Herschel Halo Heating

Performance Review of Trial Installation at St Matthew's Church, Bristol

This report summarises the key points from the review of the energy usage, carbon saving, human comfort perceptions and fabric conservation consideration for the pilot installation of four Herschel Halo chandelier heaters[i] at St Matthew's Church in Bristol in October 2022.

This summary is based on two detailed reports:

Tobit Curteis Associates Report "Herschel Halo Heaters: Environmental and Conservation Assessment, April 2023"

Inspired Efficiency Report "Halo Heating – Performance Evaluation, April 2023".

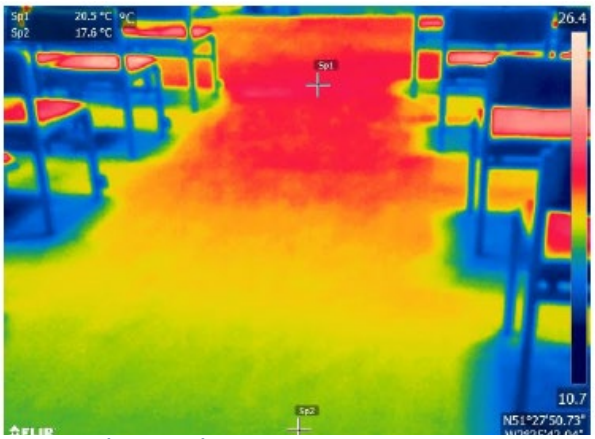
These more detailed reports have been shared with the Church Energy Advisors Network. Please contact your DAC and ask to speak to your DAC heating advisor if you need more information.

Four suspended chandelier Halo heaters were installed at St Matthew's Church, Kingsdown, Bristol for the winter of 2022/23 and a project was undertaken to evaluate their performance.

The heaters comprised 12 far infrared heat emitters located in a ring arrangement with six (optional) LED up and down lights fixed to the unit. The units are rated at 7.8kW each and are mounted approx. 4.8m off the floor and at 5.5m spacings east/west within the nave. The heaters replace a gas boiler based heating system with radiators on the side walls of the nave.

Comfort

Thermal imaging showed that the units provide heat to the area beneath them with a footprint of around 8m to 9m in diameter. Within this zone the units provide a noticeable heating effect to any surface and person directly within the footprint of the heater. Thermal comfort was generally perceived as being positive by people sitting within the heating zone. The perception of comfort was considered very good for people sitting directly beneath or in areas where the zones from two heaters overlapped. There were no effects or reports of a 'burning head' sensation and the heat output was generally observed, and noted by the congregation, to be pleasant. This is believed to be due in part to the far IR wavelength of the heaters, as opposed to the short and medium IR wavelength commonly used by many previous units.



The red/yellow/green on the IRT image shows very good heating close to and in overlapping areas of the heat (red), acceptable heat levels in the yellow area to the edges of the zone, but notably cold outside the heating zone.

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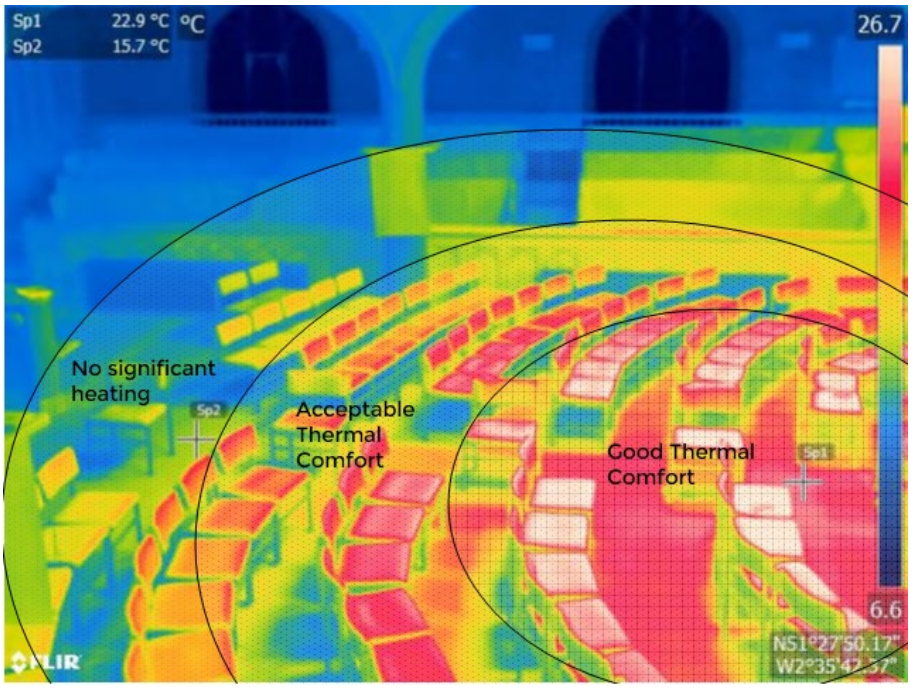


For people sitting in an area a little further away from the heaters the thermal output was noted as being acceptable, with some of the congregation having mentioned that they had adapted their clothing choices accordingly, or commented on having cold feet in this area.

