialising in the planning, design, specification, installation, integration, commissioning, operation and maintenance of ground and air source heat pump and geothermal energy technologies.

Our unbiased approach ensures that all our clients receive unbiased advice on the most appropriate technologies for their development to maximise savings on energy costs, compliance with statutory and planning requirements and capitalising on finance and incentives.

All G-Core's design, installation and commissioning procedures are performed, where applicable in accordance with the following standards and recommendations:

- Microgeneration Installation Standard MIS3005, Issue 5
- G-Core's in-house design and operating procedures
- The Ground Source Heat Pump Society Recommendations and publications
- The International Ground Source Heat Pump Association (IGSHPA)
- American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE)
- International Energy Agency (IEA)
- Environment Agency guidelines
- HVAC Guide to Good Practice – Heat Pumps [TR/30], July 2007

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Contents

1. Proposal Summary

1.1 Proposal Outline

This proposal is for G-Core Limited (G-Core) to design, supply and install a Ground Source Heat Pump system (GSHP) to provide the space heating requirements at Sunnyside Church.

This proposal outlines the system design and costs for a closed loop vertical borehole GSHP system (see Section 1.3.1).

Please read Section 1.8 which details our tender qualifications and information required to finalise the design and installation of the GSHP system.

1.2 Document Revision

This document is Revision 00.

1.3 System Summary

The peak and annual GSHP heating requirements have been provided to G-Core as 200kW and 180,000kWh, respectively.

This heating load will be provided by the GSHP system using 2No. 100kW ground coupled GSHPs providing LTHW into a thermal store.

The system will use a vertical borehole GEC sized to meet the annual heating space heating requirements. The GSHP system will be coupled to 20No. 190m deep vertical boreholes at an average spacing of 8m centre to centre. The boreholes will be individually connected to a field manifold complete with chambers and header pipework running back to the plantroom area to complete the Ground Energy Collector (GEC) installation.

We assume the GEC manifold will be located no further than 50m from the plantroom.

Our scope of works will terminate at the thermal store.

1.4 Outline Design Information Used

1.4.1 Design Parameters Used

We have based the system design and performance on the following parameters.

- Peak Heating (kW): 200
- Annual Heating (kWh): 180,000
- Heating flow (°C): 55
- Heating ΔT (°C): 10

1.4.2 GEC Design Parameters

- Thermal Conductivity (w/mK): 1.76
- Steady state ground temperature (°C): 12
- Heating minimum entry water temperature (°C): 0
- Cooling maximum entry water temperature (°C): NA

1.4.3 Information required

To verify the equipment specification and current borehole array design we require the following information:

- Confirmed peak heating and DHW loads
- Annual/monthly/hourly heating and DHW loads
- Confirmation of scope of works

1.5 System Interface and Control

1.5.1 Summary

We have allowed for control and power wiring to the equipment within our scope of works.

We have included a separate cost if we were asked to provide a full MCCP for the GSHP system.

1.5.2 Power Wiring

Mains Power and isolators for heat pump:	Others
Mains power and isolators for circulating pumps:	Others
Mains Power and isolators to PU:	Others
Final connections* from isolators to heat pump:	G-Core
Final connections* from isolators to circulating pumps:	G-Core
Final connections* from isolators to PU:	G-Core

1.5.3 Control Wiring

Fault/enable wiring from GSHP/pumps to BMS Panel:	Others
Fault/enable wiring from PU to BMS Panel:	Others
Wiring of circulating pumps:	G-Core
Wiring of flow switches:	G-Core

1.6 Borehole Depths & Liaison with the Environment Agency

Due to the nature of the underlying ground and groundwater conditions, liaison with the Environment Agency is advisable on this project. We have allowed for this within our proposal

1.7 What does this Proposal Include for

1.7.1 General

- Design, working drawings, 'as installed' drawings and O&M Manual
- Project management
- Provision of O&M manual information where required

1.7.2 GSHP System

- Supply and installation of 20No. 190m deep boreholes using 40mm PE100 single loops, grouting and pressure testing
- Supply and installation of manifold and chamber, cross-connecting pipe work between boreholes and manifolds and header pipework to GSHP plantroom
- Excavation and backfilling using graded backfill - **Optional**
- Flushing, filling and pressure testing of Ground Energy Collector
- Supply and installation of 2No. 100kW heating only Ground Source Heat Pumps
- Source side of GSHP plantroom installation consists of the following:
  - 2No. twin head variable speed circulating pumps
  - 1No. Air/dirt separator
  - Dosing pot
  - Pressurisation unit and expansion vessel
  - Suitably sized pipework, valves and fittings
- User side of GSHP plantroom installation consists of the following:
  - 2No. twin head variable speed circulating pumps
  - 1No. Thermal store
  - 1No. heat meter
  - Suitably sized pipework, valves and fittings

- Sterilisation with biocide, independent chemical analysis and filling of the Ground Energy Collector with glycol solution to the brine side of the heat pump system
- Thermal insulation of plantroom pipework using phenolic foam sections and valve muffs - **Optional**
- Testing and Setting to Work
- Commissioning of heat pump system

1.8 Proposal Price

Our total budget proposal sum is **£456,937.56, excluding VAT**, which will be added at the appropriate rate.

