CHRIST CHURCH, NEW MILL · KIRKLEES · WEST YORKSHIRE

A Grade II Listed Demonstrator for Church of England Net Zero

Funding from the Church of England's Net Zero Carbon Programme enabled Christ Church, New Mill, a galleried church occupied a few hours a week, to replace a failing gas boiler and its wet pipe circuit with 32 infrared heaters and a 62 panel solar array. No insulation works, no excavation, no external alteration. Heating one service fell from £70 to £100 of gas to about £30 of electricity.

> *“The air temperature was colder than it would have been with the old gas-fired system (around 10 °C in church that morning), [but] the majority were comfortable sitting in the pews.”*
>
> CHRIST CHURCH, NEW MILL · PARISH PROJECT REPORT

BUILDING	SYSTEM	CONTROL	SUPPLIED BY
Grade II listed galleried church in West Yorkshire, nave 20.4 × 14.0 m	20 × Etherma EXO Dark 2000 overhead, 12 × ARCAngel SOLACE under-pew	5 zones, 9 power regulators, on-site switching	ARC Thermal Solutions, with the parish's own electrical contractor

SECTION ONE

01 The challenge

Christ Church is a Grade II listed galleried church, reordered in 1881, standing on a hillside above New Mill in the Holme Valley. Its nave measures 20.4 by 14.0 metres, with stone walls, tall stained glass windows and timber galleries on three sides.

It is also, in heating terms, a building that is almost always empty. Regular worship occupies a few hours on a Sunday, with occasional evening use. Around that sits a busy community programme: brass band, orchestral and choral concerts, musical societies, private hire, scout groups. None of it continuous, all of it needing warmth on demand.

The gas boiler and its wet pipe circuit were sized for a different assumption: that you heat the whole volume of the building, and that you start early. Originally rated at around 100 kW, its measured output had fallen to roughly 70 kW and it could no longer lift the interior more than about ten degrees above the outside air. Reaching a comfortable temperature meant firing it the previous day: fifteen hours of continuous running to deliver a single service.

The galleried nave looking west. Timber galleries on three sides, stone columns and a large heated volume with no realistic route to insulation. These were the conditions that ruled out a heat pump.

THE SYSTEM BEING REPLACED

CHARACTERISTIC	POSITION AT SURVEY	CONSEQUENCE FOR THE PARISH
Boiler rating as installed	~100 kW	Sized to heat the full building volume via a wet circuit
Measured output at survey	~70 kW	Roughly 30% of nameplate capacity lost to age
Achievable temperature lift	~10 °C above external	A hard ceiling on what the system could deliver
Run time for one service	~15 hours	Heating had to be switched on the previous day
Energy per service	~1,050 kWh	Largely consumed before anyone arrived
Gas cost per weekend	£70 to £100	A recurring charge, and largely unavoidable
Carbon position	Direct combustion	Incompatible with the parish's net zero brief

The constraint that shaped everything. Selected and funded as a demonstrator church under the Church of England's Net Zero Carbon Programme, the parish set three tests for any option: it had to reduce the carbon footprint, it had to be affordable or fundable, and it had to be capable of consent from the diocese and, where relevant, the local authority. Options that depended on double glazing or insulating the stone walls ran into all three at once: cost, the prospect of consent, and the risk of interfering with how the fabric breathes.

SECTION TWO

02 Why infrared?

Four electrical options were assessed against the building. Three were defeated by the building itself: its heat losses, the ground around it, the capacity of its incoming supply. Cost compounded each failure rather than causing it. That order is one many listed churches will recognise.

OPTION 01

Air source heat pump

Output insufficient against the heat losses of a large, single-glazed, uninsulated stone building.

OPTION 02

Ground source heat pump

No usable ground. The church is enclosed by its graveyard and sits high above the water table.

OPTION 03

Electric boiler

Retaining the wet circuit demanded more current than the incoming supply could deliver.

OPTION 04 · SELECTED

Infrared, overhead and under-pew

Roughly 40 kW, within supply capacity, targeted at people rather than the building volume.

