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Heat Pump Deployment in Wales

Executive Summary

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Executive Summary

Headlines

- In 2022, Welsh Government turned to Local Area Energy Plans (LAEPs) as a tool to help Local Authorities (LAs) decarbonise local energy systems. These plans are the focus of this research project, centred upon assessing their potential impact. As an output of a six-month placement at a Gas Distribution Network (GDN), this executive summary condenses a report which explores the implications, to GDNs, of the scenarios LAEPs present for the future of heat delivery.
- LAEPs champion a standardised, yet place-based, approach to tackling local energy system decarbonisation. However, across most of the scenarios, for the majority of LAEPs in Wales, domestic heat decarbonisation is dominated by the proposed widespread adoption of heat pumps. It was found that there were also differences in modelling approaches utilised by the consultancies that developed the plans.
- Lack of clarity surrounding the coordination of the substantial infrastructure changes required to facilitate the vision of the LAEPs, means gas and electricity network operators are left to interpret time-distant deployment targets as one of the indicators for how energy system transformation may unfold.
- The analysis explores the challenges of achieving the heat pump deployment targets set out in the LAEPs. It shows that, without immediate acceleration, meeting these targets will require roll-out rates proportionally higher than the UK's heat pump installation rate targets and the current gas boiler replacement rate. Furthermore, the longer substantial progress is delayed, the more difficult it will be to manage the transition sustainably, as deployment rates may need to exceed natural replacement levels to meet 2050 targets.
- As more gas properties switch to heat pumps, GDNs will have to socialise their network costs across a shrinking customer base. The next price control period, 2031-2036, is when this could really start to impact GDNs. If heat pump deployment is not spatially coordinated, and license agreements and price control frameworks do not give GDNs the leverage to cope with the reduced demand, then their economic models are likely to be threatened.
- Whilst energy plans, including LAEPs, are not directive, and hold no regulatory legitimacy, their impact on stakeholders will be limited. Those tasked with implementing the plans have no real power to enforce them, meaning stakeholder engagement is discretionary. Such plans can be effective if they align with stakeholder interests, but when conflicts arise, organisational priorities will generally take precedence.

Background

This executive summary encapsulates a report that examines the implications of LAEPs from the perspective of a GDN. It is an output of a six-month placement completed at Wales and West Utilities (WWU) – the GDN for Wales and the Southwest of England. The report begins by presenting the findings of an analysis conducted to assess the scale of heat pump roll-out required to meet targets set out in the LAEPs. It then explores the challenges that GDNs will face as heat delivery is decarbonised, focussing on the visions for the transition outlined within the LAEPs.

The transition to a net zero energy system presents significant challenges for long-term infrastructure planning, particularly for GDNs. This is because, as the UK accelerates its efforts to decarbonise heat delivery, GDNs face increasing uncertainty over how quickly renewable heating technologies, such as heat pumps, will be deployed and what this means for future gas demand.

Recently, the Welsh Government turned to LAEPs as a key tool to help Local Authorities (LAs) manage these uncertainties and coordinate local energy system decarbonisation through a whole systems approach. Developed to support net zero targets and guide infrastructure investment, LAEPs aim to align local and national energy objectives while accounting for place-based constraints and opportunities. They are informed by technical evidence of the whole energy system, non-technical factors, and stakeholder engagement. The plans include details on supply, demand, and storage requirements and feature various renewable technology deployment targets, that help to paint a vision of the future energy system.

Research motivation

In Wales, the majority of LAEPs, across most of the net zero scenarios they present, opt for the widespread adoption of heat pumps as the preferred pathway for decarbonising domestic heat. They outline this vision using heat pump deployment targets, which act as an indicator for how heating system decarbonisation may progress. To help WWU interpret these targets, first an analysis was first conducted to compare the roll-out rates required to meet them against historic installation rates. The process highlighted significant disparities between the two, as well as several issues with the LAEP targets:

1. Current heat pump installation rates are lower than would be required to meet both short and long-term LAEP targets.

2. LAEPs often don't specify the annual deployment rates needed to meet targets, and even where they are given, they are not presented with consideration of the gradual increases in deployment that are consistent with the early stages of renewable technology adoption curves.

3. There is a lack of consistency in the models used to produce deployment targets, which has led to significant differences in model outputs, making comparisons and aggregation difficult.

4. It is hard to track progress against targets because accessing reliable, up-to-date heat pump installation data is challenging.

5. Deployment targets quickly become outdated if LAs fall behind schedule.

6. Most LAEPs don't distinguish between commercial and domestic installations, or air source and ground source heat pumps.

7. It can be unclear which heat decarbonisation scenario the heat pump targets are associated with.

8. Whilst LAEPs do present heat network decarbonisation in different scenarios, in most cases, there is little variation in predicted heat pump deployment, as a percentage of future heating technology mix.

9. Some LAEPs assume constant deployment rates as they approach 2050, resulting in projections that overlook the reduction in deployment rates that are likely to occur as full deployment nears, due to maintenance, replacement requirements, and consumer resistance.

10. It is very difficult to determine what impact heat pump deployment will have on the gas network because the LAEPs do not identify the type of central heating being replaced, or where (within a locality) this will occur.

In response to these issues, a second analysis (which makes up the basis of the report) was conducted to help visualise the scale of the challenge required to meet the targets and, in doing so, allow the implications of the deployment targets to be explored more comprehensively. The analysis includes 18 LAs in Wales. For each one, the analysis projects five heat pump deployment pathways through to 2050.

