westernpower.co.uk

Heat Pump Strategy

June 2020

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Contents

1. Introduction

1.1. Our approach

This document sets out how Western Power Distribution (WPD) will ensure that future owners of heat pumps are able to connect to the network in the manner convenient to them.

It describes research, development and deployment activities carried out during the current electricity distribution price control period and planned for the futures. It also explains the rationale behind current innovation projects and business initiatives. Furthermore, it describes future activities including the transition of early-stage solutions into business as usual practice.

This document also documents WPD's vision for heat pump connections for a range of customer types.

It provides detail on the roadmap to achieve this vision.

For heat pumps to work efficiently the building they are installed in needs to be 'energy efficient', the 'energy efficiency first' principle should apply to all, including renewable heating technologies.

This is best defined in the implementing Regulations of the Ecodesign Directive 2009/125/EC, which set minimum energy efficiency requirements.

The impact of CO2 emissions is being mainly addressed through the decarbonisation of heating and transport. Tackling emissions from heating will need to be considered in the same way as we are already dealing with transport emissions. During 2018 an estimated 38% of CO2 emissions[1] in the UK were from the heating.

Achieving a climate neutral and circular economy requires the full mobilisation of industry. It takes many years to transform heating provision, with many domestic customers only replacing heating systems on failure or at the end of a 20 year lifespan.

To reach the 2050 targets set in the Governments Clean Growth Strategy and the Future Homes Standard WPD need to ensure that the availability of the electricity network helps make that societal change.

[1] Page 3 of BEIS 2018 UK Greenhouse gas emissions provisional figures March 2019.

1.2. High Level Government Objectives

The Government's Clean Growth Strategy and the Future Homes Standard set out the UK's objectives to reduce carbon emissions. In the Clean Growth Strategy, BEIS propose it would phase out the installation of high carbon fossil fuel heating in off gas grid properties during the 2020's.

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 Governments Clean Growth website: -

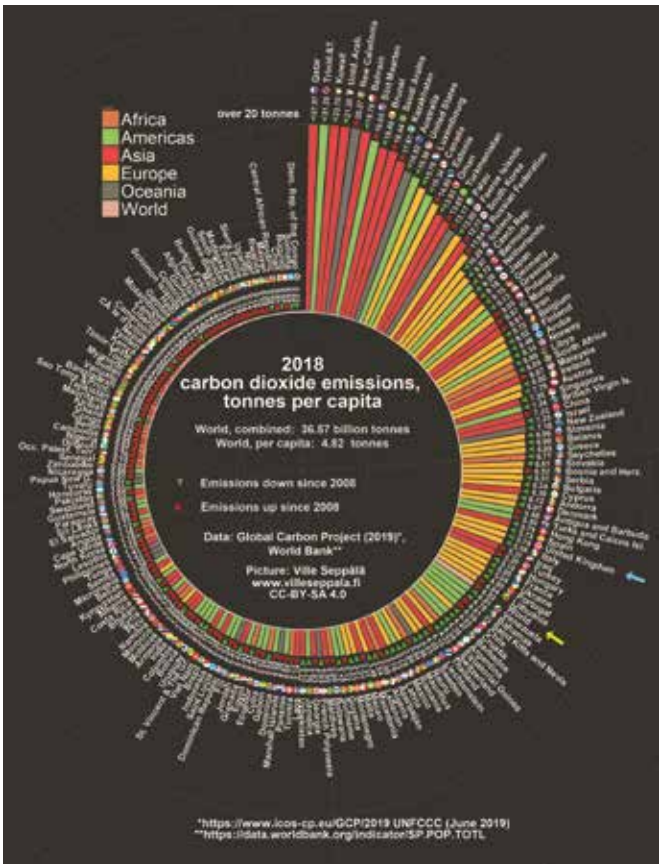
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766109/decarbonising-heating.pdf

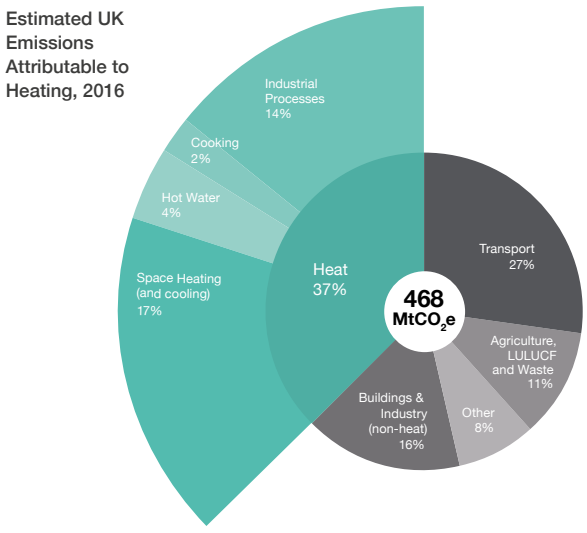
The UK electricity networks need to be ready to accept this additional demand.

WPD build networks with a 50 year asset life so steps need to be taken now to ensure that the right networks are built for foreseeable future demands.

The graph shown opposite shows all the countries of the world and their respective 2018 CO2 emissions in tonnes per capita.

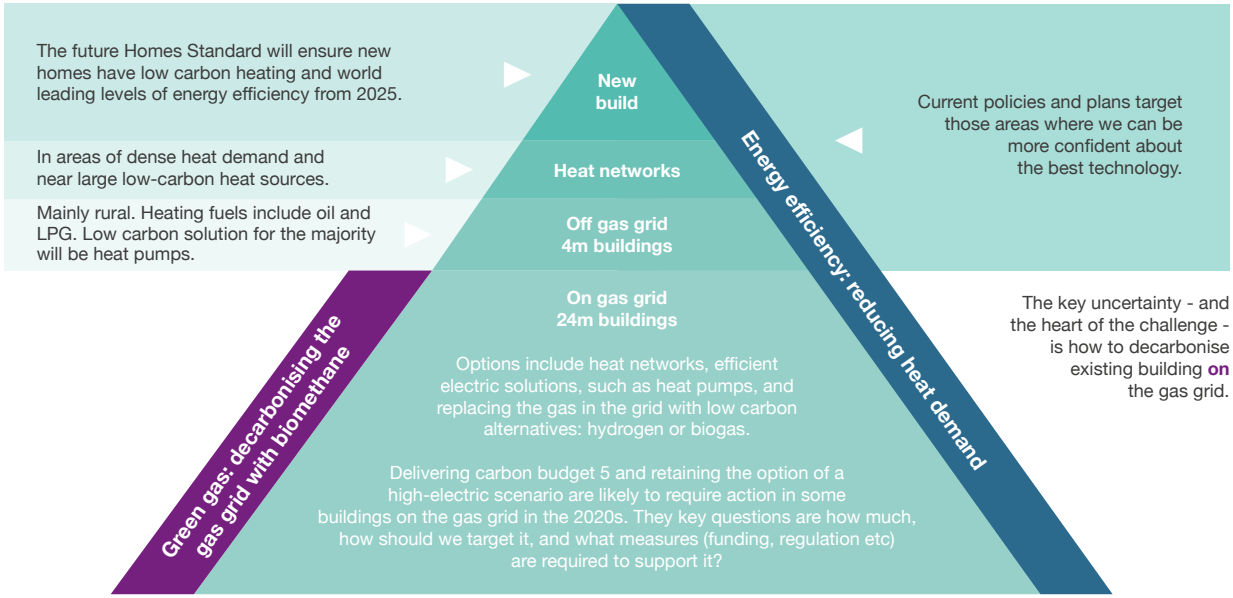
The data for the graph comes from Global Carbon Project 2019, carried out by the World Bank. The graph from ©Ville Seppälä has two arrows, one yellow = world and the other blue = UK, showing where the UK was in relation to the world average.





The Stern Review, Economics of Climate Change (2006), states that the benefits of strong and early action far outweigh the economic costs of not acting, as heat pumps meet the low carbon budget. It also points out that the government needs to define what its heating strategy as soon as possible so that all interested parties can then act with 'no regrets'.

The governments Clean Growth Strategy identifies heat as the most difficult decarbonisation challenge facing the UK. It will be costly, involve large scale transformation and with that significant consumer impacts, and wide ranging changes to the energy systems and markets.



Heat Pumps (HPs) are becoming more commonplace on our houses, be they new-build or retro fit installations. The trend towards heat pumps is set to continue and increase as the UK adopts the governments Clean Growth Strategy and the Future Homes Standard.

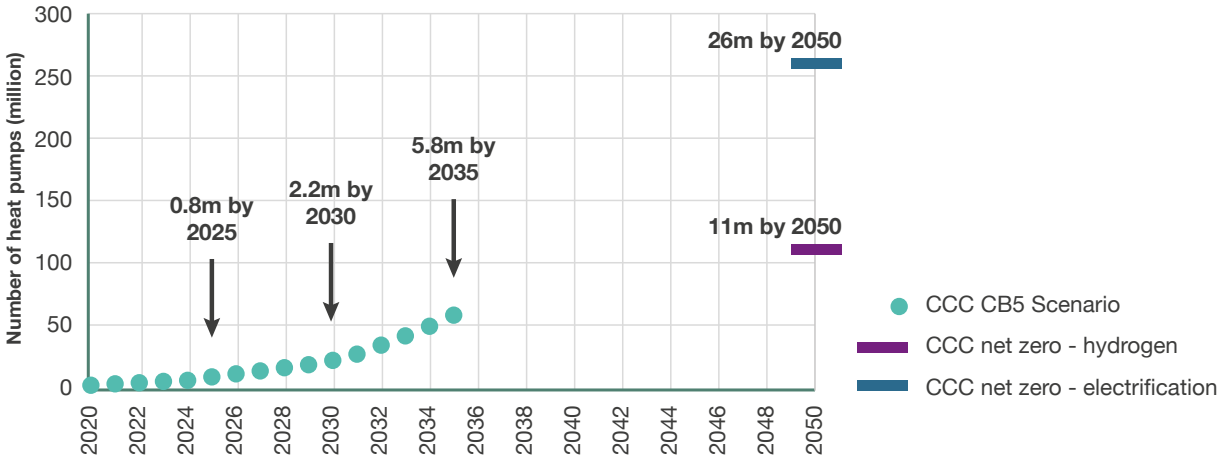
Data produced by BEIS in November 2019 states that current heat pump installation rates in the UK are circa 28,000 per year, these installations are almost split evenly between retro fits and new build properties.

