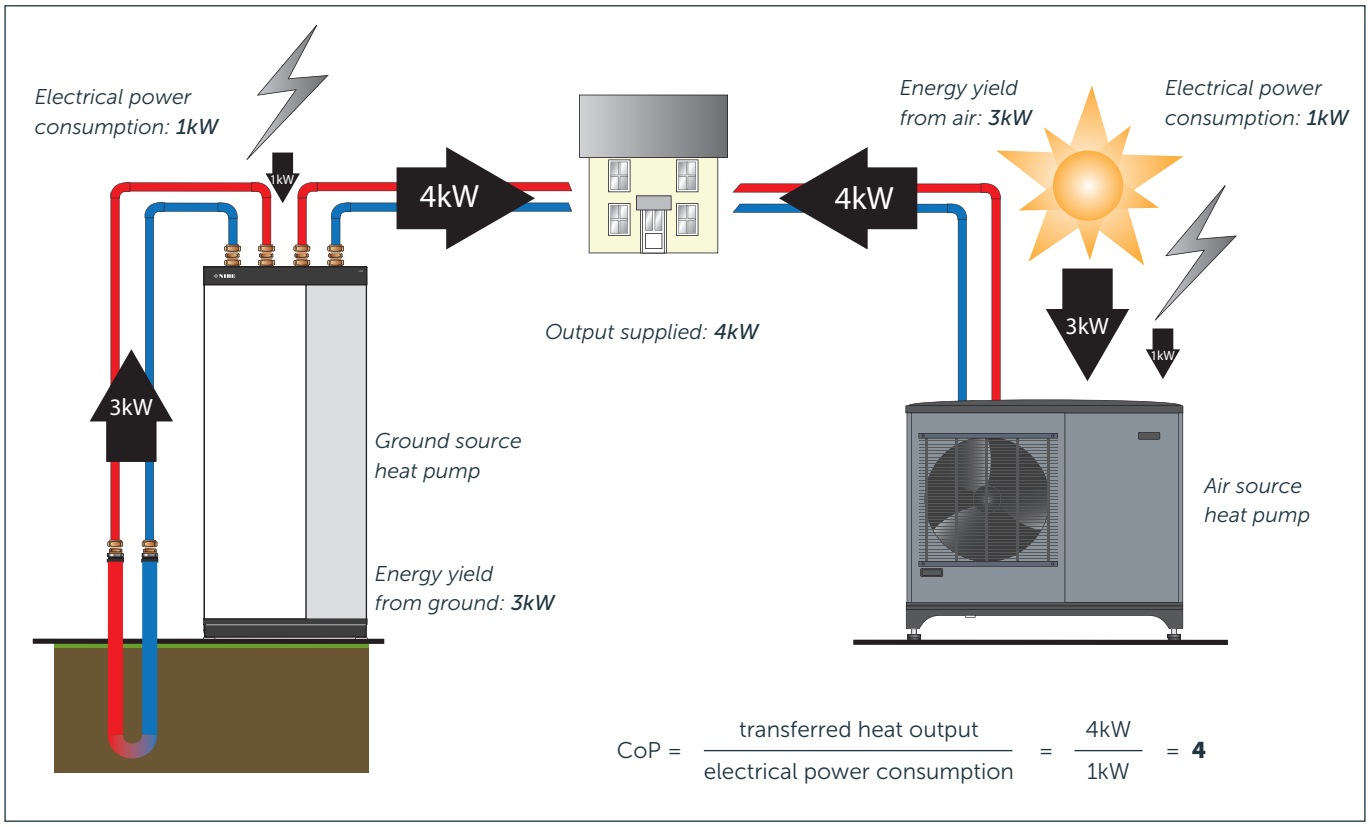
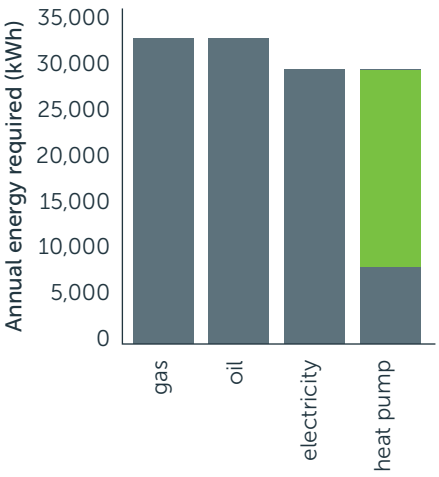
HEAT PUMPS

