

Renewables Factsheet #3

# HEAT PUMPS



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Cheshire West  
and Chester



## OVERVIEW

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Heat pumps extract energy from a natural source such as the ground, water or air to provide space and water heating. The operation of a heat pump is similar to that of a refrigerator. For ground and water systems, water or a water/antifreeze mixture is circulated through the heat source to a heat exchanger, where its heat is passed to a “refrigerant”.

Direct circulation of the refrigerant is avoided for financial and environmental reasons. The refrigerant is compressed which raises its temperature to 30-40°C. It is then pumped through a second heat exchanger, where heat is passed to the water or air used for space and water heating in the building. The refrigerant then passes through an expansion valve, cooling it further so that it can accept more heat from the source in a second cycle.

A heat pump uses electricity to power the pump and compressor. However, the heat produced is greater than the electricity consumed. The performance of a heat pump is indicated by the Coefficient of Performance (CoP). This is the ratio of the heat produced for every unit of electricity consumed. Typical CoPs for domestic systems are between 1.5 and 3.5.

Ground Source Heat Pumps (GSHP) use residual heat in the ground where, at a few metres below the ground surface, the heat is approximately constant all year round. The heat extraction pipes may be laid horizontally in trenches or vertically in wells drilled from the surface.

A vertical well enables the pipe to reach the depth of the earth where the temperature is higher than at nearer the surface but it is more expensive to drill a well than to dig a trench. However, a trench requires more land surface than a well. Thus the choice is likely to depend on both the ground area available and financial considerations.

Water Source Heat Pump (WSHP) heat extraction pipes are sunk in lakes or where there is flowing water beneath the surface (aquifer). Alternatively the system may be open, where the water is pumped directly to the heat exchanger. The deeper the water, the more constant the temperature will be throughout the year but the possibility of freezing during very cold conditions must be considered.

Air Source Heat Pumps (ASHP) may be ground or wall mounted outside buildings and extract heat from the air directly through the heat exchanger. Some designs can operate at air temperatures as low as  $-20^{\circ}\text{C}$ .

A heat pump can be used to heat radiators or it can be used with an underfloor heating system. However radiators will need to be oversized in order to provide a larger surface area because the temperature of the circulating water ( $30\text{--}40^{\circ}\text{C}$ ) is normally lower than that of a normal boiler based systems ( $60\text{--}80^{\circ}\text{C}$ ).

Underfloor systems tend to perform better due to their large surface area. Air source heat pumps may be used as an air to air system, in which the heat exchanger provides warm air rather than water to heat a room. Although heat pumps may be used to provide hot water, auxiliary heating will be required to raise the temperature to  $60^{\circ}\text{C}$ , eliminating the possibility of micro-organism growth.



## SUITABILITY FOR HEAT PUMPS

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Heat pumps are normally recommended where there is no gas network as they are less cost efficient than a gas boiler because of the relative prices of natural gas and electricity. This may, of course be offset by incorporation of renewable electricity generation such as solar photovoltaics.

GSHP is suitable wherever there is enough land to dig trenches or wells for the laying of pipes, usually in rural areas.

WSHP have similar space requirements to horizontal GSHP. Seasonal variations in water temperature may render them less efficient.

ASHP are cheaper to install than GSHP or WSHP and require less space but have a worse seasonal performance factor due to the rapid fall off as the ambient air temperature drops.

As a result of the lower circulating water temperature, heat pumps are best installed in new buildings to avoid expensive retrofitting of oversized radiators or underfloor heating systems.

## SCALE AND TYPE OF DEVELOPMENT

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GSHP systems come in varying sizes. Typical ground areas required for trench systems are 100-200m<sup>2</sup> for a 3 bedroom semi-detached house to 200-350m<sup>2</sup> for a 4-5 bedroom detached house.

## TYPICAL INSTALLATION AND COSTS

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<b>Technology</b>	<b>Installation Size (kW)</b>	<b>Cost (£)</b>
Ground source heat pump	12 kW	8,500
Ground source heat pump	16 kW	10,500
Water source heat pump	16 kW	10,500
Air source heat pump	12 kW	8,000

# ACHIEVABLE ENERGY PRODUCTION, CO<sub>2</sub> SAVINGS, AND FINANCIAL SAVINGS

The achievable energy production from a heat pump depends on the size of the system and the Coefficient of Performance. Also, the installation of the system is a factor in the performance of the system. For example, a system using underfloor heating is more efficient than a system using radiators.

Financial savings depend on the type of fuel being replaced.

The table below shows typical efficiencies from a field trial of a GSHP and have been modelled on replacing the heating system in a 3 bed semi detached home.

