westernpower.co.uk

A Guide on Heat Pumps and DNO Engagement with Local Authorities and other building owners

May 2020

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Who is this guide for?

This guide is intended for local authorities and other building owners who are considering using Heat Pumps to meet the net zero targets in the UK. They will be supporting their residents and occupiers in their move to a net zero lifestyle.

What is this guide about?

Tackling emissions from heating is vital. At 37%, heating accounts for the largest proportion of UK Greenhouse Gas emissions.

About 90% of UK homes use gas boilers, which for a long time have been accepted as a comparatively efficient and convenient heating source.

The picture of the available options is rapidly changing, with major technological developments and alternative sources of energy emerging over the last 10 years.

Currently, the choices are around district heating networks working with Combined Heat and Power (CHP), electrifying heat through the use of Heat Pumps or 'greening' the gas grid.

When heat pumps are used for heating buildings, the heat pumps which use electricity to extract additional, renewable heat from the ground or air around the building, would reduce emissions, but the heat pump capital cost though, would be more to deliver.

What is a Distribution Network?

A Distribution Network Operator (DNO) is a company licensed to distribute electricity in the UK. It is responsible for the distribution of electricity downstream from the national transmission grid, to industrial, commercial and domestic users. It also maintains and operates the underground cables, overhead lines and substations.

When new heat pumps are installed, it is the DNO that connects them to the local power network.

DNOs do not supply the electricity. Electricity suppliers pay DNOs to distribute electricity through the network to homes and businesses. Customers can choose from many different electricity suppliers.

Switching to electricity for the heating on a large scale does present challenges that DNOs are ready to meet. The impact on the electricity network will be mitigated through new ways of managing and 'balancing' electricity demand via smart metering, demand side management, battery storage and more renewables. We will also continue to update and reinforce assets as required.

How can DNOs help?

The cables, overhead lines and substations that make up an electricity network are assets with a typical fifty year life. Networks installed today are the result of many years of planning and development. Additional connections to the distribution network will need to be assessed to determine if there is available capacity or if local upgrades will be necessary.

An early engagement with the DNO and a qualified electrical contractor can help identify whether the proposed location has adequate capacity to meet the demand, the DNO can also help identify alternate locations with spare capacity, which could reduce the cost.

If there is enough capacity from the existing supply, no network reinforcement will be required. If any reinforcement is needed, it will be the local DNO who will provide this.

The DNO will also provide quotations for new connections and upgrades to existing ones. The scope of the upgrade and reinforcement could extend to include increases in capacity for existing transformers, distribution overhead lines and cables to meet the new higher peak demand and lower impedance connections. Cost calculations for grid network investments will vary depending on the local situation but a guide is provided here.

When thinking about planning to get heat pumps installed and operational, it is important to think of the process from the energy system perspective – with the DNO providing the critical link to an electrical power supply. Put simply, any plan to install heat pump infrastructure needs to consider both the hardware installation and necessary grid network reinforcement.

Considerations for buildings

Going forward new buildings should be very well insulated. When houses are built, decisions around their construction stay with the country for decades.

If new houses are built to high insulation standards, they can viably be heated using green electricity with very little strain on the grid, and no real need for the use of expensive heat pumps. Some recent studies suggest that housing can be built to a super-energy-efficient Passivhaus standards for only a 5-10% uplift in procurement costs.

This typically reduces heating demand by more than 75% compared to current building regulations.

A more challenging situation is the conversion of older properties off the gas grid, which are typically poorly insulated, and may even have no existing central heating system. Contrary to popular belief, heat pumps can work very effectively in these properties, and with the greener grid this is a sensible in carbon terms thing to do.

Typical emissions associated with heat pumps could mean a drop of more than 60% in emissions when compared to storage heaters or oil fired boilers.

Considerations for retro fitting of heat pumps

When installing a heat pump, one may need to increase the size of some of the radiators in certain rooms. This is simply because the heat demand will not be met with the existing-sized radiators. If this is the case, typically expect to pay about £200 – £300 for each radiator that needs to be replaced providing the pipework running to the existing radiator can be reused and there is no microbore tubing used to supply the radiators.