OPTIONS APPRAISAL

OPTION	VERDICT	REASONING RECORDED BY THE PARISH
Air source heat pump	RULED OUT	The building is large and its heat losses, particularly through the stained glass, are too great for the available output. Closing that gap would require double glazing and lagging the stone walls: prohibitively expensive, possibly disallowed in a listed building, and a real risk to the breathing of the fabric, with condensation problems needing careful investigation in their own right.
Ground source heat pump	RULED OUT	There is no ground near the building available for a shallow collector, because the church is surrounded by its graveyard. A vertical borehole drilled from inside was theoretically possible, but the church stands roughly 250 m above the water table. That means a very long, very expensive drill, a major operation within the building, and potential consequences for the foundations.
Electric boiler on the existing wet system	RULED OUT	A replacement would need to be rated at around 80 kW. At 70 kW the current draw is 304 A; the building's three-phase supply is limited to 300 A before other loads are counted, so the demand simply could not be met. Circulating hot water through the existing pipework does heat the building, but doing it electrically would have been exorbitant to run.
Infrared, overhead and under-pew	SELECTED	Estimated by the heater suppliers at around 40 kW, within the capacity of the existing three-phase supply. Heats the occupants directly rather than the air volume, so it runs only when people are present and can be zoned to the areas actually in use. Requires no intervention in the fabric and no change to the exterior.

What changes when you heat people instead of air

The trade is explicit, and worth stating plainly to a PCC before any decision is taken: in cold weather you lose the homely effect of walking into a warm building. What you gain is that comfort no longer depends on raising the temperature of several thousand cubic metres of air first.

RADIANT, NOT CONVECTIVE

Energy travels to people and surfaces directly. There is no warm-air layer to build and lose to the roof void, and far less stratification in a tall nave.

COMFORT WITHIN MINUTES

No thermal mass to charge. After its first full use the parish put the working figure at around 30 minutes before people arrive, in place of the previous day.

ZONED TO OCCUPANCY

Seat occupancy varies week to week. Heating only the areas in use removes the waste inherent in warming empty seating.

SURFACE-FIXED, FABRIC-NEUTRAL

Units mount on existing beams and panelling. No insulation works, no excavation, no external alteration, and no change to how the building breathes.

SECTION TWO, CONTINUED

Fitting infrared to a listed interior

Selecting infrared in principle is straightforward. Making it acceptable inside a listed church is the harder problem, and it is where the specification was decided. Three characteristics of the Etherma EXO Dark range settled the choice.

Form. The profile allows the units to be fitted to existing beams and tucked into the curvature of the gallery panelling, rather than imposed on it. Fixing brackets hold each heater roughly 60 mm clear of the timber: enough for ventilation, close enough to read as part of the structure.

Finish. Black and white were both available. Black units sit against the dark stained panelling of the gallery fronts; white units sit against the painted magnolia beams beneath the galleries. Each heater was specified to the surface it would be seen against.

Glow. The emitters are visible when running, but they do not produce the hard orange of a conventional electric fire element. The parish also notes that the glow reads less strongly to the eye than in photographs, where the camera's greater infrared sensitivity exaggerates it.

Before the faculty application was made, the proposed positions were photographed and manufacturer images superimposed to scale, so that the Diocesan Advisory Committee could see exactly what the finished interior would look like. The image is shown top right.

Pre-consent visualisation: a manufacturer image scaled and superimposed on a photograph of the gallery front, prepared to show the DAC the expected appearance from the nave.

The same position in service. The emitter glow is visible but not glaring, and reads brighter here than to the eye, because the camera sensor is more infrared-sensitive than human vision.

WHY THE CHANCEL WAS TREATED DIFFERENTLY

Overhead heating was not viable in the chancel. A unit on the south wall would have been plainly visible from the nave and would have warmed only the south choirstalls; anything on the north side would have had to be fixed to the organ case. That is aesthetically unacceptable, and a genuine technical risk, since an electric heater close to the great soundboard causes significant organ tuning problems. ARCAngel SOLACE under-pew heating was specified instead, and the chancel was left unreordered.