## GSHP

Savings from a typical performing system of CoP of 2.5

Savings from a good performing system of CoP of 3.0

<b>Gas</b>	£/yr	-£40	£70
	kgCO <sub>2</sub> /yr	280	750
<b>Electric</b>	£/yr	£420	£530
	kgCO <sub>2</sub> /yr	4,985	5,455
<b>Oil</b>	£/yr	£50	£160
	kgCO <sub>2</sub> /yr	1,085	1,560
<b>Solid</b>	£/yr	£260	370
	kgCO <sub>2</sub> /yr	4,860	5,330

# PLANNING

Heat Pumps are one of the technologies that have been granted Permitted Development Rights and thus planning permission is generally not required for their installation. However, a few other factors need to be considered in planning for a GSHP. These include:

- a. Land availability: there has to be enough land where a trench or a well can be drilled. A trench requires more land than a well, so in relatively tight situations where land is a premium, a well can still be drilled.
- b. The Geology: In addition to the availability of land, the geology has to support either a trench or a well and some soil types have poorer heat capacity.
- c. Water source heat pumps may require permission from councils and relevant water control authorities.
- d. Air source heat pumps, especially if mounted on buildings, may require permission in Conservation Areas or on listed buildings.



## SOURCES OF FURTHER INFORMATION AND ADVICE

The following websites provide further information and advice on air, water and ground source heat pumps:

**a. Energy Saving Trust:**

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Ground-source-heat-pumps>

**b. Energy Saving Trust:**

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Air-source-heat-pumps>

**c. Direct.gov.uk:**

[http://www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/Renewableandlowcarbonenergy/DG\\_197029](http://www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/Renewableandlowcarbonenergy/DG_197029)

**d. Department for Energy and Climate Change:**

[http://www.decc.gov.uk/en/content/cms/what\\_we\\_do/uk\\_supply/energy\\_mix/renewable/explained/microgen/gshps/gshps.aspx](http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/explained/microgen/gshps/gshps.aspx)

**e. Energy Saving Trust:**

<http://www.energysavingtrust.org.uk/Generate-your-own-energy/Getting-planning-permission>

**f. The Microgeneration Certification Scheme:**

<http://www.microgenerationcertification.org/mcs-consumer/installer-search.php>

**g. Local Government Improvement and Development:**

<http://www.idea.gov.uk/idk/core/page.do?pagelid=23051802>

# PLANNING CONSIDERATIONS

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## Permitted Development Considerations

Permitted development rights for domestic properties include the installation of small scale (less than 50kw of electricity or less than 45kw of heat) ground and Water Source Heat Pumps, subject to certain conditions. The changes cover installation on a dwelling house and in gardens. Air Source Heat Pumps will be included once new standards and safeguards on noise pollution have come into effect.

Ground Source Heat Pumps will be required to comply with Building Regulations; it is advisable to contact an engineer who can provide the necessary advice. Open loop ground source heat pump systems may require a licence from the Environment Agency (usually require a license to Investigate Groundwater, an Abstraction Licence and an environmental permit to discharge water), for advice please see:

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### **The Environment Agency: Ground Source Heat Pump Advice Note:**

[www.environment-agency.gov.uk/static/documents/Research/\\_21\\_GSHPs\\_mitigation\\_final\\_Nov2010.pdf](http://www.environment-agency.gov.uk/static/documents/Research/_21_GSHPs_mitigation_final_Nov2010.pdf)

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### **The NetRegs website:**

<http://www.environment-agency.gov.uk/netregs/118839.aspx>

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### **Environment Agency, Climate Change Team:**

08708 506 506 or  
[enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk)

Water Source Heat Pumps will be required to comply with Building Regulations; it is advisable to contact an engineer who can provide the necessary advice. Water Source Heat Pumps may require an extraction license from the Environment Agency (unusually require an Abstraction License and an environmental permit to discharge water), for further advice please contact:

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### **Environment Agency, Climate Change Team:**

08708 506 506 or

[enquiries@environment-agency.gov.uk](mailto:enquiries@environment-agency.gov.uk)

Air Source Heat Pumps will require planning permission and must comply with Building Regulations; it is advisable to contact an engineer who can provide the necessary advice. The main planning considerations relating to Air Source Heat Pumps are the visual and noise impact of any proposal.

As yet the permitted development rights regarding ground and water heat pumps has not been extended to non-domestic development, although these changes have been the subject of consultation and may be made in the future. Air Source Heat Pumps may also be included within these future changes, subject to the development of new standards and safeguards on noise pollution coming into effect.



Advice should always be sought from your local planning authority if you are unsure whether your development falls under permitted development rights. Your local planning authority will be able to advise you on the need to obtain planning permission.

If you want certainty that your renewable energy proposal is considered permissible (in that you do not need to make a planning application) you should apply for a Lawful Development Certificate (LDC).

### **Development Management and Planning Policy Considerations**

If planning permission is required for a Ground or Water Source Heat Pump the main planning consideration is likely to be the impact of the scheme on the surrounding area. They will also be subject to limitations/conditions, principally relating to the area of piping and (for ground source heat pumps) area of excavation.

