Historic England

Energy Efficiency and Historic Buildings

Heat Pumps

Summary

This guidance covers the issues associated with installing a heat pump in a historic building. It describes the different options available and how they work. Advice is also provided on how to minimise the potential damage to the fabric of the building in the design of the installation.

Before installing a renewable energy technology in a building, all available energy efficiency measures , including low-energy lighting, heating controls and improved insulation, should ideally already have been made.

This guidance note is aimed at providing advice for building owners and occupiers who are considering installing a heat pump to generate their own energy. It will also be useful for architects, surveyors, building contractors or similar building professionals who need to make the appropriate selection of equipment and method of installation to work within a historic building.

Historic England has a wide variety of guidance on improving energy efficiency in historic buildings. For more information see: HistoricEngland.org.uk/energyefficiency

This guidance note has been prepared by Caroline Cattini. It forms one of a series of five guidance notes covering the installation of renewables and low carbon technologies such as photovoltaics, solar thermal, hydroelectric and wind.

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HistoricEngland.org.uk/advice/planning/infrastructure/renewable-energy/microgeneration/

Front cover:
Ground loop installation.
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< < Contents

Contents

Introduction

Heat pumps are generally well-suited to historic buildings as they work efficiently when run on a constant low temperature, a method suited to buildings with thick masonry walls that are able to retain heat and release it slowly. This is referred to as having thermal mass.

Running heating on a constant low temperature can also be beneficial for older buildings because the building will heat up and cool down slowly. This means there will be less thermal movement within the building caused by expansion and contraction, thereby reducing potential damage such as shrinkage cracks.

Historic buildings are often surrounded by areas of land which increases the range of heat pumps that can be installed.

Before installing a heat pump it is worthwhile considering the following:

- the potential impact on the building's historic fabric
- the amount of energy that could be generated and value for money
- any technical risks associated with the measure
- what electrical capacity is there at the site? Heat pumps require electricity to operate.

These issues will help to identify the type of installation best suited to the building, taking building use into consideration as well as the existing construction and services.

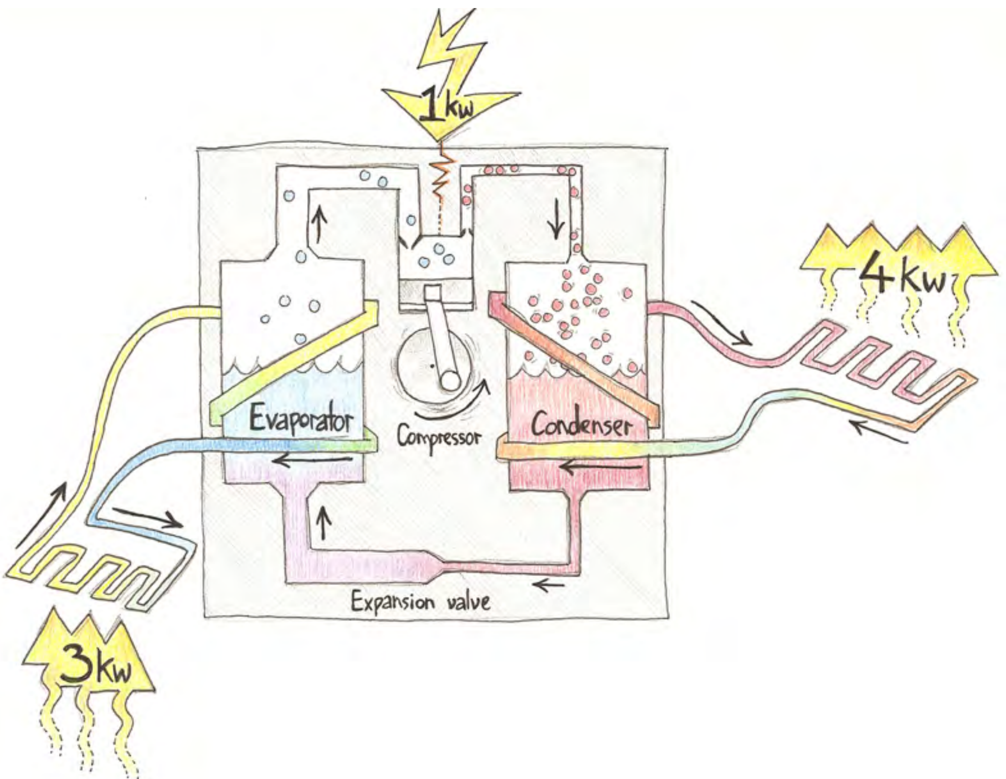
1 What is a Heat Pump?

Heat pumps can be used for heating or cooling spaces in a building but this guidance relates to their use for heating. Heat pumps take their heat energy from the ground, air, or water and consequently can cost less to run than heating systems that use electricity or oil.

The heat pump upgrades heat from lower temperatures to higher temperatures. The higher temperature heat can then be used either space heating or hot water.

A heat pump for heating uses the same process as a refrigerator. In a refrigerator the heat is removed from the inside and emitted outside (you may notice your fridge is hot at the back). For a heat pump, the heat is taken from outside the property and emitted in the building thereby heating the space or, in some cases, domestic hot water.

