



How do heat pumps work?

A heat pump is an electrically powered device that uses the earth's natural storage of solar heat and moves this to provide heating, hot water (or cooling) for buildings. A heat pump can extract heat from air, water or the ground. The technology and components in a heat pump are similar to a refrigerator.

In a ground source heat pump system there are three independent circuits: the ground loop, the refrigerant and the building's heat distribution system. They are connected via two heat exchangers within the heat pump which transfers the low grade heat from the ground into useable heat to heat the building.

Is it renewable energy?

Yes; heat pumps partly use solar heat which is renewable and free. Solar heat will not run out or increase in price.

Is heat pump technology new?

No! The technology can be traced back to the Cornish inventor Richard Trevithick during the Industrial Revolution at the beginning of the 19th Century. Lord Kelvin whose name is synonymous with the absolute zero temperature scale further developed heat exchangers in the middle of the 19th Century.

The technology is well proven and established; there are over 1 million worldwide heat pump installations, the majority in America, followed by continental Europe. One of the reasons it has been slower to grow in the UK is because of relatively cheap natural gas for the last few decades. Gas and oil are running out and getting more expensive.

So heat pumps are not new and refrigerator principles upon which heat pumps are based are even more established.

Are heat pumps efficient?

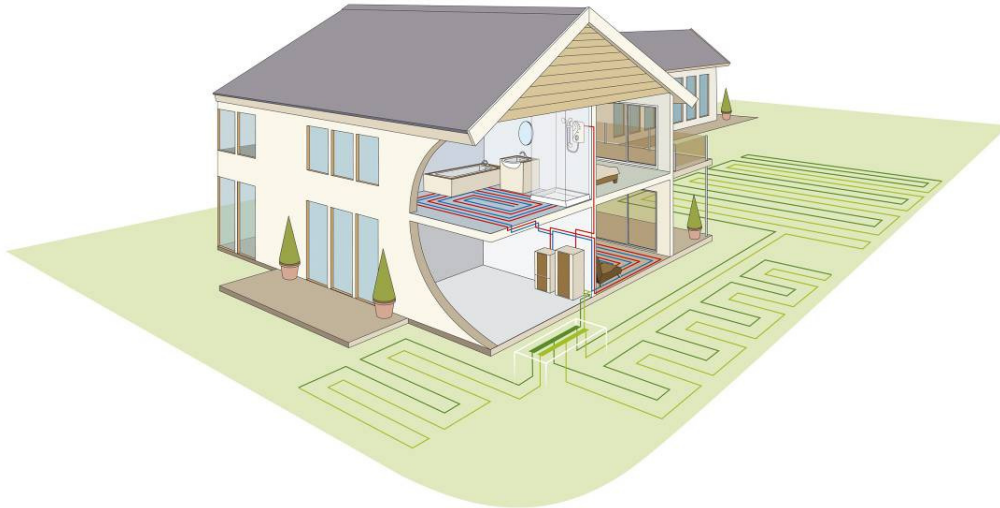
Yes, heat pumps are the most efficient type of heating appliance. The energy equation is crucial to understanding the benefit of heat pumps. Only a small amount of electricity is required to run the compressor and pump: because of the use of natural latent heat, the energy output is typically 400% of the input. The comparison is a gas or oil fired boiler which has an energy output of 90% of the input, a ratio which worsens with age on a gas or oil boiler. These factors become very significant when comparing running costs and CO₂ emissions of heating systems.

GROUND LOOPS

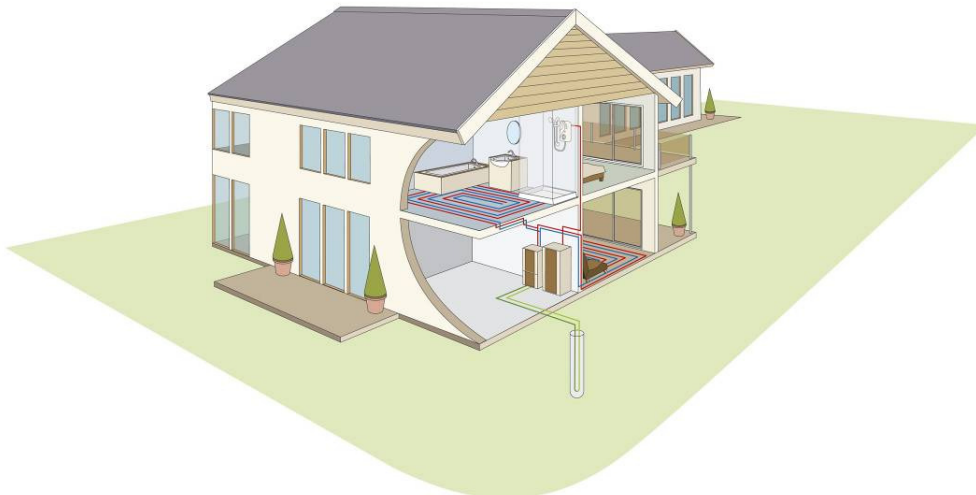
What are the types of ground loop?

