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Everything you need to know about our **Heat Pump Strategy**

June 2020

WESTERN POWER 
DISTRIBUTION

Serving the Midlands, South West and Wales

Foreword

We're turning up the heat on carbon emissions – and heat pumps are a key part of our plans to achieve net zero by 2050.

More than one third of the UK's carbon emissions come from heating so it's vital we create accessible and efficient solutions now.

Our latest heat pump strategy sets out how WPD will ensure that future heat pump owners are able to connect to the network in a way that suits them.

It also explains the rationale behind our current innovation projects and business initiatives, as well as how we're planning to turn early-stage solutions into 'business as usual' practice.

For heat pumps to work efficiently, they need to be installed in a building which is energy efficient and embraces the principle of 'energy efficiency first', including renewable heating technologies.

We realise the move to heat pumps won't happen overnight. It will take years to transform heating provision and habits, particularly as most domestic customers only replace heating systems when they fail, sometimes waiting as long as 12 years.

Add to this the fact that a climate neutral and circular economy is only possible with the full backing of industry.

At WPD, our job is to ensure the electricity network is ready to help deliver the change when homes and businesses are ready to make it.

To reach the key 2050 targets set by the government, it's time we all took a closer look at our carbon emissions and started to change our heating habits.

P. White

Peter White
DSO Development Engineer

What we do

Western Power Distribution is the electricity distribution network operator for the Midlands, the South West and South Wales.

Our job is to deliver a safe, reliable and resilient electricity network to our **7.9 million customers**. We do all this for **less than 30p a day**, investing almost **£900 million** in the network each year and **employing 6,500 highly-trained staff**.

This year, we've:

Added **2.9GW** of extra capacity by operating the network in a smarter, more efficient way



Taught **84,000** school children about electrical safety



Recruited **77** new engineering trainees



Achieved **91%** average customer satisfaction (the best performing electricity network operator in the UK for the last eight years)



Handled **two million** customer calls



Added **200,000** vulnerable customers to our Priority Services Register



Invested almost **£900 million** in the network



Served **7.9 million** customers



Achieved this for less than **30p** a day

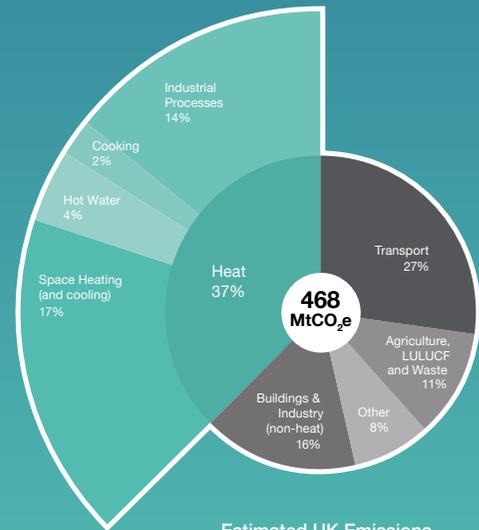


Heat pumps – why now?

We've set aside £6.1 million for heat pump installation between 2015 and 2023.

That's because we want our network to be ready for the challenge.

In fact, tackling heat emissions has been described as the most difficult decarbonisation challenge facing the UK. This large scale transformation will not only be expensive but will bring significant impact for consumers. An estimated **23 million** UK homes currently use gas as their main fuel – that's **84%** of all households. That means if there is no green gas solution for the current natural gas there will be a need to commission about **4,000** new heat pumps every day in the UK until 2050.



Estimated UK Emissions Attributable to Heating, 2016

The switch to heat pumps will also call for big changes to energy systems and markets.

With heat pump adoption increasing at the current rate, we expect more than 110,000 heat pumps to be installed on the WPD network by the end of 2023.

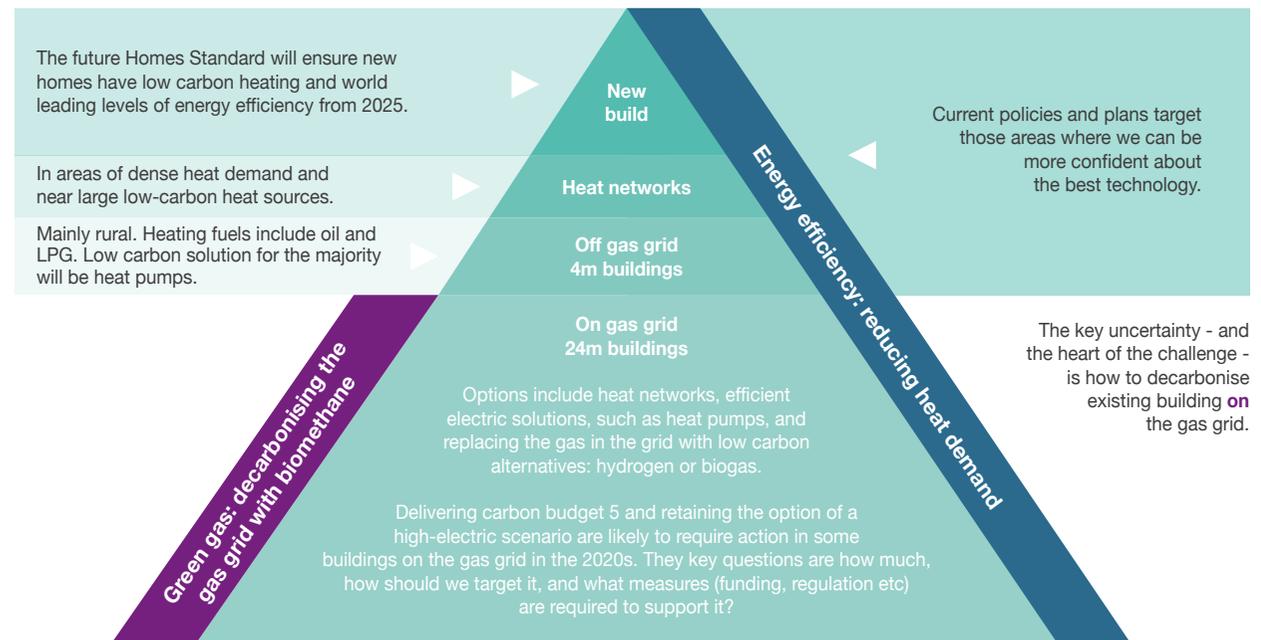
That's why we've been working on our heat pump planning for some time.

