

Appendix C – GEOTHERMAL HEAT PUMPS
IMS Heat Pumps



Renewable heat, directly from the ground.

A ground source heat pump (GSHP) extracts heat directly from the ground. The sun heats the earth every day, meaning the rock or soil beneath the surface can offer a natural source of consistent low-grade heat.

Property owners can install a vertical or horizontal ground source system. The former uses deep drilled boreholes, and the latter uses shallower trenches. The system circulates a solution through pipes or loops, which absorbs the underground heat and filters it through a heat exchanger into the pump.

A ground source heat pump is a super-efficient heating system, delivering year-round heat to residential and commercial properties.

Meet building regulations

Comply with UK government guidelines and local authority building regulations, reduce carbon emissions, and improve your SAP calculations. Go green, and get efficient.

Benefit financially

You could reduce monthly utility bills, and claim Renewable Heat Incentive (RHI) payments. A GSHP makes sense for your pocket and the environment.

Enjoy the simplicity

GSHPs are low maintenance, and straightforward to install if you have the space. Planning permission is not usually required for standard new-builds or renovations in the UK.

How do ground source heat pumps work?

The sun's rays heat the surface of the earth, and this heat energy is stored in the soil, rock, water and air, keeping the annual average temperature in the UK at approximately 10C.

Ground Source Heat Pumps work by harvesting some of this stored solar energy from the soil. A cold heat transfer liquid is pumped out of the heat pump through a long pipe network buried in the soil at a depth of 1m.

As the liquid passes through the pipes it picks up heat energy from the soil and returns to the heat pump several degrees warmer. This heat energy is then transferred into a refrigerant circuit in the heat pump, using a heat exchanger. The refrigerant is compressed, which makes it very hot, and the heat is delivered into your heating and hot water system using another heat exchanger.

Are ground source heat pumps noisy?

No, the noise of a ground source heat pump is less than a traditional fossil fuel boiler or an air source heat pump. A ground source heat pump is perhaps the quietest heating option available when standing a metre away from the system in the plant room, a GSHP may reach 42 decibels. This is equivalent to a fridge. And of course, there is no whirring outdoor fan because the heat is sourced beneath the earth, not from the air.

How efficient is a ground source heat pump?

Heat pump efficiency is measured using the Seasonal Coefficient of Performance (SCoP), also known as the Seasonal Performance Factor (SPF). This describes the amount of heat produced for every unit of electricity consumed.

Typically, ground source heat pumps produce between three and five units of heat for every unit of electricity consumed, representing a SCoP of 3 – 5 (or between 300% and 500% efficiency). By comparison, a traditional boiler might have an efficiency of between 60% and 90%

How long will a ground source heat pump work for?

If properly installed and maintained, a ground source heat pump should have a working lifespan of around 20-25 years, while ground loops should last for up to 50 years.

HEAT PUMPS FOR ARCHITECTS
THE ESSENTIAL ADVICE



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Why should you trust our guidance?
IMS Heat Pumps leads the way as an installer of heat pumps in Scotland, the North and Midlands. We offer a turnkey solution of design, installation, commissioning, service & maintenance, and finance solutions.
With over 20 years in business, 125 years of experience and hundreds of ground and air source heat pumps projects completed, IMS Heat Pumps is your reliable renewable heating solutions partner. We design, supply, install, commission, and maintain your client's bespoke energy-efficient heating system.
IMS Heat Pumps is an MCS accredited heat pump specialist, with offices in Sheffield and Perth. We specialise in ground source heat pumps, air source heat pumps, and underfloor heating systems for small and large new build, self-build and renovation projects.
We work closely with manufacturers and specialise in NIBE and Vaillant heat pump equipment. We have delivered solutions that have also included swimming pools, boat houses and passivhaus builds.