A closed loop ground source heat pump system can have the ground loop pipes installed in 3 main ways:

- Horizontal ground collectors consisting of plastic pipe installed just over a metre below the surface, for example under a garden.



- Vertical boreholes. 150mm wide boreholes can be drilled at depths of up to 150 metres and loops of pipe are inserted in each borehole which is then filled and sealed with a thermally enhanced grout.



- Pond loops: coils of pipe can be laid near the bottom of a pond or lake and heat extracted from the water

A further type of system is called open loop where ground water is abstracted usually from an aquifer and passed through the heat pump before being returned to the ground. This system is usually confined to larger commercial buildings.

GROUND LOOPS (continued)

What ground loop system should I chose?

This usually depends on land availability. If sufficient space is available, horizontal ground collectors are normally selected, because the installation cost is substantially cheaper than drilled boreholes. We will assist you in this selection process.

How much ground space is needed?

This depends on the size of the property to be heated. A modern well insulated property of say 200m² floor area would require trenches with a total length of around 100 metres, which would normally be subdivided into 3 or 4 individual trenches. Boreholes take up much less space but each hole needs to be 7 metres apart. A typical domestic property would require 2 or 3 boreholes.

Do the ground works make a mess?

Yes, as with most building works, excavation or drilling is an intrusive operation. However, once completed there is nothing to see, as all the ground loops are buried. There are no unsightly storage tanks, flues or chimneys that may be required with other heating systems.



How deep do you have to go to get ground source heat?

Not very far at all. Heat pumps use solar heat which is stored on and just below the surface. Ground source heat pumps do not use geothermal or hot rocks heat from the centre of the earth.

GROUND LOOPS (continued)

Can existing water wells be used?

This may be possible and it would be a type of open loop system. It would depend on a number of factors including the flow rate available from the well. Such a scheme may require an additional bore hole being drilled to act as a re-injection hole to dispose of the water after it had passed through the heat pump. Such a scheme is likely to require Environment Agency approval.

How much are closed loop bore holes?

The cost will vary depending on the number required and the geology of the site. For a 200m² new build house, the use of boreholes could add £10,000 - £12,000 to the installation price compared with using horizontal collectors.

What are the trench dimensions for horizontal ground collectors?

There is more than one way of using horizontal ground collectors. If trenches are selected these are normally 1,200mm wide x 1,200mm deep and up to 50 metres long

What temperature is obtained from the ground?

Below 10 metres the ground temperature is relatively constant all year round at 10°C. Closer to the surface there is more fluctuation. A typical closed loop system will take about 5°C of heat in total from the ground. Expressed another way the water entering the heat pump will be 5°C warmer than the water returning to the ground loop. The ground is then recharged like a solar battery by the sun or by the flow of ground water.



HEATING SYSTEM

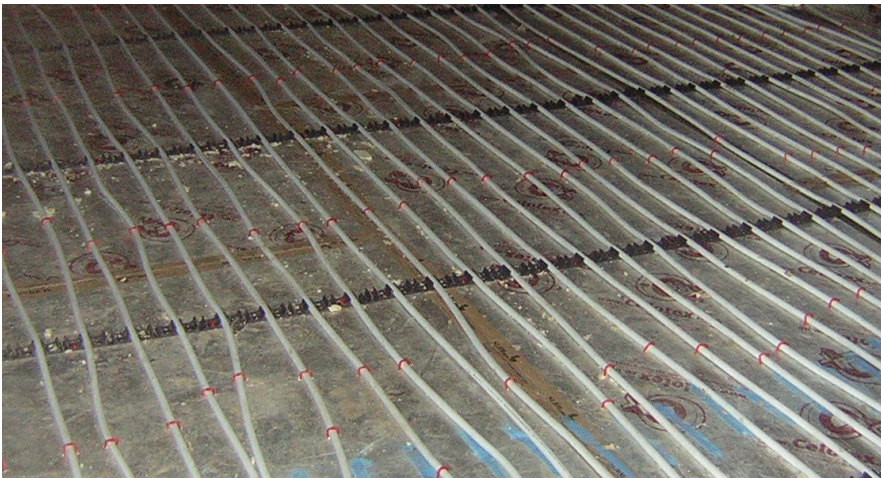
What type of heating system can heat pumps link to?