The government have stated that[2] they want the UK to remain a global leader in bringing down greenhouse gas emissions, and the major objective is to help the country rise to the challenge of cutting emissions to net zero by 2050.

The graph below shows where the Committee for Climate Change (CCC) estimate that for their central scenario CB5 to be met then 300,000 heat pumps need to be installed per year. Whilst the majority of these heat pumps would be provided via the new build market, it will also require a transition from oil fired and LPG fired central heating which are off the gas grid to be converted to heat pumps.

Using National Grid's Future Energy Scenarios by 2050 around 23-26 million gas fired central heating installations need to be converted to heat pumps to meet the criteria set out in the governments Clean Growth Strategy, assuming that hydrogen is not being injected into the gas network. That equates to approximately 4000 heat pumps being commissioned per day till 2050 within the UK. It should be noted that a typical heat pump retro fit takes circa 3 days.

Cumulative Domestic Heat Pump Installations



[2] Page 5 of the UK Low Carbon Transition Plan, national strategy for climate and strategy

1.3. General Heat Pump information

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.

The term 'Heat Pumps' refers to a group of technologies that incorporate HVAC (heating, ventilation, and air conditioning) devices that provide heat energy that is transferred from a source of heat or warmth, to a destination called a heat sink, effectively 'pumping' warmth from one place to another. Heat pumps move thermal energy in the opposite direction of natural heat flow by absorbing heat from a cold space and releasing it to a warmer one.

The primary function of heat pumps is space heating through radiators, underfloor heating systems, or warm air convectors, heat pumps can also be used to heat water for use in the home or business. Most heating 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 is functionally the same as conventional air conditioners. It's basically an air conditioner that can reverse itself.

To achieve this heat transfer Fluorinated gases (F-gases) are used in the compressor, these gases are greenhouse gases but are not designed to be emitted from the appliance (although in some cases they will leak and need to be appropriately dealt with at the end of the appliance's life). Some manufacturers are now using non F gas like R 290 to run in the compressor.

For example a detached house of 200m^2 which was built in 2010 in accordance to the relevant Building Regulations Standards would have a space heating requirement of 11,000kWh per year. In addition to the space heating, there is the domestic hot water (DHW) to account for, assume 4 people living in the house, would equate to an additional 4,000kWh per year. A typical condensing gas boiler performing at 85% efficiency would achieve this at around £1,005 per year, - £734 for space heating and £271 for DHW. An oil-fired boiler with a similar efficiency would cost about £1,615 per year. These prices are volatile as they are based on world markets.

A correctly installed ground source heat pump only providing space heating would typically have a Coefficient of Performance (COP) of 4.3, so to produce 11,000kWh of heat, the ground source heat pump would need 2,558kWh of electricity at a cost of £349.

Adding the DHW demand, the heat pump would raise the water temperature to 40°C, electric heaters could then be used to raise the temperature of the DHW to the required storage temperature.

This way the COP of 4.3 for the heating cycle maintained and the work rate of the electric heaters is reduced (at an effective COP of 1.0). The cost of DHW would cost about £395, reaching a total running cost of £744 per year - meaning a 26% reduction in annual running cost.

For a typical air-source heat pump, which runs either air to air or air to water, can be typically rated with an ambient outdoor temperature > 7°C although this rating is affected by actual temperature of the air. Data from the Met Office shows that the average UK temperature from November to March (2015-2018) was 5.78°C, this will mean the COP will be about 2.8.

This translates to the heat pump needing about 3,928kWh of electricity for space heating costing about £510 plus another £460 for the DHW, thus ending up with a total of £970 per year. The reduction in air source heat pump running costs would be of only 3.5% in comparison to a gas boiler.

Converting an existing LPG or Oil fired system to a Hybrid system is one method that can help by avoiding the high capital costs and delivering heat without creating capacity peaks on the electricity system is the hybrid heating and control technologies, these hybrid systems are an air source heat pump which is installed in parallel to the existing oil fired or LPG fired boiler, these systems can deliver low carbon heating solutions in homes that reduce CO2 emissions but keep the costs down for the customer.

One further important point that needs to be considered is that any home that has been plumbed with microbore tubing cannot be converted to any form of heat pump, unless all the microbore piping is replaced, with all the additional work and complexity that would bring.

1.4. WPD's approach to facilitate HP installation

As an electricity system operator WPD's approach is to ensure that a suitable electrical system exists for all the heating requirements in all situations. The principle is simple, the heat pump infrastructure requires higher volumes of energy and it is WPD's job to provide the conduit for this energy.

With new build infrastructure the network is designed to cater for the necessary load so heat pump demands can be built into our initial network designs. WPD's plans will vary depending on the application and we detail various different options in this section.

With retrofit installations of heat pumps the overall demand on the network will increase, perhaps to a level that was higher than the original design assumptions. Mains cables may need to be uprated. A legacy design approach where service cables were looped and shared between two properties will need to be re-configured so that the house or building being installed with a heat pump will have its own unique service cable supply. Where this is the case and a HP is to be connected the looped service will be removed at no cost to the customer.

It is expected that we will see high demands on the specific cables which supply local streets or to the service cables which feed individual properties and, especially where HPs are clustered, there is more chance of the network becoming constrained.

WPD are already installing larger cable assets on new build substations and areas that have been identified where the proactive uprating of cable networks is appropriate.

One of the idiosyncrasies of HPs is that different manufacturers have different methods of defining their equipment. To overcome this issue the Electricity Network Association has created a Heat Pump database which defines the various criteria and also assess the heat pump to ensure it meets the power quality, flicker, etc. criteria thus making the connection process easier for all including the DNOs. If an HP is offered which has not been pre-assessed into the database the details of the new HP will be assessed and included in the database.

1.5. Heat Pumps and Building design

Energy efficiency is assessed by Energy Performance Certificate (EPC) rating, where 'A' represents the best performing homes and 'G' the 'worst'. Homes with high EPC ratings will generally have high levels of insulation and efficient heating systems.

In broad terms, lower rated homes tend to be older, while higher rated homes tend to be newer due to increased Building Regulation standards.

Properties using off-mains fuels (LPG, oil or solid fuel) are more likely to have solid walls than properties using mains gas, electric or communal heating. EPCs were introduced in 2010 and off-gas homes are not only more likely to have a low EPC rating, but also less likely to have been improved.

Since the 1970s houses with gas fired central heating systems could have a microbore pipework system for the radiators, this poses a problem if the houses are to be converted to air source heat pumps, as the air source heat pump cannot cope with the back pressure created by the microbore system. This means that any existing house that has a microbore central heating piping system would need re-tubing for it to work with an air source heat pump.

With heat pumps offering low grade heat compared to gas fired central heating it means the building housing the heat pump needs to have an EPC rating of C or above. If the house is designed with say an EPC of A the heat pump will not have to run 24/7 to maintain the heat in the home and the size of the heat pump will be smaller than a house with a low EPC rating.

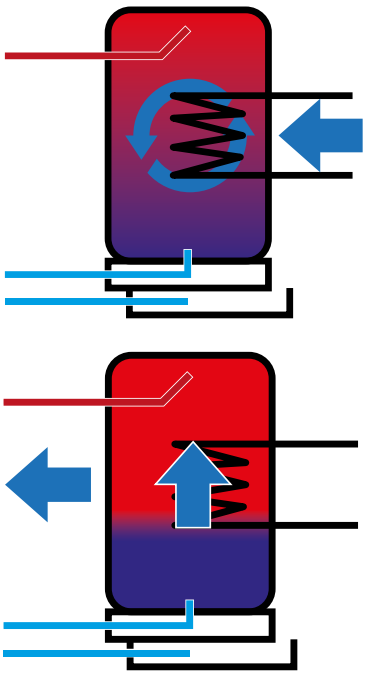
Houses with a low EPC rating will require a larger heat pump and the device is likely to be running most of the day, it's in these scenarios that some form of heat battery such as a mixed storage tank would be required to overcome the 5pm to 11pm peak load on the network.

The storage tanks domestic hot water (DHW) storage and energy storage tanks are categorized and calculated according to their mixing characteristics during charging and discharging phases.

A mixed storage tank maintains its temperature layering while in discharge mode, hot water withdrawal and has a minimal mixing zone in this mode. In the loading phase or reheating phase, the storage tank is ideally mixed due to convection.

A charging storage tank is characterised as a tank which maintains its temperature layering both in charging and discharging mode.