Making it our policy

The UK's objectives to reduce carbon emissions were set out in the government's Clean Growth Strategy and the Future Homes Standard.

In the Clean Growth Strategy, BEIS proposed to phase out the installation of high carbon fossil fuel heating in off gas grid properties by the end of the 2020s.

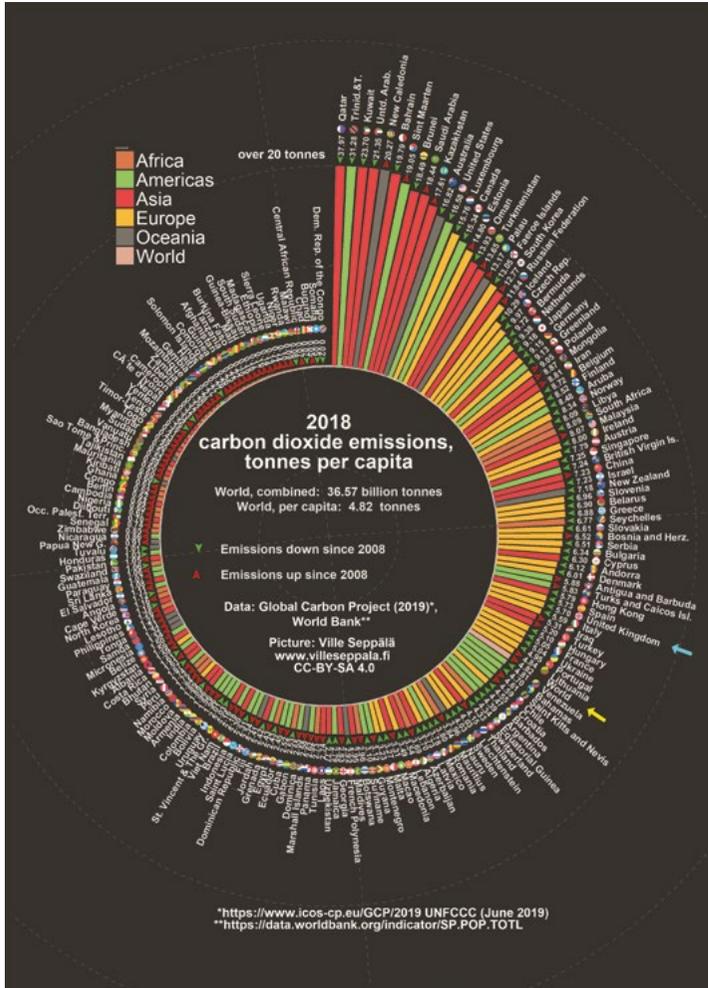
The Future Home Standard, to be introduced by 2025, will ensure new build homes are future-proofed with low carbon heating and world-leading levels of energy efficiency.