A heat pump provides low temperature hot water and thus needs a water based heat distribution system. This can be underfloor heating or radiators. In commercial buildings or where active cooling is required the heat pump can service fan coiled units or chilled beams.

Underfloor heating or radiators?

Underfloor heating is preferred:

- Lower flow temperatures than radiators
- Lower running costs & thus more environmentally friendly
- More comfortable heat (warm feet, cool head!)
- More hygienic: the radiant heat from underfloor heating produces less air and therefore dust circulation than convection heat from radiators
- Frees up wall space



However heat pumps work fine with correctly sized radiators and pipework.

HEATING SYSTEM (continued)

Can a heat pump be used in conjunction with an oil or gas boiler?

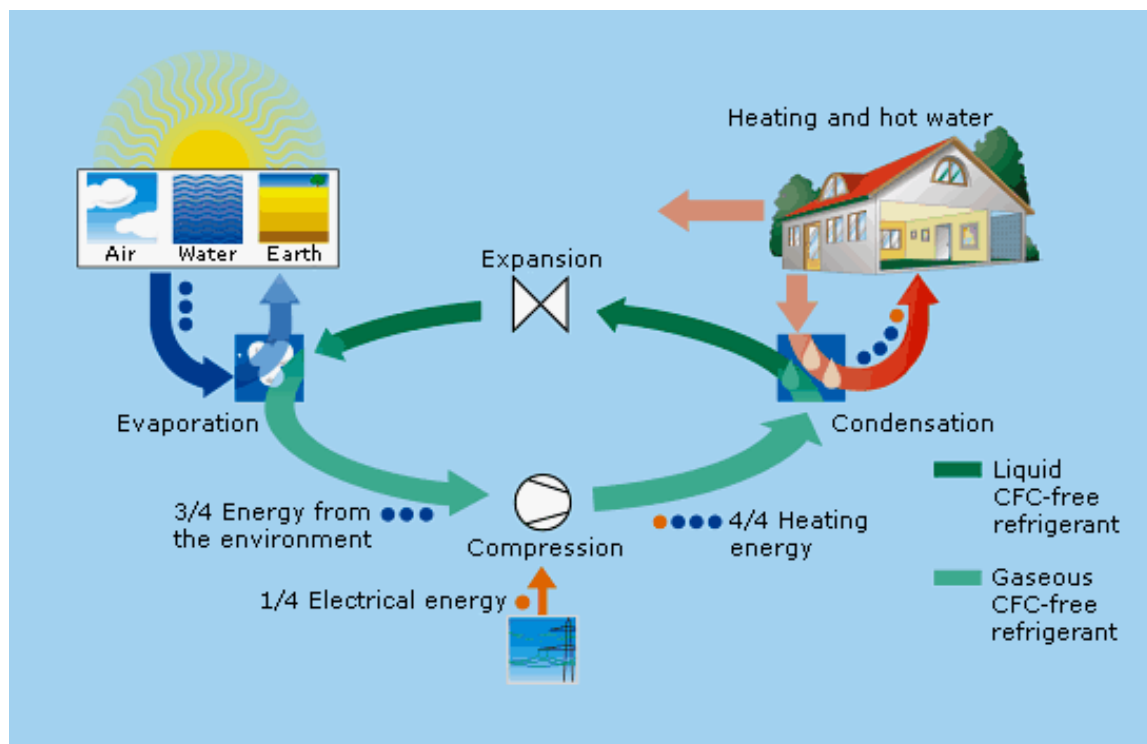
This is possible. However in most circumstances a heat pump is used instead of an oil or gas boiler.

Can a heat pump be powered by a wind turbine or photovoltaic cells?

Not directly. A heat pump needs a robust and reliable electrical supply. Both wind turbines and photovoltaic would generate electricity to help power the heat pump. Geowarmth can supply photovoltaic panels as well as the heat pump.