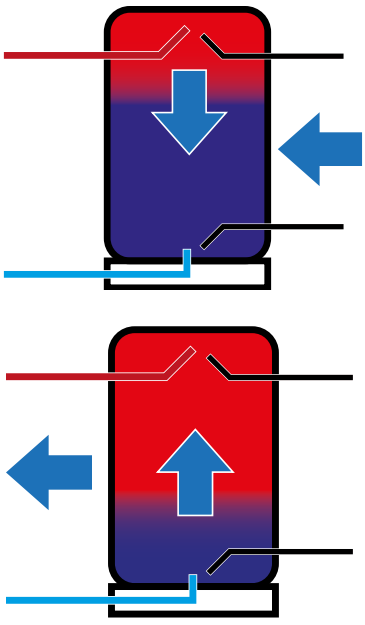
Figure 1 - Phases of a mixed storage system



a)
Charging phase of a mixed storage system

b)
Discharging phase of a mixed storage system

Figure 2 - Phases of a charging storage system



a)
Charging phase of a charging storage system

b)
Discharging phase of a charging storage system

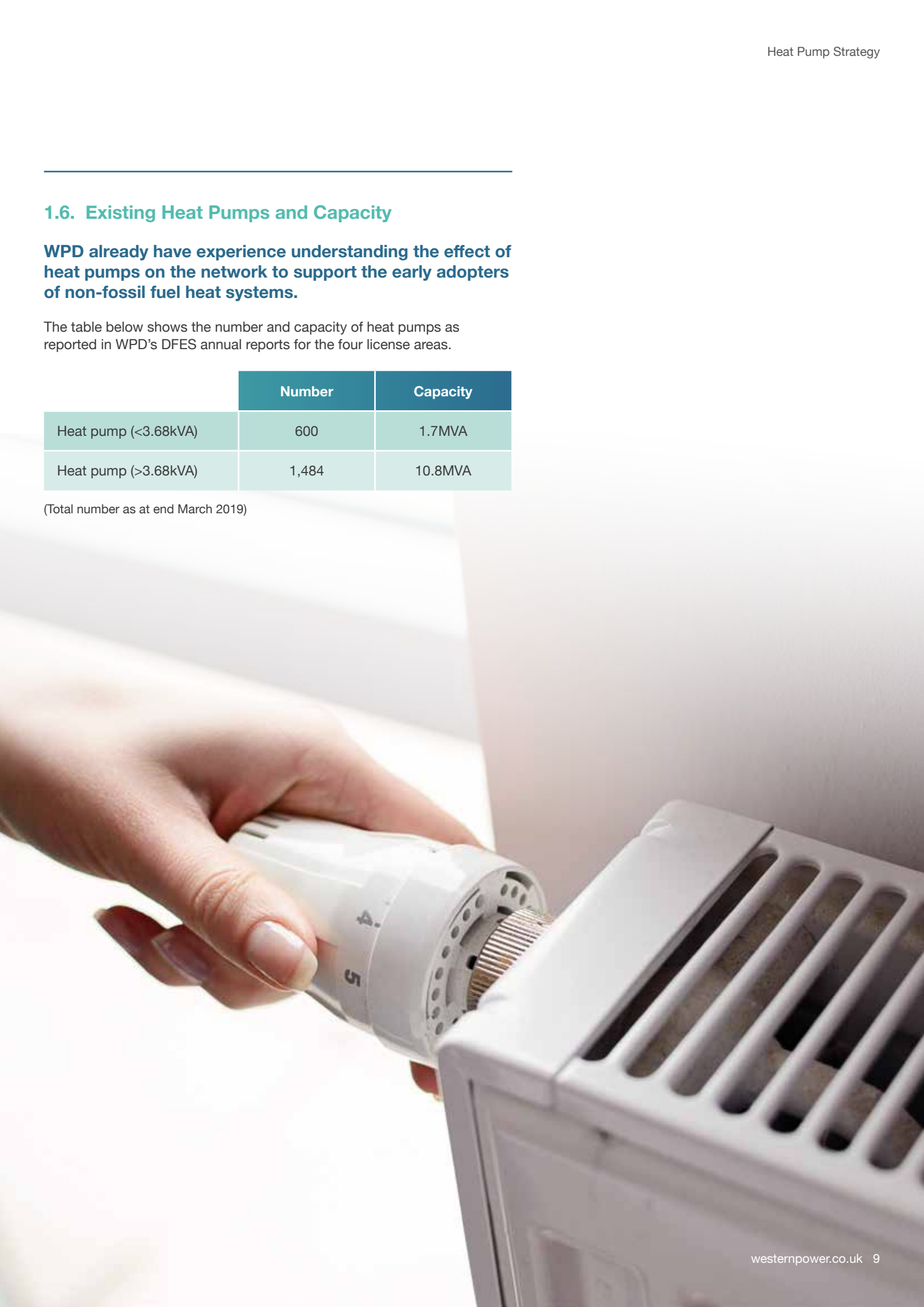
1.6. Existing Heat Pumps and Capacity

WPD already have experience understanding the effect of heat pumps on the network to support the early adopters of non-fossil fuel heat systems.

The table below shows the number and capacity of heat pumps as reported in WPD's DFES annual reports for the four license areas.

	Number	Capacity
Heat pump (<3.68kVA)	600	1.7MVA
Heat pump (>3.68kVA)	1,484	10.8MVA

(Total number as at end March 2019)



2. Forecasting and Data

2.1. Forecasting for the ED1 business plan (2015-2023)

In WPD's ED1 business plans, WPD used national forecasts to tailor scenarios for the four WPD license areas. In addition WPD worked with the Centre for Sustainable Energy (CSE) to deliver the "Who's on our wires" report. This added socio-economic factors to the national growth forecasts for all Low Carbon Technologies. For example, the numbers of heat pumps were predicted to grow in areas where the housing stock suits early adoption.

This means that it is highly likely that Low Carbon Technologies (LCTs) will be clustered closely together leading to a compound effect on specific parts of the network. This work led to our targeted uprating of assets when other works take place over around 7% of our network, in locations where we could be confident of load growth.

Since these scenarios were developed we have seen that the Department for Business, Energy & Industrial Strategy (BEIS) are targeting Oil fired central heating and LPG fired central heating systems. These heating systems are usually found in rural areas away from the gas main which are feed via single phase overhead lines, this set up would produce a cluster of heat pumps in the village or hamlet.

Data obtained from the Citizens Advice[3] builds a picture of heating mix in the UK. Of the 27 million homes in Britain, over 22 million use mains gas as their main heating fuel which creates a UK average of 84% of all homes. In total, 3.7 million homes in Britain use non-mains gas fuels for their primary heating. Around 2.3 million homes are heated by electricity (8.6%), just over 1 million homes by heating oil (4.1%), 198,000 homes by solid fuel 0.8%) and 187,000 homes by LPG (0.7%).

The current population of heat pumps within the four WPD licence areas is matching the ED1 business plan forecasts. With HP adoption increasing at the current rate, WPD expect over 110,000[4] heat pumps to be installed on the network by the end of 2023.

[3] Page 2 Off-gas consumers: Updated information on households without mains gas heating June 2018

[4] Information provided by Oli Spink from the DFES Two Degrees scenario for all DNO areas.

2.2. Developing Distribution Future Energy Scenarios (DFES)

Since 2016 WPD have been producing Distribution Future Energy Scenarios (DFES) at a license area level which predict the likely impact of HPs along with other new technologies.

The scenarios use a bottom up approach to provide future energy scenarios, at Electricity Supply Area (ESA) level, for the potential growth of distributed generation, electricity demand growth and electricity storage. These are then used to identify future constraints on the distribution network and develop strategic investment options to economically resolve those constraints, when triggered.

The analysis undertaken for each technology in the DFES involves the following four stages:

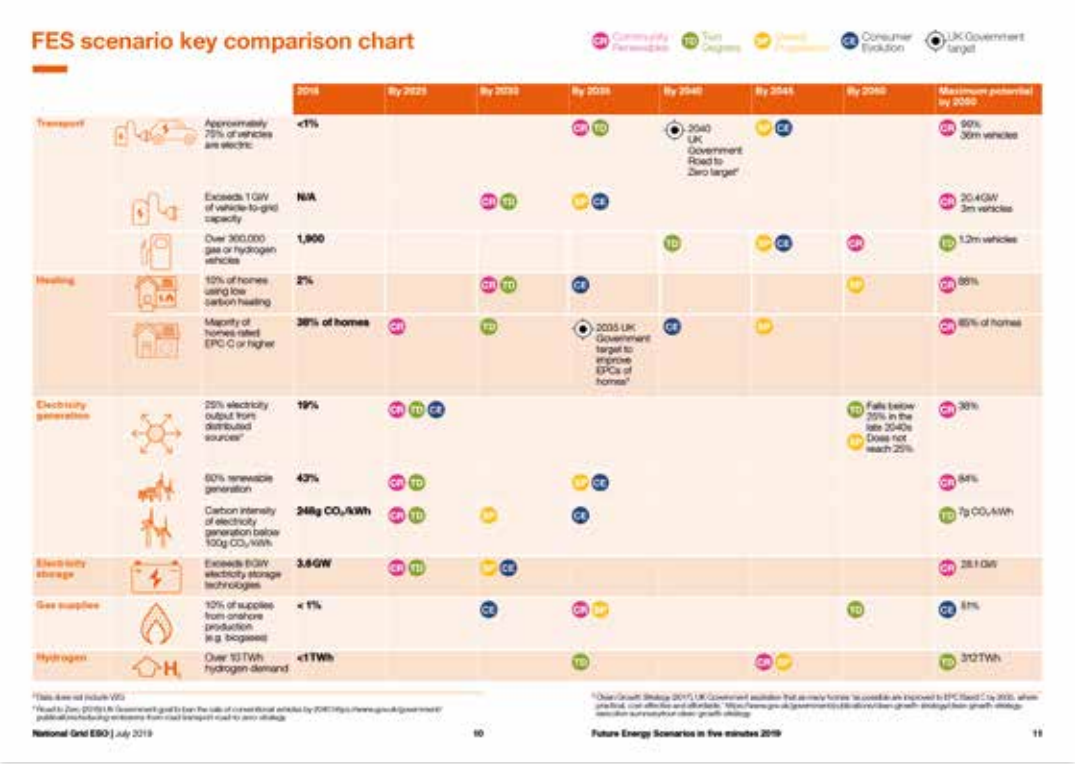
1 A baseline assessment. Technology baselines are calculated from WPD's network connection database. This information is then reconciled with other market intelligence and external databases. In addition, further desktop research is undertaken to address inconsistencies. For heat pumps the main data source is the Renewable Heat Incentive (RHI).