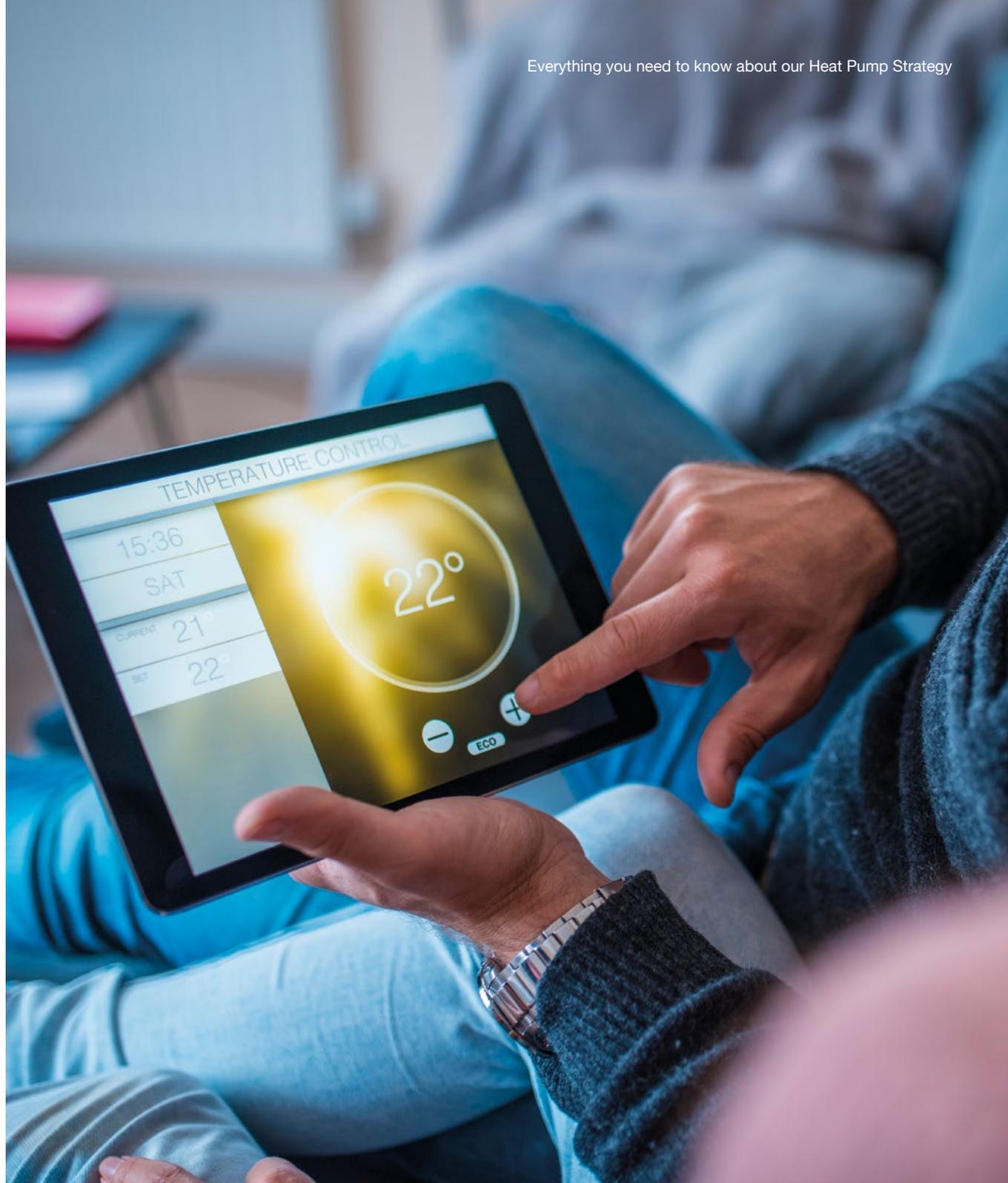
A useful reference can be found on the government's Clean Growth website.
www.gov.uk/government/publications/clean-growth-strategy

WPD builds networks with a 50 year lifespan so we need to take steps now to ensure the right networks are in place to meet future demand.

The graph below shows all the countries of the world and their respective 2018 CO2 emissions in tonnes per capita, with the UK identified by the blue arrow and the World average identified by the yellow arrow.



Graph courtesy ©Ville Seppälä. Data from Global Carbon Project 2019, carried out by the World Bank.



Heat pumps on the rise

Heat pumps are becoming more common in all our homes, both as new-build installations and retro-fits in existing homes.

In 2019 BEIS reported heat pump installations running at about 28,000 a year – but this trend has to increase if we're going to achieve net zero by 2050.

To meet these targets, circa 400,000 heat pumps will need to be installed every year to 2035 (see graph), according to the Committee for Climate Change (CCC). While the majority of these will be in new-builds, oil fired and LPG fired central heating will also need to be converted to heat pumps.

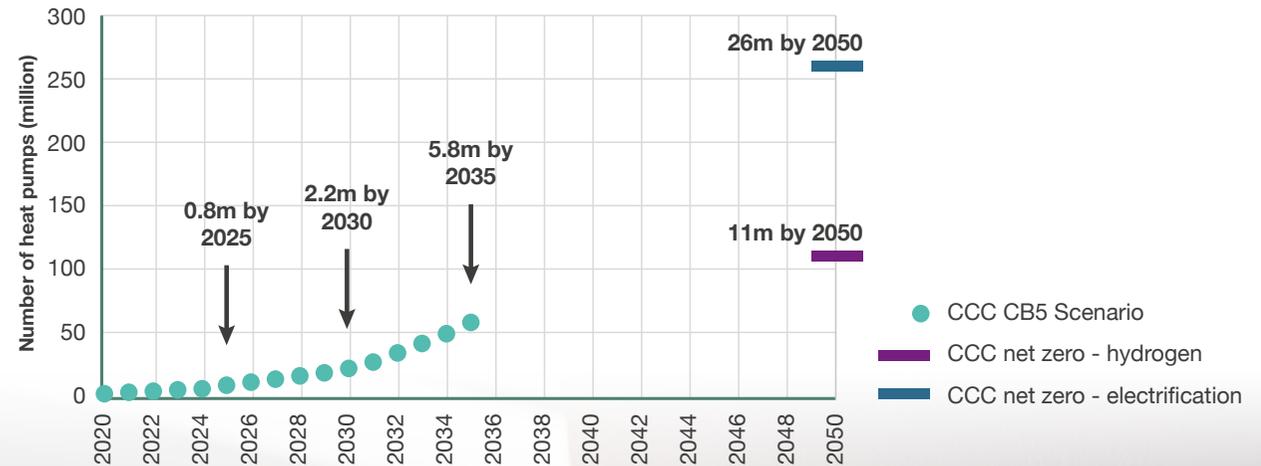
A typical air source heat pump retro fit takes about three days to complete.