1.9 Other Remarks/Qualifications

1.9.1 General Items

- This price is valid for 30 days from the date of issue and is Subject to Contract
- Current availability is 6-8 weeks from receipt of order
- Lead in time for heat pump plant is 10-12 weeks from order

1.9.2 Qualifications

- All GSHP system pipework will be HDPE (source side), welded steel (output side)
- We would make no allowance for the flushing and dosing of the heating and cooling pipework of the GSHP system (i.e., between the heat pump and buffer tanks). We would ask this be carried out by the mechanical contractor as part of their works, we can provide details of fluid volumes in this pipework to assist with the pricing of this element.
- We have made no allowance for any standing time or any other additional costs that may be incurred due to any Archaeological findings discovered during the works

2. Tender Information Provided by the Client

		Yes	No
1.	Mechanical Specification		X
2.	Heat Pump Specification		X
3.	Design Loads (peak and annual only)	X	
4.	Sap Calculation		X
5.	Plans		X
6.	Completed enquiry form	N/A	N/A
7.	• Email Information	X	

3. Proposal Sum Analysis

Item	Description	Unit	Qty	Rate (£)	Total (£)
	Section 1 – GEC				
1.1	Supply and installation of vertical boreholes including loops, grouting and pressure testing	Sum	1	£186,600.00	£186,600.00
1.2	Processing and disposal of solid and liquid waste from drilling operations	Sum	1	£22,800.00	£Optional
1.3	Supply and installation of cross-connecting pipework, manifold, chamber and header pipework to plantroom	Sum	1	£34,366.60	£34,366.60
1.4	Excavation, compaction, warning marker tape and backfilling	Sum	1	£17,550.00	£Optional
1.5	Thermal Response Test (TRT) on first installed borehole	Sum	1	£7,500.00	£Optional
				Total Section 1	**£220,966.60**
	Section 2 – GSHP System				
2.1	Supply and installation of heat pumps and plantroom installation up to and including the thermal store including control & power wiring, sterilisation, chemical analysis and filling of GEC with glycol	Sum	1	£224,380.96	£224,380.96
2.2	Optional rate for thermal insulation of pipework	Sum	1	£13,365.00	£Optional
2.3	Testing, setting to work and commissioning	Sum	1	£1,890.00	£1,890.00
2.4	Cost to supply and install GSHP MCCP Panel	Sum	1	£33,750.00	£Optional
				Total Section 2	**£226,270.96**
	Section 3 – Design & Project Management				
3.1	Project management – External Works	Sum	1	£4,100.00	£4,100.00
3.2	Project management - Plantroom	Sum	1	£2.300.00	£2.300.00
3.3	Design, drawings and O&M Manual information	Sum	1	£3,300.00	£3,300.00
				Total Section 3	**£9.700.00**
				Total Proposal Sum (in GBP Excluding VAT)	**£456,937.56**

4. Proposed Schedule of Works

4.1 Preliminaries

- Project management
- Health and safety assessment
- Risk assessments
- Method statements
- Design warranties
- Working drawings
- 'As fitted' drawings
- Site supervision/meetings

4.2 Ground Energy Collector (GEC)

- In advance of mobilization to site and commencement of the drilling works we will contact the necessary authorities in order to notify them of our intended works.
- Drilling of 20No. boreholes to a depth of 190m below existing ground level. All boreholes will be made using 150mm diameter tools.
- Supply and installation of 40mm single-U geothermal loops made from PE-100 pipe and a bespoke factory fitted u-bend.

- Supply and installation of thermally enhanced bentonite grout mixed with silica sand to provide a suitable thermal conductivity. Grouting of each installation will be via tremmie method from the base of the borehole to ground level.
- Processing and disposal of liquid and solid waste from drilling operations – **Optional**
- Thermal Response Test on first installed borehole - **Optional**
- Supply and installation of cross-connecting pipe work from boreholes to manifold
- Supply and installation of manifolds and chambers with access cover
- Supply and installation of manifolds and Supply and installation of header pipe work to plant room using suitably sized HDPE pipe and fittings as specified.
- Flushing, filling and pressure testing of Ground Energy Collector
- Excavation and backfilling – **Optional**

4.3 Plant room installation

- Supply and installation of 2No. 100kW heating only Ground Source Heat Pumps
- Source side of GSHP plantroom installation consists of the following:
  - 2No. twin head variable speed circulating pumps
  - 1No. Air/dirt separator
  - Dosing pot
  - Pressurisation unit and expansion vessel
  - Suitably sized pipework, valves and fittings
- User side of GSHP plantroom installation consists of the following:
  - 2No. twin head variable speed circulating pumps
  - 1No. Thermal store
  - 1No. heat meter
  - Suitably sized pipework, valves and fittings
- Sterilisation with biocide, independent chemical analysis and filling of the Ground Energy Collector with glycol solution to the brine side of the heat pump system
- Control and power wiring
- Supply and installation of GSHP MCCP with BMS interfaces - **Optional**
- Thermal insulation of plantroom pipework using phenolic foam sections and valve muffs - **Optional**
- Testing and Setting to Work

4.4 Commissioning

- System commissioning of heat pump system and handing over, including all installation drawings, O&M manuals and system instructions to Employer.

5. Party responsibilities/Demarcation/Attendances

	G-Core	Client
Water supply for drilling and GEC flushing, purging and filling (2 Bar, 50mm connection), within suitable distance of the working area.		X
Builders work (other than small holes and fixings)		X
Offloading, transportation across site and placement into plantroom areas of main items of plant and equipment	X	
Mains electrical work		X
Mains cold water supplies including water treatment (i.e., water softening)		X
Flushing and water treatment of load side pipework of heat pump (heating/cooling pipework)		X
Flushing and water treatment of source side pipework	X	
Control and power wiring (as per section 1.5)	X	
Thermal insulation of pipe work (Optional rate provided)		X
Plant bases and plinths		X
Electrical submeters		X
Heat Meters (between GSHP and thermal store only)	X	
Holes and penetrations requiring specialist drilling equipment		X
Excavation, marker tape and backfilling (Optional rate provided)		X
Processing and disposal of liquid and solid waste from drilling operations		X
Removal of excess spoils from excavations due to suitability of backfill or bulking (hazardous or non-hazardous)		X
Fire stopping through penetrations		X
Making good to internal/external of building fabric		X
Breaking out of hardstanding areas		X
Reinstatement of tarmac, concrete or grassed areas (including specialist surfaces)		X
Incurred costs due to delays outside our control		X

110 Volt power supply for operation of tools		X
Secure storage of parts and equipment		X
Parking for works vehicles		X
Local site fencing to collector field / trenching area during installation works		X

6. Proposed Outline Programme of Works

At this stage, we have no concerns about executing the works. However, at pre-contract stage we would request further details as the Main Contractors programme and schedule of works.