WHY THE NAVE WAS NOT

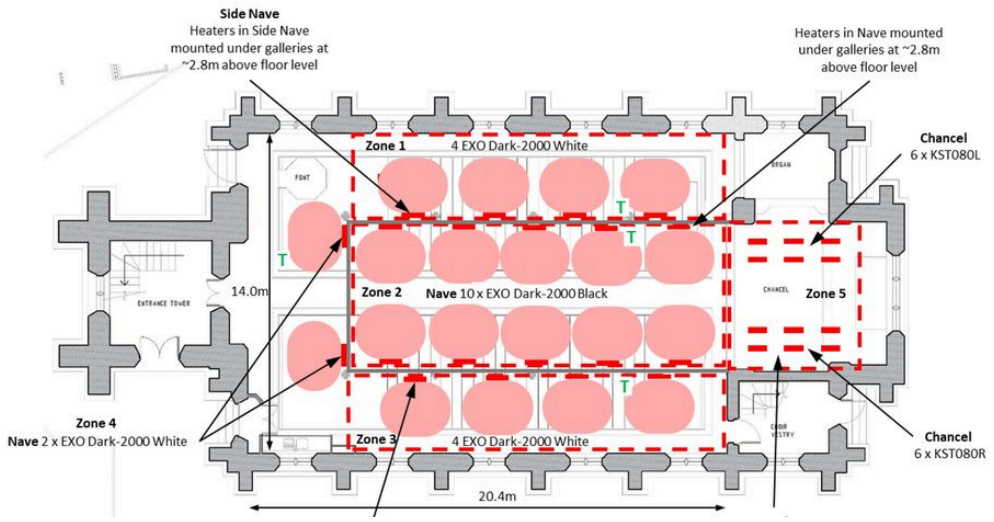
Under-pew heaters were deliberately *not* used in the nave, even though the pews there are currently fixed. The parish intends in time to replace them with more versatile movable seating, at which point pew-mounted heaters would be stranded. Overhead units are independent of the seating layout. It is a decision worth making early, because it is expensive to reverse.

> **Solar was phased first, deliberately.** The parish ran the project in two stages, putting 62 roof-mounted panels and 23 kWh of battery storage in phase one and the heating in phase two, on the reasoning that infrared would be costly to run without generation to offset it. The array reached around 17 kW output even in winter testing and carried a quoted payback of 9.5 years. Because the church tower is let to a telecoms operator drawing roughly 5 kW continuously, the building has a year-round base load to absorb that generation, which materially improves self-consumption. Any parish weighing infrared against its electricity tariff should model the two together rather than in sequence.

SECTION THREE

03 The solution

Thirty-two heaters across five zones: twenty overhead units for the nave and side aisles, twelve ARCAngel SOLACE under-pew units for the chancel choirstalls. Every unit is surface-fixed to existing timber, and no part of the installation is visible from outside the building.



ARC Thermal Solutions layout drawing, ground floor (ref. QU-2621 v4). Shaded cones show radiant coverage at seating level; red blocks are heater positions. Zones 1 and 3 are the side aisles; zone 2 the central nave; zone 4 the open west end; zone 5 the chancel, on under-pew units.

INSTALLED SPECIFICATION

LOCATION	EQUIPMENT	ARRANGEMENT
Nave, central	10 × Etherma EXO Dark 2000, black	Five per side, equally spaced, set into the curved lower section of the gallery panelling; coverage between the gallery columns and the central aisle.
Side aisles	8 × Etherma EXO Dark 2000, white	Four per side, one per bay, on the beams beneath the galleries; coverage between the columns and the outer walls.
West end	2 × Etherma EXO Dark 2000, white	On the west gallery support beam, warming the open rear of the nave where there are no pews.
Chancel	12 × ARCAngel SOLACE under-pew, 320 W each (KST080L / KST080R)	Three beneath each choirstall across four rows; a switch beside each heater for the occupant, master switch per side.
Galleries	Not heated	South gallery is storage with no public access; north gallery is overflow seating only, where downstairs output and body heat should suffice.

Mounting and load. Overhead units sit approximately 2.8 m above floor level, held roughly 60 mm clear of the beam or panelling for ventilation. Connected load is 40 kW of overhead units plus 3.84 kW under-pew; the heater suppliers' working estimate for the installation was around 40 kW. The three-phase supply already serves lighting, amplification, water heating and the tower telecoms equipment.

In service, looking east. Black units on the gallery fronts, white units on the beams beneath.