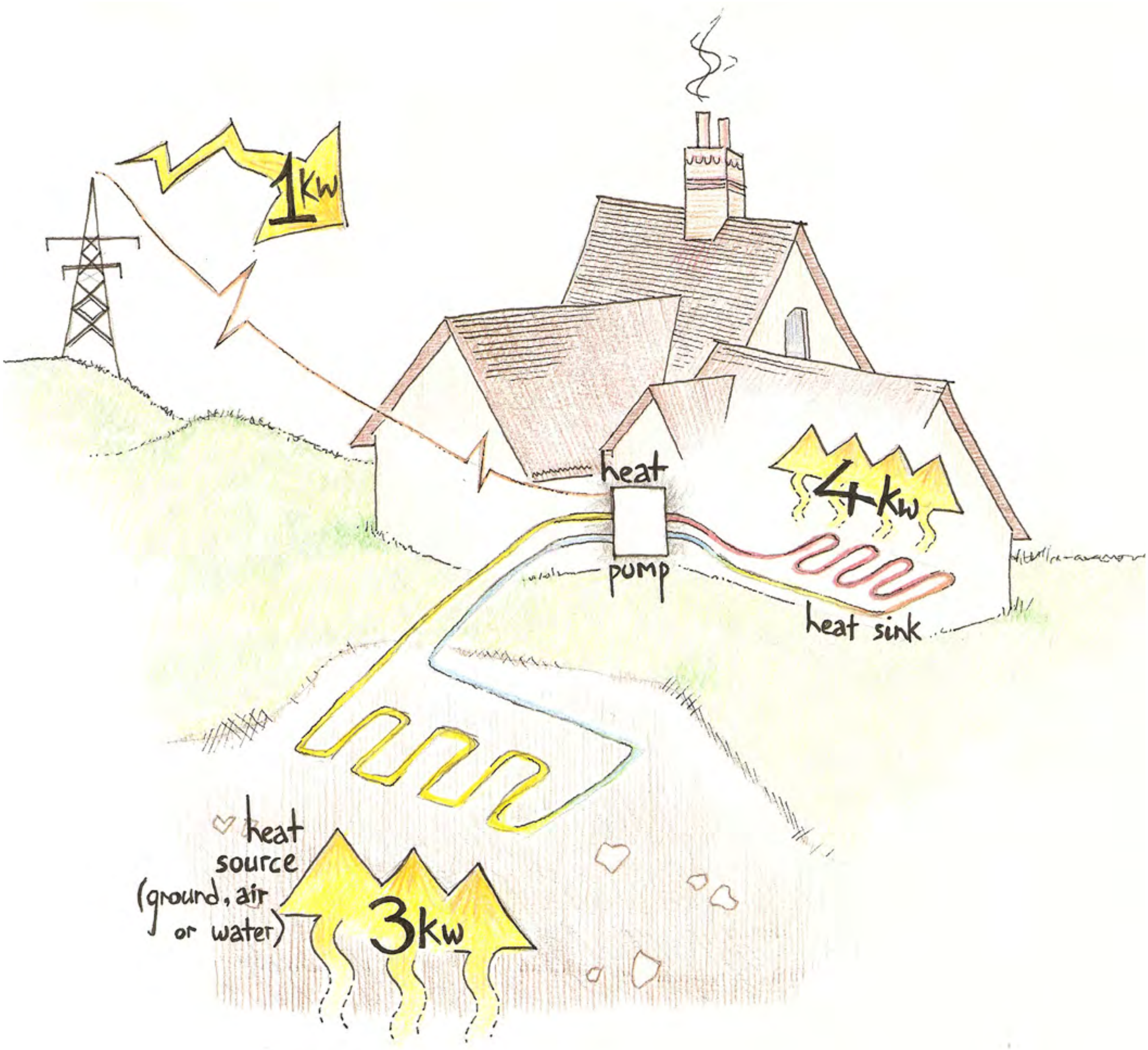
The heat pump has four main components: a compressor, condenser, evaporator, and expansion valve. A refrigerant flows between these in a process known as the 'vapour compression cycle'.



1 Vapour Compression Cycle

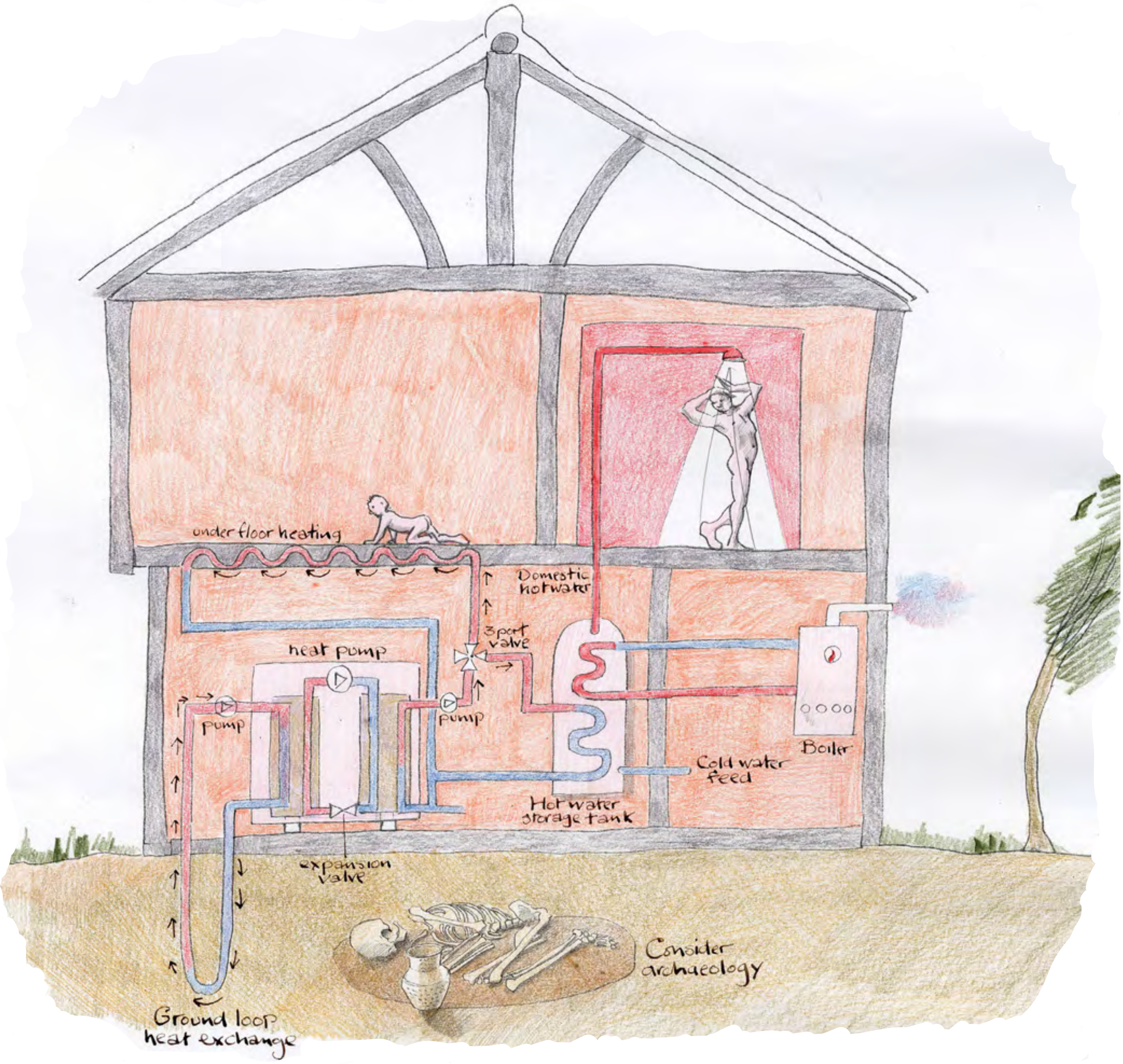
A refrigerant flows around the system changing between being a liquid and a gas and fluctuating in pressure. Where the fluid evaporates and condenses, heat is exchanged either into the system (evaporator) or out (condenser).

The changes in pressure are achieved by a compressor (low pressure to high pressure gas) and an expansion valve (high pressure to low pressure).



The amount of heat produced by the heat pump compared to the electricity required to run it is known as the appliance ‘Coefficient of Performance’ or COP. This value is useful when comparing one heat pump to another. The appliance COP can range between 2.0 and 4.5; a higher COP indicates a more efficient heat pump whilst a lower COP will indicate a poorer performing heat pump. For a heat pump working at a COP of 4, for every one unit of electricity used, four units of heat energy is produced.

2 Coefficient of Performance’ (COP). The COP determines the efficiency of the heat pump.



3 Heat pump installation.

The appliance COP should not be used to determine running costs or the overall system efficiency. It should only be used to compare the performance of one heat pump to another.