Circa
400,000

heat pumps need to be installed every year to 2035 to meet the CCC targets.

Cumulative Domestic Heat Pump Installations



So, what is a heat pump?

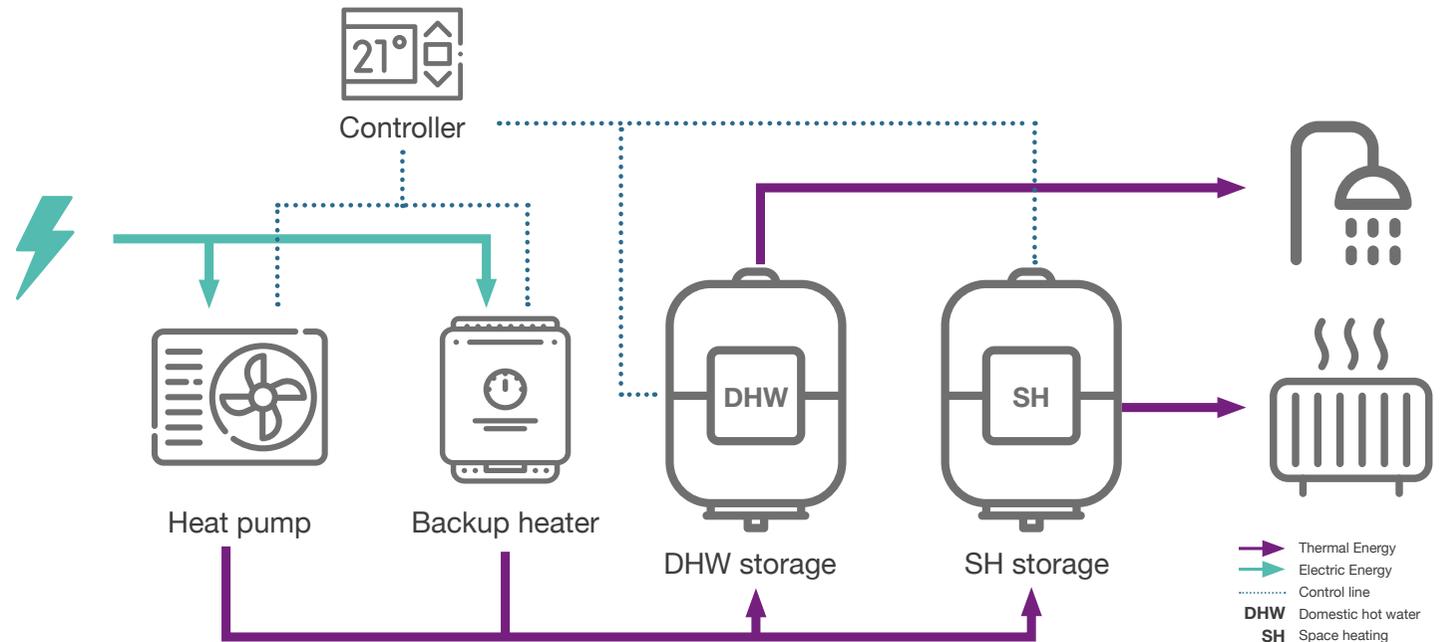
A heat pump is a device that uses a small amount of energy to move heat from one location to another. It is an energy efficient heating method.



Here's the science...

The term refers to a group of technologies that incorporate HVAC (heating, ventilation, and air conditioning) devices and provide heat energy that is transferred from a source of heat or warmth to a 'heat sink', effectively 'pumping' warmth from one place to another.

Heat Pump System



Heat pumps generate low grade heat compared to gas or oil fired central heating so need to run in a different manner.

They move thermal energy in the opposite direction to natural heat flow by absorbing heat from a cold space and releasing it into a warmer one.

Their primary function is space heating through radiators, underfloor heating systems, or warm air convectors. Heat pumps can also be used to heat water.

Most heat pumps have good climate control capabilities and can be used to provide space cooling by simply reversing the process of space heating.

In many ways, a heat pump functions in much the same way as a conventional air conditioner. It's basically an air conditioner that can reverse itself!

Cutting costs and emissions

To operate efficiently, a heat pump needs to be in a well-insulated house. If installed correctly in a suitably insulated house, a ground source heat pump could reduce household heating bills by up to 26%.

A detached house of 200m² with a typical condensing gas boiler costs £1,005 a year to heat and supply with hot water. An oil-fired boiler would push these costs up to £1,615 a year.

