Kensa Response: Ofgem Call for Input on the Future of Distributed Flexibility 2023

Background on Kensa:

Kensa is a manufacturer, installer, training provider, and financier of ground source and networked heat pumps. Kensa represents approximately 40-50% of the ground source heat pump (GSHP) market[1], manufacturers all of its products in the UK, has been operating for 22 years and is part owned by Legal and General.

Networked heat pumps are a type of heat network that have the potential to unlock the decarbonisation of millions of 'hard to treat' homes, such as terraced and high-rise – delivering the most energy efficient solution at the lowest cost to both to the householder and the wider electricity system. Centred on its vision for the use of networked heat pumps across the UK, Kensa has ambitious plans to scale up, manufacturing and installing over 50,000 heat pumps a year by the end of the decade, cost competitive with gas boilers and subsidy free by 2030.

Response:

As a manufacturer and installer of ground source heat pumps, Kensa is keenly aware of the impact that electrification of heat will have on our energy systems. Whilst heat pumps are significantly more energy efficient then their fossil fuel counterparts (three times on average)[2], the replacement of approximately 23 million boilers with heat pumps, and other forms of electric heating, will significantly increase electricity consumption and peak demand, alongside electric vehicles and new electrified industrial processes. Whilst major increases in generation and grid capacity are unavoidable, government, regulators and industry all have an obligation to ensure such increases are kept are minimised both from a practical standpoint and a duty to responsibility to protect consumers.

To help understand the potential impact of heat pumps on the grid, and to examine how different heating technologies, heat flexibility and the use of heat batteries could help minimise increases in overall energy consumption and peak demand, Kensa commissioned research from Element Energy. The full results of this "low Carbon Heat Study" will be available later this month and Kensa would welcome the opportunity to discuss and share these results with Ofgem. In the meantime, Kensa will take the opportunity to set out the key findings in response to this call for input.

Low Carbon Heat Study Overview:

The "Low Carbon Heat Study" uses Element Energy's proprietary Integrated System Dispatch Model (ISDM) to model the British electricity system in a net-zero emission future scenario in 2050. The ISDM models generation of electricity across Great Britain, integrating renewable electricity generation (from onshore wind, offshore wind and solar) with nuclear power, biomass generation, hydro power, and dispatchable generation at times of low renewable availability. The ISDM also includes the impact of demand flexibility in electricity consumption, including for heat demand flexibility and for flexible charging of electric vehicles. The electricity demand modelling includes domestic electricity demand for ASHPs, GSHPs, other electrified heating (direct electric and district heating), appliances, and other sectors including electric vehicle charging, industrial electricity demand and non-domestic heating and appliance consumption.

[1] BEIS (2020) Heat Pump Manufacturing Supply Chain Research Project
[2] https://es.catapult.org.uk/news/heat-pumps-shown-to-be-three-times-more-efficient-than-gas-boilers/

The study uses Element Energy's ISDM to model demand flexibility and renewable electricity generation in a decarbonised electricity system in 2050, with ambitious energy efficiency improvements and a British population highly engaged in decarbonisation. Six scenarios were modelled to explore the impact on the national electricity system of demand flexibility and of varying the proportion of ASHPs and GSHPs, as below. All scenarios assume the same total number of heat pumps in domestic buildings in Great Britain in 2050 (23.3 million)[3]; but with differing proportions of this total made up of ASHPs or GSHPs.

Table 1: Heat Pump and Flexibility Scenarios in 2050

Scenario	Heat pump proportions	Demand flexibility modelling	Use of heat batteries
15% GSHP	15% GSHPs; 85% ASHPs	All sectors	No
38% GSHP	38% GSHPs; 62% ASHPs	All sectors	No
100% GSHP	100% GSHPs; 0% ASHPs	All sectors	No
Only flexible heating	38% GSHPs; 62% ASHPs	Pre-heating only; other sectors inflexible	No
38% GSHP & heat batteries	38% GSHPs; 62% ASHPs	All sectors	Yes
100% GSHP & heat batteries	100% GSHPs; 0% ASHPs	All sectors	Yes

In all scenarios the domestic housing stock is fully decarbonised. There are 23.3 million homes with heat pumps installed in each scenario, with the split of these heat pumps between ASHPs and GSHPs varying between scenarios. This is in addition to 1.7 million homes using direct electric heating, and 6.2 million homes connected to district heating networks.