2 A pipeline assessment. For technologies with significant lead times WPD's network connection agreement database is reconciled with the BEIS planning database and market research is undertaken. This allows an assessment of which commercial projects in the pipeline may go ahead and in what timescale. Domestic scale and demand technologies do not have an individual pipeline, but local council economic plans are reviewed to derive volumes and locations.

3 Resource assessment. Locational data from a wide range of data sources and GIS analysis is used to understand the geographical distribution, local attributes, constraints and potential for technologies to develop within the license area and each ESA. For heat pumps this is further broken down into two types of heat pump, electric and gas back up (hybrid systems). The scenarios also break down the heat pumps into three categories - retrofit on-gas, retrofit off-gas and new build properties.

4 A scenario projection to 2032. The scenarios are based on National Grid's Future Energy Scenarios (FES) and interpreted for specific local resources, constraints and market conditions. Analysis of current market reports and the findings from a local consultation event is combined with interviews from developers, investors and other stakeholders.

In the latest report, WPD have aligned each of the scenarios with National Grid's 2019 FES, which has the following four scenarios: -



2.3. Heat Pump Growth Factors

National and local legislation will be key drivers of future heat pump growth in the licence area. The UK government Future Homes Standard will require new build homes to be future proofed with low carbon heating by 2025.

From a consumer perspective, the key hurdle will be price. Lower running costs are not yet balancing out the up-front costs, even with the current purchase subsidy. There is limited evidence relating to the actual whole life savings or resale value.

Despite the current barriers, the FES 2019 presents a much higher growth projection for heat pumps than FES 2018, reflecting that the UK government is committed to expanding the low carbon economy while hitting the carbon budgets. On 27 June 2019, the UK government set a legally binding target to achieve net zero greenhouse gas emissions from across the UK economy by 2050.

The two highest scenarios in FES 2019 (Two Degrees and Community Renewables) show 23 million gas fired central heating installations need to be converted to heat pumps to meet the criteria set out in the governments Clean Growth Strategy, assuming that hydrogen is not being injected into the gas network.

2.4. Investment allocated within ED1

Within WPD's ED1 submission £112m was approved for allocation intended for socialised reinforcement attributable to LCTs.

Of this over £6.1m was directly related to Heat Pump installation.

2.5. Forecasting local growth and pinpointing upgrades

In addition to WPD's DFES forecasting work, WPD are working with Sero and Pobl Group, a housing association, to build approximately 250 new build homes which will be fitted with the complete suite of low carbon technology including Solar Panels, Battery Storage, EV charging and Heat Pumps.

The houses will be fully monitored thereby enabling the generation of space heating and a domestic hot water profiles for each of the heat pumps across a day or a year. WPD plan to use all the profiles to create a typical After Diversity Maximum Demand (ADMD) for EPC grade A houses.

ADMD is used in the design of electrical distribution networks where demand is aggregated over a large number of customers. ADMD accounts for the smoothing of peak load a network is likely to experience. This data could then be used by Network Strategy when they undertake the four license area DFESs.

The tool will be developed to help highlight where proactive reinforcement can help prepare the local networks for LCT connections and specifically EV and HP connections. WPD will use this tool to support the business plan submissions for network upgrades.

2.6. Forecasting ED2 and informing specific ED1 plans

WPD's DFES is being used to target flexible solutions, this is found at: -

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

Where they offer better value than conventional reinforcement. Load estimates will consider all demand growth but this will always include an element of EV and HP growth. For higher voltage networks this educates and directs WPD's reinforcement plans being considered in the next few years. For WPD's local networks the scenarios can help refine the LCT hotspots identified by our CSE work.

The UK government Future Homes Standard will require new build homes to be future proofed with low carbon heating by 2025.

3. Planning and Capacity Availability

3.1. WPD's expectation of Heat Pump installations

The size and type of HP varies with the size and or type of building. Smaller size HPs are expected to be seen in domestic situations where the house EPC value is A, B or C. Larger HPs will be seen at with buildings which have an EPC of D or lower.

Heat pumps up to 32A per phase to WPD's low voltage distribution system are likely to be accommodated on existing house services but larger installations of greater than 32A will often require a three phase service or other upgrades.

Heat Pump type and power output	Likely supply requirement	Likely installation location	Specific connection requirements	Network considerations
HP up to 16A ≈ 3.8kW	Single Phase	Domestic	None – connects via household plug/socket	None
HP up to 32A ≈ 7.6kW	Single Phase	Domestic	Dedicated household circuit	In some cases limited local reinforcement is required
HP greater than 32A Over 8kW	Three Phase	Domestic	Dedicated household circuit	Likely upgrade to service cable and local mains
HP greater than 32A (high capacity)	Three Phase	Large building	Three phase dedicated supply point	Requirement for three phase connection and likely local mains upgrade

3.2. Estimating Connection cost and timescale

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

At a domestic level i.e. less than 32A per phase only minimal works will be required to accommodate the heat pump but 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 as detailed overleaf.

Heat Pump type and power output	Likely installation location	Approximate connection lead-time	Network considerations	Approximate customer connection cost
HP up to 16A ≈ 3.4kW	Domestic	Immediate	None	None
HP up to 32A ≈ 7.6kW	Domestic	Immediate in most cases	Usually none	Usually none
HP greater than 32A Over 8kW	Domestic	4 to 8 weeks	Likely upgrade to service cable and local mains	£1,000 to £3,000
HP greater than 32A	Large building	8 to 12 weeks	Street works and permissions	£3,500 to £12,000

It should be noted that in a retrofit situation it typically takes three days to plumb in an air source heat pump to an existing gas or oil fired central heating system.

3.3. Simplifying the application processes

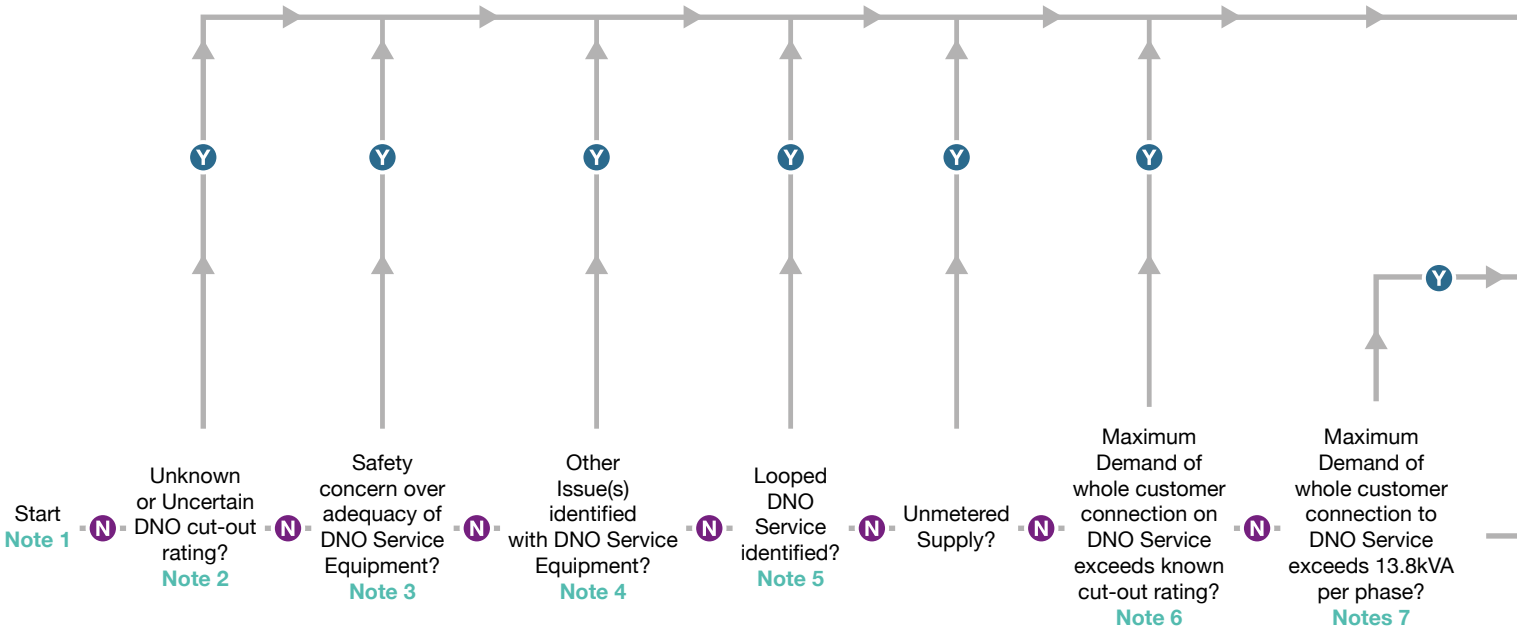
WPD have adopted the ENA application form for both EV and Heat Pump applications. This form helps customers by offering consistency across all DNOs.

The installer of any LCT infrastructure needs to follow the application process which can be defined in two ways: -

1. Where the connection of the LCT is LESS than or equal to 32A; or
2. Where the connection of the LCT is GREATER than 32A.