Our current outline programme of works is as follows:

- Pre-Mobilisation 4-6 Weeks
- GEC Installation 8-10 Weeks
- Heat Pump Installation 5-6 Weeks
- Commissioning 1 Week

7. End Client 'Soft Landings' & System Optimisation

We are conscious that the proposed installation represents new technology to end Clients. As such, a more detailed handover is required, which can include multiple visits over an extended period.

Therefore, we commit to engaging with the end Client beyond the normal obligations under a subcontract defects liability period. This engagement includes a commitment to regular, reasonable visits including training sessions as requested by the end user within the first 6 months of Handover.

This 'Soft Landings' approach is designed to incorporate a 6-month System Optimisation process, whereby the performance of the system is assessed and confirmed as operating within the Specified parameters. Should operating adjustments be required to improve system performance or the end Client's requirements alter from the Specification, adjustments (where possible) will be made within this period.

8. Warranties

The system design and installation will be warranted under subcontract Collateral Warranty.

All manufacturers' warranties for installed plant and equipment will be transferred in favour of the end Client upon completion.

9. Service and Maintenance

In order that the installed plant and equipment remains within manufacturer's warranty, the system must be serviced annually in accordance with the manufacturer's instructions.

Typically, we provide service and maintenance contracts either for 1 year or long-term contracts for periods of 3 and 5 years. G-Core can provide an annual service and maintenance contract for this project.

QVANTUM

HEAT PUMPS FOR SUSTAINABLE CITIES

QVANTUM RS/2 — TECHNICAL DATA

Specification		Q32RS/2	Q41RS/2	Q48RS/2	Q65RS/2	Q81RS/2	Q96RS/2	Q123RS/2	Q144RS/2	Q162RS/2	Q192RS/2
Heating capacity according to EN14511											
Heating capacity 0°C/35°C	kW	26,2	31,0	37,2	53,4	62,0	74,4	93,0	111,4	124,0	148,8
Heating capacity 10°C/35°C	kW	34,4	41,0	49,1	68,8	82,0	98,2	123,0	147,3	164,0	196,4
Heating capacity 0°C/45°C	kW	26,7	31,6	37,8	53,4	63,2	75,6	94,8	113,4	126,4	151,2
Heating capacity 10°C/45°C	kW	34,2	40,7	48,8	68,4	81,4	97,6	122,1	146,4	162,8	195,2
Heating capacity 0°C/55°C	kW	27,9	33,0	39,6	55,8	66,0	79,2	99,0	118,8	132,0	158,4
Heating capacity 10°C/55°C	kW	34,2	40,6	48,7	68,4	81,2	97,4	121,8	146,1	162,4	194,8
COP 0°C/35°C		4,8	4,8	4,6	4,8	4,8	4,6	4,8	4,6	4,8	4,6
COP 10°C/35°C		5,9	5,7	5,6	5,9	5,7	5,6	5,9	5,7	5,6	5,9
COP 0°C/45°C		3,7	3,6	3,6	3,7	3,6	3,6	3,6	3,6	3,6	3,6
COP 10°C/45°C		4,7	4,6	4,5	4,7	4,6	4,5	4,7	4,6	4,5	4,7
SCOP average climate, 35°C/55°C		5,14/4,17	5,04/4,12	4,94/4,03	5,14/4,17	5,04/4,12	-	-	-	-	-
SCOP colder climate, 35°C/55°C		5,25/4,31	5,13/4,25	5,03/4,16	5,25/4,31	5,13/4,25	-	-	-	-	-
Energy efficiency class											
Energy efficiency class, space heating, 35°C/55°C		A+++ / A+++	A+++ / A+++	A+++ / A+++	A+++ / A+++	A+++ / A+++	-	-	-	-	-
Condenser											
Condenser flow rate (ΔT=7K, 0°C/45°C)	l/s	0,90	1,06	1,27	1,79	2,13	2,54	3,22	3,86	4,30	5,14
Condenser flow rate (ΔT=10K, 10°C/45°C)	l/s	0,90	1,06	1,27	1,79	2,13	2,54	4,18	4,98	5,56	6,64
Pressure drop condenser (0°C/45°C)	kPa	11,0	13,0	18,0	27,0	26,0	39,0	13,0	13,0	16,0	18,0
Pressure drop condenser (10°C/45°C)	kPa	11,0	13,0	18,0	27,0	26,0	39,0	18,0	20,0	22,0	28,0
Max operating temperature	°C	65,0	65,0	65,0	65,0	65,0	65,0	65,0	65,0	65,0	65,0
Connection size condenser		Cu35,0	Cu35,0	Cu35,0	Cu54,0	Cu54,0	Cu54,0	Cu54,0	Cu54,0	DN65 int thread	DN65 int thread
Evaporator											
Evaporator flow rate (ΔT=3K, 0°C/45°C)*	l/s	1,42	1,91	2,27	3,23	3,83	4,53	5,73	6,80	7,63	9,07
Evaporator flow rate (ΔT=5K, 10°C/45°C)*	l/s	1,38	1,59	1,89	2,69	3,18	3,78	4,60	5,48	6,06	7,35
Pressure drop evaporator (0°C/45°C)	kPa	32,0	36,0	30,0	38,0	39,0	38,0	43,0	40,0	43,0	45,0
Pressure drop evaporator (10°C/45°C)	kPa	27,0	18,0	22,0	24,0	26,0	25,0	48,0	47,0	66,0	69,0
Temperature evaporator inlet (Min/Max)*	°C	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25	-5 / 25
Temperature evaporator inlet (Min/Max)**	°C	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25	-10 / 25
Connection size evaporator		Cu35,0	Cu35,0	Cu35,0	Cu54,0	Cu54,0	Cu54,0	DN65 int thread	DN65 int thread	DN65 int thread	DN65 int thread
Dimensions											
Weight	kg	234	248	268	506	528	551	580	590	680	700
Length	mm	600	600	600	1 200	1 200	1 800	1 800	1 800	2 100	2 100
Width	mm	640	640	640	640	640	640	640	640	640	640
Height	mm	1 668	1 665	1 668	1 668	1 668	1 418	1 418	1 418	1 438	1 438
Compressor	Fully hermetic EVI scroll										
No. Compressors	pcs	1	1	1	2	2	2	3	3	4	4
No. refrigerant circuits	pcs	1	1	1	1	1	1	1	1	2	2
Refrigerant											
Amount of refrigerant	kg	3,8	4,2	4,6	8,9	9,5	9,9	12,2	13,0	2x7,9	2x8,3
GWP (AR5)		1 624	1 624	1 624	1 624	1 624	1 624	1 624	1 624	1 624	1 624
$CO_2(e)$	tons	6,17	6,82	7,47	14,45	15,43	16,08	19,81	21,11	25,66	26,96
Sound levels											
Sound power level (L_{WA}) according to EN12102	dB(A)	47	47	47	50	50	50	51	51	53	53
Power supply											
Nominal voltage	V/ph/Hz	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50	400/3/50
Electric power											
Electric power 0°C/35°C	kW	5,5	7,0	8,0	11,4	14,0	17,0	21,0	25,5	28,0	34,0
Electric power 0°C/45°C	kW	7,3	8,7	10,4	14,6	17,4	21,2	26,1	31,8	34,8	42,4
Electric consumption											
Maximum electric consumption	A	19,6	23,7	28,6	39,2	47,4	56,8	71,1	85,2	94,8	113,6
Recommended fuse	A	25	35	50	50	63	80	125	125	125	160
Appearance											
Color side plates		White	White	White	White	White	White	White	White	White	White
Color stand		Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized	Galvanized