The scenarios with 100% deployment of GSHPs are not intended to represent likely scenarios, as ASHPs are likely to play a significant role in the electrification of heat in the future. These 100% GSHP scenarios were included to explore the potential benefits to the British energy system of increasing GSHP deployment alongside demand flexibility. Current market deployment of GSHPs in the UK is estimated at around 15%, whilst a 38% deployment level for GSHP is equivalent to that modelled by National Grid's 'Consumer Transformation' scenario in 2050 within its Future Energy Scenario report.

It should be noted that recent policy changes, including the replacement of the Renewable Heat Incentive with the Boiler Upgrade Scheme, have reduced the relative deployment levels of GSHP compared to ASHP. As such, a 15% GSHP deployment level should not be taken for granted and policy changes will likely be required to deliver the benefits outlined in this study.[4]

Relevant Low Carbon Heat Study Findings:

Using performance data available on the operation of heat pumps and heat flexibility potential across a modelled 2050 housing and consumer profiles, the report finds that:

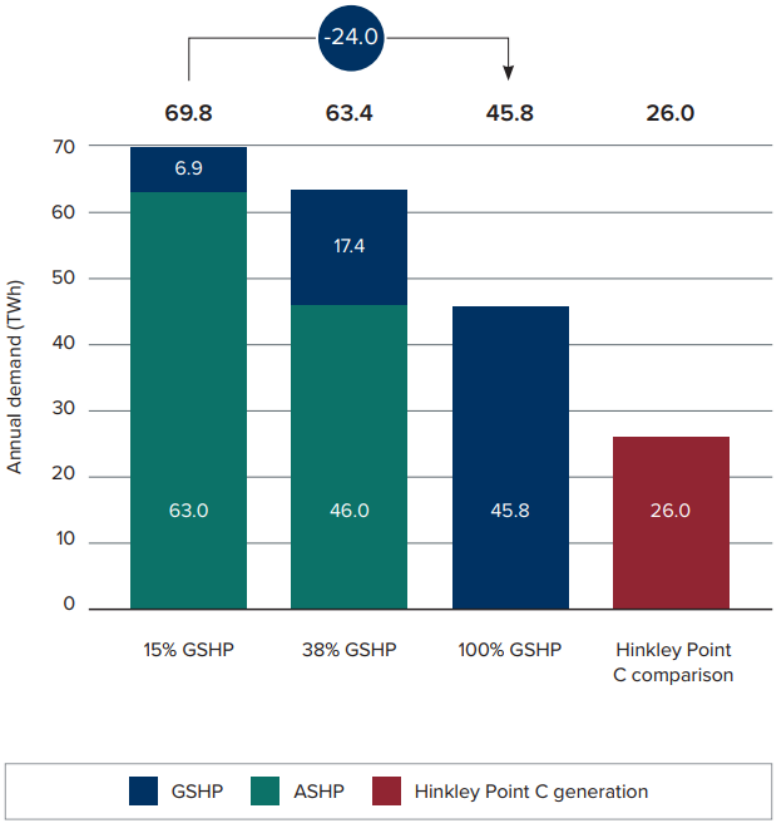
- Installing GSHPs in 38% of British homes with a heat pump, rather than in 15% of such homes, would save 6.5 TWh per year in 2050.

[3] This 23.3 million is aligned to the total number of heat pumps installed in Great Britain in 2050 in National Grid's Future Energy Scenarios Consumer Transformation scenario

[4] Ofgem (February 2023) Boiler Upgrade Scheme Quarterly Report - Issue 3. GSHP made up 2.4% of the total heat pump installations funded via the scheme

- Installing GSHPs in every British home with a heat pump, rather than in 15% of such homes, would result in savings of 24 TWh per year in 2050.

Figure 1: Annual electricity demand from 23.2 million heat pumps



The annual peak electricity demand was also modelled for the six scenarios using Element Energy's ISDM before and after demand flexibility, with key results shown in Figure 2.