With a correctly installed ground source heat pump, heating and hot water for the same house would cost just £744 a year. (An air source heat pump would result in only very small savings compared to a gas boiler).

For some customers, hybrid heating and control technologies may be the most efficient solution, enabling them to combine an air source heat pump with their existing oil-fired or LPG-fired boiler.

This reduces emissions but also cuts the running costs of the heating installation.

The energy for change

Our job is to ensure our network can meet everyone's heating requirements. The principle is simple: the heat pump infrastructure requires higher volumes of energy and we need to be able to deliver that energy where it's needed.

Heat pumps are already being factored into our network designs for new build properties.

But, with retrofit installations, demand on the network will increase, often to a higher level than was predicted in our original designs.

That means mains cables may need to be upgraded and/or service cables reconfigured.

In areas where we anticipate high demands on service cables and/or 'clusters' of heat pumps, we are installing larger cables. New build substations are also being installed with larger cable sizes.

We've also helped develop a heat pump database run by the Energy Networks Association which brings together information on different makes and models to make the connection process easier.



A ground source heat pump could provide up to a

26%

reduction in household heating bills.

The rate of change

Energy efficient homes are easier to convert to heat pumps. (Homes are Energy Performance Certificate (EPC) rated A to G, where A is the most energy efficient and tends to apply to newer homes).

For the heat pump to work efficiently, homes with an energy rating of C or above should be considered for conversion.

Homes with an EPC rating of A can use smaller heat pumps which will run for shorter periods of time. For homes with a lower EPC rating of say G, the heat pump will be larger and is likely to run for much of the day.

In these cases, a heat battery such as a mixed storage tank would be needed to manage the 5 – 11pm peak load on the network.

There's an added complication with older gas-fired homes which often have a microbore pipework system for radiators.

Any homes with a microbore central heating piping system would need to be re-tubed before a heat pump installation could take place.

At WPD, we already understand the effect of heat pumps on the network from our work with early adopters of non-fossil fuel heating systems. We've seen more than 2,000 heat pumps installed across our four licence areas.



	Number	Capacity
Heat pump (<3.68kVA)	600	1.7MVA
Heat pump (>3.68kVA)	1,484	10.8MVA
Total heat pumps	2,084	12.5MVA

(Total number as at end March 2019)

Homes of the future

We are partners on a project estate of 250 homes in which each house has a complete suite of low carbon technologies (LCTs).

These include solar panels, battery storage, EV charging and heat pumps, all of which are managed by computer to provide optimal performance.

The monitoring of heat pumps and other technologies in these homes, which are part of a project with Sero and housing association POBL Group, will generate heating and domestic hot water profiles for each of the heat pumps across the length of the project.

These profiles will be used to plan solutions for peak load in similar settings across our network and will help to highlight where proactive reinforcement can help prepare the local networks for LCTs, particularly heat pumps and EV charging.

This will form part of our Distribution Future Energy Scenarios (DFES) which forecast how patterns of energy use will change and evolve in the future.



www.westernpower.co.uk/network-flexibility-map
and www.flexiblepower.co.uk

What's the plan?

Smaller heat pumps are likely to be accommodated on existing homes but larger installations of greater than 32A will often require a three phase service or other upgrades.

The cost and complexity of the electricity network required to support new heat pump installations will vary with size.

At a domestic level – for heat pumps less than 32A per phase – only minimal work will be needed to accommodate the heat pump. For larger installations and small district heating systems, new transformers and substations are likely.

The cost and works timescale will vary with the complexity of the works. We're also looking to speed up the installation process by making applications easier.

We've adopted the ENA application form which ensures consistency across all network operators.



24million

UK homes currently on the gas grid.

Heat Pump type and power output	Likely installation location and supply requirement	Specific connection requirements	Approximate connection lead time	Network considerations	Cost to customer
Up to 16A ≈ 3.8kW	Domestic – Single Phase	None – connects via household plug/socket	Immediate	None	None
Up to 32A ≈ 7.6kW	Domestic – Single Phase	Dedicated household circuit	Immediate in most cases	In some cases limited local reinforcement is required	Usually none
Greater than 32A Over 8kW	Domestic – Three Phase	Dedicated household circuit	4 – 8 weeks	Likely upgrade to service cable and local mains	£1,000 to £3,000
Greater than 32A (high capacity)	Large building – Three Phase	Three phase dedicated supply point	8 – 12 weeks	Requirement for three phase connection and likely local mains upgrade	£3,500 – £12,000



Ahead of the game

To enable us to design and extend networks that will remain in place for 50 years, it is vital we are informed of plans to install heat pumps or any other low carbon technologies by the installers. By planning the network efficiently, we can help to keep bills lower for everyone.

That's why we always look to predict future changes – including the adoption of low carbon technologies like heat pumps – and assess how we can reasonably accommodate them into our current plans and designs.

Work to futureproof our network is key to remaining ahead of demands. For instance, we're already increasing the minimum cable size for all new underground cable installations, to avoid the need for cable overlays as LCT take-up grows. We're also taking steps now to address technical issues related to heat pumps, such as thermal capacity, by increasing the size of service cables and transformers.