*Version with water as brine
**Version with brine bioethanol 29%

7.5 ASHP Information

PACAIR
Unit 1 & 2 The Heron Business Park
Eastman Way
Hemel Hempstead
Hertfordshire HP2 7FW
Tel 01442 254401
Fax 01442 236515
Web www.pacair.co.uk

Pages:	4	**From:**	Nick Ryman
To:	Michael Doyle	**Tel (direct):**	01442 254401
Company:	SVM Consulting	**Tel (mobile):**	07554886506
Fax no:		**Fax no:**	01442 236515
Tel no:	01442869369	**Email:**	nick@pacair.co.uk
Date:	10 May 2023	**Prepared by:**	Nick Ryman
Project ref:	P267194 - Sunnyside Church		

Proposal no: Q0903-110956 **Validity:** 30 days from the above date

Please quote this reference number on all correspondence relating to this proposal

Proposal

Ref.	Qty	Model	Description	Unit Price	Nett Price
Bill of Materials					
ASHPs					
	7	CAHV-R450YA-HPB_+ DPS + Commissioning	CAHV-R 40kW HP with Differential Pressure Switch and Commissioning	£21,010.00	£147,070.00
	1	TW-TH16-E	CAHV HEADER PIPE THERMISTOR	£404.00	£404.00
	1	PAR-W31MAA-J (HH)	PAR-W31MAA-J (HH) Remote Contr. E-Series	£153.00	£153.00
				Subtotal	**£147,627.00**
				TOTAL NETT PRICE EXCLUDING VAT	**£147,627.00**

Regards
Nick Ryman

This proposal assumes that you will carry the relevant AI/BSP status for installation and maintenance throughout the warranty period. Please download all commissioning log books from the web site www.mitsubishielectric.co.uk/aircon. Please e-mail completed logbooks to commissioning.logbook@meuk.mee.com to activate your warranty.

- This quotation is given by PACAIR in good faith based upon information provided by you or your company.
- We recommend that you assess final product selection and make the final system design based upon your own analysis and project knowledge, including any project requirements which might impact on that selection.
- Please check carefully any requirement for a Mitsubishi Electric product to integrate with any third party equipment. They are not responsible for integration capability of their products with any third party equipment unless they have expressly confirmed that this integration is approved in the current Mitsubishi Electric product specification or in a current technical bulletin.

Palmer Air Conditioning Limited t/a PACAIR Incorporated in the UK Company Reg No: 04862763
Unit 1 & 2 Heron Business Park Eastman Way Hemel Hempstead Hertfordshire HP2 7FW
This document is confidential and may also be privileged. If you are not the intended recipient, please notify this office immediately. You may not copy it, use it for any purpose nor disclose its contents to any other person.

This quotation is issued subject to PACAIR's Terms & Conditions of Sale; additionally the quotation is valid for a period of 30 days after which time we reserve the right to amend our offer. E & O E.

-If this quote contains Heating Products. Purchasing and installing customers must pass the relevant Heating Training Course before an order can be placed. Call on 01442 254401 to book.
-All quotations containing CAHV, CRHV and/or Cascade Systems must be accompanied by a Mitsubishi Electric technical proposal. Please contact your Account Manager if you have not received one.