With both of these connection procedures there should be no identified adequacy or safety concerns with the properties existing LV service equipment.

Electric Vehicle & Heat Pump Process



Note 1:
This process should be used for premises with an existing DNO connection. For new DNO connections, this process should be followed in addition to a new electricity connection application.

DNO Service Equipment comprises DNO service cable, DNO cut-out (service head) and DNO earth terminal.

Note 2:
If the cut-out rating is unknown or uncertain, it can be established by raising an enquiry with the DNO. If the supply capacity still cannot be established, the 'Apply to Connect' process must be followed. Please note that the cut-out should not be opened. Guidance on cut-out ratings is available on the ENA website.

The rating of the DNO service equipment must be established as adequate. BS 7671 – the Wiring Regulations – gives 132-16 'Additions or alterations to an installation': 'No addition or alteration, temporary or permanent, shall be made to an existing installation, unless it has been ascertained that the rating and condition of any existing equipment, including that of the distributor, will be adequate for the altered circumstances.'

Note 3:
Safety concern over adequacy of DNO Service Equipment Safety concerns over adequacy of DNO Service Equipment should be reported to the DNO in accordance with the MOCOPA Service Termination Issues Guidance available on the MOCOPA website: https://mocopa.org.uk/wp-content/uploads/2018/03/MOCOPA-guide-version-3.5.pdf

The guide gives specific examples of issues that can give rise to danger, classified as "Category A Situations", and how these should be reported to the DNO. All emergency issues (Category A Situations) must be reported to the DNO using telephone number 105 (GB only).

Note 4:
Other Issue(s) identified with DNO Service Equipment Other issues with DNO equipment that do not necessarily give rise to danger are described in the MOCOPA Service Termination Issues Guide: https://mocopa.org.uk/ wp-content/uploads/2018/03/MOCOPA-guide-version-3.5.pdf

These issues are covered in the Category B and Category C Situations sections of the guidance document where specific examples are given of what is reportable to the DNO. All Category B and Category C Situations (non-emergency issues) should be reported to the DNO using their general enquiries number found on the customer's bill or online.

Note 5:
Some DNO cut-outs have more than one DNO service cable terminated in the DNO cut-out. Such a situation indicates a 'Looped Service' where there are one or more services connected via the cut-out.

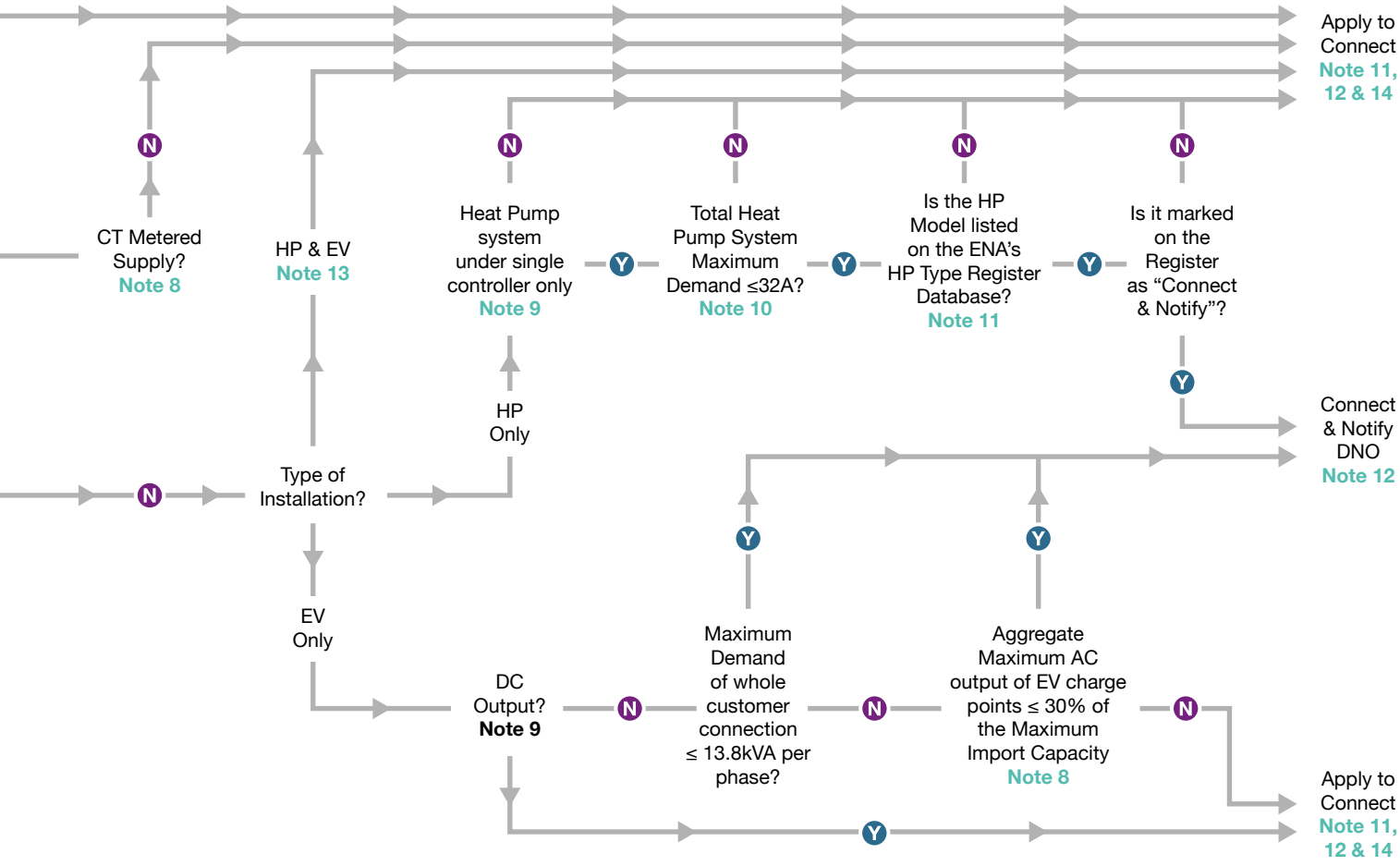
Note this may impact on the adequacy of the DNO Service Equipment. Looped services can be found anywhere, but are often found in rural areas and terraced housing.

Note 6:
Maximum Demand is the highest level of new demand that could occur on the whole customer connection, and includes all new HP and EV devices.

The maximum cut-out rating may be visible on the cut-out. Ratings below 60A are possible (e.g. 30A, 40A and 45A), especially in rural areas.

Note that the cut-out rating will be reduced from its stated value if the ambient temperature at the cut-out location is high e.g. due to inadequate ventilation, adjacent heat sources etc.

Note 7:
IET Guidance Note 1, Appendix H gives qualified electricians guidance on the assessment of Maximum Demand for the whole customer connection.



Note 8:
CT Metering is typically any meter rated at over 100A. This rating should be found on the meter name plate. CT metered installations are typically subject to a Maximum Import Capacity (also known as Agreed Supply Capacity).

Note 9:
Multiple heat pump systems or DC Electric Vehicle charge point installations must be 'Apply to Connect.'

This means a single heat pump system under a single controller (but potentially with multiple devices) being installed in one property in isolation, as opposed to a cluster of separate heat pumps in the same or adjacent properties.

Note 10:
Including any additional components, i.e. boost, back-up or immersion heaters. A boost heater is a Direct Electric Resistance (DER) heater to supplement heat output when the HP cannot provide the necessary heat located in the primary heating circuit. A water heater/immersion heater is a DER heater located in the sanitary hot water cylinder and used to top up heat or pasteurise for legionella control. A back-up heater is a DER heater that is capable of replacing all or some of the heat output from the heat pump in the event of the heat pump not being operational. This would be positioned in the primary heating circuit.

Note 11:
Please see ENA HP Type Register Database on the ENA website here: www.energynetworks.org/electricity/futures/electric-vehicles-and-heat-pumps.html.

It is the installers responsibility to provide all information required to populate the Heat Pump Type Register Database, as well as ensure any existing information within the Database is correct.

If the heat pump is not registered you must gather all of the required information and submit to ENA for inclusion in the Database.

NB: the Register is not an endorsement or recommendation of a particular heat pump model but is a means of simplifying the application and connection process.

Note 12:
Please note that to ensure you comply with GDPR requirements, applications and notifications should only be sent to the relevant DNO that corresponds to the MPAN.

Note 13:
With combined Heat Pump and Electric Vehicle Charge Point installations, the DNO will need to consider the Power Quality implications, and hence one must 'Apply to Connect.'

Note 14:
Depending on the size and/or number of devices being connected, the DNO may ask for additional information to be supplied.

Where the maximum demand of the whole customer connection is less than 23kVA, the DNO will respond within ten working days, assuming the complete set of required information has been provided.

3.4. Planning and Design Changes

When WPD design and extend the network it is expected that assets should remain in service for around 50 years, it is imperative that a heat pump installation and any other LCTs are notified to us. Notification of the heat pump installation to the DNO is a requirement on the customer/installer and helps WPD plan the network which results in lower bills for everyone.

This means that WPD always look to predict future changes and assess how WPD can reasonably accommodate the changes into the current plans and designs. WPD's ED1 plans looked at changes that could be made to support the adoption of LCTs.

Work which can future proof our network are key to remaining ahead of demands. On the WPD cable networks, the cost of excavation and reinstatement works are a large proportion of the overall costs so rather than potentially needing to overlay cables as LCT take-up increases, WPD increased the minimum cable size for all new underground cable installations. Similarly, when working at substations, the plant cost of transformers meant that WPD increased the minimum ground mounted transformer sizes with only a marginal increase in installed cost.