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Keeping you in the loop

We've put together useful and up-to-date guidance for customers who are considering installing a heat pump. This includes:



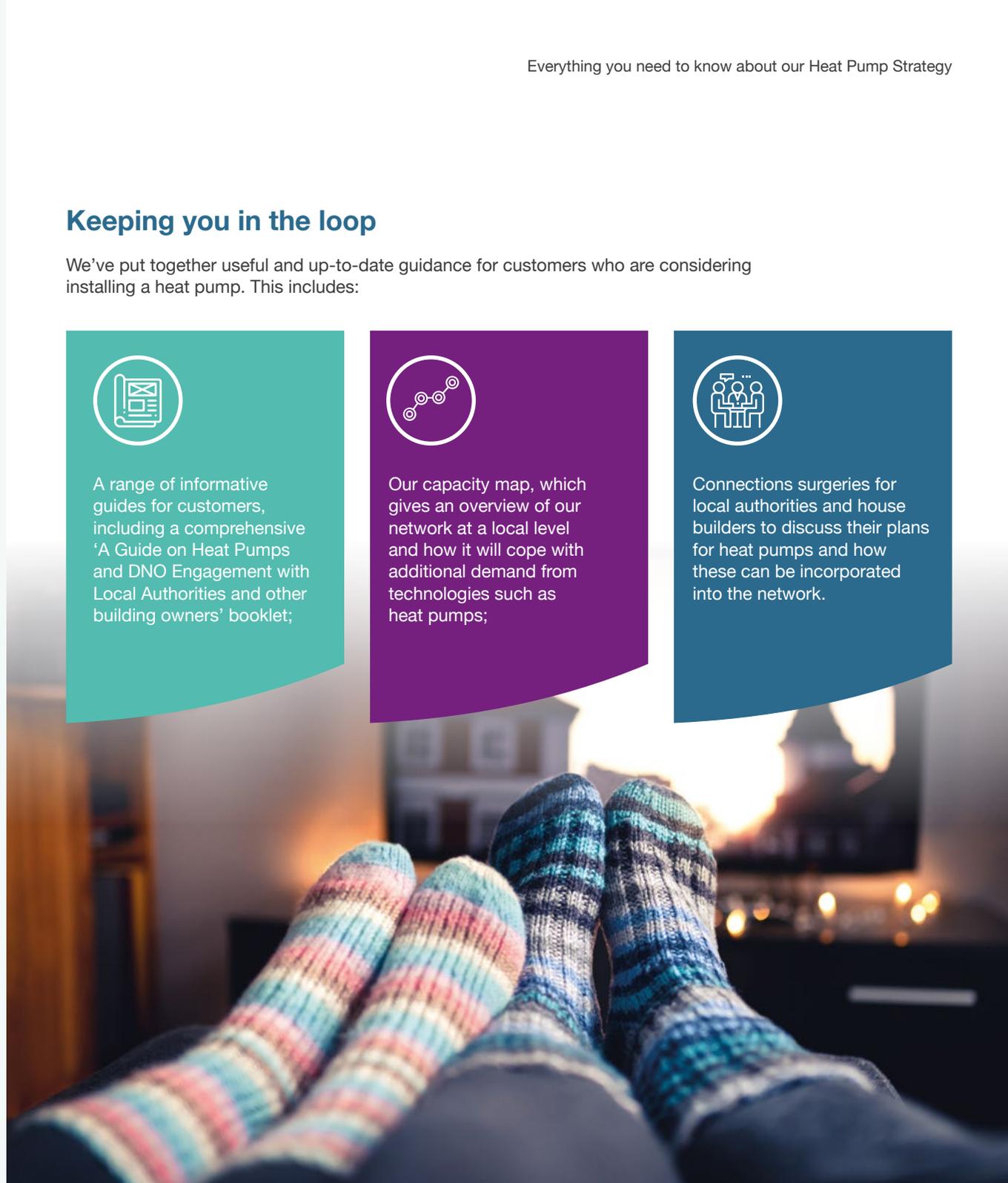
A range of informative guides for customers, including a comprehensive 'A Guide on Heat Pumps and DNO Engagement with Local Authorities and other building owners' booklet;



Our capacity map, which gives an overview of our network at a local level and how it will cope with additional demand from technologies such as heat pumps;

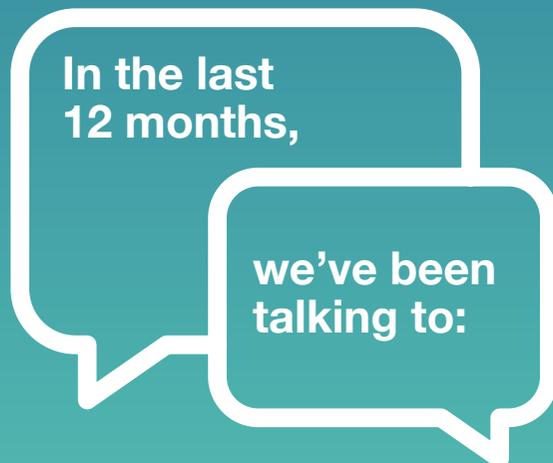


Connections surgeries for local authorities and house builders to discuss their plans for heat pumps and how these can be incorporated into the network.