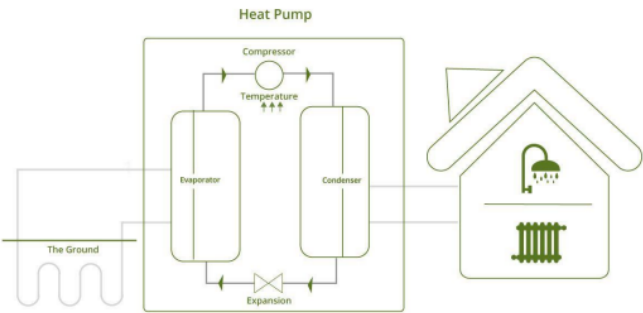
Architects! Why do you need to know about heat pumps?
Whether you're designing a small commercial or residential building, the more energy efficient the better. Governments, local authorities, and clients all demand an unprecedented level of energy efficiency and renewable power in modern buildings. The construction industry is on the front line, and for good reason. Architects are now expected to understand renewable energy technology and be able to incorporate it into their creations.
Heat pumps are recognised as a renewable energy technology for hot water and heating in the UK. This means that these systems are favoured in planning permission applications for compliance with Part L building regulations. IMS Heat Pumps will always advocate "fabric first" approach to energy efficiency, with support from a renewable heat system.

And what do you need to know about heat pumps?
In this guide, we will cover the following common questions asked by architects:

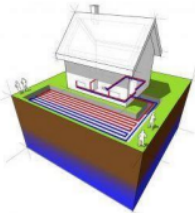
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1. What is a heat pump and how does it work?
Heat pumps extract ambient heat from the environment, through either ground loops containing a brine solution or from the air using a fan. This thermal energy is raised to 50°C through a refrigerant cycle. This provides your property with an efficient source of heat and hot water.

Ground source heat pumps (GSHPs)
Ground source heat pumps (GSHPs) absorb low grade heat in the ground from rock, surface soil, or from a nearby lake or riverbed. The system transports and releases this energy in the property for hot water and central heating. The energy bill savings are significant, and the technology qualifies for the government's domestic Renewable Heat Incentive (RHI) scheme.

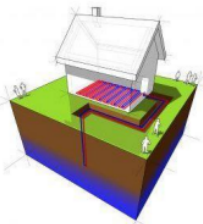


Horizontal GSHP systems:
At IMS Heat Pumps, we use straight lengths of collector pipe rather than slinky arrays. These systems are more effective because heat collection is spread over a wide area, and they reduce the risk of cold spots in the collector system.



Vertical GSHP systems:

Vertical systems need less underground space than a horizontal array, and also require less space at the surface. However, access for the site must be considered. As you know, drilling rigs are large machines. Back gardens are often not suitable sites for borehole installation.

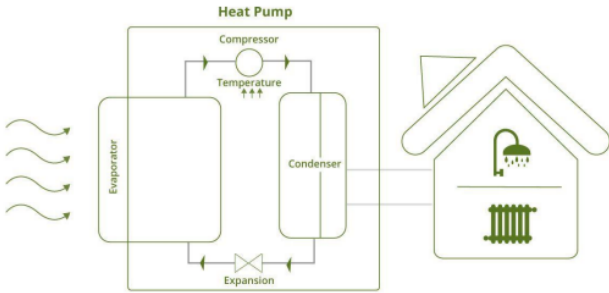


Air source heat pumps (ASHPs)

An air source heat pump uses a fan unit, which sits outside the property to extract heat from the air. The energy is compressed inside the heat pump to form a higher temperature, creating the heat that is sent into the home for heating and hot water.

The temperature outside doesn't impact effectiveness. Even in freezing conditions, this is a viable property heating system.

ASHPs are officially classified as renewable energy technology, and property owners can benefit financially from the UK government's RHI scheme.



5. The provision of fixed building services which are energy efficient, have effective controls, and are commissioned to optimise power consumption.

