**Faculty Application References : 637370 /Proposal 2023-089944**

This ‘Options Appraisals’ document has been created as an ADDENDUM (1) to the original faculty application for a replacement heating system for St John the Divine Church in Selsdon CR2 8DD. Its purpose is to identify the various technologies available for consideration by St John’s for the purposes of this project and consider their viability for use by discussing the ‘For’ and ‘Against’ attributes. It is to be read in conjunction with the

Heating Systems Options study prepared by Martin Dow of Building Services Consultants, ENG DESIGN Ltd. , London SE1 3TX with report reference 3265-M-1 and dated 18 April 2023.

1. **Electric Radiators (Radiant)**

*For*

* Carbon neutral (We use a green energy supplier)
* The radiators are neat in appearance
* 100% efficient
* Installation costs are likely to be lower than wet systems

*Against*

* The radiators are 90% radiant heat. Fan convector heaters are required to get warmth to the centre of the church
* The church is supplied with a 100amp three phase electrical supply. This is insufficient to support a full electric radiator system as well as existing requirements and the incoming supply will need to be upgraded (local and then to network). The cost of this will be significant (circa £5 figs). There is NO guarantee that the NETWORK supplier (connection) will agree to upgrade
* High running costs, estimated at £44.80 per hour based on current tariff

Electric radiators are not considered a viable option

1. **Freestanding Gas Convector Heaters**

*For*

* Low capital cost
* Relatively simple design
* Fan convectors to push warm air to centre of church

*Against*

* Gas is a fossil fuel.
* Old technology, model range and suppliers limited (future support?).
* Reverse air flow convectors not available.
* Disruption to the fabric of the building for multiple flue terminations
* Possible visual issues with flue terminals.
* Heaters are bulky and with guards fitted will impact on aisle access
* ‘Smart’ controls not available.
* No means of future proofing

Gas convectors are not considered a viable option

1. **Electric Pew Heaters**

Neither the Nave nor Lady Chapel have pews (chairs). However, the choir stalls would be suitable for under pew heaters. These were considered but it was felt that wet system fan convectors, adjacent to the stalls, was more suited to our requirements. In addition, if of a fan type, the designs are unsophisticated and fans wound be noisy.

If necessary pew heaters can be considered at a later date.

1. **Heat Pumps**

There are available SIX types of Heat Pump installation technologies, namely :

* air to air
* air to water
* ground to water
* hybrid (water)
* exhaust air
* cascaded heat pumps

*For (all)*

* As a heat pump captures heat that is already present in the environment, the system itself does not burn any fuel and therefore emits no carbon dioxide.
* Carbon Neutral (We use a green energy supplier)
* Up to 400% efficient

*Against*

air to air:

* Need to factor in Seasonal Coefficient of Performance (SCoP). Efficiency drops at low temperatures, perhaps 150% at sub-zero temperatures (uses more electricity to maintain o/p)
* Owing to high heat loss and poor insulation in the church with limited opportunity to improve, will necessitate Variable Refrigerant Flow (VRF) technology plant to supply multiple emitters.
* Resulting in significantly higher capital cost - £250,000 plus
* Significant visual and noise impact from external compressor units.
* Blown warm air. Unacceptable internal visual and impact from ducting and outlets. Unacceptable fan noise
* May be necessary to upgrade incoming electrical supply. The cost will be significant and the supplier may not agree (see ‘Electrical Radiators’ summary)
* Running costs 25% more than proposed gas boiler option assuming average 300% efficiency and current tariffs

air to water:

* LPHW heat emitters. Water supply temperature at 35deg to 45deg too low to operate fan convectors. 80/60 flow/return differential required

ground to water:

* requires significant ground area to install (vertically or horizontally)
* significantly higher cost of ground works install
* LPHW heat emitters. Water supply temperature at 35deg to 45deg too low to operate fan convectors. 80/60 flow/return differential required

hybrid :

* significantly higher cost of installation as two systems required

exhaust air & cascaded pump:

* with current technology maturity of these types of systems, they are too complicated and significantly high costs.
* air to air solution discounted on high cost and significant infrastructure impact
* air to water solution discounted on lack of maturity in water temperature capability
* ground to water solution discounted on significantly high costs, lack of maturity in water temperature capability and significant infrastructure impact
* hybrid solution discounted on high cost ALTHOUGH the proposed solution will include the capability to be upgraded using this technology
* exhaust air & cascaded pump solution discounted of significantly high cost, complexity and lack of proven maturity

Initially the primary focus, however, though St John’s would be happy to use air to air heat pumps, at the present stage of technological development they are not feasible in meeting our requirements. Air to air Heat Pumps work well in our Church Hall, which is smaller and has high level of insulation.