Can solar thermal provide my heating?

Not fully, but it can contribute to it. This technology is usually confined to domestic hot water heating only. However Geowarmth have a system for integrating a heat pump with solar thermal so that that the solar panels provide heat for both space heating and domestic hot water. Please ask for our separate solar thermal fact sheet. A heat pump can do both heating and domestic hot water.



COSTS

How much does it cost?

Pricing depends on a number of factors including the size of the property, size of heat pump and type of ground collector. A budget figure for installing a ground source heat pump with horizontal ground collectors for an average sized new build domestic property would be £60 per square metre of floor area of the property, plus VAT. It can be more or less, so please ask for an accurate site specific quotation.

What are the running costs of a heat pump?

A ground source heat pump is the cheapest form of space heating. To heat a well insulated 200m² new build property by a heat pump via underfloor heating including an off peak electricity tariff would use around £500 of electricity per annum. Natural gas could be nearly double this cost; oil or LPG around 3 times the price.

Fossil fuel boilers require an annual service which would be a further cost. A heat pump has no such requirement.

The performance of microgeneration heat pump systems is impossible to predict with certainty due to the variability of the climate and its subsequent effect on both heat supply and demand. This data above is given as guidance only and should not be considered as a guarantee.

What grants are available?

There are currently no nationally available grants for installing renewable energy systems in domestic properties in England and Wales. Domestic grants are available in Scotland. The maximum domestic grant is £4,000 in Scotland for a heat pump.

There are various regional grants and particular schemes for not for profit organizations of up to 50% grants. Please ask for our separate grants fact sheet.

Geowarmth are accredited installers; this is important in order for clients to be able to obtain a grant.

How much electricity do heat pumps use?

A heat pump with an output of say 12kW in a modern well insulated house would use around 3kW of electricity when connected to an underfloor heating system.

RENEWABLE HEAT INCENTIVE

What is this?

The UK has a target of 15% of our overall energy consumption to come from renewable sources by 2020. The Renewable Heat Incentive (RHI) will provide a clean energy cash-back for renewable heat provided by technologies including heat pumps and solar panels. It is expected to commence in April 2011 and applies to installations completed after July 2009.

Who gets it?

The owner of the renewable heating equipment.

How long for?

Ground source heat pump owners will receive the annual payment for 23 years (20 years if the heat pump is larger than 45kW); air source heat pump owners for 18 years.

How much?

The calculation will be based on anticipated kilowatt hour run time of the heat pump each year. For ground source schemes up to 45kW the payment is expected to be 7p per kilowatt hour. For a 9kW ground source heat pump (200m² well insulated new build) the payment would be around £1250. For a 16kW ground source heat pump (350m² well insulated new build) the payment would be around £2,200.

Air source heat pump payments (schemes up to 45kW) are expected to be 7.5p per kilowatt hour. Example payments for the same sizes of air source heat pump would be around £1,350 and £2,400.

Are there any catches?

Yes – both the heat pump and the installer must be accredited under the Microgeneration Certification Scheme (MCS). Geowarmth are accredited as are the heat pumps we install. The RHI is not yet finalised. The above information is based on proposals.



MICROGENERATION CERTIFICATION SCHEME

What is this?

The Microgeneration Certification Scheme (MCS) is an independent certification body accredited by the United Kingdom Accreditation Service (UKAS). The MCS assesses installation companies and products against robust standards. It provides assurances as to the quality, durability and energy generation performance of microgeneration products, and guarantees to consumers on the quality of installations. In addition, the MCS provides a level of consumer protection that meets the requirements of the Office of Fair Trading.

Why is it important?

As well as the assurances above, in order to get any grant or the Renewable Heat Incentive, both the installer and the product need to be MCS accredited.

Are Geowarmth accredited?

Yes Geowarmth are MCS accredited installers. Our accreditation number is MCS1212 and covers heat pumps, solar thermal and photovoltaic.

TAX BENEFITS

Is reduced rate VAT available?

A heat pump is defined as an energy saving device by HMRC and a reduced rate of VAT of 5% can be charged by us where the installation is in a residential dwelling.

If the heat pump is installed during the course of construction of a new dwelling, our supply may be zero rated.

If our client is a registered charity, our supply may also be zero rated.

Are there any other tax benefits?