Nu-Heat UNDERFLOOR & RENEWABLES

Information sheet

Heat pump guide – Ground & air source heat pumps





Why use a heat pump to warm your home?

With an increasing emphasis on the reduction of carbon emissions, heat pumps provide a practical solution to heating the home. Heat pump systems powered by standard tariff electricity can still produce 40% lower carbon emissions than gas fired and 55% less than oil fired installations, due to the 'free' energy the heat pump harvests from the environment.

Put simply, in a well insulated property, Nu-Heat's heat pumps can provide 2 to 3 kilowatts of free energy for every 1 kilowatt of electricity used to power them. This ratio is known as the Coefficient of Performance (CoP).

A dwelling requiring 30,000 kilowatt hours of heat per year would require 33,333 kilowatt hours of oil or gas running at 90% efficiency. With the heat pump operating with a CoP of 4, only 7,500 kilowatt hours of electricity are required.

Government funding of low carbon technologies

The government's Renewable Heat Incentive (RHI) provides financial support through tariff payments to the owner of the heat pump. To qualify the installer and equipment must be certified under the Microgeneration Certification Scheme (MCS). Nu-Heat offers a comprehensive range of MCS and RHI compliant support packages to assist the installer and homeowner in their application.

For full details please see www.gov.uk/rhi.

Heat pumps and underfloor heating – perfect partners

As the heat emitting area is so much larger with UFH than with radiators, the heating water temperature can be much lower. This ranges from typically 35˚C – 45˚C compared to 55˚–65˚C with radiators in a heat pump system (and higher again in gas or oil fired installations). Low flow temperatures are ideal for heat pumps as they enable the maximum CoP to be achieved. A study commissioned by the European Association for Surface Heating and Cooling (Eu-ray), found that using underfloor heating combined with a heat pump cuts energy consumption by 30% compared to using radiators.

Is your project suitable?

In order for the system to be effective and cheap to run, it is essential that the building has a low rate of heat loss, therefore air-tightness should be considered alongside insulation.

The aim should be to insulate the building so that less than 50W of heating are required per m^2 of floor space. This will ensure that the UFH water temperatures can be kept to a minimum and the heat pump can operate at a high CoP. The savings in both carbon emissions and running cost will be maximised. In general it is more cost effective to increase insulation levels than it is to install a larger heat pump.

The Building Regulations/Standards set the levels of thermal insulation required when carrying out building work, either for new build or refurbishment projects. These are expressed as a U-value which needs to be achieved; the required U-value will depend on the location of the project (England, Scotland, Wales), type of building (domestic, non-domestic) and the application (floor, wall, roof). The table below shows suggested U-Values.

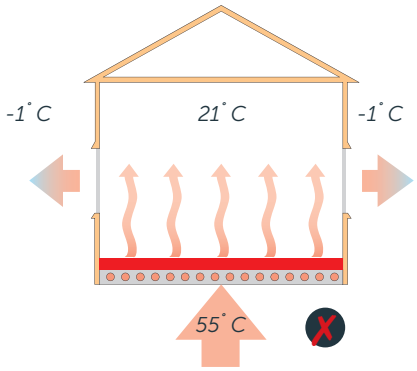
Recommended U-values for domestic buildings – summary