Outside the zone of the heaters the environment was noted to be cold. Monitoring data and thermal imaging showed that, with a background air temperature of 10°C, surfaces exposed to the heaters could reach a value of 26°C within the heating footprint, while outside the footprint, surface temperatures remained close to that of the air.

The heaters warm the surface of the chair seats and floor (carpeted at St Matthew's) so, by being turned on for a maximum of 30 minutes prior to a service, the heaters do provide some additional comfort both by preventing heat loss and by warming the surfaces with which the body has direct contact.

Energy, Carbon and Cost

The four Halo units used for the trial only provide heating to the central eastern area of the church. For the purpose of a comparison with the previous gas radiator heating system, the energy consumption from the 4 units was extrapolated to a system comprising of 6 Halo units (adding two more to the rear) and allowing for under pew heating in the side gallery areas, which are shaded from the chandelier units.

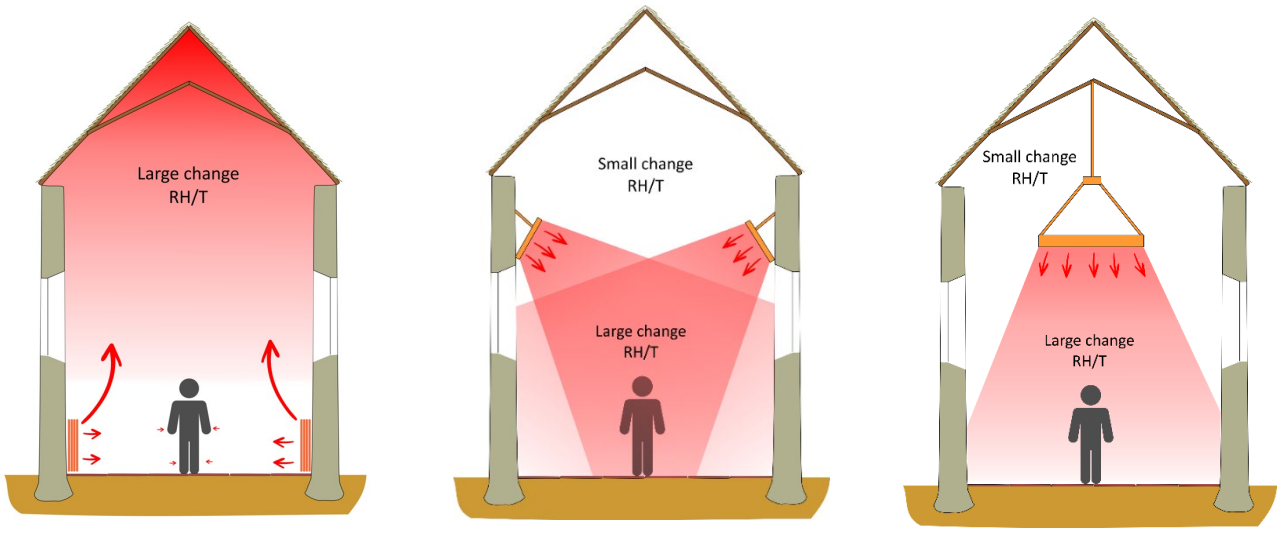
Significant energy, carbon and cost savings were noted. This was largely due to the pre-heat timing reducing from 3 hours for the gas/radiator system to 30 minutes for the Halo system. The Halo system was calculated to use 148kWh of electricity per service (comprising of 30 minutes of pre-heating and two hours for the service and refreshments afterwards). The gas system used 1,104kWh of gas for a service (comprising of a 3 hour warm up period and a 2 hour service period). At energy rates of 9p/kWh for gas and 32p/kWh for electricity, the energy cost using the Halo system was in the region of £50 per service, which was approximately half that of the gas system, which was in the region of £100 per service.

Using the current gas and grid electricity carbon factors, the Halo system shows an 85% reduction in carbon emissions. Due to the decarbonisation of the grid this would increase to a 96% reduction by 2030 and, as it runs entirely on electricity, this could be reduced to Net Zero Carbon emissions through the purchase of 100% renewable electricity.

PER SERVICE	Energy Usage	Energy Costs	Carbon Emissions
Existing Gas System	1,104kWh of gas	£99.36	198.72gCO_2e
Halo and Under Pew Heating System	148 kWh of electricity	£47.36	31.24gCO_2e