Chancel choirstalls: three 320 W ARCAngel SOLACE units beneath each stall.

SECTION THREE, CONTINUED

Controls and installation

The twenty overhead heaters are switched through nine power regulators: two 6 kW controllers each driving a group of three, and seven 4 kW controllers each driving a pair. Grouping rather than individual switching saved substantially on control units and cabling.

Power regulation, not thermostatic control. Because the heaters deliver comfort to seat occupants immediately, there is no case for the remote or thermostatic control a boiler needs. What matters instead is turning the output *down*: between spring and autumn full power is rarely required, and the parish expects further running-cost savings to come from regulation.

Radio interference was tested, not assumed. Phase-angle switching regulators can generate RF interference, a serious risk for a church that livestreams its services. ARC attended site and demonstrated a proposed heater running with its recommended regulator against the church's own microphone and streaming setup. No detectable interference was found. The specification was confirmed on that basis.

Remote control was rejected. The heaters are available in a more expensive variant with handset control. Twenty handsets would have been difficult to manage, and pointing a remote at a heater during a service was judged inappropriate. Fixed controls sited behind the congregation were the better answer.

Position. The control gear sits on a section of west nave wall beside the wardens' pew: close to the person who needs it, out of sight of the congregation, and short on cable runs, with trunking confined to corners and painted to match.

The nine installed regulators on the west nave wall. A cabinet to conceal the units and wiring, and to prevent casual misuse, remains to be built. See lesson 05.

Controller unit, 280 × 200 × 80 mm. Nine were specified: 2 × 6 kW and 7 × 4 kW.

PROJECT SEQUENCE

- **2024** — Options appraisal and local authority application for the solar array
- **APR 2025** — ARC heating layout and specification issued (QU-2621 v4)
- **OCT 2025** — Phase one complete: 62 panels and 23 kWh battery in operation
- **PHASE TWO** — Faculty granted without difficulty; heaters supplied and installed
- **BY MAR 2026** — First full service on the infrared system; evaluation reported

Delivery model. ARC Thermal Solutions produced the initial design recommendations and carried them through several revisions as the parish's thinking developed. Although ARC could have installed the system, the parish preferred to use its own local commercial electrical contractor, and ARC worked alongside them. When a problem arose with the heaters as supplied by the manufacturer, ARC resolved it and confirmed the system working correctly. Isolating switches were fitted at each heater position by the electricians, a detail not in the original design, and one the parish presumes was required by wiring regulations. It is one it would now handle differently (see lesson 03).

SECTION FOUR

04 Results

89%	3 hrs	~£30
less energy to deliver one service: **1,050 kWh down to 120 kWh**	of run time replacing **15 hours** starting the previous day	estimated per service at full unit rate, against **£70 to £100 per weekend** in gas

ENERGY AND COST, PER SERVICE

MEASURE	GAS SYSTEM	INFRARED SYSTEM	CHANGE
Input power	70 kW (measured)	~40 kW (estimated)	Within existing supply capacity
Run time required	15 hours	3 hours	80% lower
Energy consumed	1,050 kWh	120 kWh	89% lower
Pre-heat lead time	Previous day	~30 minutes	Same-day operation becomes possible
Cost to heat	£70 to £100 / weekend	~£30 at full unit rate	Approx. £26 net of solar on the test day

What the congregation reported

On the first full use of the system the church stood at around 10 °C, cooler in air temperature than the gas system would have delivered, with the heaters at 80% power. Choir and congregation reported that the majority were comfortable seated in the pews, and the parish concluded there was headroom to turn the output up further.

> *"Our treasurer is particularly pleased… it was costing us around £70 to £100 per weekend in gas to heat the church [a rise of 6 to 10 °C]… but 3 hours of electrical heating would have cost us only around £30 at the full unit rate."*
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Carbon and generation

Removing gas eliminates combustion at the point of use. The parish's supplier indicates its grid electricity is sourced from North Sea wind, and the array generates against the building's year-round base load. The planning application for the array estimated a saving of approximately **10 tonnes of CO_2 per year** from generation alone.

Between commissioning in October 2025 and early March 2026, the least productive part of the solar year, the monitoring app recorded total earnings of £912, a figure the parish notes is complicated by the recharged telecoms load in the tower.