Palmer Air Conditioning Limited t/a PACAIR Incorporated in the UK Company Reg No: 04862763
Unit 1 & 2 Heron Business Park Eastman Way Hemel Hempstead Hertfordshire HP2 7FW

Page: 3
Proposal: Q0903-110958
Project: Sunnyside Church
Date: 10 May 2023

Palmer Air Conditioning t/a PACAIR Terms and Conditions

Special condition: COVID-19 impact disclaimer:
The global spread of coronavirus ("COVID-19") is liable to result in material delay to component procurement, production, shipment and delivery and in other supply chain delays which in turn may cause delays in any delivery date or completion, whether foreseen or unforeseen (together, or separately, a "COVID-19 related Delay"). As a prevailing special condition to our quotation, and without prejudice to our Terms and Conditions of Sale, you acknowledge and agree that any indicated or proposed date, milestone or other time period set out in this and/or in any other document, email, purchase order, order acknowledgment or communication (in oral or recorded form), is to be construed solely as an estimate for time of delivery or performance; and any provision or term to the to the contrary is deemed amended and to be interpreted in accordance with the terms of this Disclaimer.
Any COVID-19 Delay will not be grounds for you to terminate or cancel your order for the goods or services the subject of our quotation.
PACAIR and its employees, do not accept liability for any loss, cost, liquidated damages or any unascertained, general or special damages of any nature whatsoever or any other claim or fine or expense, whether directly or indirectly connected to: (i) any COVID-19-related Delay or (ii) the applicable terms of trading. In the event that we proceed to contract with you, where either party becomes aware of the likelihood of delay or any actual delay in delivery or performance resulting from a COVID-19-related Delay, the party first aware of the COVID-19-related Delay shall use its reasonable endeavours to notify the other of the same in writing by recorded post to the other party.

PAYMENT TERMS

TRADING TERMS and CONDITIONS OF SALE

Strictly nett monthly account for approved credit accounts. New accounts must be applied for on our application form stating two trade and one bank reference at least one reference must be air conditioning based. At least ten days must be allowed for credit status clearance. Where no approved credit account already exists payment must be CASH WITH ORDER or CASH ON DELIVERY. No new account will be opened for an initial order of less than £500.00. Goods despatched per C.O.D. post will carry additional charge of £15.00. The right is reserved to charge interest on accounts overdue and to claim all charges, legal and otherwise, involved in collecting payment. The Vendor reserves the right to uplift goods from the Buyer's possession should these payment terms not be complied with. The Buyer shall permit access to the Vendor for this purpose. All costs and losses incurred by the Vendor in so doing shall be charged to the Buyer together with the restocking charge referred to below. Our payment terms for our credit account customers are as per our account opening letters sent at the time of opening. All credit accounts are reviewed annually in line with our ISO
9001:2015 procedures. A copy of which is available on request. Minimum Invoice value excluding VAT is £49.95. Minimum Invoice value will be applied to all small orders and charged at the minimum billing charge ruling on the date of dispatch if applicable.

PRICES
Prices are subject to change without notice and goods will be invoiced at the price ruling on the date of dispatch. Catalogue prices are exclusive of VAT.
CARRIAGE
We reserve the right to charge carriage on all dispatches plus an additional amount where a special service is requested such as AM/PM, same day, OOH, specialist vehicle or overnight etc.

CANCELLATIONS AND RE-STOCKING
Orders cannot be cancelled without our written consent. Returns for credit are subject to prior arrangement and restocking fees will apply based on the nett invoice value of the goods. A returns window is also in operation with a maximum time allowance after delivery. Please contact us for details.
NOTICE OF CLAIMS
a) Goods must be checked by the buyer on receipt and any deficiencies or errors be notified in writing to the vendor within 14 days of receipt date. b) Damage in transit must be notified to the vendor and carrier within 3 days of receipt date.
c) Losses in transit must be notified to the vendor and carrier within 14 days of the date of invoice.
d) Goods must be signed for on receipt and "Unexamined" signatures do not remove the buyer's obligation to check goods on receipt and notify the vendor of any irregularities. The vendor shall not be liable in respect of any claim if the provisions of this clause are not complied with.

FORCE MAJEURE
The vendor shall not be liable whatsoever for non-delivery or delay in delivery directly or indirectly resulting from or caused by an Act of God, outbreak of war, hostilities, insurrection, riot, civil disturbance, fire, flood, explosion, accident, theft, climatic conditions, Government Act or regulation, shortage of materials, strike, lock out or trade dispute (either the vendors employees or other parties) or caused by any other circumstance out with the vendors control.

RISK AND TITLE IN GOODS SUPPLIED
Risk in the goods passes to the Buyer on delivery. Notwithstanding delivery, all goods remain the Vendor's property until all sums due by the Buyer to the Vendor on any legal ground whatsoever are paid to the Vendor in full.

WARRANTIES and EXCLUSIONS OF LIABILITY
a) Goods manufactured by the vendor are subject to a twelve month warranty in respect of defective materials or workmanship. The vendor reserves the right to either repair or replace defective goods free of charge.
b) All other goods sold by the vendor shall be covered by a warranty or guarantee equivalent to the warranty or guarantee offered to the vendor by the supplier of such goods in respect thereof.
c) Goods which are the subject of warranty or guarantee claim must be returned to the vendors premises at the expense of the buyer.
d) Under no circumstances shall the Vendor be liable to the buyer for any loss of profit, revenue, anticipated savings or goodwill or any type of special, incidental, indirect or consequential loss or damage
e) Nothing in this agreement shall restrict or exclude the Vendors liability: under Part 1 of the Consumer Protection Act 1987; in respect of fraudulent misrepresentation. For death or personal injury caused by the Vendors negligence; or arising under S12 Sale of Goods Act 1979.

Palmer Air Conditioning Limited t/a PACAIR Incorporated in the UK Company Reg No: 04802763
Unit 1 & 2 Heron Business Park Eastman Way Hemel Hempstead Hertfordshire HP2 7FW
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This quotation is issued subject to PACAIR's Terms & Conditions of Sale; additionally the quotation is valid for a period of 30 days after which time we reserve the right to amend our offer. E & O E.

LIEN

The vendor shall have a general lien on all goods for all outstanding sums due at any time. The vendor shall be entitled to dispose of or sell the goods at the buyer's expense, all nett proceeds there from being set against payment of such sums subject to written notice of 14 days being given.

JURISDICTION and PROPER LAW

Any disputes arising from the above must be considered as being subject to the jurisdiction of the Court and subject to English Law. Common law rights are not affected.