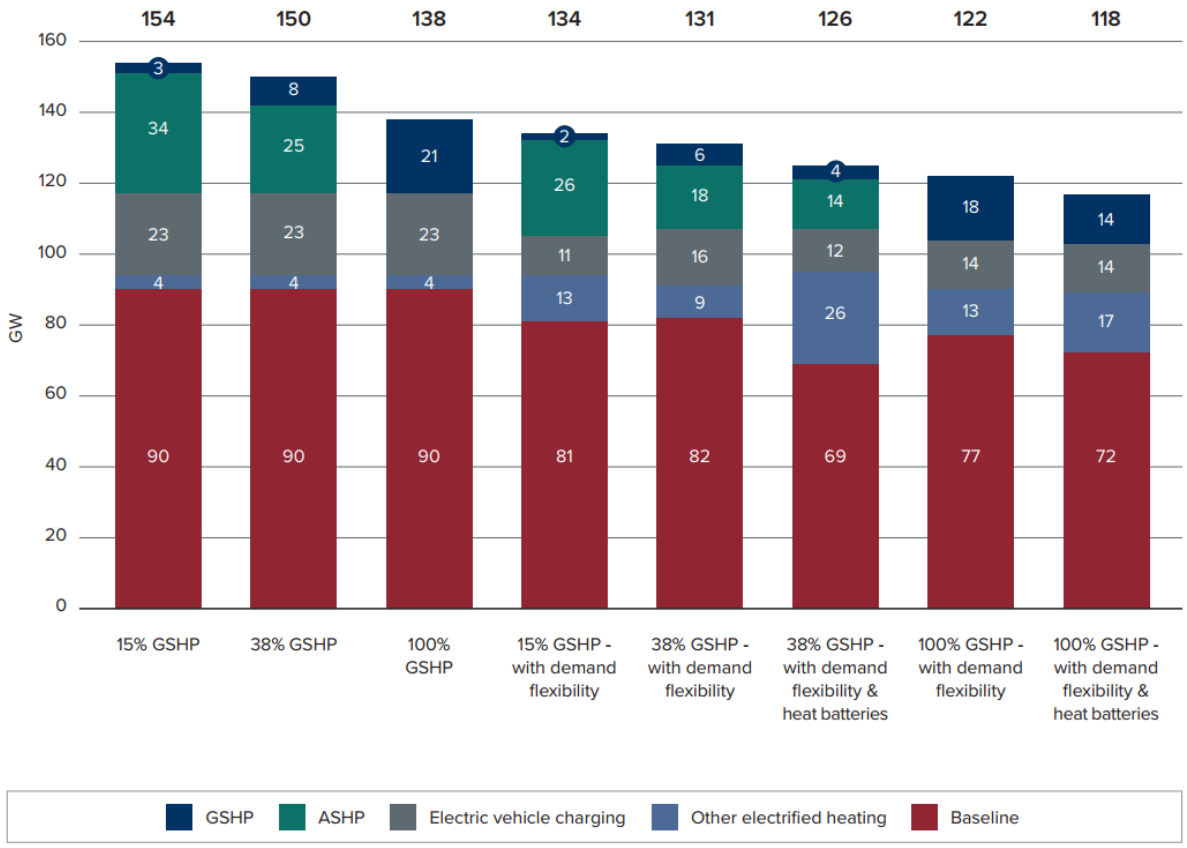
- Increasing the proportion of GSHPs in domestic homes in 2050 from 15% to 100% of heat pumps leads to a 16.8 GW reduction in peak electricity demand even without any demand flexibility, due to the higher efficiency of GSHPs.

- Pre-heating alongside demand flexibility in electric vehicle charging and other sectors leads to 20.8 GW peak electricity savings with 15% proportion of GSHPs; this increases to 32.5 GW when demand flexibility is used alongside 100% GSHP deployment.

- Installing heat batteries in 50% of homes with heat pumps alongside 100% GSHP deployment leads to the largest savings of the scenarios studied, with 36.6 GW saved compared to 15% GSHPs and no demand flexibility. This represents a 24% reduction in peak demand compared to this initial case.

- In the scenarios below, "baseline" represents all other uses of electricity other than domestic heating and electric vehicle charging. Baseline electricity consumption in the peak hour changes as a result of a number of factors including movement in the timing of the peak demand hour in various scenarios.

