



Air Source Heat Pumps Basics

Capturing heat from the surroundings, even at -10°C

Key Points

- Provides space heating and hot water for all household needs throughout the year
- Captures low-grade heat from the surrounding air and upgrades it to useful temperatures
- Best performance in well-insulated buildings connected to an underfloor heating system
- Lower performance than ground source units; also needs planning permission

How does it work?

A heat pump extracts low-grade heat from the environment, upgrades it, and delivers it to a conditioned space. It works on the same principle as most domestic fridges.

In a fridge, heat is removed from the internal refrigerated volume and 'dumped' into the kitchen. An air source heat pump (ASHP) captures heat from the ambient outside air and delivers upgraded heat to a hot water cylinder, underfloor heating, low-temperature radiators or fan coils.

Most domestic ASHPs are of the packaged type: all components are housed within the exterior unit, which is connected only via the hot water flow and return pipes. Split systems also exist, whereby the main unit lives internally, and a cold brine circuit connects to an exterior air handler.

Every ASHP contains an electrically-driven refrigeration unit and two heat exchangers, one for the 'cold' side (the air handler or brine circuit) and one for the 'hot' side (the hot water buffer tank or heating network).

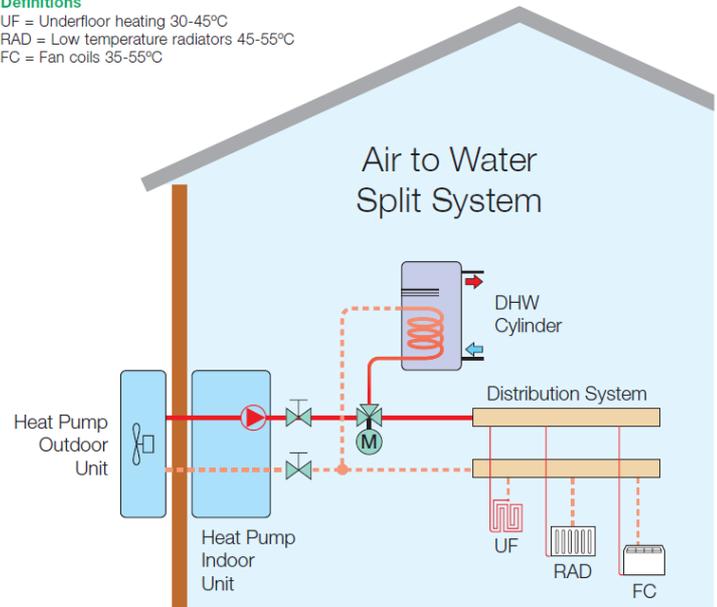


Exterior unit of a 14kW domestic ASHP

The temperature lift on the cold side may be as little as 4°C , but this is enough to capture a useful quantity of 'free' heat from the ambient air, even on very cold days.

Definitions

UF = Underfloor heating $30-45^{\circ}\text{C}$
RAD = Low temperature radiators $45-55^{\circ}\text{C}$
FC = Fan coils $35-55^{\circ}\text{C}$



Schematic of an air to water heat pump, supplying either underfloor heating (UF), low-temperatures radiators (RAD) or fan coils (FC). Image courtesy of FETA / Heat Pump Association

What are the advantages?

By harnessing a free and inexhaustible resource, an air source heat pump uses much less energy than a conventional heating system to provide the same amount of heat.

Because of this, it also has lower CO₂ emissions: a well-designed ASHP system (running on standard mains electricity) causes 20-25% fewer CO₂ emissions than an equivalent oil boiler. Compared with mains gas, carbon savings are more modest, however, a heat pump running on genuine 'green' electricity qualifies as a 100% renewable and zero-carbon heat source.

Air source heat pumps are also low-maintenance, low-noise solutions, cause zero local pollution, and are free from the safety and regulatory obligations of gas appliances. Although planning permission is needed, due to the modest noise and visual impacts of the outdoor unit, the best models have noise footprints of only 48dBA at 1m distance.

How much energy can it supply?

Air source heat pumps are available in a wide range of output capacities. Units delivering up to 14 kW of heat (sufficient for a very large new-build home) can run on a normal domestic single-phase supply; larger heat pumps usually require three-phase electricity.

Most ASHPs can provide hot water at up to 55°C , with an

immersion boost used to raise the stored hot water temperature above 60°C occasionally, to prevent Legionella growth. Some high-temperature ASHPs are also available, which use different refrigerants or even two-stage cycles to deliver water at 80°C without immersion heating.

Suitability for heat pumps

Although ASHPs are a good option for new, well-insulated buildings—particularly those without a mains gas supply—they can also be used successfully in a retrofit scenario. In these cases, the requirements to consider are:

- Upgraded building insulation and air-tightness, to allow the lower-temperature heat delivery to be effective
- Heat delivery—underfloor heating can rarely be retrofitted, so replacement low-temperature radiators or fan coils may be used instead, adding to costs
- An adequate electricity supply is required to drive the heat pump compressor (i.e. three phase for larger units)
- Outdoor location for the main external unit or air handler, sensitive to any visual or noise impacts on adjoining properties.
- Space for the internal unit and thermal store (which may or may not be integrated); split systems with internal compressors generate interior noise, and are best sited away from bedrooms etc

Costs

A typical domestic ASHP costs in the range of **£6,000 to £8,000**, which includes the heat pump itself, hot water buffer tank, computer controller and all of the required plumbing works to link these to a heat distribution network. If new heat emitters are required (e.g. low-temperature oversized radiators), costs will obviously rise.

Unlike with ground source heat pumps, there are no geological surveys or ground works required, making overall installation costs and disruption significantly lower.



The interior components of a large packaged ASHP installation, dominated by the tall thermal store

Grants

All grants for domestic renewable energy systems ended in early 2010. However, heat pumps will be supported under the Government's *Renewable Heat Incentive (RHI)*, which arrives in April 2011.

This will pay a beneficial rate for each unit of 'green heat' heat generated, and is similar to the Feed-In Tariffs (FITs) already in place for renewable electricity generators.

Metering and payment mechanisms, as well as the actual RHI tariff rates, are currently under consultation, with further details expected to be announced later in 2010.



The manifold for an advanced underfloor heating ASHP installation. Each zone uses a separate electronic programmer, with each room regulated by a wall-mounted thermostat.

Further Information

Microgeneration Certification Scheme

Find approved ASHP products and installers
www.microgenerationcertification.org

Heat Pump Association

www.heatpumps.org.uk

Severn Wye Energy Agency Ltd

Unit 15 Highnam Business Centre
Highnam, Gloucester, GL2 8DN

Renewables Helpline — **01452 835087**

E-mail — renewables@swea.co.uk

Web — www.swea.co.uk