	England & Wales – from 6th April 2014				
	New Build		Existing Buildings		
	Best Starting Point (Fabric Only)	Limiting fabric value* (back-stop)	Extension	Refurbishment	
				Threshold U-value*	Target U-value
Roofs	0.13 W/m^2K	*0.20 W/m^2K**	0.16 W/m^2K	*0.35 W/m^2K**	0.16 W/m^2K
Walls	0.18 W/m^2K	*0.30 W/m^2K**	0.28 W/m^2K	*0.70 W/m^2K**	0.55 W/m^2K (cavity)
Floors	0.13 W/m^2K	*0.25 W/m^2K**	0.22 W/m^2K	*0.70 W/m^2K**	0.25 W/m^2K
Windows	1.40 W/m^2K	*2.00 W/m^2K**	1.60 W/m^2K	*1.80 W/m^2K**	1.60 W/m^2K

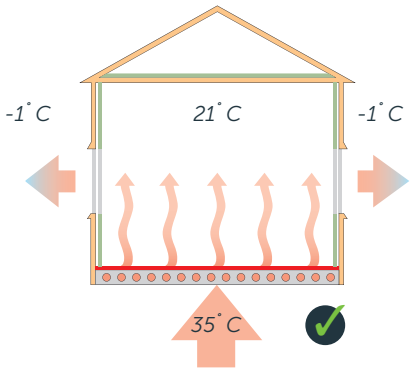
Selected reference values from the (AD)L1A 2013 Notional Dwelling Specification and (AD)L1B.
* These values should not be adopted for compliance with Building Regulations.
The requirements for the conservation of fuel and power, which includes thermal insulation, in buildings in England are detailed in Approved Documents (AD) L1A, L1B, L2A and L2B to the Building Regulations 2013 which came into effect on 6th April 2014 and are available to view at www.planningportal.gov.uk.

Buildings with higher heat losses

In theory there is nothing to prevent a heat pump from working in a building with a higher heat loss, such as a property that requires up to 80 watts of heat per square metre. However higher heat loss requires higher heating water temperatures from the heat pump – typically 55˚C rather than 35˚–45˚C. Consequently, the heat pump's CoP will suffer; it may only achieve 3 in a ground source unit and less with an air source model. It is also worth noting that radiators are normally designed to run at around 65˚–75˚C in these situations, leading to even lower efficiencies.



The temperature generated by the heat pump can be increased, but only at the expense of its efficiency.



Heat pumps will only be truly satisfactory in a building insulated to current Building Regulation standards.

Underfloor heating – special considerations

The performance of underfloor heating is affected by three key variables:

1. The temperature of the heating water
2. The quantity of tube in the floor
3. The thermal resistance of the covering

Maintaining the water temperature at a low level helps the heat pump's efficiency. In order to achieve this, the amount of tube in the floor must be increased and the thermal resistance of the covering reduced.

Nu-Heat's highly flexible pipework and large choice of fixing methods enable tube runs to be installed down to 100mm spacings, enabling flow temperatures from the heat pump to be kept low.

As a floor covering, tiles offer the best performance characteristics by imposing low thermal resistance. Conversely, the high thermal resistance of carpet requires higher flow temperatures from the heat pump. Therefore in some circumstances, particularly rooms with high heat loss, carpets can be unsuitable, although this would be unusual in properties built to meet current Building Regulation standards.

Even if the property has a high heat loss and heat pumps are unsuitable, UFH may still be a viable option with a different heat source.

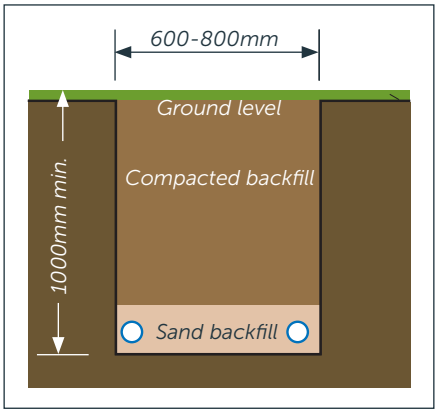
HEAT PUMP TYPES: GROUND SOURCE AND AIR SOURCE

All heat pump types operate using similar principles – by harvesting energy from the environment and 'compressing' it to a temperature that can be used in the home.