It is more useful to use the 'Seasonal Performance Factor', or SPF, when looking at running costs and the overall system efficiency. The SPF is a measure of the operating performance of an electric heat pump averaged over a year. This value is the ratio of the 'Seasonal Coefficient of Performance' for the heat pump and all the electricity needed to run the system for the year.

2 System Options

This section lists some of the most common types of heat pump systems, giving an overview of the issues that should be taken into account when planning your system. When choosing a heat pump there are several different options to consider.

- the type of heat source - ground, air or water
- the heat pump itself
- the heat distribution system - radiators, underfloor heating, air heating

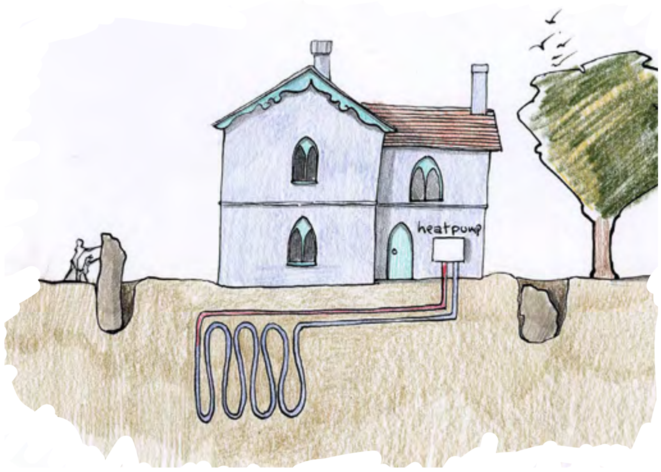
The options outlined in the following section are initially by type of heat source: ground source (closed loop and open loop), air source, and water source (closed loop and open loop). Typical methods of heating the spaces are then discussed including underfloor heating, radiators and warm-air systems.

2.1 Ground-source heat pumps

Solar radiation is absorbed by the ground, which means a fairly constant temperature (8–12°C) is maintained from around 1.5m deep. This low-grade heat is taken from the ground using a buried pipe known as the ground loop, around which a mixture of water and anti-freeze is pumped. This heat is then taken from the liquid within the loop by the heat pump and upgraded to a higher temperature and therefore, more 'useful' heat.

Closed loop

Closed loop is the most common type of heat pump consisting of a sealed loop of pipe which is usually filled with a mixture of water and anti-freeze. The liquid increases in temperature as is passes around the loop through the warmer ground. This heat is then removed from the loop by the heat pump.



4 A closed-loop ground-source heat pump.

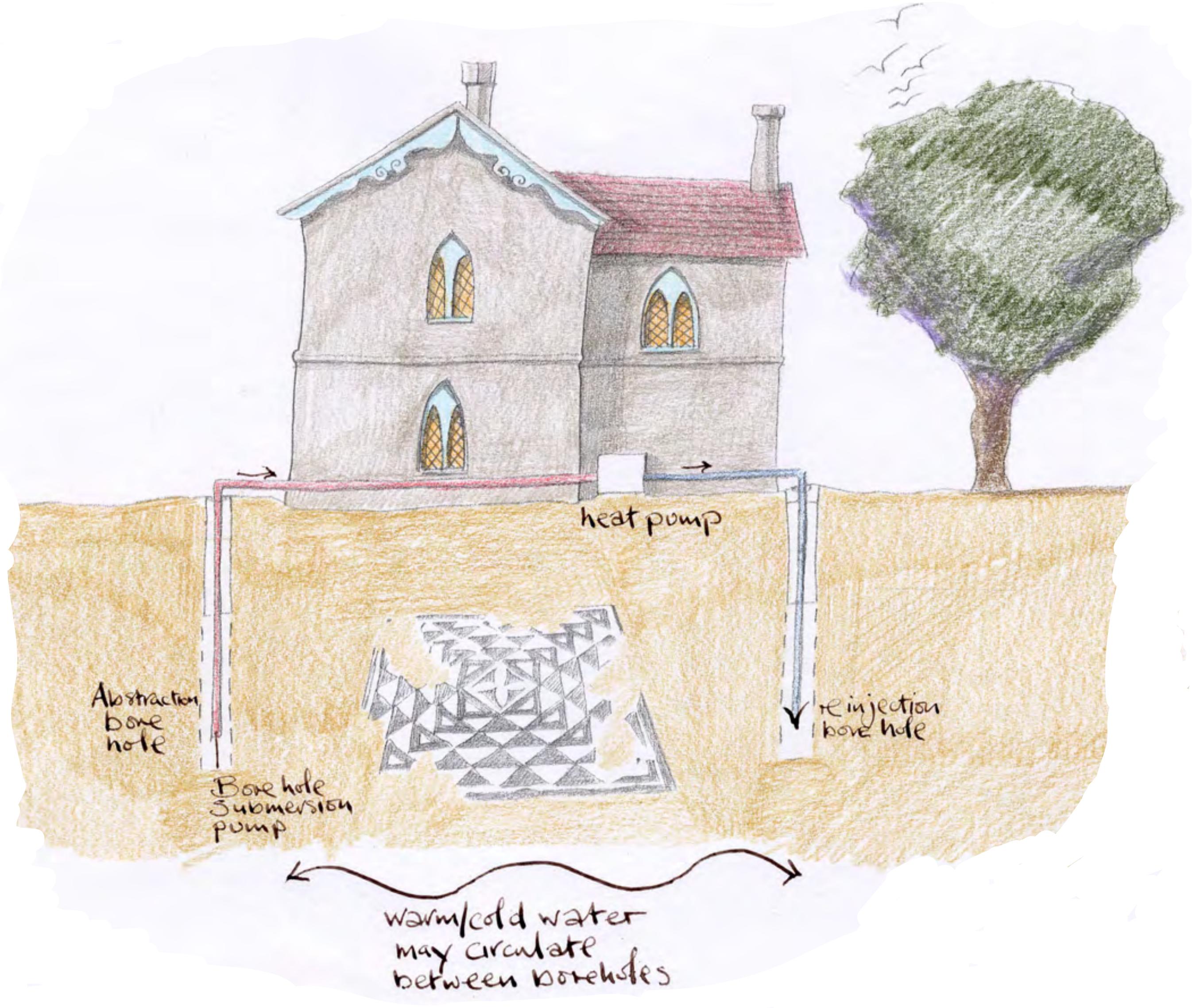
Open loop

Open-loop systems tend to be fairly rare. Groundwater is taken from water sinks (aquifers) underground. Pipes are installed in boreholes from which water is pumped. Variations to open loop also include water extracted from lakes, rivers and even the sea (see section 2.3).

Heat is then removed from this water by the heat pump, before the groundwater is re-injected through another borehole. The re-injected water should not mix with the extracted water or the system will reduce in efficiency: this mixing is known as 'short-circuiting'.

It is necessary to apply to the Environment Agency for groundwater investigation consent first, and if work proceeds you will require an abstraction licence and a permit to discharge. The groundwater may surface elsewhere, so removing this water may adversely affect other users of the water. Digging the boreholes and trenches to connect them to the property can often cause disruption and access will be needed for the large drilling machinery.