Palmer Air Conditioning Ltd t/a PACAIR, Units 1 and 2 The Heron Business Park, Eastman Way, Hemel Hempstead, Herts HP2 7FW Tel: 01442 294401

Email: sales@pacair.co.uk

P910893-17/01/2020

This quotation is issued subject to PACAIR's Terms & Conditions of Sale; additionally the quotation is valid for a period of 30 days after which time we reserve the right to amend our offer. E & O E.

Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

CAHV-R450YA-HPB

Air Source Heat Pump

Project Name	Sunnyside
Project Reference	TBC
Quote Reference	TBC
Prepared By	Nick Ryman

Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

General

i. Air Source Heat Pumps will defrost the outdoor unit heat exchanger coil in periods of low ambient temperature such that condensate will be discharged – adequate provision should be made to prevent this condensate from collecting around the unit and pipework to avoid freezing, such as a soak away or drip try , which can cause a Health & Safety risk.

ii. If the unit is continuously operated for a long time with the outside air temperature below the freezing point, install a heater at the base of the unit to prevent the water from freezing at the unit bottom

iii. All water systems should be designed, installed and commissioned in accordance with industry good practice guidelines; such as, but not limited to: BSRIA Guide BG2/2010 – Water System Commissioning, BSRIA Guide BG29/2021 – Pre-Commissioning of Pipework Systems, BSRIA Guide BG50/2021 – Water Treatment for Closed Heating & Cooling Systems, CIBSE Commissioning Code W – Water distribution systems.

iv. Air Source Heat Pumps are designed to produce low pressure hot water which may be used in a variety of applications – it is your responsibility to check that the equipment proposed is suitable for the specific design and application intent.

v. Air Source Heat Pumps perform more efficiently by utilising low water flow temperatures and also making use of weather compensation.

vi. Mitsubishi Electric takes no design responsibility or liability for the system, components, equipment selections or control strategy – it is your responsibility to check the suitability of the proposed equipment selections.

vii. It is your responsibility to check that the Equipment selections parameters, as laid out in the Technical Submission document, are as provided by yourselves.

viii. In order to comply with the Mitsubishi Electric warranty requirements all Mitsubishi Electric products must have adequate planned preventative maintenance undertaken in accordance with our recommendations.

ix. To meet Mitsubishi Electric's warranty requirements a suitable method of filtration must be provided within the system. In addition, each Air Source Heat Pump must be provided with a strainer (minimum 20 mesh), line size flushing bypass, isolating valves and flow protection device. The flow protection device can be either a flow switch or differential pressure switch, with the preferred method being a differential pressure switch.

x. The recommended water flowrates must be maintained at all times when the equipment is operating. Particular attention should be paid to any change in pressure drop due to glycol and start up temperatures. Operating the equipment with less than the recommended flowrate will invalidate the warranty.

xi. It is recommended that glycol is used for protection of the low pressure hot water heating circuit to protect against freezing – should glycol anti-freeze protection not be used, another suitable form of frost protection must be employed to adequately protect the water circuit. If the water circuit freezes and damages the equipment the warranty will become void.

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Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

Project Reference: Tbc

Design Conditions		
Application		Radiators (Rads)
Outdoor Temperature Condition	°C	-4
Water Inlet Temperature	°C	45
Water Outlet Temperature	°C	50
Glycol		Ethylene
Concentration of Glycol	%	25
Freeze Protection Temperature	°C	-7
Number of Units	No.	7

Selection Results		
Total Deliverable Capacity by Units	kW	224.8
COP (at design condition & 100% load)		2.0
SCOP (Low/Medium)		3.57/3.24
Number of Controllers (PAR-W31MAA)	No.	1

Water Requirments		
Minimum Flow Rate (per Unit)	l/s	1.9
Recommended Pipe Size (to unit)*	mm	54
Header Pipe Thermistor	No.	1
Total Required Flow Rate	l/s	13.3
Main Header Recommended Pipe Size*	mm	133
Pressure Drop (through CAHV)	kPa	10.9

*pipe sizing is based on copper.

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Commercial Heating | Technical Data

Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Efficiency Priority Mode - Part Load per Unit

Operating capacity: 100%		
Capacity of Unit	kW	32.1
Input Power per Unit	kW	15.9
COP		2.0
Operating capacity: 75%		
Capacity of Unit	kW	28.4
Input Power per Unit	kW	14.9
Operating capacity: 50%		
Capacity of Unit	kW	18.6
Input Power per Unit	kW	9.5
Operating capacity: 25%		
Capacity of Unit	kW	8.8
Input Power per Unit	kW	5.5
Operating capacity: Lower limit		
Capacity of Unit	kW	3.8
Input Power per Unit	kW	3.7

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Commercial Heating | Technical Data

Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Refrigerant		
Refrigerant Type		R454C
GWP per Unit		148
Charge per Unit	kg	9
Equivalent CO_2 Emissions per Unit	kg	1332

Compressors		
Compressor Type		Inverter Scroll Hermetic Compressor
Starting Method		Inverter
Number of Compressors per Unit	No.	1
Compressor Motor Output (per Compressor)	kW	12.1

Heat Exchanger		
Heat Exchanger Type		Stainless Steel Plate
Minimum Water Circuit Volume per Unit	Litres	525
Total Minimum Water Circuit Volume	Litres	3675

Fans		
Fan Type		Propeller Fan
Starting Method		Inverter
Number of Fans per Unit	No.	2
Total Airflow per Unit	l/s	5000
Fan Motor Output (per Fan)	kW	0.92
Available External Static Pressure	Pa	10

Electrical Data		
Power Supply per Unit	V/ph/Hz	380-415V/3-phase/50-60Hz
Max Total Current	A	282.1
Max Current per Unit	A	40.3

Weight & Dimensions		
External dimensions (H × W × D) per Unit	mm	1710 × 1750 × 740
Net Weight per Unit	kg	359

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Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