Conservation

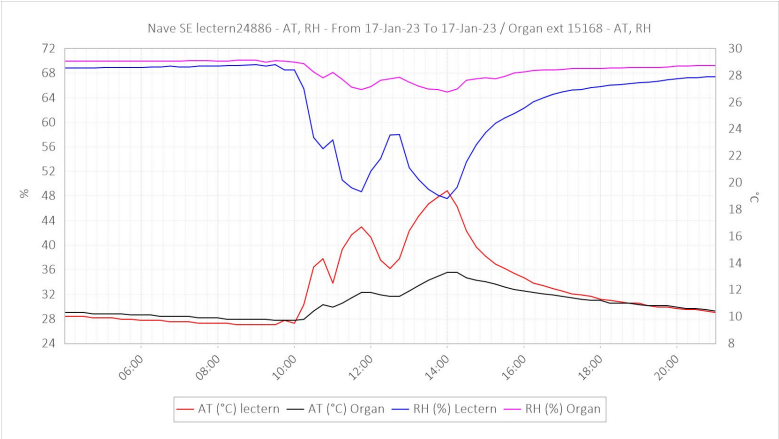
Inappropriate heating is one of the main factors causing damage to the sensitive fabric and artefacts in historic churches. This occurs due to fluctuations in air temperature changing the relative humidity (RH), which in turn causes materials such as timber, textiles, books and manuscripts to expand and contract, and materials such as plaster and stone to suffer from salt activity. The resulting damage can be significant and irreversible. Traditional convective or warm air heating requires the entire airmass in a building to be heated in order to warm the people within it. This is inefficient due to the relatively small area in which people are located, in comparison to the size of the building. Furthermore, the buoyancy of warmed air causes it to rise to the upper part of the building above the people and so only provides warmth once the whole airmass is heated, which impacts on the RH and the conservation of the fabric and artefacts in all areas of the building.



Schematic images showing heat distribution from convective, wall mounted IR and chandelier IR

Radiant heating, such as that provided by the Halo heaters, is transferred directly to exposed surfaces, including people, without warming the air in between. As long as sensitive artefacts are not exposed to the IR radiation, this allows warming to be provided for the people without the risk of damaging historic materials. Traditional wall mounted IR heaters were required to emit heat across the church to heat the people in the middle, with the result that they often also heated the walls and sides of the building, where sensitive material was located. By introducing the ability to be suspended above the people, chandelier heaters, such as the Halo, can focus the entire heating effect on the people below without directly exposing adjacent areas, as demonstrated in the thermal imaging.

Environmental monitoring during services and other events showed that, away from the exposed areas of heating, the effect on the air temperature and therefore on the RH, was also far less than when traditional convective heating was employed, so that the conservation risks were greatly reduced. As with the reported energy efficiency, this was due in part to the far shorter operational time, without the need for a long pre-warming period.



RH and air temperature outside the immediate heating zone (pink and black) are far less affected than areas exposed to the IR heating (blue and red)

Suitability

The Halo system appears to be a suitable addition to the range of decarbonised heating solutions for churches to consider.

The congregation of St Matthew's Church were unanimously positive regarding the visual appearance of the units. Visiting members from other DACs generally indicated that these units could be acceptable in the right settings and with good, well considered design.

The Halo system would be able to be a sole heating system so long as the positioning was such that the main congregation were seated near to or in an overlapping zone of units. This may require spacing between the units of around 4 to 5 metres.

As with all systems being used to provide sustainable warmth for people in churches, this should take place in combination with controlling heat loss, both from the building, through regular maintenance of the fabric, draught exclusion measures etc., and from individuals, through the use of appropriate clothing, floor coverings, seat cushions etc.

The Halo units require locating as a suspended unit and so require a tall space. They would be well suited to use in a nave and taller chancels and might also be suitable in taller side aisles. However, they would not be suited to smaller 'rooms' or spaces with lower ceilings.

IR heating allows heat to be delivered to people with a much reduced effect on air temperature and therefore limits the risk to sensitive historic fabric and artefacts outside the exposed areas. The chandelier design enables the heaters to be positioned for optimal heating of people in the centre of a church, with limited effect in peripheral spaces. However, avoiding exposing sensitive materials remains essential to control conservation risks and so establishing a layout to avoid the exposure of sensitive materials is an important part of the design process.

Halo units are most likely to be considered for use in churches where the pews have been removed and therefore do not have the option for local fixed heating within fixed pews. The Halo units would be of most benefit in churches which are used for a limited number of intermittent periods during the week, as one of their main (cost) benefits is the short warm up period that they require. In situations where a church requires heating all day the benefit of a short warm up period diminishes and a direct electric solution (such as the Halo) becomes of less financial benefit (with a likely cross over point of around 4 to 5 hours per day being the point when direct electric heating loses its short warm up time benefit to systems such as heat pumps).

The Halo system would be effective in supplementing both underfloor and under pew heating. Some underfloor heating systems require a "boost" to supplement the temperature for services and this is often delivered by a separate radiator circuit. The Halo could provide this boost to increase the effect of the underfloor heating. Likewise, when used in conjunction with under pew heating, the Halo system could provide increased all-round comfort levels. In these situations the Halo units could be spaced further apart (in the region of 8m spacings).

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THE CHURCH OF ENGLAND
Environment Programme

To speak to the church about their experience, contact PCC member and project manager of this pilot, Simon Pugh-Jones Simon@ashstudios.co.uk

[i] Herschel Halo heritage heater for historic buildings (herschel-infrared.co.uk)