Ground loops can be installed either vertically as a borehole, or horizontally in a trench. The type selected will be dependent on the area available, access and the geological conditions.



5 An open-loop ground-source heat pump.

Boreholes

Boreholes (vertical) are normally drilled where there is not a large land area available for a horizontal collector loop. The loop is usually installed into a borehole between 100 and 150 mm in diameter and 15 to 120 metres deep. Water with anti-freeze (or brine) is pumped around these loops.

Boreholes must be correctly spaced: too close together and the net cooling effect on the ground will reduce the efficiency of the system. The cost and efficiency of the system will also be highly dependent upon location. There is a possibility that a borehole loop could leak if incorrectly installed, potentially causing huge expense: good system design and a well-planned installation process minimises this risk.

Horizontal trench

An alternative to using a borehole is to employ a 'horizontal' or trench loop. These are commonly laid in trenches 1.2 to 2.5m deep. Horizontal loops typically require a larger land area than borehole loops. Another way of laying horizontal loops is by using a 'slinky' coil of pipe; the pipes overlap and so require less area. Horizontal loops can be considerably cheaper than vertical boreholes. They are also usually less efficient than boreholes due to the fluctuating ground temperature near the surface.

The trenching process can be very messy, especially during wet weather. Because of the large amount of landscaping work needed, potential archaeology might be an issue in historic landscapes. Documentation should be kept: if any kind of subsequent excavation work is undertaken within the location of the ground loop, there is a high risk of damage.

6,7 Horizontal trench groundworks.

Closed loop systems generally do not require a permit from the Environment Agency. Where they are installed adjacent to or in a watercourse flood consent may be required. Owners do still remain liable for any adverse effects that maybe caused by their system, such as if a leak which could cause pollutants to enter the groundwater. It is therefore advisably to follow the Environment Agency's good practice guidance.

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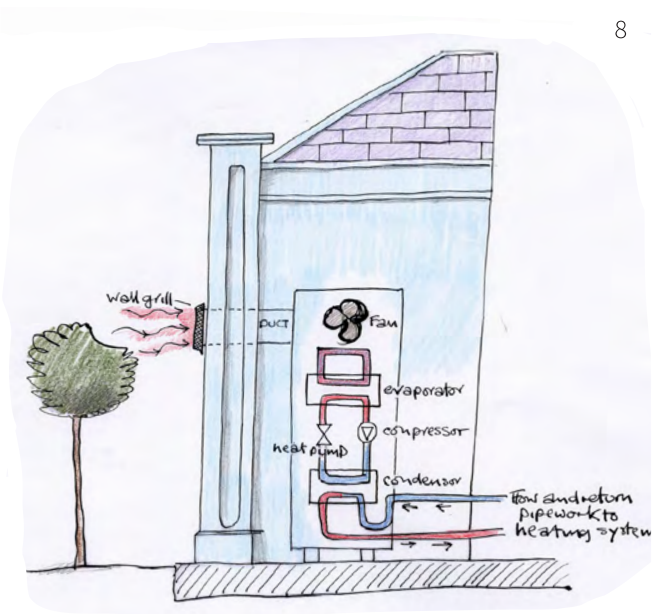
2.2 Air-source heat pumps

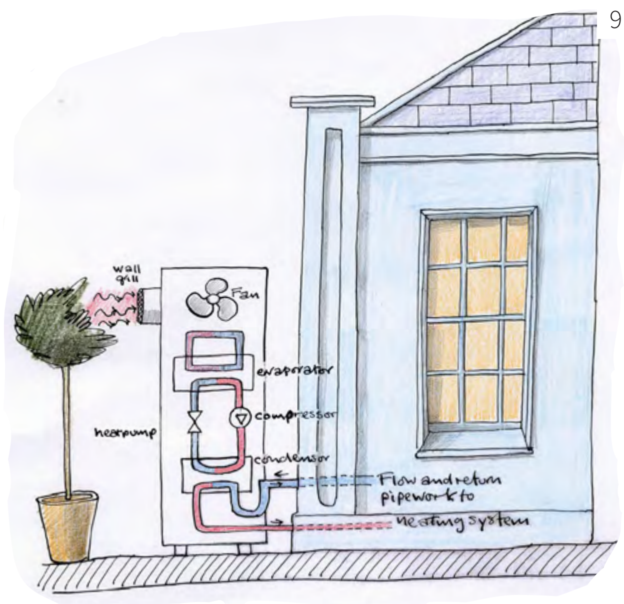
As their name suggests, air-source heat pumps extract heat from the outside air and release it into a building. Outside air is drawn in by a fan and some of the heat energy is removed. This heat is then upgraded to a higher temperature in the heat pump. This refrigerant can then either heat air to be distributed around the property (air-to-air) or heat water for a conventional low-temperature hot water system (air-to-water).

Air-source heat pumps can be installed inside or outside the building. When they are installed inside, air will be taken from outside, so ductwork may need to pass through the wall of the building. The heat pump being installed internally can also produce noise, which can be noticeable in a quiet environment. The heat pump will also take up space internally.

An internal heat pump will have a lesser impact on the aesthetics of the building; the only visual clue would be a grille or louvres on the external wall. No space is needed externally, so these systems can be installed in a wide variety of locations. A larger amount of space is taken up internally than with other systems so the placement of the heat pump within the building will need to be considered carefully.

Similar to the commonly seen 'air-conditioning' systems, a unit outside the property extracts heat from the air. A refrigerant runs between the external and internal units, heating either air or water internally.





8 Internal air-source heat pump.

9 External air-source heat pump.

10 Example of an external unit.

11 Example of an Internal unit.

The external parts will require some space outside, so the location of these should be carefully considered. They can often be placed in locations where they are not visually intrusive, such as along hedge lines. Some manufacturers colour the external units so that they blend into their surroundings more easily. It is also possible to screen the unit – providing manufacturers' guidelines are followed – so as not to interfere with the air intake.

The internal emitter needs to be carefully sited if the internal space has sensitive décor. There is a trend to site them high up on the wall like an air conditioning unit. This does not need to be done; they can be sited lower where you would expect a conventional radiator to be, and the chassis can be removed and fitted into a decorative wooden or metal enclosure to match the interior.

Some grants exclude air-source heat pumps as their efficiency and performance can be difficult to measure. They are typically less efficient than ground-source or water-source heat pumps but can be considerably cheaper as no groundwork is needed.

Since outside air is often cooler than the ground and more variable, air-source heat pumps' COP is generally lower at between 2.0 and 3.5.

2.3 Water-source heat pumps

In a water-source heat pump heat is usually extracted from a lake, river, canals or streams. The temperature of the water is often higher than the ambient air temperature in the winter. Like ground-source heat pumps, the collector can be an open- or closed-loop system. A typical COP for a water-source heat pump is around 3 to 3.5.

Water, together with anti-freeze, is pumped around a loop located in a river, stream or lake. The heat is collected from the water and then passed through the heat pump. If the body of water is not large enough, there will be a net cooling effect, so the average temperature of the water can be altered, reducing the efficiency of the heat pump. Water temperature is less constant than ground temperature, so the COP will vary more than with a ground-source heat pump.