Businesses may be able to claim enhanced capital allowances allowing them to fully write off the cost of installation of a heat pump system against tax in the year of installation.



PAYBACK

What is the payback on my investment?

Once we have provided you with a quotation you can compare the installation cost of a heat pump with another type of heat source. Then you need to consider and place a value on the following:

- Running cost savings
- The life expectancy of the heat source. Heat pumps have a design life of up to 25 years; new boilers are less than 10 years. You should factor in at least one replacement boiler during the life of the heat pump
- The absence of routine servicing with a heat pump
- The efficiency of the heat source over its life time. The operating performance of a heat pump does not deteriorate over time. Boilers reduce in efficiency and cost more to run.
- Likely future trends in energy costs: the price of a barrel of oil was \$20 in 2002; it has been over \$80 in 2010. If such a trend continues the running cost savings of a heat pump will widen.
- Proposed Renewable Heat Incentive annual payment
- Other financial benefits from installing a heat pump, for example grants, lower VAT or enhanced capital allowances.
- The impact on the capital value of the building. A residential property with a heat pump could achieve a higher rating on the property's energy Performance Certificate. A commercial building with low heating and cooling costs from a heat pump should be able to command higher rental levels than one without.

Payback is thus particular to individual circumstances and overall heating usage, hence it is not easy to simply quote a definitive number of years. Once all the above factors are taken into account, a heat pump is usually a very sound investment!



INSTALLATION REQUIREMENTS

Is a heat pump noisy?

There is small amount of noise, in the same way that a boiler or the compressor at the rear of a fridge makes a noise. We recommend that heat pumps are installed in a utility room or garage.

How big is a heat pump?

Heat pumps are around the size of a refrigerator. With an integral hot water cylinder they are the size of a tall fridge freezer, or the hot water cylinder could be a separate item.

Can heat pumps be used in old buildings?

A heat pump is not a substitute for insulation. Older buildings tend to be poorly insulated. Because a heat pump produces low temperature hot water a building needs to be well insulated to benefit from a heat pump. Older buildings often have radiators which are not the best combination with a heat pump or the most efficient way of heating a building. Yes a heat pump can be installed in an older building or an extension to an existing building, but it may require modifications to the existing heating distribution system such as installing larger radiators and improving insulation.

Is planning permission needed?

Planning permission is not normally needed for the installation of a ground source heat pump (although permission is needed for boreholes in National Parks). You should check locally about planning requirements for air source heat pumps.

A heat pump could actually assist in obtaining planning permission for a building project. Planning authorities usually require a proportion of renewable energy, particularly in commercial buildings.

Part L of the Building Regulations is focused around the CO₂ emissions of the building and a heat pump scores very well in the assessment criteria and can help a building project meet the CO₂ requirements of the Building Regulations.

How long does the installation take?

From order placement to commissioning of system can take as little as 6 weeks. We like to work with our clients and integrate with other aspects of their building project. This normally means that the ground loop installation happens first and the heat pump is installed once the building is ready internally.

DOMESTIC HOT WATER

Can a heat pump provide domestic hot water?

Yes there are a number of ways of heating domestic hot water using a heat pump. A conventional indirect hot water cylinder with a coil can be heated by a heat pump by installing a diverter valve connected to the heat pump. Secondly some heat pumps have an integrated hot water storage cylinder.

A third method is a hygienic hot water system where water from a thermal store is used to instantly heat incoming mains cold water so the water drawn off at taps is always fresh not stored hot water and is at mains pressure. This system is the most environmentally friendly and cheapest to run because the water only needs to be heated to the temperature required at the taps. Geowarmth are one of the few heat pump companies to offer this system.



Can I use solar thermal panels for domestic hot water?

Yes. Solar thermal hot water heating is a very commendable renewable technology which can provide around 60% of a property's domestic hot water needs. Geowarmth have some excellent solutions for integrating solar thermal with heat pumps. Please see our separate solar thermal fact sheet.

What temperature can a heat pump achieve?

Typical flow temperatures for an underfloor system from a heat pump are 35°C. For radiators or domestic hot water a heat pump can provide water at up to 55°C. Some heat pumps can provide water for an integrated hot water cylinder at up to 65°C.

Can heat pumps heat swimming pools?

Yes heat pumps can heat the water for swimming pools. Air source heat pumps are commonly used for outdoor pools which have a mainly seasonal use. Ground source heat pumps work well for indoor pools which are used all year round, although more ground loops will be required than for a heat pump just serving a normal heating system.