Things to consider before investing in an air source heat pump:

Placement of the air source heat pump: An air source heat pump requires plenty of space, either to mount on an external wall or to be placed on the ground. The unit needs good air flow, and foreign objects such as boxes, containers etc. need to be kept well away.

Insulation: Unlike gas central heating, heat pumps provide low grade heat on a consistent basis. To maximise effectiveness, ensure that the home is suitably energy efficient by installing wall insulation either cavity or solid wall and draught proofing. These are low cost measures that will make a big difference to the utility bills, therefore it is worth investing in them prior to replacing the heating system with an air source heat pump.

Noise of air source heat pump: An air source heat pump does make some noise when operating, as both a fan and a compressor will be in motion. The noise is, depending on the system, approximately 40-60 decibels from a distance of one metre away. Therefore it is sensible to ensure the air source heat pump, it is not placed where it will be a nuisance to all parties.

Efficiency of air source heat pumps: Despite air source heat pumps being able to operate at -15°C, the efficiency decreases as the outside temperature drops; therefore in a particularly cold location, the heat pump may well need to activate the supplementary heating element to obtain the required heat output.

Converting an existing LPG or Oil fired system to a Hybrid system: One method that can help by avoiding the high running costs and delivering heat without creating capacity peaks on the electricity system is the hybrid heating and control technologies, where an air source heat pump is added into the existing heating system, these hybrid systems can deliver low carbon heating solutions in homes that reduce CO2 emissions but keep the costs down for the customer.

There is one important point that needs to be born in mind, any home that has been plumbed with microbore tubing cannot be converted to any form of heat pump, unless all the microbore piping is removed, that cost is approximately £10k for a four bed home.

How do Heat Pumps work?

An important consideration for heat pumps, is heat pumps do not heat up water to the same extent as gas or oil fired boilers within a wet central heating system, there are some important things to research before a heat pump is installed.

The first is radiator size. If one is replacing an existing wet central heating system with a heat pump, the current radiators may not be of an adequate size for the rooms. Secondly, as the heat is not of the same temperature as gas, oil and biomass boilers it is essential to have a well-insulated house to ensure that the required temperature is reached.

A heat pump does not create heat. It simply moves it from one place to another through the vapour compression cycle or in other words the refrigeration process to make it more useable. Heat from the air or the ground gets absorbed into a fluid, which is then compressed, raising its temperature. The higher temperature is then transferred into the heating system. Electricity is needed to power the pump. The efficiency, or the measure of the heat energy output per kW of electricity, is stated as the Coefficient of Performance (CoP).

With air source heat pumps the CoP varies throughout the year, with lower figures achieved during the colder months meaning they are running less efficiently, since there is less ambient heat available to remove from the air. This makes comparing the efficiency of different heat pump systems very difficult, therefore what is known as the Seasonal Performance Factor is used to compare like for like performance of models.

This is the annualised CoP, taking into account the different performance throughout the year.

For example, using this scale an air source heat pump efficiency as high as 4, whereas a ground source heat pump could reach 5. This means for every 1kW of electricity, heat pumps have the potential to produce 4 or 5 units of heat respectively.

Air source heat pumps don't produce boiling water, the air source heat pump does not produce the sort of hot water temperature one would associate with a gas, LPG or oil-powered boilers. With a boiler, one would expect the hot water to be heated to about 85°C, while a heat pump produces water to about 55°C. Trying to increase the water temperature from a heat pump beyond this requires the compressor to work harder, meaning more electricity – this in turn reduces its efficiency or coefficient of performance.

As a result, it is very important to minimise heat loss from the property prior to installing a heat pump. This includes insulating the walls, loft and ideally the floor too. This means that even though the radiators won't get as hot when using heat pumps, the house is still heated effectively and ones not straining the heat pump – which is expensive.

Air Source Heat Pumps

The air source heat pump gets its energy from the surrounding air, so as the air temperature drops, so does the efficiency. The bigger the difference between the outside air and the target temperature (either the indoor room temperature or domestic hot water), the lower the efficiency.

It is therefore key to understanding the heat load of the property and the performance characteristics of the heat pump. For space heating, air source heat pumps work best with underfloor heating, but low-flow temperature radiators will work as well.