Both of these incentives partially, future-proof new networks at minimal increase in cost.

Connections which include PV, ES, HP and EV charging shall be designed with a network impedance that meets the WPD defined value at the point of common coupling (PCC), i.e. at the point where the customers system meets the WPD system.

Connections of PV, ES, HP and EV charging to existing houses where the houses are connected via a looped service cable shall not be connected until the looped service is removed. Where a connection supplies more than one LCT, no diversity shall be allowed unless load control is provided and verified by the relevant LCT installer to prevent the service and cut-out from being overloaded.

3.5. Technical Changes related to Heat Pumps

To permit the connection of heat pumps there are typically some technical aspects to overcome, including thermal capacity, power quality and harmonic emissions.

All these issues are covered off in WPD's Standard Technique documents in the SD5G suite.

These Standard Technique documents describe WPD policy for processing the applications from customers, or their nominated installer, for the installation and connection of individual or multiple LCTs (Electric Vehicle Charge Points and/or Heat Pumps) where any items have a rating greater than 32A per phase, onto WPD's low voltage distribution system.

WPD use the information provided by the customer or installer to assess the suitability of the existing network to supply the Electric Vehicle charging or Heat Pump infrastructure.

Suitability will be based upon the network's susceptibility to voltage fluctuations, flicker and harmonic voltage distortion, as well as ensuring it is kept within the designated thermal and voltage limits.

3.5.1. Thermal Capacity

To assist with thermal capacity, i.e. the ability to carry more load within the low voltage network, WPD have increased the minimum size of the low voltage mains cable to have a cross sectional area of 185mm^2, increased the minimum size of service cables to 25mm^2 Copper or 35mm^2 Aluminium. The smallest rated ground mounted transformer has increased to 500kVA and the smallest rated pole mounted transformer to 25kVA single phase.

3.5.2. Power Quality

As Heat Pumps use power electronics which can cause interference and possible damage to the electricity network there is a need to ensure these installations comply with BS EN 61000 Part 3-2, Part 3-3, Part 3-11 and Part 3-12. As a result the ENA have created a Heat Pump and EV charger data base, where the heat pumps have been assessed for compliance to the relevant standards and the results recorded for all DNOs to use, this pre-assessment will take into account the effect of the harmonics and power quality.

Once the heat pump has been assessed by the ENA the DNO only requires to undertake a thermal or load assessment of the local network where the heat pump is to be connected, thus reducing the time the host DNO will require to assess the installation.

4. Providing information to Customers

4.1. Guidance and Advice Documents published

WPD have developed a guidance document for local authorities and customers who are considering converting or installing heat pumps into their properties.

WPD's "DNO heat pump engagement for local authorities and customers guide" provides information specifically tailored to local authorities and customers wanting to connect heat pumps into housing stock. The guide covers some of the technical considerations related to heat pump installations as well as offering advice on how to make applications and discuss plans with us.

4.2. Guidance and Advice Documents planned

WPD have published a guide giving advice for heat pump installations, we will continue to review the number and content of our guides to help customers when they are considering heat pump options for their homes or businesses.

4.3. Capacity Indication for customers

WPD already offer a capacity map on the website which shows customers the level of generation capacity and demand capacity at our major substations.

WPD have extended the map to show the local substations and the local scope for connection of generation capacity and demand capacity at a local level.

At this local level there will always be specific considerations which can affect WPD's ability to connect individual heat pumps, but this map will provide a generic view of the capacity which is available in local streets.

4.4. Connections Surgeries

Local authority and house builder customers have the opportunity to request one to one connection surgeries with our teams.

At a local level they will be able to discuss plans for heat pumps and how the electricity network can be adapted and updated to accommodate future plans.

5. Stakeholder Engagement

5.1. WPD's Approach to Stakeholder Engagement

WPD's approach to engagement varies depending on the requirements of individual stakeholders. In some cases a company level strategic engagement is needed and in other cases a more local engagement is required.

WPD provide front end service using locally based teams that are responsible for their local networks and the local customers connected to them. At this level a more informal engagement is the most efficient solution and complements the more formal strategic stakeholder engagement.

5.2. Business Plan Strategic Stakeholder Engagement

WPD have an excellent track record of stakeholder engagement across the range of topics contained within our business plans.

Since 2010 they have included elements of LCT readiness. In the early years the focus was on pragmatic steps we could take to support what was a small population of heat pumps.

The engagement sessions helped form WPD's plans and have also informed innovation projects related to heat pumps. In 2020 the strategic stakeholder engagement included a specific topic on heat pump readiness.

5.3. Strategic Engagement with local authorities

Local Authorities are beginning to take the lead on installing and retro fitting heat pumps in buildings & housing association sites.

WPD have published a heat pump guide for local authorities and customers to help them with their plans.

5.4. Local Engagement with local authorities

WPD will be directly engaging all 130 local authorities in our area during 2020 on their local energy plans.

Whilst this will cover all LCTs, heat pumps and decarbonisation of heat will be a major topic.

A key aspect of this will be the crucial role WPD has to play in meeting the local energy needs of the communities we serve. This is set to increase further as local authorities set their own Net Zero targets and build energy plans.

We will be outline WPD's current future energy scenario modelling, how it has been developed and the predicted technology volumes for your area. We also hope to understand Local Authority's plans for decarbonisation and any current local energy development plans which are in place. We want to ensure future energy requirements are accounted for within WPD's energy scenarios and future investment plans.

5.5. Engagement for Housing Associations

WPD have engaged with Pobl Housing Association and Sero with a new build of approximately 250 houses using single phase heat pumps and a new build of 210 houses where three phase heat pumps and other LCT devices are being fitted to the houses.

These will be full monitored for some two years so that learning can be gained on the heat pumps and the other LCT devices, both these projects will have new service cables designs where three phase will be feed to each house with a view to help reduce the losses when compared to single phase supplied houses.

5.6. Engagement for housing design

WPD's plans to change the house service cable designs, have been included in reports compiled by the Renewable Energy Association as a part of their works to lobby government and planners.

WPD were pleased to share stakeholder engagement with them on this subject and are continuing discussions with relevant government departments.

WPD's Superfast Electricity project was developed in conjunction with Pobl Housing Association and Sero, an innovative Welsh based provider of Energy Positive homes.

5.7. Engagement with the UK Government

WPD and various other parties are involved with BEIS in their Stakeholder engagement, this engagement has been brought about by the Governments Clean Growth Strategy which details the de-carbonisation of heat and transport.

WPD are trying to ensure that to meet the challenges of the Clean Growth Strategy that new buildings should also accommodate the complete suite of PV, ES, HP and EV charging of LCTs thus providing a holistic approach.

WPD have engaged with the BSI and BEIS on Smart Device Standards which will allow products to communicate with each other and be controlled to manage network demands. The various projects undertaken with Sero and Pobl will show the merit of having a common standard for smart devices within the home. As one of objectives of these projects will be to try to limit fuel poverty for the householders.

5.8. Engagement with the Welsh Government

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

WPD were able to engage early with the Welsh Government and have followed their plans for decarbonisation alongside UK Government plans.

5.9. Engagement with Go Ultra Low Cities (GULC)

Three of the four Go Ultra Low cities, Nottinghamshire & Derby, Milton Keynes and Bristol, are within our operating area.

Bristol in particular have held numerous discussions about de-carbonizing heat in their buildings.

Using many of the specific delivery plans listed above, we will work with each city at a local level to help them deliver their targets.

5.10. Engagement with Local Enterprise Partnerships (LEPs) and Electricity Supply Areas (ESAs)

Ensuring WPD's future network investment plans are aligned to developments being planned at a local level is a key priority for WPD as a distribution business.

The four Electricity Supply Areas in WPD are local areas which match our higher level network feeding areas. We engage with customers in an each ESA to build our plans for high level network growth.

Every 6 months, under WPD's Strategic Investment Options work, workshops are undertaken with local stakeholders from a licence area to understand their pipeline of projects and ensure WPD are capturing the correct data to feed into the investment strategies.

WPD then build a bottom up vision of demand, generation and storage growth by absorbing the locally published plans and other market intelligence to enable WPD to study the network under future growth scenarios.

The data that accrues is also shared back with Local Enterprise Partnerships, local authorities and other stakeholders and has been used to inform local energy plans. The aim is to ensure that the LEPs future energy requirements are accounted for within WPD's energy scenarios and future investment plans.

5.11. Stakeholder Engagement Plans for 2020

WPD will continue to engage with the UK Government through BEIS and their Clean Heat Team.

Due to the Covid 19 lockdown WPD has been unable to undertake Local Authority stakeholder events, once the Covid 19 lockdown has been removed WPD will restart the Local Authority Stakeholder engagement, as Stakeholder engagement forms a major part of WPDs operations.

6. Plans to support Heat Pumps

6.1. Profiling and Modelling

As the UK meets the challenge of the Clean Growth Strategy and the Future Homes Standard by de-carbonizing heating, the change in heat generation technology from fossil fuel towards heat pumps will lead to altered electricity demand profiles of buildings and neighbourhoods.

As a consequence of the low grade heat produced by the heat pump, electricity demand profiles will change on the houses that have been converted to heat pumps. The HP profiles from the project work WPD are involved with in Tonyrefail and Cardiff will generate profiles for space heating (SH) of the houses and a domestic hot water (DHW) of the houses.

Each house will generate two profiles, SH and DHW, these will apply to each of the heat pumps used on the projects, which over time, WPD can then use all the profiles to create a typical ADMD for EPC grade A houses. Consistent, interlinked demand profiles of electric usage are important for the electric network operators and their planners, to correctly design electricity network. It is envisaged to attempt finding a retrofit HP project to create SH and DHW profiles for lower EPC graded houses.