Water-source heat pumps are only possible if there is a lake, river or stream close to the building in question. Trenching is needed between the building and the water source for the flow and return pipework to run.

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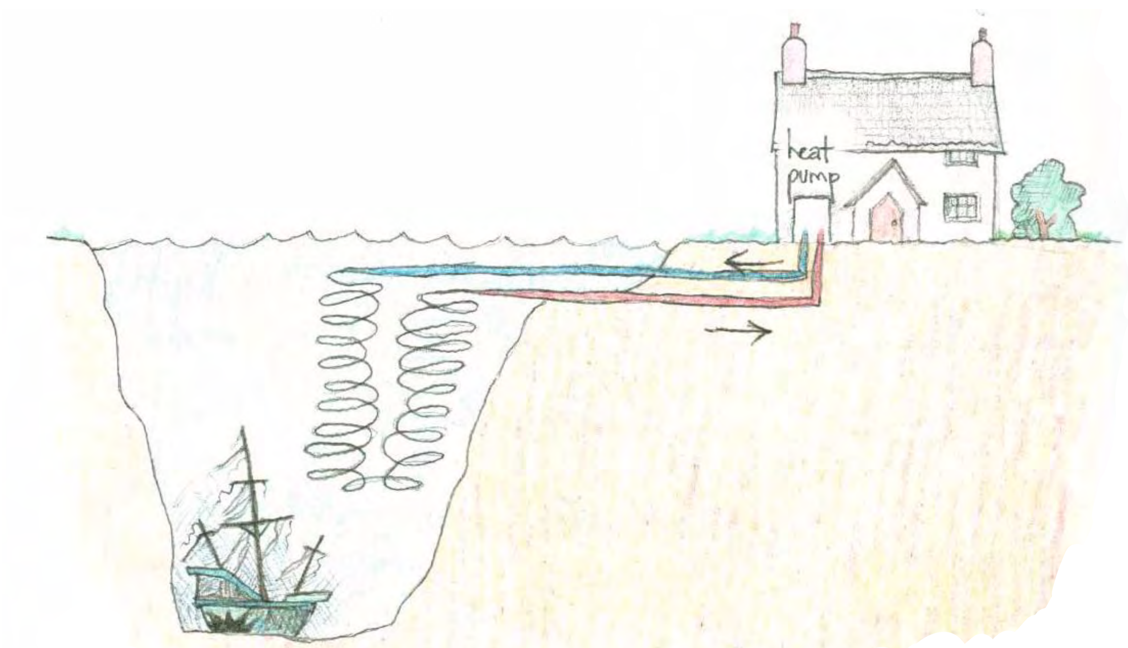
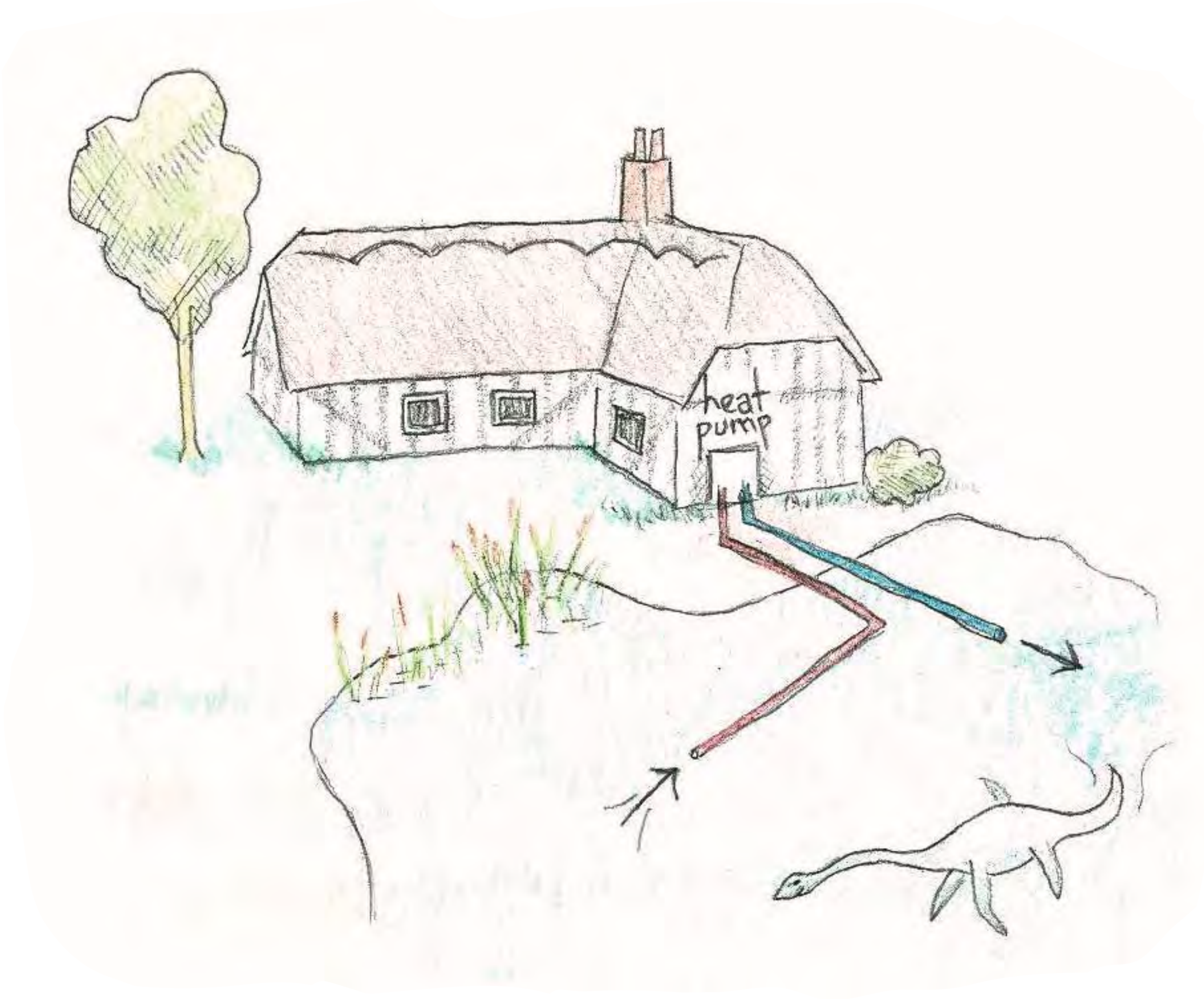


12-14 Closed-loop water-source heat pumps.

For an open-loop system, water is extracted from the source and passed through a heat pump and upgraded. The water is then pumped back to where it came from, but in another location, ensuring short-circuiting will not occur. Some type of filtration system will be required.

Closed-loop systems generally do not require a permit from the Environment Agency but where they are installed adjacent to, or in a watercourse, flood consent may be required. Owners do still remain liable for any adverse effects that may be caused by their system, such as whether a leak could cause pollutants to enter a water course. For open-loop systems, due to the potential harm that could be done to wildlife and the water course, an abstraction licence and discharge permit will be required from The Environment Agency. It is therefore advisably to follow the Environment Agency's good practice guidance.