ENVIRONMENTAL & OTHER BENEFITS

What are the CO₂ emissions from a heat pump?

None. A heat pump does not produce any carbon dioxide or any other emissions on site. There is no combustion and no flue. Whilst it uses electricity that may have been generated from fossil fuels, even allowing for this there are considerable CO₂ savings in using a heat pump compared with fossil fuel boilers. For a modern well insulated property of 200m² using a heat pump would save 2 tonnes of CO₂ per annum compared with a new mains gas boiler or 4 tonnes compared with a new condensing oil boiler.

Is a back up system needed?

No! Heat pumps are very reliable and have a life cycle of up to 25 years. They are based on refrigerator technology. How often do we need to get our refrigerators repaired?

What are the maintenance requirements?

None: there is no scheduled maintenance or servicing required with a heat pump; unlike say boilers. Some minor periodic inspection is recommended.

What are the main advantages?

The key advantages of a Geowarmth heat pump are:

- Annual clean energy cash back under planned Renewable Heat Incentive
- Use of free renewable solar energy
- No CO₂ emissions from the property
- High reliability with no scheduled maintenance
- Safe and clean
- Long life cycle
- Zero or 5% VAT or enhanced capital allowances for businesses
- Substantially lower running costs than other heating systems
- Possible grant towards installation cost
- Easier compliance with Building Regulations
- High rating on Energy Performance Certificate
- Can also be used for cooling
- Domestic hot water from the heat pump as well
- Integration with solar thermal domestic hot water
- Choice of manufacturers for optimum system solution
- Experienced MCS accredited installer

COOLING

Can heat pumps do cooling?

Yes. There are two methods:

- Reverse cycle or active cooling, where the heat pump operates in reverse mode passing cooler water around the building and dissipating heat back to the ground. These systems do not work with radiators or underfloor, but require either fan coiled units or chilled beams.
- Natural or passive cooling. This is a very economical form of cooling for use with an underfloor heating system. The cooler water from the external pipes is passed via a heat exchanger around the underfloor circuit. The main heat pump is not running; the only electrical input required is to run the circulation pumps. Natural cooling works best with vertical ground collectors in boreholes but can also be used where the ground loops are installed horizontally. Some heat pumps offer natural cooling as a standard feature at no extra cost. Natural cooling through the underfloor utilises the thermal mass of the building fabric to keep it cool; this is a similar principle to the way underfloor heating works. To be effective the external air temperature needs to be over 20°C, sometimes a rarity in the UK.



ABOUT GEOWAMRTH

What makes of heat pump do Geowarmth supply?

Unlike many heat pump companies, Geowarmth are not tied to one manufacturer. The types of heat pump we supply include Waterkotte, Dimplex, Nibe, Viessman and Mitsubishi. This gives us the flexibility to satisfy virtually all customer requirements.

What is Geowarmth's experience?

Geowarmth is a MCS accredited designer, supplier and installer of ground source and air source heat pumps, solar thermal and solar PV systems. The Geowarmth team has a successful track record in residential, community and commercial schemes, including closed loop in trenches, boreholes, ponds and open loop systems. We operate nationally and have completed over 100 schemes totalling many magawatt. The Geowarmth portfolio includes a number of significant eco friendly schemes such as Cockermouth Eco Centre (24kW from 3 boreholes), The Greenhouse, Annfield Plain (120kW of heating and cooling from 15 horizontal trenches of 55m length) and Yorkshire Dales National Park Authority headquarters (88kW from 8 boreholes) plus a large number of residential properties.

What do Geowarmth offer?

Geowarmth's service includes advising on an appropriate system, the supply and installation of the ground loop pipes, heat pump and circulation pumps, connecting the ground loops to the heat pump via a manifold, along with fully installing and commissioning the system, including connections to your heat distribution system. Our installation often includes a domestic hot water cylinder or a hygienic thermal store to provide fresh (not stored) hot water through the taps. For a complete service we can supply and install the underfloor heating or radiators as well. Where boreholes are required we provide them. In addition to help pumps we also supply and install both solar thermal and photovoltaic panels. You should find our service is a very comprehensive offering.

What information is needed to provide a quotation?

The information we require to put together a comprehensive quotation is summarised on our Quotation Request Form, which can be downloaded from our website. Please complete this and return it to us or call us to talk it through..



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