Pump up the volume

We've been talking – and listening – to our stakeholders since 2010 about our plans for low carbon technologies, including heat pumps. If we're to meet our net zero targets by 2050, we need to keep these conversations going and make the argument for heat pumps loud and clear.



Local authorities

Due to the Covid-19 lockdown, WPD has been unable to undertake Local Authority stakeholder events. We plan to restart the Local Authority stakeholder engagement programme as soon as it is safe to do so – with heat pumps and decarbonisation of heat taking centre stage. WPD will play a crucial role in meeting the local energy needs of the communities we serve and helping them to meet their net zero targets.

By working closely with local authorities, we can ensure their future energy requirements are taken into account in our energy scenarios and future investment plans.

Housing Associations

Our work with POBL Group and Sero to monitor the use of LCTs in two new home projects will help to inform our understanding of, and future planning for, the use of heat pumps.

Housing design

We've been working with the Renewable Energy Association by sharing our plans to adapt house service cables to accommodate low carbon technologies, such as heat pumps.

This information continues to be important in discussions with planners and government departments.

Go Ultra Low cities

Three of the four Go Ultra Low projects – Nottinghamshire/ Derby, Milton Keynes and Bristol – are in our operating area.

We will work with each city at a local level to help them deliver their targets.

It's good to talk!

Welsh Government

WPD's projects in conjunction with POBL Group and Sero to demonstrate Superfast Electricity have all been developed with the help of the Welsh Government.

Local Enterprise Partnerships (LEPs) and Electricity Supply Areas (ESAs)

By meeting with local stakeholders from each ESA every six months, we ensure we understand their pipeline of projects and capture the correct data to feed into our investment strategies.

This data is shared with LEPs, local authorities and other stakeholders to help inform local energy plans.

UK Government

In line with the government's Clean Growth strategy, we're working hard to make sure our network allows new buildings to accommodate a full suite of LCTs.

We've also engaged with the British Standards Institution (BSI) and BEIS on smart device standards. These will enable LCT products to communicate with each other and be controlled to manage network demands. It is hoped that if these devices are managed properly they could help to limit fuel poverty.

You!

We have lots more conversations planned for 2020, including more stakeholder engagement sessions, many with a heat pump theme.

Due to the Covid-19 lockdown, WPD has been unable to undertake Local Authority stakeholder events. We plan to restart the Local Authority stakeholder engagement programme as soon as it is safe to do so, as stakeholder engagement forms a major part of WPD's operations.

Heat pumps in profile

We need to build a profile of heat pump users to determine how their patterns of energy use will affect the electricity network.

Our work with POBL Group and Sero is already helping us to create this profile for the most energy efficient, A-rated homes.

It is hoped that future projects will help to create a similar profile for less energy efficient homes and advance our plans for the retro-fitting of heat pumps.

We're also drawing on our wealth of experience in designing housing networks to ensure heat pumps can be accommodated in the most efficient and economical way.

Where upgrades are needed, we will use innovative solutions to find faster and more efficient connections. In many cases, our existing electricity network has the capacity to cope with the anticipated levels of heat pump activity.



Feeling at home



Many home owners don't know if their property is compatible with a heat pump.

We're working with the ENA LCT groups to create a UK-wide tool accessible to all customers, which will enable them to gauge the capacity of their service cable and whether it can cope with the demand of low carbon technologies.

Most new homes (built since the early 1990s) will be able to meet the added demands of a heat pump and other LCTs. If a property is connected via a looped service cable (which is not compatible with LCTs), WPD will remove this free of charge when a heat pump is fitted.

Clustering



We gather information from various sources on possible clusters of heat pumps and other LCTs to tell us where we need to reinforce the electricity network.

As an industry leader in responding to supply interruptions, we're looking at ways of implementing innovative temporary solutions where clusters pose a risk of network overload.

Smart and flexible

Heat pump technology is a great opportunity to reduce heating-related greenhouse gas emissions – but brings its own challenges too.

Potential peaks in demand from heat pumps could create problems in terms of available generation and network capacity.

That's why heat pumps need to be operated in a smart way, as part of a wider smart grid.

We're already using smart and flexible solutions to manage the network, harnessing the latest technology through our Flexible Power programme.

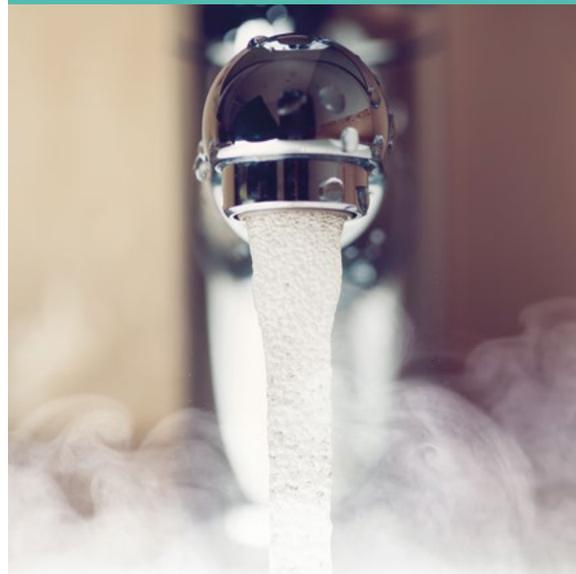
To manage the demands of heat pumps, we will continue working with customers to deliver innovative and flexible solutions.