One of the first decisions to make when buying or specifying an air source heat pump is whether it will provide 1) space heating (SH) or 2) domestic hot water (DHW) — or both. The key here is that the 'flow temperature' the temperature of the water in the heating system) is different:

Space Heating

Will usually require a flow temperature of around 35°C to 45°C for underfloor heating or low-temperature radiators. While;

Domestic Hot Water

Will require a minimum flow temperature of 55°C.

With new homes that meet or exceed the recent and current Building Regulations most air source heat pumps can do both, but this is not always the case. One way of meeting the above temperature difference between SH and DHW is to use two heat pumps, one that is optimised for the space heating and the other for domestic hot water.

The advantages of using the two heat pumps is that each unit is optimised for the required flow temperature and there is no priority system that causes the space heating circuit to 'cool' while the domestic hot water is being reheated.

The domestic hot water heat pump typically uses a different refrigerant that can produce higher flow temperatures but also requires a higher source temperature (above 4°C) to be efficient.

It tends to be lot smaller than a space heating heat pump and can be built into the hot water cylinder. It draws its air either from the room it is in or from the exhaust waste heat of a ducted mechanical ventilation system — and is known as an 'exhaust heat pump' or a 'micro heat pump'.

The dual heat pump system has been taken a step further by some manufacturers, what they are doing is using the dual heat pump to produce higher temperature heat pumps. In order to achieve the higher temperatures, these manufacturers have built the two different refrigerant systems into one heat pump in a 'cascade' system that can create flow temperatures of up to 80°C.

Such systems, such as the Daikin Altherma are designed for hot water and should not be used as a high temperature boiler replacement unless the lower efficiency has been carefully calculated to ensure that it is the best option for the property.

There are also other new technological advances that are worth noting such as compressors that allow the compressed vapour to be re-injected into the compressor to enhance the temperature. These systems can get flow temperatures of around 65°C.

Ground Source Heat Pumps

Ground source heat pumps use the earth as a heat source, taking advantage of the stable temperatures in the ground to provide heat and hot water for the home.

Ground source heat pumps are not a new concept and have been around since the 19th century. This technology became very popular in Sweden in the 1970s and since then units have been sold worldwide.

A ground source heat pump system uses heat trapped beneath the ground and boosts it to a higher temperature using a heat pump.

This heat is then used to provide home heating or hot water. The heat pump performs the same role as a boiler does in a central heating system, but uses ambient heat from the ground rather than burning fuel to generate heat. Initially, a heat transfer liquid normally glycol is pumped through pipes buried deep in the ground.

As the liquid travels through the pipework it absorbs ambient heat from the ground and warms up, before returning back to the ground source heat pump unit.

Once it returns, a heat exchanger removes the heat from the liquid and it then continues to travel round and round the pipework in a continuous cycle. The low-grade heat is transferred through the heat exchanger, then passes through a heat pump compressor which drives the temperature up to a level that is usable for heating and hot water.

How much pipework does a ground source heat pump require?

The length of the ground loop depends on the size of the home and the amount of heat that is required – longer loops can draw more heat from the ground, but need more space to be buried in.

The pipework can either be laid horizontally or vertically. If laid horizontally, the pipework tends to be buried in trenches 2-3m deep, spread over a huge surface area to ensure the heat transfer liquid has the opportunity to increase to a sufficient temperature.

If the pipework is installed vertically, boreholes get drilled in to ground typically at a cost of £6,000 – £8,000 for each borehole.

The boreholes need to be drilled by professionals and will regularly exceed 100m in depth to ensure that the heat transfer liquid again has the opportunity to absorb enough heat.

Do I need planning permission for a heat pump?

This depends on where you live in the UK. Usually, unless you live in a listed property or conservation area, ground source heat pumps are considered a permitted development.

One shouldn't need an application for planning permission, but it is still worth checking with your local authority before starting installation, however. With air source heat pumps, in England and Scotland you can install an air source heat pump as it forms part of permitted development. However in each region, the home owner needs to follow specific guidelines and not contravene them in order to proceed with the installation.

