Interest in the use of heat pump technology is growing rapidly as efforts are made to comply with increasingly stringent building regulations and planning requirements. Most interest is focused on closed loop GSHPs (Ground Source Heat Pumps), open loop GSHPs and air-to-water ASHP's (Air Source Heat Pumps).

The most suitable option for any development will, inevitably, be influenced by the motivations of the purchaser. For example, the requirements of a housing association – the continuing obligation to service the properties and the desire to offer lower income tenants the cheapest possible running costs – are quite different from a speculative house-builder who may simply wish to select a product which economically satisfies regulatory issues.

It is beyond dispute that GSHP's are more efficient. The average ground temperature in winter will always be significantly warmer than the average winter air temperature, so GSHP's perform more efficiently. That said, "dedicated" heating-only ASHP is simple to fit and requires no expense on ground arrays in trenches or boreholes. It also has the benefit of coming "in a box" like any other heating appliance, and therefore needs no ground array expertise. Some appear much cheaper than others but the distinction is between 'dedicated' units and air conditioning chillers which can heat but are optimised to cool. The latter category is certainly not suited to the UK's winter climate and there is no case study experience to dispute this claim.

The acknowledged reduction in efficiency of an ASHP appears to more than offset by the extra cost and complexity of a GSHP solution. However, other factors need to be taken into consideration.

Facts at a glance

SAP Ratings—GSHP's have a higher base figure of 3.2 when calculating carbon emissions under SAP. ASHP's have a figure of 2.5 which is decreased to 1.75 if the ASHP is producing DHW. This is roughly equivalent to a gas boiler.

Performance Ratings—ASHP performance is often quoted at an air inlet temperature of 7°C whereas GSHP's are quoted at a ground inlet temperature of 0°C. GSHP's have a higher efficiency than ASHP's, however it is often claimed they are similar using figures obtained under these different inlet temperatures.

Buffer Tanks—GSHPs generally do not require buffer tanks where as ASHPs do.

Life—GSHP systems have a design life of around 40 years, ASHPs due to their large moving components have an expected like of approximately 10 years.

Planning Permission—ASHP are a permitted planning right if stringent criteria regarding its install are met. In practice this means the majority will still require planning.

Drilling Costs

Drilling costs, linked to the provision of boreholes for GSHPs, are becoming more competitive as drillers are able to mitigate the risk (and added expense) of unfavourable site conditions across a greater volume of projects. In addition, more companies are entering the market which reduces prices through greater competition, and increased levels of expertise. Finally, many housing associations are developing sophisticated lifetime ownership cost models (see separate section) to justify the selection of GSHPs.

SAP

The main selling point for any heat pump is carbon savings over boilers. For a GSHP, the base figure in SAP is 3.2, whereas it's just 2.5 for an ASHP. If a heat pump, ASHP or GSHP, is connected either to heat DHW, or to radiators (as opposed to under-floor heating) then its efficiency under SAP is further reduced by a multiplier of 0.7. So, a GSHP goes down to 2.24, whereas an ASHP goes down to 1.75. A condensing mains gas boiler has a COP equivalent under SAP of between 1.7 and 1.9. For these reasons, an ASHP is unlikely to be sold on a carbon saving against a gas boiler. Equally, it will not be able to compete on an economic basis. This means that ASHP technology is unlikely to appeal to any house needing to achieve Code Level 3 or above if mains gas is available.

Ratings

The performance of an ASHP is often quoted with "A7" (this being the air at 7 deg C) – whereas GSHPs are almost always quoted at B0 (this being the ground at 0 deg C). For this reason, ASHPs are often portrayed not only as being as efficient as GSHPs, but also having a higher output that they would achieve in the field. ASHPs are often quoted as "operating down to –15 deg C ambient" even though the power output is never quoted at that figure. At such temperatures, the output is very low almost to the point where there is no effective heat at all since the heat pump is almost permanently in defrost mode. As a result, the efficiency declines significantly.

Buffer tanks

GSHPs generally do not require a buffer tank. ASHPs generally require a buffer tank when connected to under-floor heating to cope with the defrost cycle. Besides putting up the capital cost and the complexity substantially, there is often an issue over where to put a buffer tank in a small house.

Lifetime Ownership Costs

Under funding proposals, BEIS has acknowledged that the design life for a GSHP is 40 years in a district heating system. As ASHPs are located outdoors, they are more susceptible to damage, and certain components, including those involved in the defrost mode, are more prone to failure due to their workload. As a consequence, the lifetime ownership cost of a GSHP is lower since there is a longer design life and a lower exposure to emergency maintenance/replacement caused by component failure, climatic conditions or vandalism.

Acoustic Issues

ASHPs are a Permitted Development GPDO (General Purpose Development Orders) if stringent criteria are met. This includes the need for air source installation to meet the MCS020 Planning Standards, in which it is required that the noise level must be below 42dB(a) at a position one metre external to the centre point of any door or window to a habitable room of a neighbouring property as measured perpendicular to the plane of the door or window. Most air source heat pumps cannot currently meet this and unless you have no neighbours you are still required to obtain planning permission.

Acoustic issues are not likely to be an issue for an isolated dwelling, but many isolated dwellings would have land to accommodate slinkies and a GSHP.

For any sort of dense residential area in a town or village it is safer to obtain full planning permission before fitting an ASHP. This will generally require a full acoustic report written by a specialist acoustic engineer. This becomes even more important if more than one ASHP is planned to be fitted, for example in any high density social housing scheme, as the risk multiplies significantly. Most urban areas will now not allow ANY increase in noise levels at all and permission is regularly denied, as it is entirely inappropriate for the planning process to permit development that could give rise to a statutory nuisance. ASHPs will have to run throughout the night to maintain adequate temperatures, so the nuisance will occur when many people are trying to sleep, which is entirely different to office air conditioners running in a commercial or industrial environment

Even if the acoustic report is undertaken and planning permission is granted, any resident can make a formal complaint to their local authority, and the following procedure then applies.

Where a local authority is satisfied that a statutory nuisance exists, or is likely to occur or recur in the area of the local authority, the local authority shall serve a notice ("an abatement notice") imposing all or any of the following requirements: -

- Requiring the abatement of the nuisance or prohibiting its occurrence or recurrence;
- Requiring the execution of such works, and the taking of such other steps, as may be necessary for any of those purposes

Effectively, it will demand the removal of the heat pump.

Conclusion

ASHPs appear to be a straightforward and easy technology for salesmen to “box shift”.

There is a lack of expertise of those selling and installing ASHPs – and this extends to those that are buying them because the technology has been “over-sold”.

In practice, GSHPs are likely to be the better choice, for the longer time, in most applications.