SAP ratings

An integral element of Part L (2013) is the SAP rating of a new home. This is the Standard Assessment Procedure, which is the government-approved method for assessing the energy efficiency of a new home. Assessments are carried out by accredited professionals at the design stage of a new dwelling, and any new home must pass the SAP rating; otherwise the house cannot be sold or let.

SAP ratings are based on a number of factors, including how well the fabric of the building retains heat, solar gain, quality of construction, and commissioning of systems. A higher SAP rating (100 is the maximum) means lower running costs for householders.

The characteristics of a dwelling with a good SAP rating include:

- High efficiency heating system
- High quality (and well installed) building fabric with low U-values
- Minimal thermal bridging (reducing heat loss through junctions with external walls)

The use of heat pumps (and other renewable tech) makes compliance with building regulations and higher SAP ratings much more likely. The reduced carbon emissions from this technology will help a building reach a lower carbon emission rate than the maximum (kgCO₂/m²/year) in the SAP calculations.

4. I've heard that heat pumps are noisy. Is this true?

This is a common misconception, there is in fact a wide range of sound performance. It is a reputation that has emerged from shoddy work, poorly planned projects and low-quality products, you get what you pay for.

Noise: Ground source heat pumps

A ground source heat pump produces some noise due to the components within it, but this is negligible in almost every case. In truth, GSHPs are quieter than ASHPs. This is because they have no requirement for a fan or condensing unit. Furthermore, GSHPs have a lower compressor power capacity, since the extraction of heat from the ground is more consistent. The temperature is warmer down there, and this means the heat pump doesn't need to work quite so hard to heat your home and/or hot water.

A GSHP has a typical decibel level of 42 dB, and that's if you're standing a metre away. This can be compared to a fridge in any normal home. In addition, there is less need to worry about the neighbours because the system is largely contained within your walls – often in a garage, a shed, or in with your utility room or basement.

Overall, it can be confidently estimated that if installed correctly, a ground source heat pump is likely to be less noisy than a traditional gas or oil boiler.

5. What about heating distribution and heat pumps?

Heat pumps work most efficiently with underfloor heating. This is because it provides a constant lower temperature heat over a larger surface area. There's a good chance that you've already considered underfloor heating. If not, this requirement needs to be considered in early design phase. Floor constructions, joists types and floor / door / ceiling heights will be affected.

Heat pumps do work with radiators, but they need to be big enough to allow the system to operate at an efficient level. The size of radiators is very important in this scenario, which might impact your allocation of wall space as a designer.

6. How a heat pump will help me create a low carbon building?

Heat pumps can be 300 - 400% efficient, which means for every 1 unit of electricity, the homeowner generates at least 3 - 4 units of heat (in other words, for every 1 kWh in you get 3 - 4 out). As a renewable technology, heat pumps reduce energy consumption and can help clients obtain planning permission. But they do need a small amount of electricity to function.

To ensure that the energy efficiency of a heat pump solution is accurately reflected within SAP, the assessor must use the correct heat pump system reference. Using default SAP settings will give you incorrect results.

To create a zero-carbon building, the electricity provided to the heat pump must be generated on-site via solar or wind, or the homeowner must purchase electricity from a green energy provider.

The market for green electricity is growing, and therefore this is a perfectly feasible option for the client. Of course, generating electricity on-site with solar or wind power requires extra consideration by the architect and project stakeholders.

7. Does the client need planning permission for heat pump systems?

Installing a heat pump (of any kind) is usually considered as a permitted development, so planning permission is not required. That said, if you live in a listed building or a conservation area you should contact your council to clarify local requirements.

The laws differ between England & Wales and Scotland. There are, of course, conditions which must be met for a heat pump system to meet the permitted development status.

For a full list of these conditions, check out our regularly updated blog post on planning permission for heat pumps in the UK. This is updated when new regulations are launched, so it's worth bookmarking for the future.

8. How can I convince a client that a heat pump is the right choice?

In some circumstances your client will need to be convinced that a heat pump is the right way forward. What's wrong with a traditional heating system?