Figure 2: Modelled Peak Demand in 2050



Element Energy's ISDM has modelled Great Britain's national electricity system at an hourly resolution, and analyses how engaged residents can flexibly use their heat pumps and electric vehicles to maximise the use of renewable electricity and to avoid peak hours of electricity demand. Increasing the use of renewable electricity reduces electricity system costs due to lower need for dispatchable generation (i.e. low-carbon hydrogen in turbines). Shifting electricity demand away from peak hours results in further cost savings due to reducing the need to upgrade the electricity network in Great Britain following electrification.

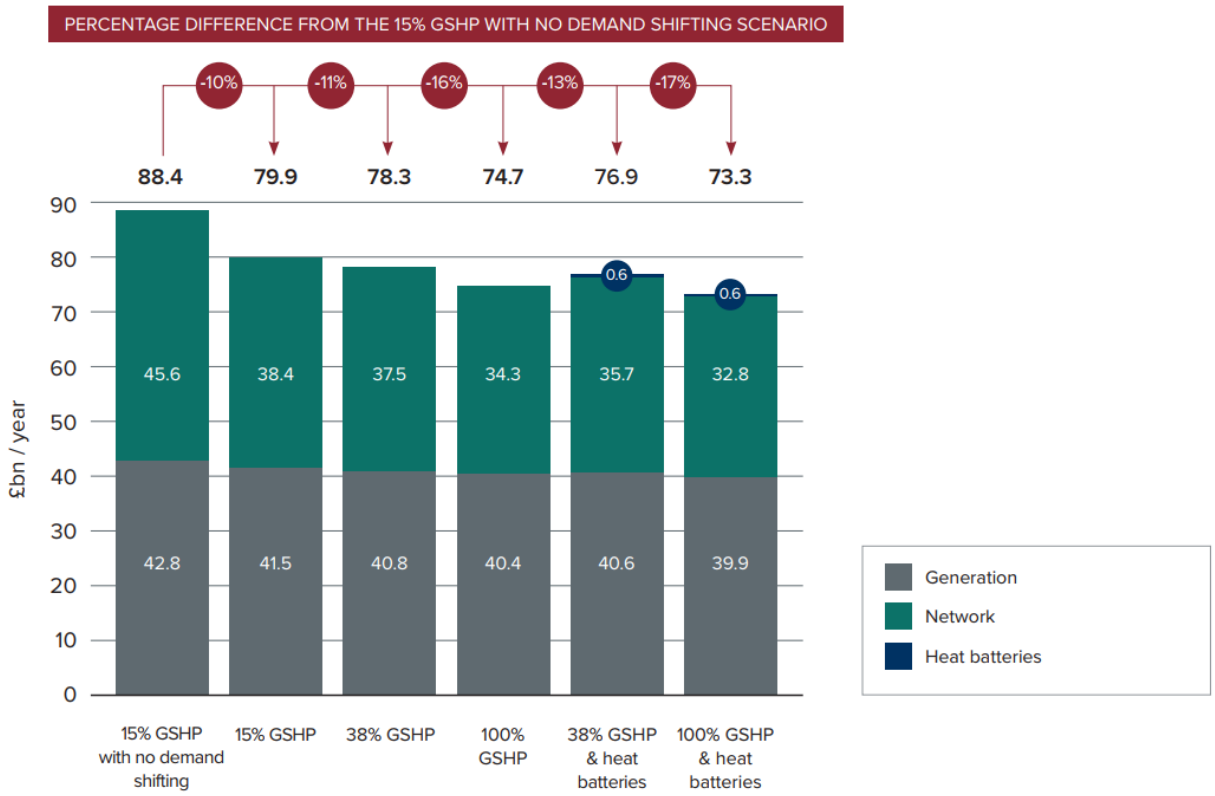
- The graph below shows the annualised cost of electricity production (generation) and transmission and distribution (network); in the heat battery scenarios on the right the additional annualised cost of installing a heat battery in 50% of homes with heat pumps is included. All scenarios shown below, with exception of "15% GSHP with no demand shifting", include impact of demand shifting.

- Demand shifting with heat pumps and electric vehicles reduces electricity system costs in all scenarios, by £8.6 billion per year where GSHPs make up 15% of all heat pumps, and £13.8 billion per year where GSHPs make up 100% of all heat pumps.