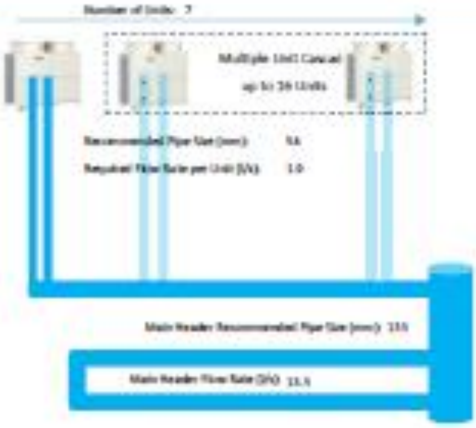
Project Reference: TBC

Recommended Pipe Size

Flow Rate per Unit	l/s	1.9
Number of Units		7
Total Flow Rate*	l/s	13.3
Pressure Drop**	kPa	11

* With Main header

** Including Glycol

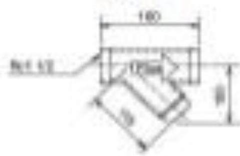


Pipe work sizing is the responsibility of the installing contractor and consultant. All pipe work sizes are based on CIBSE design conditions and water systems should be commissioned in accordance with the latest CIBSE Commissioning Code W for Water. All water should be cleaned and treated in accordance with BSRIA BG 29/2021 Pre-Commissioning Cleaning of Pipework Systems All pipe sizes are based on copper to BS EN 1057.

Optional parts

Install the strainer at the water pipe inlet

Strainer



External-water temperature sensor (TW-TH16)

Vertical installation

Horizontal installation

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Commercial Heating | Technical Data

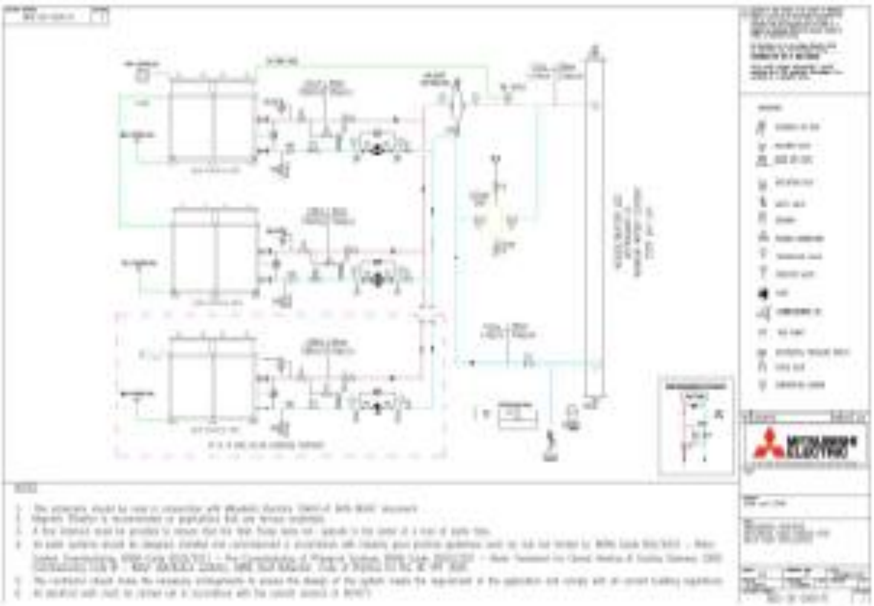
MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

Project Reference: Tel:

Example Schematic



Water Filtration

Strainer	Magnetic Filter	Air Dirt Separator
20 Mesh or More (Minimum)	Recommended if steel pipe	Minimum

Minimum-Without this filtration method the installations risks not receiving full warranty.
Recommended -This filtration method has recognised benefits for this type of system but its inclusion will not affect warranty.

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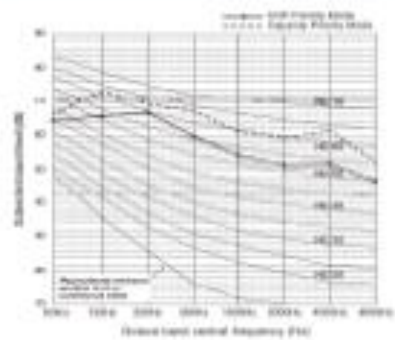
Commercial Heating | Technical Data

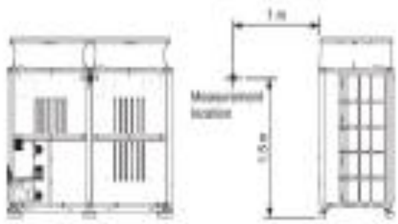
Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Noise Level



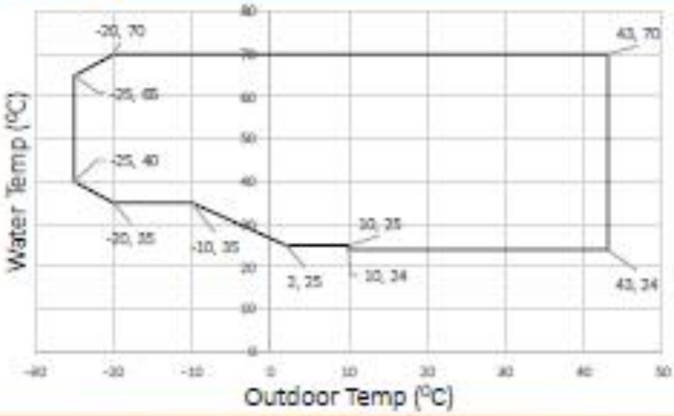


Measurment Position for Sound Pressure Level

Sound Pressure Level: 64/72 dB (COP Priority Mode/Capacity Priority Mode)

Opetation condition: COP Priority Mode: 7°CDB/6°CWB, Inlet water temp.: 40°C, Outlet water temp. 45°C

Operation Window



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Commercial Heating | Technical Data