Let's look at some of the issues that you can bring to light.

Cost savings

Heat pumps will save your clients money on their utility bills. How much exactly? It depends, of course. You can calculate estimated savings with our calculator, available here. When compared to other

2. How will a heat pump system impact my building design?

Of course, the inclusion of a heat pump system will have some impact on your design. But you've had to account for heating and hot water systems since the dawn of time, so nothing really changes here. Let's look at what to consider in terms of building design.

Ground source heat pumps

Whether you recommend a horizontal or vertical GSHP system, there are several factors to consider for impact on your design.

- The design of a suitable plant room and its proximity to the heat collector system
- The size of the required kit and the system as a whole

Ground source heat pumps have minimal impact on the exterior of your building. Most of the heavy-duty technology is underground. With regards to inside the building, you will need a plant room. A plant room needs to have a 1 x 3 metre footprint, subject to the system size.

Whilst architects are typically more familiar with air source heat pumps, it is true that ground source heat pumps are less impactful on design and are often favoured. This depends on client budget, outside space, and heat demands of the property.

Air source heat pumps

An ASHP has a very clear visible impact, but this can be minimised with a smart approach. Regardless of context, an air source heat pump will need to be placed externally on the building itself or within its immediate surroundings.

The good news is that whilst many buildings do have their ASHP on an outer wall, you could situate the system up to 15 metres away from the plant room. This would cost the client extra - between £100 to £130 per metre - but wouldn't compromise design to the same extent. It is also possible to enclose an ASHP system on the outer wall within a purpose-built container.

With regards to the plant room, it needs to have a 1 x 1 metre footprint.

3. What do heat pumps mean for building regulations and SAP ratings?

Part L (2013) of the Building Regulations has five key requirements which housebuilders must meet in new dwellings.

Here's an overview:

1. Requirement 26A requires dwellings to achieve or better a fabric energy efficiency target, in addition to the carbon dioxide target.
2. Regulations require an overall 6% CO₂ savings across the new homes build mix, relative to Part L (2010).
3. The feasibility of high efficiency alternative systems must be considered before construction commences. This includes heat pumps.
4. Housebuilders should limit heat gains and losses with good insulation in roofs and walls.

Noise: Air source heat pumps

This is more contentious than ground source heat pumps. ASHPs have developed a reputation for being noisy. It must be stated that these cases are in the minority. ASHPs wouldn't have become so popular if they were an inherent nuisance to every homeowner. Don't be dissuaded by the scare stories!

There are four main components in an ASHP that cause noise: the compressor, the AC condenser, the evaporator, and the expansion valve. However, it is the fan that often causes most worries. In addition to the compressor, the fan is typically the element that could raise the decibels to a concerning level for the homeowner. The level of fan noise depends on the manufacturer and model, together with the airflow and pressure. A ground source heat pump has no fan, which is why noise concerns are a less popular topic for that particular technology.

The details of ASHP noise:

Depending on the system manufacturer, you can expect noise of between 40 – 60 decibels (dB) from an ASHP. This measurement is based on a one-metre distance, and reduces the further away you get from the system. 60 decibels is very uncommon, but can be compared to the noise level of a regular conversation, or background music. 40 decibels can be compared to a bird call, or the ambient sound in a library.

It's not only the components that create noise, but the vibrations that are created by the system exchanges. There will be inevitable noise from the air interacting with the heat exchanger, but this depends on the pressure levels at any given time. The motor, as a moving part, will also add some noise, although this is minimal if maintenance is conducted accordingly.

Depending on the heating requirements for the property, the fan might be required to work harder and thus runs at a higher speed. In general, smaller ASHP fans operate at a lower speed, whilst the bigger systems are quicker. Modern heat pumps systems alter their speed according to the conditions, to maximise efficiency.