The Chartered Institution of Building Services Engineers have produced a *Code of Practice CP2 Surface Water Source Heat Pumps: Code of Practice for the UK - Harnessing Energy from the Sea, Rivers, Canals and Lakes*, setting a minimum standard and best practise that should be followed.



15 Open-loop water-source heat pump.

< < Contents

3 Planning the Installation

The design and installation of a heat pump needs to be carefully considered so that its efficiency can be maximised, the impact of the installation minimised, and the largest possible savings achieved.

As there are several types of heat pump systems, the options can be reduced by determining what is possible in each particular building and location. This requires information about the building itself and how it is currently heated. For historic buildings, thought needs to be given to the impact of any installation on the historic fabric.

3.1 Impact on building fabric and landscape

A heat pump consists of the collector loop outside the building, and the heat distribution system inside the building, which are connected by pipes and cables. The installation (and potential later removal) of the system should be considered in its component parts.

Pipes will need to run between the heat source and the heat pump and a route through, under, over, or around the external wall will be needed that does not cause damage to historic fabric. Generally in ground- and water-source systems the pipework will enter the building below the ground level. For air-source heat pumps the pipework will normally be above the ground. Where possible, existing holes through the external wall should be used.

The visual impact of the heat pump system is an important part of the design. All parts of the system that are visible should be considered carefully: pipes, cables, conduit, trunking, grilles, louvres and radiators which should not impact negatively on the building.

There may be existing floor channels or voids in which the pipes can run. If they cannot be hidden, then using appropriate materials and good workmanship will be vital. The materials used will have an enormous impact on the end result, and on the overall suitability of the project. Permanent damage should be avoided: for example, cutting holes through joists, floors, walls or ceilings. Consider how the heat pump system will be removed without damaging the building.


16

With ground-source heat pumps the impact that the collector loop may have on the landscape also needs to be considered, including: archaeology, flora and fauna and existing services such as underground cables. Digging large trenches or bore holes can be messy, and will often require machines such as mechanical diggers to access the site.

The most appropriate heat source will depend on the geography and the geology of the site. The average level of the water table and the type of rock will affect the ground temperature, the rate at which heat can be drawn from the ground, and how easy it is to physically install. The British Geological Survey offers further information on these aspects on their website.

Before excavating, it is important to assess the possibility of buried archaeology on the site. If the building or grounds are listed or scheduled, the statutory description may cover this aspect of the site. In cases where there is known or suspected buried archaeology present, allowances should be made in the project to include for a Written Scheme of Investigation (WSI) for an archaeological watching brief in support of any planning application and the cost of an archaeologist being in attendance during any ground works.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16, 17 Ground trenches.

3.2 Consents

Work may need various consents.

The installation of a ground-source heat pump or a water-source heat pump on domestic premises is usually considered to be permitted development, not needing an application for planning permission. For non-domestic buildings, ground- or water-source heat pumps are also likely to be considered permitted development but will have important limits and conditions which must be met to benefit from the permitted development rights. Air-source heat pumps are also considered to be permitted development but have a list of limits and conditions which must all be met. You can find out more about permitted development rights by visiting the UK Planning Portal website.

If the building is a scheduled monument or within the area of a scheduled monument, then Scheduled Monument Consent will be required.

Installations of either a ground-, water- or air-source heat pump will have to comply with the Building Regulations.

The viability of different heat sources will depend mainly upon the site on which the building is located. If it is on or within a Scheduled Monument, Site of Special Scientific Interest (SSSI), Ramsar Site (wetland of international importance), Special Area of Conservation (SAC) or Special Protection Area (SPA), relevant permissions will need to be obtained.

The Environment Agency will need to be consulted for open-loop systems which will require permissions from them:

- groundwater investigation consent (if you are going to drill for a ground-source scheme)
- an abstraction licence (unless the volume of water abstracted is less than 20 cubic metres per day)
- an environmental permit to discharge the water (or a registered exemption from this requirement if you meet the criteria for a low-risk activity)
- an environmental permit for flood risk activities or ordinary watercourse consent (if you are carrying out works near a watercourse, flood defence or sea defence)

Information is available on the website for the Environment Agency.

3.3 The existing heating system

The existing heating system will probably produce heat by burning gas or oil, or by passing electricity through a heating element. Before any changes are made it is a good idea to assess the existing heating system. If the system is particularly old or unusual it may be important in its own right. The Chartered Institution of Building Services Engineers (CIBSE) Heritage Group has some useful information about older systems on their website. Alternatively you can contact Historic England who will be able to help with advising on the importance of the system.

If the building is listed, the listing protects everything and this may include the heating system, so listed building consent may be required.

With older systems, asbestos was used to insulate boilers and heating pipework. If it is possible that asbestos was used, then this must be assessed by a suitably qualified professional and a licensed contractor will be needed to remove and dispose of any asbestos.

Heat pumps operate more efficiently when the temperature of the distribution circuit is lower, because the heat pump has less work to do. This means that more, or larger, radiators might be needed to emit the same amount of heat to the room. Underfloor heating is usually efficient because it is effectively using the floor as a large low-temperature radiator. In many cases this can be difficult or impossible to retrofit so large radiators are the most common solution.

A heat pump is usually around the size of a domestic fridge freezer and will need to be located somewhere in the property, usually within the building. There may be a boiler house or utility room where it could be located.

The entire heating system may not need to be replaced when installing a heat pump. Existing distribution pipework and radiators, for example, can sometimes be re-used. If this is the case, the remaining life of these should be considered.

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18,19 Plant rooms with large heat pump installations.

3.4 Finding an installer

Installers can be found through the Microgeneration Certification Scheme (MCS). The Ground Source Heat Pump Association provides a list of members who comply with their code of practice, and this can be found on their website. However, neither of the schemes identify installers that have worked in historic buildings so when choosing an installer, it is important to ask questions about how they are going to carry out the installation:

- It should be possible to view examples of the installer's previous work, which will give you a good indication of whether they are the right company to match to your particular needs.

- Ask if they have worked on historic buildings in the past and whether they understand conservation issues and working in a sympathetic manner to avoid damage.

- Obtain a written quote for the project. Assume that if it is not specifically mentioned it is not being provided. Be sure you know exactly what is and what is not included to make it a fully operational system and to work optimally, particularly with the interface to any existing systems.

- Get as much detail as possible: where pipes are going to run, and how they will be fixed. Be sure you receive relevant drawings; for instance, of the ground array location and depth for ground-source systems, and in particular the location of any joints or manifolds which are areas of weakness where access may be required in the future.

- Consider a clause for a follow up visit two months after installation and ideally during the next heating season.

4 Heat Distribution Systems

There are many options when deciding how best to heat a building. Heat pumps work most efficiently with a low-temperature distribution circuit. This means that heating systems designed to work with low average temperatures (around 30°C), such as underfloor heating and warm-air heating, will be good methods of distributing the heat.