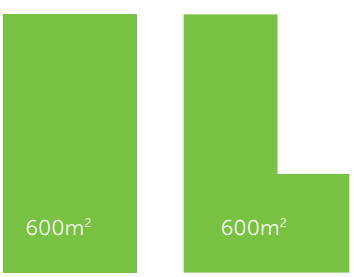
The environment from which energy is harvested may be the ground, groundwater or the outside air. Ground source and air source units suit new-build houses over 50m² floor area (or minimum 3.5kW heating load) depending on the electricity supply available. They can also be used with a low-temperature heat emitter such as underfloor heating in renovation projects where the building insulation and heat losses meet current Building Regulation standards.

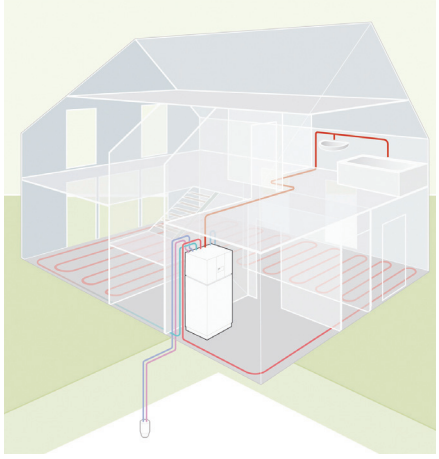
Ground source heat pumps – horizontal ground array

The CoP of ground source systems is high because the temperature is generally higher and more consistent in the ground or ground water compared to that in the air. Energy is harvested by using horizontal ground arrays or collectors laid in 1m deep trenches spaced at an average of 0.75m apart. The rule of thumb is to install 4m of ground pipe (equivalent to 3m² of land) per m² of internal heating space. Therefore, a 200m² property requires 600m² of land for its ground array.



A plot of any shape may be used if it covers the correct area, e.g.

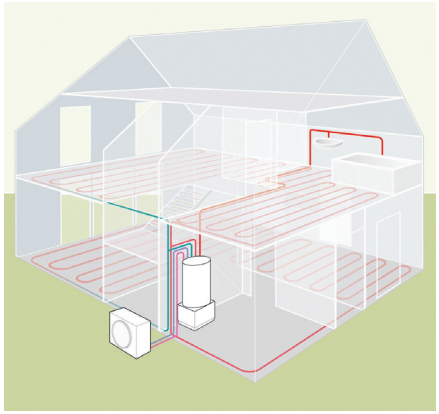




A ground source unit can be supplied by either a ground array or borehole.

Ground source heat pumps – boreholes

Where insufficient land is available for ground loops, vertical boreholes are an option. The boreholes contain tubes extending between 40 and 120 metres vertically down. The number and depth of boreholes varies depending on the heat load of the property. Nu-Heat has links to a network of drilling contractors across the country.



An air source heat pump requires less land and can be an easier installation

Air source heat pumps

Air source heat pumps are often more practical to install than ground source models; there is no digging or drilling involved and often fewer plumbing connections are required during installation. They are able to extract useful energy from the outside air down to temperatures as low as -15˚C although at these temperatures the CoP will be reduced. A storage cylinder provides domestic hot water, whilst a buffer tank increases the working volume for the heat pump and provides an immersion heater for boost in the coldest weather.

Nu-Heat is able to supply an air source heat pump to suit the exact requirements of the individual project