1. **Infrared**

*For*

* Instant heat
* High efficiency
* Low capital cost and installation cost
* Carbon neutral

*Against*

* Visual impact
* Will be necessary to upgrade incoming electrical supply. The cost will be significant and the supplier may not agree (see ‘Electrical Radiators’ summary)
* Concerns over ‘warm head, cold feet syndrome’
* High running costs, estimated at £44.80 per hour based on current tariff

Infrared not considered a viable option

1. **Gas boiler and LPHW heat emitters. This is the preferred option for St John’s.**

*For*

* High efficiency condensing and modulating gas boilers (Hydrogen Ready). Efficiency typically up to 98%. Cascade of two boilers providing dual redundancy back up in the event of one failing.
* Reverse flow fan convectors will move warm air to the centre of the church and recirculate and so minimise loss upwards.
* Smart control system with central fan control to minimise fan noise (extremely LOW (dBA) from the fanned convectors during a service.
* Future proofing. System has connections for heat pump should technology develop in the future to make a heat pump viable.
* Fan convectors will reduce the time the boiler needs to be on for the church to reach a comfortable temperature.
* No external visual impact. The existing flue run will be utilised.
* Estimated running cost, full on, £11.20 per hour.
* Vestries and porch heated by electric convectors. 100% efficient and carbon neutral.
* Known, tried and tested technology

*Against*

* Gas is a fossil fuel unit
* Relatively high capital cost
1. **Gas boiler connected to underfloor heating.**

Briefly considered but not feasible due to excessive disruption to the floor and substructure.

**8 Destratification Fans**

Stratification is the formation of vertical air temperature gradients in a space.

Destratification fans work by continuously circulating a column of air from the ceiling to the floor, mixing the stratified air to create a comfortable environment. These fans help to balance the temperature of the air so you don’t have to overheat. There is an energy saving possibility of up to 30%.

De-stratification fans have been considered as a means of preventing warm air moving upwards to the roof void. We expect that reverse flow fan convectors will largely eliminate this. We will treat this as a separate project once any new system is installed.

**9 Solar Panels**

These have been considered but relate to collection of energy from the sun and not a direct heating source technology. So, a complete additional cost.

Would involve seeking the approval to add a significant number of solar panels to the Church’s existing pitched roof, significantly changing the aesthetics look of the building. There is approximately 200m2 of south west facing tiled roof (half available). Quick research identifies that a60kW system would require up to 300m2 of area.

This technology requires a large infrastructure of equipment. Namely, Photo Voltaic Panels, Solar Regulators, Deep Cycle Solar Batteries for storage and Inverters to facilitate/feed AC loads.

Capacity is dictated by ‘Peak Sun Hours’. An average would be approximately 5 for a reasonably powered output. Since our location is in the northern hemisphere, it will be a struggle to achieve this.

The estimate for St John’s current electrical requirement is approximately 28kW (AC), mostly lighting. If an electrical heating system were to be introduced the demand, as has been discussed, would rise significantly - >100A/69kW (AC). This would give rise to the need for a commercial/industrial type solar power installation needing 3- phase inverter technology. As a reference guide, the cost of panels ALONE, without installation or support infrastructure/hardware, to facilitate a 60kW system is in the region of £50,000 +VAT.

To quote from ENG Design report ‘*Solar panels do not help with the heating in winter, and so may be considered as a stand-alone option for reducing carbon emissions but not as part of the heating system*.’

At present, the cost of professional design fees, hardware purchase and installation costs of this technology is considered to be unsustainable. In addition, the payback rate for any electricity generated, whilst the Church is not in use, and sold back to the network is too low for the investment incurred.

Lower power solar energy could be considered for partial powering of low demand assets. Would need to be considered as a standalone project.