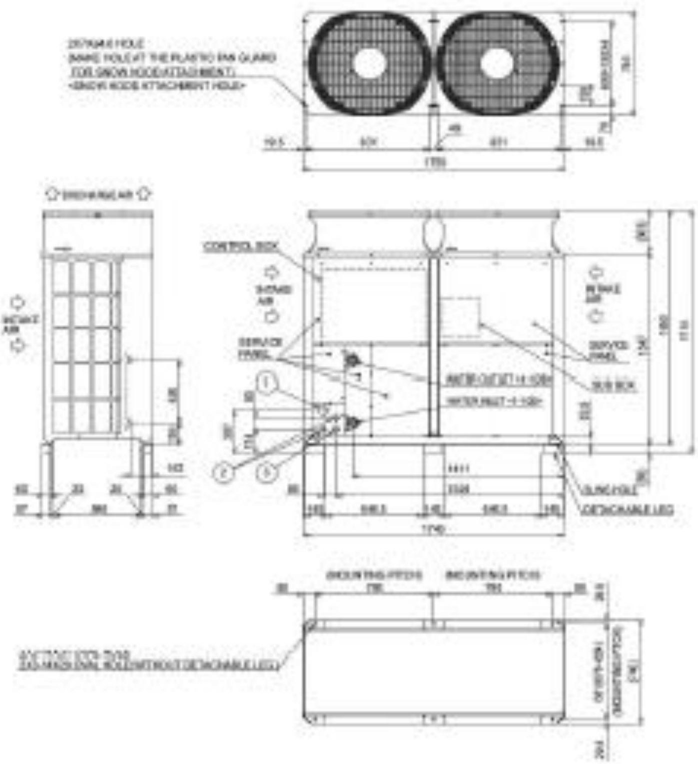
Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Dimensions

Unit: mm



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Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Specifications

The outdoor unit will be constructed from steel plate and painted with acrylic paint Munsell 5Y 8/1 and is a packaged type inverter driven air to Water heat pump capable of delivering an integrated (with defrost) capacity of 33.4kW at -5°C ambient temperature and 55°C outlet water temperature.

The single unit heat pump is made up of one scroll compressor hermetically sealed refrigerant circuits utilising R454c as a low GWP (148) refrigerant.

Water temperatures shall be between 24°C and 70°C and the unit is capable of working between ambient temperatures of -25°CDB and +43°CDB.

Multiple units can be connected together by a shielded 2 core cable and controlled using the inbuilt supplied control logic. Up to 16 units can be piped together delivering up to 534.4kW at -5°C. The inbuilt logic will cascade the units on and off based on the load and also deliver an optimised cascade based on compressor frequency and COP. Backup and rotate will allow for even wear of the system whilst also providing backup within a single unit and within a multiple unit installation. The SCOP (Low/Medium) is 3.57/3.24 at outdoor temperature of 7°CDB, the outlet water temperature of 45°C.

A minimum circuit size of 525litres per unit is required and all pipe work should be installed in accordance with related BS regulations and the Mitsubishi Electric design guide. The refrigeration process of the CAHV unit will be maintained by pressure and temperature sensors controlling check joints and four-way valves.

The CAHV unit has a max running current of 40.3 Amps and requires a 380V-415V AC 3 phase and neutral 50A mains supply. Control will be via a 30V DC signal generated by the outdoor unit. This signal will be sent to other outdoor units in its group via a 2-core non polar screened cable.

Control of the system is via volt free inputs and outputs into the BEMS/BMS. An error signal will alert the BMS and through interrogation of the PAR W31MAA. Flow or return temperatures can also be monitored via the PAR W31MAA.

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Commercial Heating | Technical Data

MITSUBISHI ELECTRIC

Technical Selection

CAHV-R450YA-HPB

Project Reference: TBC

Import to Read

IMPORTANT: Please read and observe our "Safety precaution" warnings and cautions and any warnings included within the Technical guidance set out in the relevant equipment data book before you carry out any function on the product. This output is based upon the best available information but is given as indicative guidance only and should not be considered as final system design. We recommend that the information in this Technical Proposal Form is read in conjunction with the latest equipment data book and installation manual at all times. All water systems should be designed, installed and commissioned in accordance with good practice guidelines; such as, but not limited to: BSRIA Guide BG2/2010 – Water System Commissioning, BSRIA Guide BG29/2021 – Pre-Commissioning cleaning of Pipework Systems, BSRIA Guide BG50/2021 – Water Treatment for Closed Heating & Cooling Systems, CIBSE Commissioning Code W – Water distribution systems. Mitsubishi Electric takes no design responsibility or liability for the system, components, equipment selections or control strategy – it is your responsibility to check the suitability of the proposed equipment selections. In order to comply with the Mitsubishi Electric warranty requirements all Mitsubishi Electric products must have adequate planned preventative maintenance undertaken in accordance with our recommendations. To meet Mitsubishi Electric's warranty requirements a suitable method of filtration must be provided within the system – please refer to installation manual available from the document library. The recommended water flow rates must be maintained at all times when the equipment is operating. Particular attention should be paid to any change in pressure drop due to glycol and start up temperatures. Operating the equipment with less than the minimum flow rate will invalidate the warranty.

The temperatures, capacity de-rates and pressure drop based on glycol concentration will vary between manufacturers. We also remind you of our quotation texts:

This quotation is given by Mitsubishi Electric in good faith based upon information provided by you or your company. We have not undertaken a site survey to support this quotation. Whilst we endeavour to factor into our quotation any special site conditions or user requirements which you may have expressly identified to us previously in writing, this quotation is not a project system design and is not a confirmation of project volumetric or yield analysis. We recommend that you assess final product selection and make the final system design based upon your own volumetric or yield analysis and project knowledge, including any project requirements which might impact on that selection. Please check carefully any requirement for a Mitsubishi Electric product to integrate with any third party equipment. We are not responsible for integration capability of our products with any third party equipment unless we have expressly confirmed that this integration is approved in the current Mitsubishi Electric product specification or in a current technical bulletin.

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