For the design and simulation of energy concepts for residential buildings and areas, simple methods to generate consistent demand profiles for electricity, space heating and domestic hot water demand (DHW) are needed.

Time-dependent characteristics of residential energy demand depend strongly on user behaviour which needs to be accounted for in models. The diversity of the load profiles must be respected to avoid aggregation of peaks and capture occurring smoothing effects.

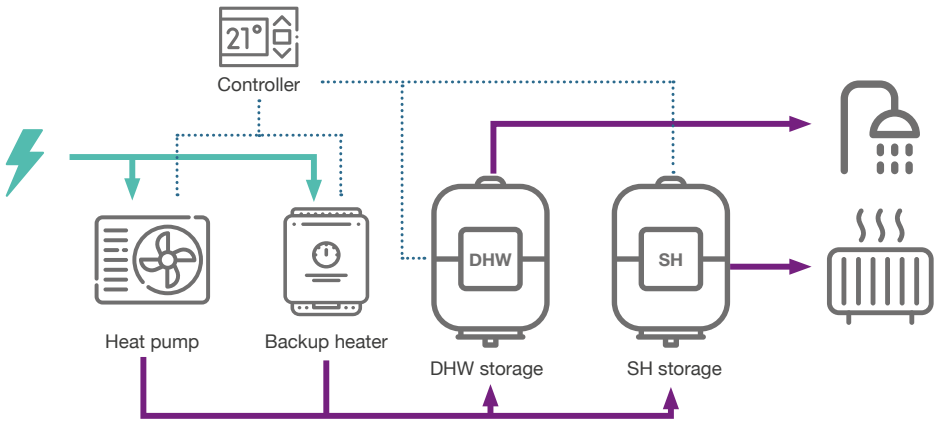
Typically heat pumps are selected for the respective homes on the basis of thermal demand for space heating and domestic hot water. By using standardised load profiles for space heating approach an average load profile is derived from measurements, usually linked with outdoor temperature and scaled to a specific annual energy demand.

Since the method is based on a vast number of datasets which are averaged, resulting profiles can be seen as valid. The drawback of using standardised load profiles is that those profiles represent a large number of buildings or occupants and thus show usually low variation. They only partly reflect individualities in the building due to different physical building properties or the inclusion of solar gains. The challenge with the profile is to correctly reflect user behaviour, which will significantly influence the building energy performance. The methods for DHW consumption modelling are similar to those applied for space heating demand.

Heat pump operational data in the UK is limited as what projects that have been carried out have had low numbers of heat pumps which makes the data statistically insignificant. WPD have a wealth of experience in designing housing networks and recognise the need to evolve our design methodologies to include new use cases. WPD will use this experience to ensure that heat pumps can be accommodated in the most efficient and economical way.

Where existing network architecture is not best suited to permit heat pumps WPD will take steps to mitigate this and, if upgrades are required, use innovative solutions to allow faster and efficient connections. For example WPD are considering oil fired and LPG fired central heating systems are usually installed in rural settings, these areas are invariably supplied by small cross sectional area, single phase overhead lines (OHL) when these outlying areas change to heat pump and electric vehicles that the single phase OHLs are upgraded to three phase OHLs this would allow the village to convert to heat pumps and electric vehicle charging and not produce out of balance loading of the phases.

Heat Pump System



Variations in:

- Sizing of storage and heat pumps
- Heat distribution system temperatures
- Source temperatures
- HP efficiencies

6.2. Releasing existing network capacity

WPD's low voltage network already includes a finite volume of available capacity. When WPD establish local transformers for new developments the Planners choose between three pre-set transformer capacities.

This means that there is often capacity available between the designed demand of the network and the size of transformer which feeds it.

WPD also expect that the backbone 33kV network and transformers will be able to accommodate a finite level of heat pump activity.

6.3. New Homes

The modification of Building Performance Regulations brings consultation on requirements for new homes.

WPD have already seen an interest from some developers and local authorities to add a readiness for future charging requirements and heat pump installations.

WPD already design and install mains networks which include a level of diversity, which allows for the fact that all customers do not use all of their installed demand at the same time. This means that our mains networks are able to flex to the demands placed on them and only require reinforcement when a proportion of customers have increased their demands.

The service cable, which runs from the street to an individual property, cannot make use of this diversity as it needs to provide the whole supply for that specific customer. WPD have already identified that increased LCT demands could require larger capacity service cables and are trialling these in the Superfast Electricity projects.

6.4. Existing Homes

A large section of WPD's existing networks were designed for 1950s, 1960s and 1970s where the electricity usage assumptions at the time of installation were lower than our current standards[5].

Whilst most new homes connected from the early 1990s will have a service provision which is not looped and can accommodate a normal domestic demand and the new demand of a Heat Pump and other LCT installations will need to be assessed.

WPD appreciate that the capacity of a house service/cut-out is the last thing on a customer's mind when they choose a heat pump so WPD are working with the ENA LCT Group to make this assessment and acceptance as simple as possible. The ENA LCT group are currently running a project in ascertaining the absolute values of the various cut-outs and service cables combinations which will allow customers/installers a simple way of identifying the capacity of a service cable; the project will create an application which can be used across the UK and for any DNO network.

Where a customer wants to install new Low Carbon Technology to their property there is a need to check that their property is not connected via a service loop. If the property is serviced via a looped service then WPD will remove the looped service free of charge.

[5] More than 1m over 55s living in hazardous homes Home Care Insight study finds. Access/Intelligence/Studies by Sarah Clarke 09/05/2019 www.homecareinsight.co.uk

6.5. Clustering

WPD's low voltage networks rely on a level of diversity between connections.

Heat Pumps can provide a period for load shifting depending on the thermal mass of the building. As heat pumps should be installed in houses which have an EPC rating of C or above, it is envisaged that if heat pumps were installed on houses with a low EPC rating it is unlikely that there will be diversity to be applied.

In addition to the forecasting work WPD have done and are doing, notifications of installed heat pumps are being used to identify hotspots and clusters of heat pumps and other LCTs. Unfortunately not all LCT installations are reported to the host DNO, to this end WPD are in the process of carrying out phase 2 of the LCT detection project which will further enhance the identification of LCTs which will include locations where notifications were not received.

WPD are using this clustering information to direct the proactive reinforcement of networks.

6.6. Mitigation of local network constraints

There may be isolated locations where a cluster of new heat pumps will exceed the capacity of the WPD local network.

It is hoped that many of these sites will be identified with the clustering modelling. Where clusters are not identified and WPD have not anticipated the change in demand it could result in blown fuses and customers being inconvenienced.

Delivering an upgraded network from scratch will take a specific duration and, whilst these works are being planned and executed, it is not acceptable for our customers to continue being inconvenienced by supply interruptions.

Where Heat Pump design allows for flexibility through energy store systems, this could form the first line response to local overload situations. WPD may be able to make use of equipment developed for EVs in the Connect and Manage project. This equipment would only be used as a last resort while the network is upgraded.

WPD local teams have shown themselves to be the industry leaders in response to supply interruptions and this technology will allow them to provide this same high level of service where LCTs create a specific problem.

7. Smart Solutions and Flexibility

7.1. WPD's approach

Meeting the Clean Growth Strategy decarbonisation of heating targets, heat pumps (HPs) are an existing technology that meet the requirements and are slowly being recognised as a key technology in the new build housing sector.

Heat pump technology provides great opportunities for reducing heating related greenhouse gas emissions, but the wide-spread deployment could also create new challenges in the electricity distribution sector.

Operating heat pumps in a "smart" way, as part of a wider smart grid, would help to address many of these challenges. In particular the potential demand peaks from heat pumps in a largely decarbonised future building stock could turn out to be a significant future challenge, both in terms of available generation and the capacities of the electrical network. This could well lead to an increasing need for demand side response (DSR) in the electricity system, as intermittent renewable generation meets increased demand from the heat pumps.

In an average winter, large parts of the housing stock should be able to provide flexibility in the case of a DSR event, without any upgrades to the thermal properties of the building or the heat pump being required. But it is likely that if a 1-in-20 winter occurred then significant improvements of both the thermal mass and the insulation are likely to be required in many UK buildings in order to achieve sufficient levels of flexibility.

Flexibility is already an established network management tool for WPD, developed under the Flexible Power brand name. Where constraints are identified WPD could look at a range of solutions to rectify them, including smart and flexible solutions.

Flexible Power has traditionally looked to larger customers to provide the flexibility responses, so we would predict that HP flexibility would be provided to us via aggregators. We also predict that customers would be encouraged away from times of peak electricity usage through time of use tariffs developed by electricity suppliers.

7.2. Domestic Flexibility

In order for heat pumps to be able to realise their full potential for demand-response, there are a number of challenges which need to be overcome.

According to the Centre for Ageing Better, 21% of all homes in the UK were built before 1919, 38% were built before 1946, and only 7% after 2000, making the UK housing stock the oldest in the EU[6].

UK building stock needs to be made more suitable for heat pumps (and their flexible operation) in that the buildings need to be brought up to the current level of insulation standards.

The introduction of a simple heat store for the space heating would provide the ability to not run the HP at peak times introducing some flexibility into the existing housing market.

7.3. Commercial Flexibility

The majority of the UK commercial building stock also being pre 1970s this commercial building stock needs to be made more suitable for heat pumps (and their flexible operation) in that the buildings need to be brought up to the current level of insulation standards.

The introduction of a simple heat store for the space heating will provide the ability to introduce flexibility into this section of the existing commercial market.

