Heat pumps and Churches – some points to bear in mind.

Heat pumps take low grade heat from a heat source (ground, air or water) and concentrate this heat - normally into hot water – this is then be used for heating buildings via various types of emitters (under floor heating, fan coil, or 'standard' radiators etc). Heat pumps can also be used to provide domestic hot water.

Ground source heat pumps (GSHP) extract heat via ground collectors or bore holes. Ground collectors are arrays of pipe buried in the ground – typically 1-1.5m deep. Boreholes are typically up to 100m deep. The size of boreholes or ground collectors must be carefully sized to avoid extraction of too much heat from the ground leading to ground freezing and reduction or toal loss of heating capability. Ground source heat pumps will typically require a plant room, and for heat pumps above 10kW a 3 phase electrical supply is normally required.

Air source heat pumps (ASHP) extract heat from the air and will operate at air temperatures down to -15deg C. The efficiency (COP) of air source heat pumps reduces as outside air temperature reduces. Most air source heat pumps have an electrical immersion heater that will cut in if the air source heat pump cannot cope with the heating load. ASHP are typically mounted outside, and may or may not require equipment inside the building. Poor design and specification can lead to the situation where an undersized heat pump system will use large amounts of electricity – essentially all the heating in extreme situation is electric water heating! Large ASHPs – over 16kW will normally require a 3 phase electrical supply.

Beware comparing outputs of ground and air source heat pumps.

Outputs of heat pumps are measured to an EU standard. GSHP use 0^{o}C input and 35 ^{o}C output temperature, whereas ASHP use 7^{o}C and 35^{o}C output temperature. A 10kW GSHP is therefore much more powerful than a 10kW ASHP!

COP – what is it ? and why is it important?

COP is the ratio of heat power output to electrical power input. i.e. a COP of 3.5 means that with if 1Kw of electrical energy is used by the heat pump, you will get 3.5kW out as heat i.e. you get 2.5 kW of energy for free! Modern GSHPs can achieve a COP's of 4.8, and ASHPs 3.9.

The thermodynamics of a heat pump mean that they work most efficiently (i.e. have a high Coefficient of Performance COP) when operating with low flow (water output) temperatures. – Typically systems should be designed to operate with a 35-40 ^{o}C flow temperature. All heat pump manufactures will claim high output temperatures for their devices – this is true, but look at the curve of output

temperature vs COP – the COP reduces as the output temperature increases. This can be dramatic.

What are the ideal conditions for Heat Pumps?

Heat pumps are ideally suited to buildings which are well insulated, are draught proof and have either under floor heating, or fan coil emitters. Typically these are new buildings or old building that are completely refurbished. In such buildings the thermal properties are well understood, and systems can be integrated into the building at the design stage to ensure that the heat pump is designed to run optimally for the intended application throughout the year.

Successful Integration of heat pumps into retrofits (old buildings) can be very difficult and expensive compared to new buildings. Poor design and can often lead to disenchantment of the client in the technology, poor performance, and disputes.

Churches and Heat Pumps – a match <u>not</u> made in Heaven!

If you were designing a modern church, church centre or village hall – intended to have a high occupancy ie used for several days and evenings a week, then a heat pump, with a backup LPG or oil boiler would be high on your list of options for heating the property.

Typical Church of England churches are characterised by:-

- solid stone walls
- high vaulted roofs
- large internal air volume
- poor roof
- wall and floor insulation (if any)
- single glazing
- poorly draught proofed doors
- low occupancy levels

Existing heating systems are typically:-

- cast iron heating pipes
- finned copper
- convector radiators
- electrical convector heaters
- night storage heaters

In summary they are extremely thermally inefficient buildings and the heat loss is very high. Existing internal heating systems are usually completely inappropriate to use in getting low grade heat into the building effectively.

Heat pumps will not provide instantaneous heating – as provided by oil, gas or electric heating typically on timers. They should be used to provide constant

heating being thermostatically controlled by the required air temperature. They are thus not suited to buildings that are only occasionally used e.g. every Sunday

In Conclusion

- Heat pumps are unlikely to be suitable for use within the majority of existing typical churches without extensive improvements to the thermal characteristics of the building, i.e. insulation to ceilings, roof, floors, walls, glazing improvements and extensive draught proofing. Major modifications will normally be required to existing heating systems – to use either fan coil radiators, or under floor heating specifically designed for use in conjunction with low flow temperature heating systems.
- Only use a company that is MCS (Microgeneration Certification Scheme) approved for the technology that is proposed, - They should have an MCS certification number and they should be listed on the www.greenbooklive.com website as an approved installer. The MCS scheme is the way the microgeneration industry is regulated to ensure all renewable installations and equipment meet agreed standards. All grants are dependent on use of MCS installers and equipment.
- Ensure the design, supply, install and commissioning is done by ONE company – there are many companies who will sell you a heat pump, but not be prepared in install or guarantee its performance – if you go this route BE VERY VERY VERY CAREFUL!!

This guidance is given in good faith based on personal experience.

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