Domestic flexibility

Only 7% of UK homes were built after 2000 – which means that many need to be adapted to accommodate heat pumps and their flexible operation.

The introduction of a simple heat store would make it possible to run a heat pump at non-peak times, introducing some flexibility into the existing housing market.



Whole system flexibility

Flexible heat pumps, storage heating and hot water tanks are a fundamental aspect of flexibility. They are key to achieving the net zero target without the need for expensive system-wide electrical storage or unnecessary network reinforcement.

We're looking at ways in which heat pumps can bring added flexibility to the system.

Projects

All of our projects are grounded in innovation and shared with our customers, to make sure we're working on the right blend of technical and flexible solutions.



£6.1 million

set aside for heat pump installation between 2015 and 2023.

Hot off the press – Future projects



Eastern Avenue Three Phase Heat Pump Project

Your home is your power station! As part of this project, homes will be fitted with solar panels and battery storage, as well as three phase heat pumps and three EV charging, turning each one into a mini power station. Each property will generate and store its own electricity. Where a home does not generate enough electricity, this will be extracted from the low voltage (LV) network at off-peak times.

All homes will be fitted with three phase service connections, rather than the usual single phase, to spread load and reduce energy losses.

The project will also help us to get a better picture of how heat pumps impact the network.



Smart Meter Load Control

This scheme follows our successful LV Connect and Manage project, continuing our work to ensure the LV network is not overloaded.

It will demonstrate how smart meters can be used to stop network overload.



Self-assessment

We're working with the Energy Networks Association to set up a centralised system that allows customers to tell us about their home – and for us to assess quickly if it is suitable to accept a heat pump or EV charger.

Projects

The heat is on – Current projects



Superfast Electricity Housing for the Future

The Superfast electric project in Tonyrefail uses three phase service cables and single phase devices, so it is still possible to get out of balance loads on the network, but to a lesser degree than a full single phase housing estate.

With the Eastern Avenue project which is using three phase supplies and three phase devices, then, merging the two project results will show that three phase services are the best solution for new housing estates.

Using this knowledge, we plan to amend our design policies to standardise on three phase service cables.



LCT detection

We're using artificial intelligence to find a way of locating differing types of LCT installations that have not been notified to WPD.

In partnership with Electralink and IBM, our LCT Detection project will give us the most up to date information on LCT take-up within the licence areas – and help to compensate for the failure of some installers to notify us when they have fitted new heat pump equipment.



Projects

Hot discoveries – Completed projects



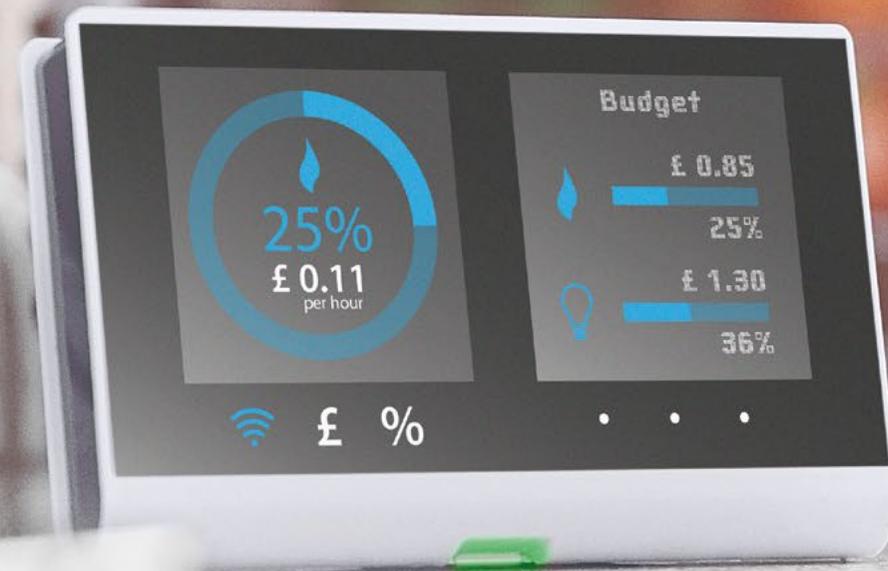
Freedom

The Freedom Project installed 75 PassivSystems smart hybrid heating systems in Bridgend, South Wales, as part of a two-year programme.

We teamed up with Wales & West Utilities (WWSU) and PassivSystems to turn the concept of low carbon domestic heating into a reality.

Using an air-source heat pump and high-efficiency gas boiler hybrid system in 75 residential properties, the project clearly demonstrated the value that an integrated approach to deploying low carbon smart technologies can deliver.

The project suggests that a hybrid approach to decarbonising our heating, combined with green gas growth, could lead to the total decarbonisation of domestic heat.



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