If you live in Wales and Northern Ireland, speak to the relevant local authority to get a planning application submitted and approved before proceeding with the installation.

Since the end of 2011, if you live in England, all heat pumps (air and ground) are considered a permitted development, so no planning permission is required. Further details can be sought from the relevant planning authority.

You also need to make sure that the developer that is installing the air source heat pump speaks to the local authority and gets clearance for the size and type of unit being installed. Not all systems may necessarily comply with permitted development criteria.

Installing a ground source heat pump

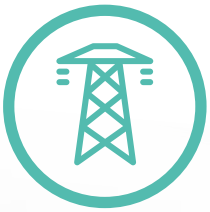
The Energy Saving Trust (EST) recommends households considering a ground source heat pump to consult a Microgeneration Certification Scheme installer and only use a properly accredited professional to complete the work.

During its trial, the EST found a variety of heat pumps incorrectly installed, which therefore didn't perform as efficiently overall as they could have.

Who is involved in the electricity connection process?

Electricity connections require a number of different services. The DNO, the electricity supplier, heat pump installer and an electrical contractor need to be contacted and involved.

Heat Pump Installation



DNO

Provision of required network capacity and electrical infrastructure

Electricity Supplier

Installation of meter to the property

Suitably Qualified Contractor

Heat pump installation

When? Who? Why?

The following steps should be followed when considering the installation of any charge point: -

1

- Identify some possible properties and locations
- Decide on the number and type of heat pump(s)
- Make initial contact with your DNO to submit an enquiry and discuss network capacity at the locations concerned or request guidance for alternative locations
- Appoint an electrical contractor for the heat pump installation

2

- Download the ENA EV and HP Application form from the Electrical Network Association website, you will need your MPAN number which you can obtain from your electricity bill
- Submit a map where the preferred location is marked with a circle rather than a specific point
- For multiple applications, prioritize the locations
- Provide your DNO with the technical data sheet for the heat pumps you are planning to install

3

- Receive, review and accept the DNO design and quotation received
- Appoint an electricity supplier who will bill for the electrical energy used
- Agree start and end dates for DNO works

4

- Energise your heat pumps(s)
- Operation and maintenance

Estimating connection cost and time

The new or retro fit of heat pumps to buildings can have an impact on the electricity network, this section provides illustrative costs and time for the power supply to be connected to different types of charge points including a column detailing the connection characteristics of multiple installations of Rapid charge points.

Heat Pump assume 6kW	Likely installation location	Typical approximate connection lead-times	Network and Third Party considerations	Approximate connection cost
House Looped service	Retro fit Domestic	Immediate in most cases	None	None
House No other LCTs fitted	Retro fit Domestic	Immediate in most cases	Usually none	Usually none
House Other LCTs fitted	Retro fit Domestic	4 to 8 weeks	Likely upgrade to service cable and local mains	£1,000 to £3,000
New House with LCTs	New Domestic	8 to 12 weeks	Streetworks and permissions	£2,000 to £12,000
New estate circa 120 houses complete with LCTs	New Domestic	16 weeks	Streetworks, permissions and cost of land for transformer	£70,000 to £120,000

Key points to consider

The cost and time for each heat pump project will always be location and application specific. Each project will have a planning phase, procurement phase, along with an installation and commissioning phase.

When planning a heat pump project, it is strongly advised that you contact your DNO early in the planning process. As a simple rule of thumb, in your timing plan, allow as much time for information exchange and dialogue with your DNO during the planning phase as you allow for installation and commissioning.

It is essential that the heat pump that you wish to purchase is identified and considered prior to making your order. Some equipment has a high impact on the electricity network whereas other types can be accommodated more easily.

Pre-procurement market engagement with candidate heat pump providers will also help, as they have years of experience when it comes to installation and commissioning and will be able to offer helpful advice.

Western Power Distribution (East Midlands) plc, No2366923
Western Power Distribution (West Midlands) plc, No3600574
Western Power Distribution (South West) plc, No2366894
Western Power Distribution (South Wales) plc, No2366985

Registered in England and Wales
Registered Office: Avonbank, Feeder Road, Bristol BS2 0TB

www.westernpower.co.uk

@wpduk