A new heating system may entail various alterations to the building. These can range from excavation or the penetration of walling to accommodate pipes to the displacement of pews to allow space for radiators in the case of churches and chapels. The impact and cost of these alterations should be assessed when considering the options for new heating.

It may be that an appropriate solution is to have a mixture of heat emitters within a building. For example, it is relatively common to have underfloor heating in some areas, with radiators in others. Some of the more common methods of heating are detailed in the following section.

4.1 Underfloor heating

This method of heat distribution turns the floor into a large radiator. Because the radiator is so big, the temperature can be much lower. Underfloor heating is ideally suited to heat pumps as these lower temperatures mean the heat pump can work much more efficiently and will achieve a higher SPF.

One or multiple loops of pipe containing low-temperature hot water are laid on the floor, with a layer of insulation underneath, and a cement or limecrete finish (known as a screed) is poured on top.

20 Underfloor heating plastic pipes before they are covered over with a layer of screed

The underfloor heating pipework loops can be made from steel, copper or plastic and are terminated into a ‘manifold’. The job of the manifold is to take the low-temperature hot water from the heat pump and distribute it through the underfloor heating loops. The manifold is fitted with actuators that control the flow and return of the low-temperature hot water to each of the heating pipework loops, depending on the amount of heat that is required for the heat space it is serving. The manifold will also be fitted with a means of isolating and draining the system down. It is important to maintain access to the heating manifold.

The entire contents of each space will need to be removed for the underfloor heating to be installed. Harder concrete screeds, impermeable insulation and damp-proof membranes will all stop the floor ‘breathing’ and could trap moisture, causing issues of damp in walls where previously there was none. More permeable screeds, such as some limecretes, will breathe.

Installing underfloor heating in a traditional building may be a disruptive process compared to other heating methods. The floor may need to be replaced in its entirety, or a new floor added above the existing. Changing the floor can alter the appearance and character of the spaces and impact upon archaeological remains. In such instances the importance of existing floor finishes and levels should be assessed to help understand the impact of the proposals.

The lifetime of the underfloor heating system is dependent upon the use of the space, and the quality of workmanship and materials. A good method of checking if the underfloor heating system is working is to carry out a thermographic survey. A thermal image will not only show the routes of the heating loops, but also the floor surface temperature and if there are any problems. It is a good idea to carry out the survey as close to when the system is commissioned so the contractor can rectify any problems. The maintenance required for an underfloor heating system is similar to that for a conventional radiator system.

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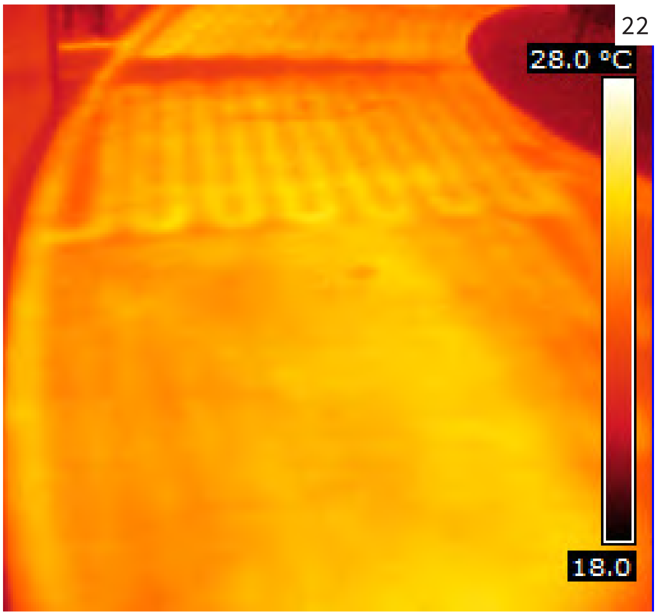

21 Underfloor heating manifold.

22 Underfloor heating thermographic survey.

4.2 Radiators

Conventional radiators are a good way of heating a traditional building as they are the most suited to maintaining the building at a constant temperature and can be adjusted as necessary. In buildings that have never had such a system, the installation of a radiant heating system may entail some difficulties in respect of its effect on the historic fabric or character of the building. In view of the advantages of this form of heating it should nevertheless be considered before others.

Radiators can be used with ground-source heat pumps. As mentioned before, the heat pumps' SPF will be higher when lower temperatures are used than would be conventionally used with a boiler installation. The effect of this is that more radiators could be needed: another solution would be to use larger radiators or alter the heating profile so you are heating for longer periods.

Some manufacturers are now supplying small domestic fan convector heaters especially for use with heat-pump systems. These increase the flow of air over the hot pipes so that lower temperatures and a smaller 'radiator' can be used.

4.3 Warm-air heating

Warm air heating can be through stand-alone heaters or through a central air-handling plant.

With a central air-handling system fitted with a heat pump, warmed air is distributed into the rooms through ductwork running within the building fabric, typically located under the floor or in ceiling cavities. This type of system would be more typical in larger buildings. With this type of system it may require the creation of a substantial opening within the external walls of the building to accommodate the air intake. If there are no ducts or grilles already within the walls, then it might be difficult to install this form of heating without causing irreparable damage to the building.

More commonly found are stand-alone heaters which take air from within the building, heat it and blow the warmed air around the building

If there are many gaps and cracks in the building through which air can escape, heating of this kind will often not be the most efficient method.

Hot-air systems can be noisy in operation and crude in appearance. Although they can be used to maintain a steady low temperature, in practice such systems are generally used to heat the building rapidly for short periods and are not compatible with traditional construction.

4.4 Water heating

A heat pump can also be used for providing domestic hot water – the water we use for washing and bathing. The water heated by the heat pump is transferred to a hot water cylinder, much the same as with a conventional indirect hot water system. The hot water cylinder will have additional heat supplied by electric single or twin heat-exchanger coils inside the cylinder for backup.

Due to the higher temperature required to generate hot water, the output temperature has to be as hot as possible. With all heat pumps, the higher the output temperature, the lower the efficiency. Domestic hot water is stored and used at 55°C – as opposed to the 40°C of a heating system – so a heat pump performs less when used to provide hot water.

5 Maintenance and Working Life

It is important that heat pump systems are properly maintained to ensure that they continue to operate efficiently and that there are no environmental impacts or health and safety risks.

A heat-pump unit is very similar to a refrigerator: very little maintenance is needed. As part of the handover process when your heat pump has been commissioned, the installer should advise you about the maintenance requirements and maintenance services available for your heat pump.

It is suggested that checks are performed every year before the beginning of the heating season. Manufacturers' guidance should be followed on the frequency and expertise needed to perform these checks; the guarantee is often dependent upon this.

As well as designers and installers being MCS-certified, any maintenance work undertaken on heat pumps should be done by certified persons. The main legislation, called the 'F-Gas regulations', regards the refrigerant within the heat pump unit. This is a controlled substance due to its global warming potential and must be handled by an approved person.

Some typical components in a heat pump system are shown in the following table. The figures indicating the life of the system are taken from the Chartered Institution of Building Services Engineers' *GVM/14 CIBSE Guide M: Maintenance Engineering and Management*. The guide provides a table of indicative life of components if correctly maintained.