How to read these figures. They are the parish's own, and carry two qualifications. The energy comparison is gas kWh against electricity kWh, which are not priced alike. The cost line is the fairer measure and already accounts for it. And at the time of reporting the full system had been used in service *once*: the run-time arithmetic is not in dispute, but a full heating season of data does not yet exist.

ISSUES ENCOUNTERED

Grid voltage, not system fault: the solar inverter resets after a few minutes when incoming mains spikes outside safe limits, at 263 V against a 253 V ceiling. The network operator is investigating; impact is minimal. **Manufacturer supply:** a problem with the heaters as delivered was identified and resolved by ARC.

WORK STILL OUTSTANDING

Areas not yet covered: a wall convector for the lower vestry, also giving frost protection; portable heaters for the altar area. **Frost protection:** with the wet circuit drained and gas capped, trace heating is to be run along the retained copper pipework, switching in below about 5 °C.

SECTION FIVE

05 Lessons for other churches

The parish would specify this system again, but parts of it differently. Those are the more useful findings for anyone at the start of the same process.

01 DECIDE ZONING AROUND OCCUPANCY, NOT CABLING

Nine controllers were grouped as two threes and seven pairs. The parish would now specify six threes and one pair, seven units instead of nine. Net saving is not automatic: 6 kW controllers cost more than 4 kW ones, and the change needs more cable and larger trunking.

02 INDIVIDUAL SWITCHING IS WORTH PAYING FOR

Seat occupancy varies week to week. Switching each heater separately from the control position, rather than in fixed pairs and threes, is what stops empty bays being heated.

03 SITE ISOLATING SWITCHES WITH THE CONTROLS

Twenty isolators were fitted on the beams beside each heater, presumed to be required by wiring regulations. They were not in the original design. The parish would now consolidate them at the control position from the outset.

04 POWER REGULATION MAY MATTER MORE THAN ZONING

Full output is rarely needed once ambient temperatures rise. The parish expects most heaters will end up set to similar power for a given ambient, which would make fine-grained zoning less valuable than anticipated, and regulation more so.

05 PROGRAMME THE CONTROL CABINET WITH THE WORKS

The parish did specify a ventilated enclosure in its faculty submission, but it had still not been built at the time of reporting, leaving nine controllers and their wiring exposed on a nave wall. Put it in the installation programme, not on the list for afterwards.

06 TEST REGULATORS AGAINST YOUR AV BEFORE SPECIFYING

If services are livestreamed or amplified, insist on an on-site demonstration of the proposed heater and regulator against your own equipment. Phase-angle switching can introduce RF interference; a paper assurance is not a test.

07 AVOID HANDSET-CONTROLLED UNITS IN WORSHIP SPACES

Remote-controlled variants exist and cost more. Twenty handsets are unmanageable, and operating one during a service is inappropriate. Fixed controls behind the congregation work better.

08 MATCH HEATER TYPE TO YOUR SEATING PLANS

Under-pew units suit permanent choirstalls. They do not suit a nave you intend to reorder with movable seating. Cheap to get right at design stage, expensive to unwind later.

09 PLAN FOR WHAT INFRARED DOES NOT REACH

Vestries, sanctuary and altar areas, and any retained water pipework need separate provision: convectors, portable units, trace heating. Budget for them at the outset rather than discovering them afterwards.

10 SET EXPECTATIONS BEFORE THE FIRST COLD SUNDAY

The building *will* be cooler to walk into. Say so in advance, explain why, and switch on around 30 minutes before most people arrive. Managed openly, this parish found the trade readily accepted.

Considering the same decision?

Every listed building fails a different test. The value of an appraisal like this one is that it works through the options in the order the building imposes, namely supply capacity, ground conditions, fabric and consent, before anyone talks about price. ARC produces layout drawings, coverage modelling and zoning proposals suitable for a faculty application, and will attend site to demonstrate equipment against your own AV setup.

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Figures, quotations and photographs are drawn from the parish's own project evaluation report for Christ Church, New Mill, and from ARC Thermal Solutions layout drawing QU-2621 v4. Energy and cost figures reflect the position at the time of writing, following the first full use of the completed system. Performance in any other building depends on its fabric, occupancy, supply capacity and tariff.