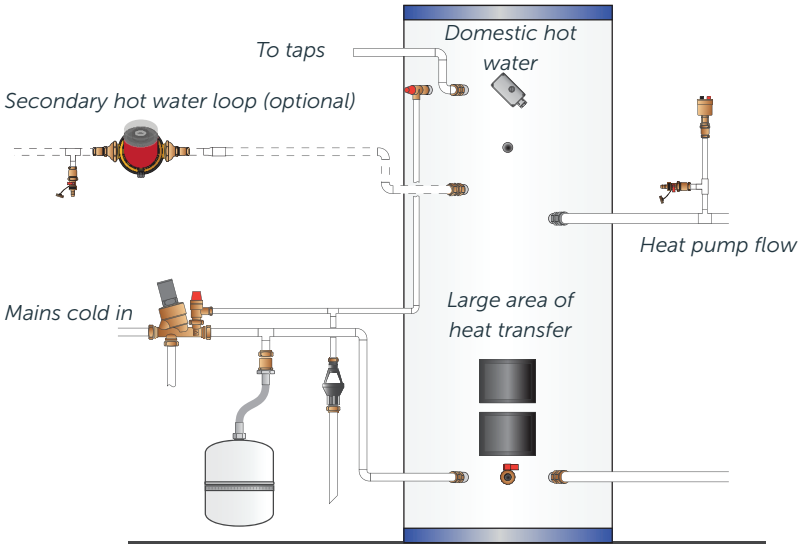
Electricity supply

Heating loads of up to 15 kilowatts can be supported by a single phase electricity supply (dependent on region); any more than this and a 3-phase supply or a second dedicated single phase supply for the heat pump will be required.

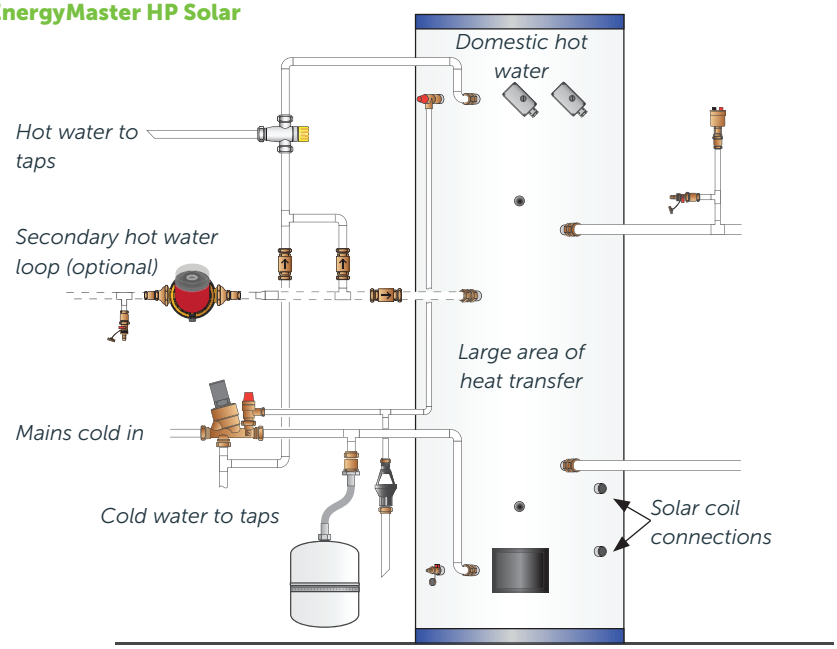
A heating load of 40W/m^2 implies a 375m^2 upper limit of dwelling size for single phase supply unless it's extremely well insulated; alternatively a supplementary heat source can be installed.

It is not unusual for a larger property to incorporate a 3-phase electrical supply, in which case a larger 3-phase heat pump would be specified to suit.

EnergyMaster HP



EnergyMaster HP Solar



Domestic hot water supply

Nu-heat offers a wide range of domestic hot water cylinders that have been specifically designed for use with heat pumps. Because heat pumps produce lower temperatures than a conventional boiler the heat transfer area of the coil must be greater; maintaining a low pressure drop across the coil. This enables the heat pump to run efficiently even whilst producing the higher temperatures necessary for domestic hot water.

The range includes cylinders that incorporate solar thermal input, whilst retaining the large heat pump coil.

Solar thermal panels are connected via an additional coil.

Where there is no access to mains water to feed the cylinder (e.g. where water is supplied via a borehole or well), Nu-Heat can offer a range of Super Duplex stainless-steel cylinders able to cope with the more aggressive water. Please ask your Account Manager to include this in your quotation.