Location	Component	Expected lifetime (in years)	Maintenance
Collectors (source)	Air intake	10	Check clean of leaves and vegetation Ensure the fan sounds smooth
	Air extract	10	Remove any blockages Check for signs of corrosion
	Open-loop pipes	10	Check for blockages
	Open-loop system pump	10	Ensure pump is running smoothly Visual check where possible
	Ground array	30	Engineer to perform every 5 years
Heat pump	Valves (motorised)	15	Check not seized
	Electric controls	20	Visual check where possible
	Pipes (plastic)	35	Visual check where possible
	Compressor	20	Sealed unit
	Circulating pump (commercial)	20	Listen to sound to ensure smooth operation Visual check where possible
	Pipe connections	35	Visual check where possible
	Refrigerant pipework system	35	Approved persons to work on systems to which F-Gas regulations apply
Emitters	Circulating pumps (domestic)	10	Listen for noise Visual check where possible
	Calorifier (copper)	25	Visual check where possible
	Radiators (steel)	20	Visual check where possible
	Underfloor heating (concrete-encased plastic pipes)	35	Visual check where possible
	Heating pipework system (copper)	45	Visual check where possible
	Heating pipework system (plastic)	35	Visual check where possible
Traditional systems	Domestic condensing boiler	15	N/A
	Oil storage tank	30	N/A
	Flue	15	N/A

6 Incentive Schemes

The Renewable Heat Incentive (RHI) is a UK Government scheme set up to encourage uptake of renewable heat technologies amongst householders, communities and businesses through financial incentives. Ground-to-water heat pumps, air-to-water heat pumps and water-source heat pumps can claim RHI support. The eligibility requirements and rules of the scheme are on Ofgem's website:
www.ofgem.gov.uk/environmental-programmes/domestic-rhi
www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi

7 Glossary

Air conditioning Altering the properties of air to fall within specific limits of relative humidity, temperature, cleanliness and freshness.

Air source Heat is taken from the outside air before being concentrated in the heat pump.

Aquifer Water underground that maintains a fairly constant temperature.

Closed loop A loop of pipes through which a liquid is pumped. These can be located within the ground or a body of water.

Coefficient of performance (COP) A measure of the efficiency of a heat pump.

$$\text{COP} = \frac{\text{Thermal Heat Output (kW)}}{\text{Electrical Power Input (kW)}}$$

Collector The coil or section of pipe within the heat source that 'collects' the heat.

Conduit/trunking Enclosed, mechanically protected channels or pipes, either galvanised, painted or enamelled.

Ground loop A loop of pipes buried under the ground through which a liquid is pumped.

Ground source Heat is taken from the ground before being concentrated in the heat pump.

Heat distribution The network of pipes or ducts through a property.

Heat exchanger This is designed to exchange heat between two fluids without them coming into contact with one another.

Heat pump The part of the system that converts the heat from low-grade to high-grade heat. This will house the compressor, condenser, expansion valve and evaporator.

Heat pump system All parts of the heat pump including the collector, the heat pump itself and the heat sink.

Heat sink The part of the heat pump system inside the building that heats the spaces. This will typically be radiators, underfloor heating or air heating.

Heat source The place the heat is collected from. This will either be the ground, air or water.

Heating manifold A larger pipe where smaller pipes terminate into. Usually wall hung.

Horizontal loop A horizontal pipe network running in trenches at a minimum depth of 1.2m. Heat is collected from the ground by this pipe network.

Microgeneration Certification Scheme (MCS) A scheme to accredit installers and designers of heat pump systems to prove they are competent.

Seasonal Performance Factor A measure of the operating performance of an electric heat pump heating system over a year.

$$\text{SPF} = \frac{\text{Total Heat Energy Output per annum (kWh)}}{\text{Total Input Electricity per annum (kWh)}}$$

Short circuiting In an open loop system, the abstracted and re-injected water mix lowing the efficiency of the heat pump.

Upgrading This is concentrating the heat energy that has been gathered from the source using the vapour compression cycle within the heat pump, raising the temperature.

Vapour compression cycle The physical process of upgrading the heat from lower temperatures to higher. Compressor, condenser, evaporator, expansion valve – Components supporting physical processes in the vapour-compression cycle.

Water source Heat is taken from a lake, river, stream or the sea, before being concentrated in the heat pump.

8 Where to Get Advice

8.1 Historic England guidance

This guidance forms part of a series of five documents which are listed below, providing advice on the principles, risks, materials and methods for generating energy from the sun, wind, water or even from the heat of the ground.

This series forms part of a wider comprehensive suite of guidance providing good practice advice on lower carbon forms of energy supply, their application and likely impact on older buildings.

The complete series of guidance is available to download from the Historic England website:

HistoricEngland.org.uk/advice/planning/infrastructure/renewable-energy/microgeneration/

- Small-scale solar thermal energy and traditional buildings
- Small Scale Solar Electric (Photovoltaics) and Traditional Buildings
- Micro-Hydroelectric Power and the Historic Environment
- Micro wind generation and traditional buildings

For information on consents and regulations for energy improvement work see the Historic England website: HistoricEngland.org.uk/advice/your-home/saving-energy/consent-regulations/

8.2 Contact Historic England

East Midlands
2nd Floor, Windsor House
Cliftonville
Northampton NN1 5BE
Tel: 01604 735460
Email: eastmidlands@HistoricEngland.org.uk

East of England
Brooklands
24 Brooklands Avenue
Cambridge CB2 8BU
Tel: 01223 582749
Email: eastofengland@HistoricEngland.org.uk

Fort Cumberland
Fort Cumberland Road
Eastney
Portsmouth PO4 9LD
Tel: 023 9285 6704
Email: fort.cumberland@HistoricEngland.org.uk

London
1 Waterhouse Square
138-142 Holborn
London EC1N 2ST
Tel: 020 7973 3700
Email: london@HistoricEngland.org.uk

North East
Bessie Surtees House
41-44 Sandhill
Newcastle Upon Tyne NE1 3JF
Tel: 0191 269 1255
Email: northeast@HistoricEngland.org.uk

North West
3rd Floor, Canada House
3 Chepstow Street
Manchester M1 5FW
Tel: 0161 242 1416
Email: northwest@HistoricEngland.org.uk

South East
Eastgate Court
195-205 High Street
Guildford GU1 3EH
Tel: 01483 252020
Email: southeast@HistoricEngland.org.uk

South West
29 Queen Square
Bristol BS1 4ND
Tel: 0117 975 1308
Email: southwest@HistoricEngland.org.uk

Swindon
The Engine House
Fire Fly Avenue
Swindon SN2 2EH
Tel: 01793 445050
Email: swindon@HistoricEngland.org.uk

West Midlands
The Axis
10 Holliday Street
Birmingham B1 1TG
Tel: 0121 625 6870
Email: westmidlands@HistoricEngland.org.uk

Yorkshire
37 Tanner Row
York YO1 6WP
Tel: 01904 601948
Email: yorkshire@HistoricEngland.org.uk

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