- The benefit from the additional flexibility provided by heat batteries in 50% of British homes with heat pumps offsets the cost of installing the heat batteries themselves.

- Up to £15.1 billion per year could be saved in the scenario with the highest deployment of GSHPs and heat batteries. The electricity system cost savings from increased deployment of GSHPs and use of demand flexibility could be passed onto consumers, so that decarbonisation of the national electricity supply and of heating provides benefits to consumers, including through consumer fuel bills.

Figure 3: Annualised electricity system costs in scenarios modelled



Networked GSHPs and heat demand flexibility have the potential to deliver significant benefits to householders, national energy security, climate goals and the electricity system, but incentives will be required to encourage the flexible use of heat pumps, electric vehicle charging.

Despite the lower annualised CAPEX of GSHPs, and the wider system benefits they can provide to Britain, the complexity and upfront costs of installing shared ground loop arrays is likely to be a barrier to higher levels of deployment of the technology through to 2050. Additional policy, specifically targeting rollout of networked GSHPs will likely be required to unlock the long-term and system wide benefits this approach can offer.

Policy Implications:

Heat Flexibility must be incentivised/rewarded: Regardless of the relative deployment of different heat pump technologies, heat flexibility can provide major reductions in peak demand in a fully electrified heating system. However, this flexibility/demand shifting will only happen through effectively implementation of smart time of use tariffs, as well as flexible heating systems. Flexible/time of use tariffs must become the norm for all consumers, and regulation has a key role to play in some level of standardisation of approach to these tariffs across energy suppliers.

Flexible Heating Systems: Critically, whilst some consumers will actively engage with time of use tariffs, significant numbers, quite possibly the majority, will not. As already considered by the government, including in the Delivering a smart and secure electricity system consultation, requirements for appliances to operate flexibility will be key to ensure 'passive' consumers are also able to participate in heat demand flexibility and receive the financial benefits of doing so. It is worth noting here, as already conveyed to government, that it is important to focus on the overall heating system and ensure this operates flexibility and response to market signals, not the heat pump itself. When a call for heat is requested, that is when the compressor is turned on and the heat pump runs. It's more important to focus on a smart heating system rather than a specific energy-smart appliance. The requirement/mandate should be on the wider system, and a mandate on devices should just be to ensure they can communicate with the system with the heat pump only as an asset in the wider system.

The UK electricity system needs regional and future planning. Through the creation of the Future Systems Operator and local energy planners, the grid will benefit from an understanding of local needs and pressures as well as increased collaboration between DNOs and local authorities. This will also introduce a greater degree of accountability, more equal access to data and can de-risk investment. Critically, future planning for the electricity system should be done in line with government ambition for heat pumps and accompanied by a 'heat zoning' strategy. Ofgem should support the idea of heat zoning, going beyond the designation of centralised heat network zones, and mapping out the UK for the most suitable heating technologies for the right areas. This exercise should consider the most energy and cost-efficient solutions for areas, but also considerations of local grid capacity. Whilst consumer choice remains critical, a planned approach with appropriate supporting policy from government, will limit the amount of grid expansion and upgrades required.

Support for the most energy efficiency technologies: As shown in the report summary above, high rates of deployment for the most energy efficient heating technologies can reduce energy consumption and peak demand considerably. The government rightly recognises of market intervention to encourage uptake of more efficient technologies over less efficient ones (heat pumps over direct electric heat for example) to ensure that the benefits of energy efficiency are deliver to consumers and the energy system, but also to overcome the fact that the least efficiency technologies typically have lower upfront costs and are easier to install. Whilst the government has taken some steps to encourage heat pump uptake over less efficient technologies, it still largely takes a "one-size fits all" approach within the heat pump market – with too little differentiation made in policy terms between ground and air source heat pumps, despite the significantly higher efficiencies available from the latter. If we are to see the major grid benefits available through GSHPs – some policy reform will be required. Ofgem could support this aim through recognition of the benefits available through GSHP, building it into its future planning, and, where possible, reflection of the efficiency benefits of GSHP within the schemes it administers/regulates such as ECO.

Contact:

Richard Warren
Director of Public Affairs
richard.warren@thekensagroup.com
07930 619 354