With commercial buildings using heat pumps for space heating and hot water tanks suitably sized heat stores and hot water tanks are a fundamental aspect of "flexibility" and key to aligning the generation of zero carbon energy with the use of the energy without burdening the UK bill payer with vast investments in system wide electrical storage or over provisioning of generation capacity and network.

7.4. Whole System Flexibility

Flexible heat pumps, storage heating and hot water tanks are a fundamental aspect of "flexibility" and key to aligning the generation of zero carbon energy with the use of the energy without burdening the UK bill payer with vast investments in system wide electrical storage or over provisioning of generation capacity and network.

Some heat pumps that have a heavy reliance on inflexible direct heating (boost) elements on low temperature days, this has the potential to significantly drive up the network and generation requirements at the very point they most stressed. The specification of heat pumps or efficiency measurement methodologies should take this into account, rewarding the correct sizing and good quality heat pump capable of providing a healthy coefficient of performance in the lowest expected temperature conditions expected in the installation locations without the use of Boost.

[6] Page 1 More than 1m over 55s living in hazardous homes Home Care Insight study finds. Access/Intelligence/Studies by Sarah Clarke 09/05/2019 https://www.homecareinsight.co.uk/more-than-1-million-over-55s-living-in-hazardous-homes-study-finds/

8. Projects to demonstrate Heat Pump connections

8.1. Developing a balanced portfolio of projects

WPD's projects are developed through the Innovation Strategy. WPD always look for projects which cover the three main themes of Assets, Customers and Operations.

WPD ensure the projects retain this balance by the regular review of the Innovation Strategy which is supported by more general Stakeholder Engagement.

WPD use the Local Authority Stakeholder Engagement sessions to ensure our projects are providing the right blend of technical and flexible solutions.

8.2. Completed Projects

8.2.1. Freedom

The Freedom Project has concluded following a two year programme, installing 75 PassivSystems smart hybrid heating systems in Bridgend, South Wales that ran over the 2017/2018 heating season. Western Power Distribution (WPD), Wales & West Utilities (WWU) and PassivSystems, have been working closely 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. Project learning indicates that a hybrid approach to decarbonising our heating that is combined with green gas growth could lead to the total decarbonisation of domestic heat.

The Freedom Project set out to investigate the role of multi-vector solutions in the form of a hybrid heating system. The combination of a conventional gas boiler and an air source heat pump (ASHP) with PassivSystems optimised smart controls has addressed these issues and presents a cost-effective decarbonisation pathway, where reinforcements to the electricity grid can be avoided by utilising the existing energy storage capability of the gas grid at times of peak demand and when renewable power generation output is not delivering. The project has addressed all aspects of the energy trilemma, with a specific focus on heat and the potential for hybrids to be transformational in delivering solutions that will shape future energy market dynamics.

As a result of the work delivered in the Freedom Project, hybrid heating systems have demonstrated that they are a complementary solution across the various futures of heat pathways, providing the opportunity for partial electrification combined with hydrogen in major cities and other decarbonised gas elsewhere. The findings of the project will contribute to the challenge of reducing carbon emissions at the lowest cost impact for domestic consumers by delivering increased heating system efficiencies and a reduced unit cost from the energy supplier for energy consumed by the hybrid heating system.

To address the objectives of the Freedom Project, WPD, WWU and its project partners developed and improved their energy systems modelling to consider and optimise the operation of hybrid heating systems served by a combination of electricity and gas. The optimal split between the two energy sources is intrinsically determined by finding the lowest cost choice to meet the heating demand while also considering the costs in other parts of the system, such as seasonal storage, interconnection and reinforcement. This cost-optimal split will generally vary from one hourly interval to another and will be driven by the assumed price of gas as well as the endogenously driven cost of generating electricity in a given hour.

The global recognition of the challenges of climate change, in particular the ambitious reductions in carbon emissions proposed by the UK Government (i.e. 80% reduction relative to 1990 levels), are driving significant changes across the energy landscape. Significant progress is being made in decarbonising electricity generation and seeking low-carbon gas alternatives.

However, in the UK, domestic heating remains largely unaffected by attempts to lower-carbon outputs, aside from the considerable progress made through increased boiler efficiency. Gas boilers are the predominant technology for the provision of domestic space heating and hot water in the UK with a market penetration of 80% of homes. In order to meet ambitious carbon reduction targets, our high dependency on fossil gas heating will need to reduce, with hybrids offering the flexible solution to make best use of renewable gas and electricity.

8.3. Current Projects

8.3.1. Parc Eirin Superfast Electricity Housing for the Future

WPD is looking to new and innovative areas, to this end WPD are working with Pobl and Sero where currently in Tonyrefail, South Wales circa 250 new build homes are being built, each house is fitted with single phase PV, ES, HP, EV charging, smart white goods each device is connected to a PLC these homes will be supplied via three phase service cables and dark fibre to each house.

WPD will be fully monitoring the estate, including the heat pumps so that demand profiles will be generated to show thermal demand and show different characteristics regarding daily and yearly patterns compared to the present day, the demand profiles of the space heating and DHW are important for the planners, to correctly design energy grid and supply concepts for buildings and neighbourhoods.

8.8.2. LCT Detection

Electrical installers who fit HP equipment at customer homes are required to notify the host Distribution Network Operator as part of the connection process. Working with the Energy Networks Association all the DNOs are making improvements to the notification process to make it simpler for electrical installers to tell us where charge points have been fitted. This should reduce any mismatch.

WPD are currently undertaking the project LCT Detection with Electralink and IBM. The project will identify whether it is possible to automatically locate the installation of new charging equipment through the analysis of metering data. Using artificial intelligence techniques our project partners will evaluate the potential for such a solution together along with any regulatory and privacy controls which may be necessary.

This project will provide WPD with the most up to date information on LCT take-up within the licence areas and will negate the fact that some installers are failing to advise the host DNO that they have connected LCTs it is likely that this project should also highlight non-technical losses within the licence areas.

8.4. Future Projects

8.4.1. Eastern Avenue Three Phase Heat Pump Project

This project sets out to investigate the use of three phase service connections to provide balanced LV connections for new housing customers, where demand can be balanced across the phases.

Most domestic services have historically been single phase design. By using three phase service cables this will mean the load that would have been carried by the single phase cable has now been reduced by spreading it across three phases. It will also reduce the losses in the service cable, which are related to the load carried.

In addition by using three phase service cables the major items of equipment like heat pumps, EV chargers, Stoves etc. will be three phase devices this will mean all houses loads would be evenly spread across the LV Mains cable this balancing of the loads will eliminate the out of balance losses in the LV mains cable and the out of balance losses in the local transformer.

These houses will also be fitted with three phase powered heat pumps, there is currently very little useful data on the impact heat pumps will have on a network, this project will be used to define a typical profile for the space heating of the house and a second profile for the heating of the domestic hot water this will enable new ADMD calculation to carried out to aid in future house designs.

As the houses will be fitted with PV and battery storage each house will be a power station in its own right generating the electricity right where it is to be used this will offset future new build power stations and also have an overall reduction on losses, as the PLC will be trying to manage the house to “live” within its generation capability any shortfall will be extracted from the LV network at the most advantageous time to all parties thus helping to minimise the 5pm to 11pm peak load on the network.

8.4.2. Smart Meter Load Control

This project follows on from our LV Connect and Manage project, which developed a domestic load controller which will ensure that the low-voltage network is not overloaded.

It will demonstrate how SMETS2 smart meters can be used to control specific load within a property.

Working with an energy supplier offering specific electric vehicle tariffs, we intend to determine whether the smart meter can be used for this overload protection function.

8.4.3. Self-Assessment

When a customer chooses a Heat Pump or Electric Vehicle their next task is to consider is whether the cut-out and service cable are looped or suitable for LCT connection.

Through the Energy Networks Association this project is being developed in conjunction with the other DNOs to provide a centralised way of providing us with pertinent information about their service which will allow us to quickly assess if it is suitable to accept a heat pump or EV charger.

9. Targeted Commitments in 2020

9.1. Realising benefits

Work completed in projects only becomes fully valuable once the findings transition into business as usual.

With respect to heat pumps and new build housing estates WPD have already made changes to the technical design and as a consequence minimum cable designs are now adopted. In addition with existing houses fitted with looped LV service cables these are to be removed and replaced by individual service cables. As the various projects that are currently underway it is likely there will be more changes that will be made as a result of information gathered from the projects.

The sections below detail changes WPD expect to make in 2020.

9.2. 2020 - “Superfast Electricity”

The Superfast electricity Housing for the future – Tonyrefail project houses will see the houses fitted with heat pumps.

As there is currently very little useful data on the impact heat pumps will have on an electrical network, this project will be used to define a typical profile for the space heating of the house and a second profile for the heating of the domestic hot water. Both of these two discrete profiles will be obtained from the 238 houses and the data will then enable new ADMD values to be created for heat pumps that can then be added to the current ADMD number that WPD use for planning of new estates, this will new data will enhance the calculations to carried out in future housing estate designs.

9.3. 2020 – Design capacity assumptions

For many years WPD have used a set of After Diversity Maximum Demand (ADMD) figures to design the backbone network that supports housing developments.

It has allowed for the efficient and economic connection of traditional gas and electrically heated homes. The impact of LCTs will change this design model. WPD will use data from our innovation projects to calculate a new ADMD which includes allowances for Heat Pumps, EV charging and other LCTs.

9.4. 2020 – Network capacity indication

WPD have already produced a network capacity map to indicate the capacity that is available across our network to support connection of EV charging.

It is envisaged the map can be amended to include heat pumps and EV charging. This map published alongside WPD’s other network maps for generation and demand capacity and will be interactive and available on the WPD website.

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