How to implement guide on air source heat pumps

If your organisation currently uses electrical heating you could save energy and costs through the installation of an air source heat pump (ASHP). This guide takes you through the initial stages of implementing an effective ASHP system.

Introduction

ASHPs use a heat pump to absorb free energy from the outside air and emit it at a higher temperature.

To do this it uses a reverse refrigeration cycle. Heat from the outside air is absorbed by the heat pump via a heat exchanger which contains a refrigerant. The heat pump's compressor concentrates the refrigerant causing it to condense at a higher temperature which can be used to heat water or air inside the building.

The Business Case

ASHPs have the potential to save energy and carbon when installed to replace an electric heating system.

A small ASHP installation can cost between £4,000 and £7,000. Larger installations can cost much more depending on the system size and application.

For example replacing the electric heating system in a building with an annual heat demand of 18,000kWh with an ASHP will save 12,000kWh per year, assuming a coefficient of performance of 3. This gives an annual carbon saving of more than 6.5 tonnes of CO2. At a unit price of 9p/kWh for electricity, you'd save £1,080 per year and assuming a typical installation cost of £5,500 you'd recoup your costs in about five years. The paybacks associated with replacing gas or fuel oil bases heating systems will be considerably longer than this.

The Technology

ASHPs can have a coefficient of performance of three, meaning that for every 1kW of electricity used, over 3kW of heat can be generated. Another important measure for heat pumps is the system efficiency, which is the sum total of the heat produced by the system against the total electrical energy required to run the system. This can include circulator pumps, fans and supplementary heating equipment.

The two generic types of ASHP systems available are air-to-air and air-to-water.

- Air-to-air systems produce warm air which is then circulated by fans to provide space heating for a building. Such systems are designed for space heating only and not hot water supply.
- Air-to-water systems transfer the heat from the heat pump into a wet heating system which may include radiators, fan convectors or under floor heating systems. These systems may be used for domestic hot water heating.

ASHP installations usually have an external evaporator unit with a fan, and an internal condenser unit to release the heat. Single packaged units for either indoor or outdoor installation are also available, but will require ducting to the heating distribution system.

The effectiveness and savings that are possible from an ASHP installation are largely dependent on having a well insulated structure and a detailed understanding of the building's heat loads.

ASHPs are temperature sensitive such that below 6°C, ice could easily form on the external evaporator, restricting air flow and subsequently reducing the system's performance. Well designed systems are fitted with a defrost mechanism. The most common defrosting method is to extract heat from the interior of the building and supply it in reverse to the external unit to melt any ice.

This process leads to partial loss of heating and lower system efficiency. Some systems come with direct acting electrical heaters in the event of extreme weather conditions.

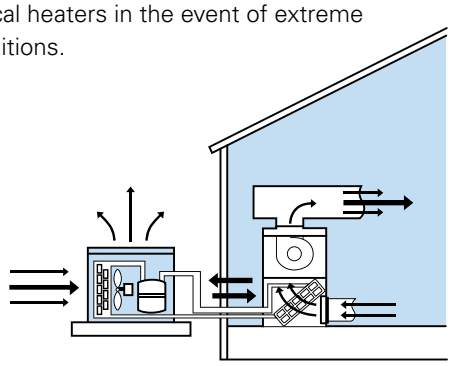
Applications

ASHPs are relatively easy to install in new and existing buildings, and provide a good option where no mains gas supply is available. Where a gas supply is available the cost and carbon savings associated with installing a heat pump must be carefully compared to installing a gas fired heating system. A qualified heating engineer can help with making this assessment.

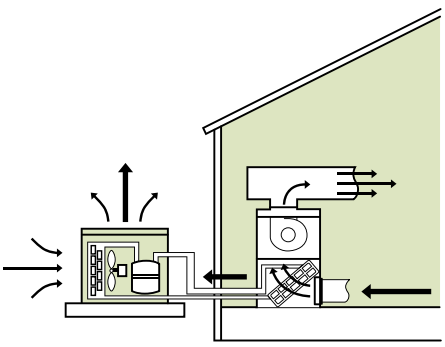
Air-to-air heat pumps are best installed on ducted air heating systems where they can be used to heat more than one room. Typically they are suitable for use in offices, schools, places of worship, shopping halls and commercial premises.

Air-to-water systems on the other hand are best installed in radiator, fan convector and under floor heating systems to provide space heating. In the right circumstances, domestic hot water and cooling are possible. Common building types for use include offices, schools, hospitals, sports halls, banking halls, shopping malls, fire stations, places of worship, police stations and court buildings.

Air source heat pumps are characterised by the production heat in the region of 30°C to 55°C, whereas traditional boiler systems generate hot water in excess of 70°C. As such ASHPs are more effective in providing space heating via under-floor heating systems which are specifically designed to operate at temperatures of around 30°C. If retrofitting a heat pump into an existing wet heating system, consider whether the radiators and fan convectors need to be resized to accommodate the lower output temperatures. However, the lower temperature means that when ASHPs are used for hot water supply, a source of top-up heat is often required to keep the hot water temperature above 60°C for microbial control.



Winter



Summer

Specification checklist

Before undertaking an ASHP project, your first step should be to undertake the following checks to ensure that an ASHP is the appropriate solution for your site.

Table 1 Specification checklist

Check	Comments
Is there a need for space heating and hot water, or space heating only?	Select between air-to-water and air-to-air systems and consider top-up electrical heating if hot water is required.
Is there a suitable location to site the external unit?	Ensure a secure location is available with air flow to the heat pump unit.
Is this technology less energy/carbon intensive than a gas based system?	This step may require the assistance of a qualified heating engineer who can undertake the necessary calculations.
Is my building suitable for a heat pump?	A building insulated to modern standards will be required to obtain the most benefits. Poor controls, inadequate insulation and draughts will reduce the benefits of any heating system.
What type of heating distribution systems do I have?	Ensure the system selected will work with any existing heating system otherwise higher costs would be incurred.
Will noise from the external fan be a nuisance?	Understand the noise level of the air source heat pump in decibels and consider suitable locations for external units.
Do I have enough electrical capacity to install a suitably sized system?	Investigate the available electrical capacity in the building. This may be important for buildings previously heated by oil.
Will this technology save costs?	Compared to oil heating, storage electric heating and electric peak time heating ASHPs cost less to run. You need to do a business case to assess how much energy and cost this could save.

Commissioning procedure

It is important to use a specialist engineer to commission an ASHP installation for optimum performance. ASHP performance should be regularly checked to make sure the predicted savings are being made.

Common Problems

- Poor understanding of the building's heat demand leading to under sizing of the unit.
- Inadequate controls, insulation and draught proofing reduce benefits.
- Poor commissioning by unqualified persons can result in poor efficiency and excessive noise.
- Insufficient training on controls for building occupants may result in incorrect and inefficient running of the system.
- Obstruction or fouling of the air flow to the external unit reduces the effectiveness of the heat pump to extract heat from the air.

Finding a supplier

The Micro Generation Certification Scheme is a good source for finding accredited installers for small to medium sized systems.
http://www.microgenerationcertification.org/

Further information can also be obtained from the Heat Pump Association. http://www.heatpumps.org.uk/

It is always advisable to seek installers with experience of building types similar to the building being considered.