Underfloor heating and heat pump control principles

Nu-Heat systems are based upon weather compensated control. This works by matching the heating water flow temperature to the heat loss of the property as this varies in proportion to the outside temperature. By controlling the flow temperature to match the heat input to the heat loss, room comfort should be automatically achieved. However, to allow for real-world differences, and provide more intuitive user control, each room is also controlled by a thermostat that opens and closes the actuator(s) on the underfloor heating manifold. When the room reaches the desired temperature there will be no heating flow to that room. This combination should provide perfect comfort.

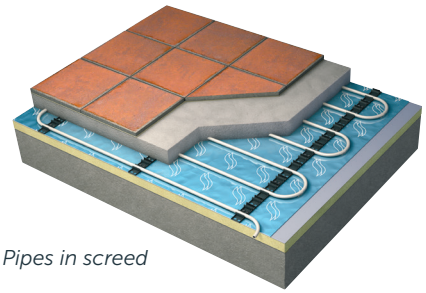
Buffer tank

Buffer tank

Nu-Heat always recommends a wall or floor-mounted buffer tank with each system. This increases the effective system volume, providing a load for the heat pump when some thermostats switch off. The buffer also stores energy to perform the defrost cycle on air source heat pumps.

Heating a building for intermittent use

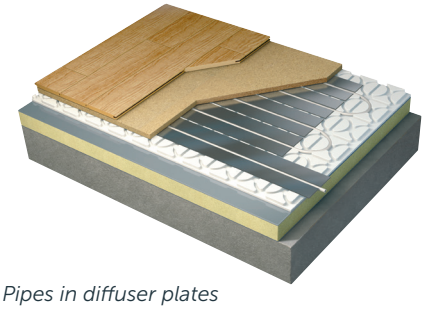
It is important that internal building temperatures are not allowed to drop past a limit of around 15˚C (i.e. by switching the system off) – a situation that often occurs in holiday homes. The output of the heat pump is so closely matched to the building's heating load that any extra energy required to 'kick start' the system will not be available in cold weather conditions, resulting in extended warm-up times.



Pipes in screed

Suitable underfloor heating floor constructions

Nu-Heat's aim is to design each heating system with the lowest viable heating water temperature, as this optimises the heat pump's CoP and offers better comfort and control. In order to do this the floor constructions used must be thermally conductive, containing as much floor heating pipe as can be practically installed. Screed or timber and floating floors, using closely spaced metal diffuser plates, are the best options.



Pipes in diffuser plates

Estimated costs

A ground source heat pump system for a medium sized house will cost in the region of £8,000 to £10,000, plus underfloor heating and installation. An air source model would be significantly less, between £4,000 and £8,000.

Maintenance and longevity

Annual servicing of the heat pump is required as a condition of the warranty and ongoing RHI payments.

The heat pump refrigeration circuit is unlikely to need attention, however it is sensible to check the operation of the heat pump as part of the heating system's annual service.

The Nu-Heat service

For over 20 years, Nu-Heat has been at the forefront of Britain's heating industry, supplying state of the art domestic heating solutions. The company offers what is arguably the most complete service on the market, taking responsibility for every project from initial enquiry and offering several routes to system commissioning and MCS sign-off to suit customer preference. System design is completed using our bespoke *Predictor* software and information is presented in a comprehensive *Handover Pack*. Nu-Heat pays full attention to the details that most of our competitors overlook.