Planning standards assume that background noise is consistently under 40dB. Compliance with planning laws mean that an ASHP should be under 42dB from an assessment position equidistant to the space between the system and a neighbouring property. In general, a UK council will take action against a noise which is +10 dB above normal background noise in the area. An increase of +5 dB isn't usually a problem, but much higher will be a likely source of complaints.

Consider that the expected noise level is 40 – 60dB (more likely 40 – 50dB in truth) from a metre distance away. This drops dramatically as you get further away. It's very unlikely that your property (or at least the ASHP installation location) is 1m from a neighbour. This would be poor installation procedure, and not recommended by any decent installer. Therefore, it's very unlikely that the noise levels will be disturbing to anybody.

In a nutshell, you can expect a regular "hum" from an ASHP, due to the movement of the air and the components within the system. However, if an air source heat pump is installed in the correct position at a suitable property, it is highly unlikely to cause concern. This is especially true since clients are mostly outside in the summer, when the heat pump will rarely be operating, as it will just be producing hot water.

alternative energy, heat pumps also come out cheaper. For example, if there is no gas supply, an ASHP is cheaper than the Solar PV and boiler combo.

Financial support

The domestic and commercial RHI payments incentivise the switch to renewables, and heat pumps qualify. Again, you can determine your estimated RHI payments using our calculator. If you have any questions, contact Smart Renewable Heat.

Environment

Heat pumps are better for the environment. For every 1 kWh in, the homeowners get 3 - 4 out. The greener the electricity supply to the heat pump, the greener the system overall. The household can generate its own green electricity onsite (via solar panels, for example), or buy electricity from green energy companies to create 100% green utility.

Planning permission

Councils and planning authorities aim to reduce the impact of homes on the environment. When evaluating planning permission requests, they look for this as a green light. Installing a heat pump is better for the environment than alternative heating and will serve in your client's favour when they apply for permission on a new, renovated, or extended property.

Ease of installation and maintenance

Heat pumps are no longer the futuristic phenomenon they once were. They are straightforward to install, cheap to maintain, and they have a long lifespan (20 - 30 years). We're specialists in this regard and would love to help on your project. Give us a call to get things started.

They're simply more comfortable

It's a myth that heat pumps can't do hot water. This isn't true. We have systems which can heat to 65 degrees without an immersion heater. Furthermore, heat pumps are better for home comfort than traditional heating, especially when combined with underfloor heating. The heat pump will heat a home constantly through the day, without the worries of wasting oil or gas.

9. Key points to remember

The main points from this guide are as follows:

- Heat pumps are desirable, feasible, and effective for heating your client's property
- Provided the building has effective insulation, the client will benefit from reduced utility bills and Renewable Heat Incentive payments
- The size and setup of a heat pump is not prohibitive for cutting-edge design.
- Heat pumps are not noisy and won't compromise peace and quiet in your client's home
- Renewable heating is actively sought-after for the planning authorities

IMS Heat Pumps is an MCS accredited heat pump specialist, with offices in Sheffield and Perth. We specialise in ground source heat pumps, air source heat pumps, and underfloor heating systems for small and large projects. We work closely with manufacturers and as a result, we can provide the most appropriate heating and hot water solution for any situation.

We give you peace of mind and confidence about renewable heating.

10. About IMS Heat Pumps - Contact & Social

IMS Heat Pumps is a friends and family company with offices in Perth and Sheffield.

Established in 1997, IMS have been working with heat pumps for over 20 years and house some of the most knowledge and experienced heat pump people in the UK. We pride ourselves on our excellent designs, installed by our skilled and knowledgeable Engineers, ensuring that our customers' bespoke systems provide them with all the hot water and heating they need.

Our in-house team provide all the design, installation and maintenance services for ground and air source heat pumps, as well as the underfloor or radiator fitting services. Working predominantly for clients, architects and main contractors with new build, self-build and renovation projects we operate across Scotland, the North and the Midlands.

With unparalleled experience in Ground & Air Source Heat Pumps and a fantastic team of designers and installers, our installations simply work.

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