If planning permission is required for an Air Source Heat Pump the main planning consideration is likely to be the noise impact of the unit, which will need to be considered through the submission of noise information as part of a planning application (a unit should not be louder than 45dB). Other considerations are the nature of the unit (certified through the Microgeneration Certification Scheme); and their visual impact on the building, the area where it is located and on neighbourhood amenity.

Proposals are likely to be assessed on the location of the unit; its dimensions; how well it relates to the character of a building and its surrounding area, with the potential proliferation of visual clutter on roofscapes and in street scenes being an associated issue.

Your local planning authority will be able to assist you in identifying the issues and planning policies that will be need to be taken into account for a particular proposal. Advice should always be sought from your Local Planning Authority before submitting an application.

## Conservation Area or Listed Building Considerations

Visual impact is a particular consideration within Conservation Areas and on listed buildings.

On Listed buildings, an Air Source Heat Pump would be assessed against the extent to which it would interfere with the appearance, structure, design or character of a listed building. When this would have a negative effect on a listed building's special interest, a proposal would not be allowed.

It is more than likely that listed building consent will also be required when proposing development which could affect a listed building. This is in addition and separate to the granting of planning permission, but similarly seeks to ensure that any alterations to a listed building, whether internal or external, do not alter the special interest of the building.

Particular care needs to be taken in Conservation Areas, where units will not be acceptable if visible on prominent roofs, when viewed from the street or other public vantage points. Their acceptability on less prominent roofs may depend upon their size. In terms of visual impact, placing Air Source Heat Pumps on side or rear pitched roof slopes, concealed valley roofs and on flat roofs hidden by parapets is less likely to affect the appearance of the property and character of the area (including Conservation Areas).

Advice should always be sought from your Local Planning Authority before submitting an application, if you think it could affect a listed building or Conservation Area.

In addition to listed buildings and Conservation Areas, the development of air, ground and water source heat pumps could affect scheduled monuments, historic parks and gardens, historic battlefields and World Heritage Sites. There will be other considerations to take into account when proposing development within or in the vicinity of these sites and areas. Local designations may also apply to specific sites and buildings.

Advice should always be sought from your Local Planning Authority before submitting an application.



# PLANNING APPLICATION REQUIREMENTS

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When planning permission is required, the following information will normally be required in support of a planning application. Guidance on how to make a planning application can be obtained from the Planning Portal website at:

<http://www.planningportal.gov.uk/planning/applications/howtoapply>

National requirements for all planning applications will apply to any proposal. These can be found at:

<http://www.communities.gov.uk/publications/planningandbuilding/validationguidance>

Alternatively, this information can usually be obtained from your local planning authority, along with details of the application fee that will apply. It is recommended that you contact your local planning authority for further advice before submitting an application.

Local planning authorities can also set out local requirements for the information that will be required in support of a planning application, but in most cases it is likely that the following information would be needed to support an application:

- Design and Access Statement
- Visual Assessment
- Noise Impact Assessment
- Conservation Statement and Heritage Impact Assessment
- Energy Statement

Please note that this is not an exhaustive list and additional information may be required to assess an application depending on the characteristics of a site. It is likely that additional information would also be required to support larger scale schemes.

It is recommended that you contact your local planning authority for further advice before submitting an application.

When it is believed that equipment is permitted development and considered permissible (in that you do not need to make a planning application) you should apply for a Lawful Development Certificate (LDC). The fee for LDC applications relating to proposed development is half of that payable for a planning application. Further information on LDCs can be found at:

<http://www.planningportal.gov.uk/planning/applications/howtoapply>

or alternatively you should contact your local planning authority.

# BUILDING CONTROL REQUIREMENTS

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If you wish to install grounds, water or Air Source Heat Pumps Building Regulations will normally apply. Building Regulations also apply to other aspects of the work such as electrical installation. It is advisable to contact your Local Authority Building Control Section or an installer who can provide the necessary advice.

It is recommended that you contact your local authority Building Control section for further advice when considering a particular proposal.

FURTHER INFORMATION ON PLANNING  
REQUIREMENTS WILL BE AVAILABLE FROM  
YOUR LOCAL COUNCIL.

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## CHESHIRE EAST COUNCIL

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Development Management

**T:** 0300 123 5014

**E:** [planning@cheshireeast.gov.uk](mailto:planning@cheshireeast.gov.uk)

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## CHESHIRE WEST AND CHESTER COUNCIL

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Development Management

**T:** 0300 123 7027

**E:** [planning@cheshirewestandchester.gov.uk](mailto:planning@cheshirewestandchester.gov.uk)

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## WARRINGTON BOROUGH COUNCIL

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Development Management

**T:** 01925 442819

**E:** [devcontrol@warrington.gov.uk](mailto:devcontrol@warrington.gov.uk)

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