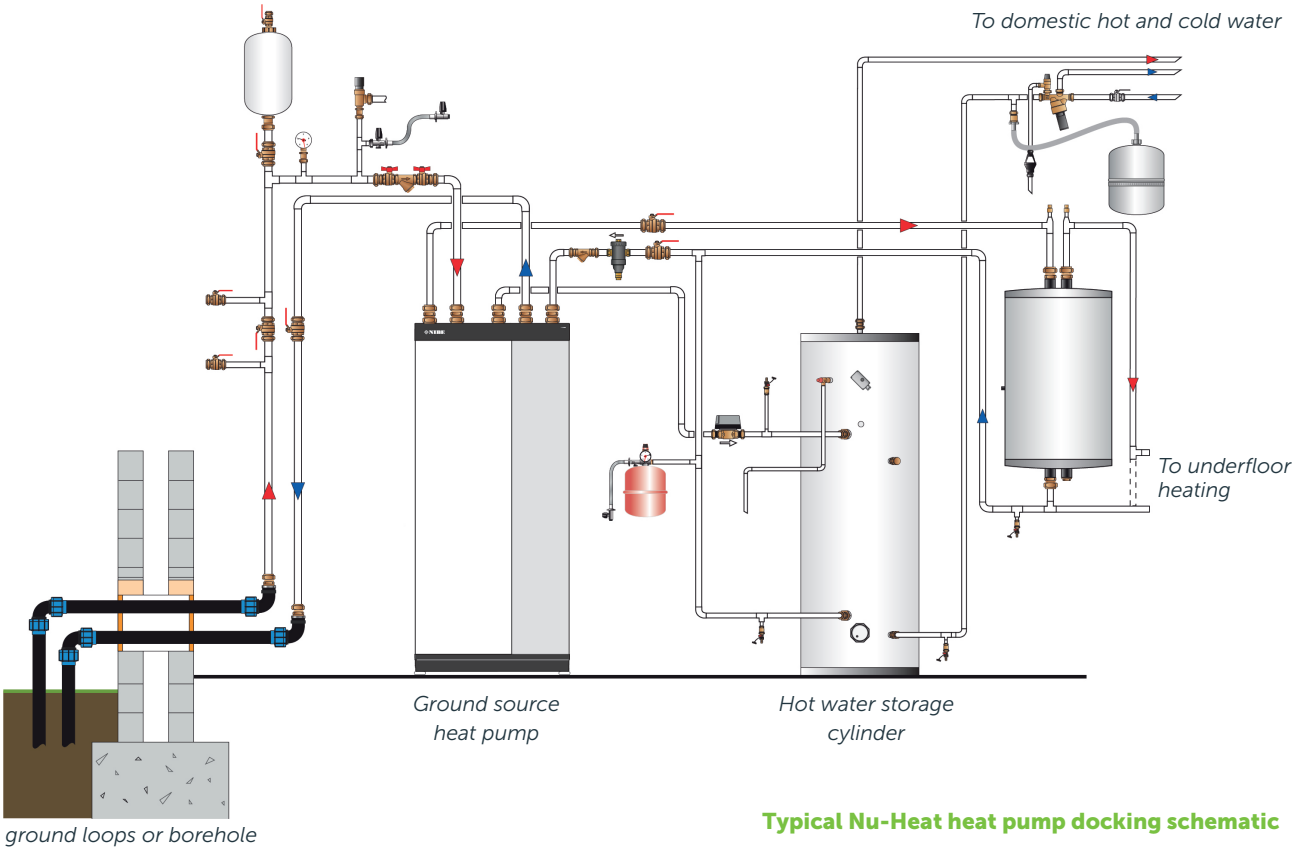
What you get

When comparing quotes from other suppliers it is important that they are equivalent. Nu-Heat supplies every component required, excluding only the copper pipework, electrical cable and common sundry items.

The schematic drawing below shows a typical ground source system – all coloured components are supplied as part of the package. Many competitors sell only the heat pump, and possibly ground loop kit, meaning the installer would have to source shut-off valves, expansion vessels, connectors, strainers, pump sets, sensors, gauges, temperature control valves and numerous other fittings.

As well as comprehensive component supply, Nu-Heat also supports the installation process in detail with each assembly illustrated by specific exploded diagrams including numbered components and a full set of mechanical and electrical 1st and 2nd-fix drawings.

By choosing Nu-Heat, you can be sure that the job will be done properly.



Typical Nu-Heat heat pump docking schematic