Research approach

The five deployment pathways considered in the analysis were:

1. **No Improvement:** heat pump deployment continues at the current rate.

2. **Match Gas:** by 2030, heat pump deployment rates match estimated current gas boiler replacement rates.

3. **Best-Case:** lowest possible deployment rate to achieve 2050 deployment target; hitting maximum rate by 2030 and starts merging into a replacement rate around 2045.

4. **Delayed Roll-Out:** a version of the 'Best-Case' pathway where more time is given (up to 5 years) to reach maximum deployment rate (adjustment made when the 'Best-Case' pathway was deemed unrealistic).

5. **LAEP Projections:** reflect LAEP aspirations, starting at the baseline year set within the plan (which varies depending on the LA) and ignoring all other historic data points.

To connect the historic installation data with the target data points (relevant to 'Match-Gas', 'Best-Case' and 'Delayed Roll-Out' pathways), an 'S-curve' adoption profile was used; adoption begins slowly with the early adopters, accelerates to a sustainable maximum deployment rate that enables widespread uptake, and then levels off as it merges into the replacement rate. This phenomenon is supported by the Climate Change Committee and is widely reported; solar panels, wind turbines, and lithium-ion batteries all followed such adoption curves.

For each pathway, the maximum deployment rates (the rate during the middle section of the 'S' curve) across each LA were combined, to give a combined maximum deployment rate. This allowed for comparison across pathways to see what impact changing certain parameters has on the roll-out rates required to meet deployment targets. The combined deployment rates were also scaled to UK-wide levels, allowing for comparison against UK heat pump deployment targets outlined in the Seventh Carbon Budget.

The analysis also estimates the impact heat pump deployment has on domestic gas connections. In doing so, the implications of heat pump roll-out on the gas demand could be explored.

Results

LAEP targets

Current trajectories fall short – if heat pump deployment carries on at its current rate none of the LAs will meet their 2050 target. This stresses a need for policy and market intervention to deliver the scale of roll-out required.

Deployment rates are as important as absolute targets – absolute targets for heat pump deployment fail to convey the true scale of the challenge, as they are time-distant and abstract. By detailing the deployment rates required to achieve the targets, it is easier to understand where the key challenges lie. Supply chain and workforce constraints – even if heat pumps are installed at the same estimated rate that gas boilers are currently replaced, just under half of the LAs in the analysis don't reach their 2050 targets. This suggests that many LAEP targets rely on roll-out levels that exceed current local supply chain and workforce capacity.

Deployment rates – the analysis showed that making heat pump targets more achievable requires significant improvements in deployment rates (the number of heat pumps installed each year). In most cases, achieving the targets set for 2050, requires maximum deployment rates to be achieved and sustained from 2030 onwards. Any delay to this, increases the number of installations required each year if the 2050 targets are still to be met. For 12 of the 18 LAs analysed however, meeting maximum installation rate by 2030 appears unrealistic, because doing so requires significant increases from current levels of deployment. In six of the locations deemed 'unrealistic', this would require at least a thirty-fold improvement in heat pump deployment rate in the next 5 years.

Replacement rate – if heat pump deployment is to be sustainable, installation rates need to align with natural replacement cycles so that, once the market matures, the deployment rate merges into a replacement rate. However, the longer progress towards deployment targets is delayed, the more likely it becomes that roll-out rates will need to exceed sustainable replacements levels to meet 2050 targets. The greater the gap between deployment and replacement rates, the harder it will be to manage the transition sustainably, as, once the market is saturated, supply chains and the workforce will have to contract in line with reduced demand.

Disparity between national and local targets – in this analysis, if the deployment rates required for LAs to meet their heat pump deployment targets were repeated across the whole of the UK, total deployment rates would need to be well above the CCC target of 1,500,000 installations per year by 2035. If roll-out rates were to follow the CCC's trajectory, then the heat pump deployment targets, in the majority of the LAEPs analysed, would be missed. Considering this alongside the other findings, suggests that, in most cases, the heat pump deployment targets in the LAEPs reviewed are too high.

Impact on GDNs

Contrasting modelling approaches – LAEP heat pump deployment targets are a product of broad system modelling and the plans themselves are aspirational, unenforceable, and, as this analysis has shown, may not be achievable. GDNs, on the other hand, make their forecasts by exhaustively modelling data from hundreds of thousands of meter points (depending on the size of the network), in weather-sensitive demand models. This forecasting approach is highly robust and is a key part of ensuring they conform to the license conditions that govern their operations. Since LAEPs do not face the same consequences, they can afford to be speculative. However, in being so, their influence on gas network forecasts is limited, as GDNs cannot risk basing their projections on aspirational targets, as it is highly unlikely that the regulator, Ofgem, would allow them.

Transitional considerations – total gas consumption is predicted to follow the inverse of the 'S-curve' that has been used to project heat pump deployment in this analysis. The consequence of this is that the next price control period (2031-2036) will be a critical juncture for GDNs. If heat pump deployment targets are to be achieved, then heat pump roll-out will need to be reaching maximum levels during this period, resulting in precipitous decreases in gas demand. If Ofgem does not anticipate heat pump roll-out to dramatically increase during this period and they don't give networks the levers to deal with it if it does, then this could mean one of two things:

1. LAEP targets will be very difficult to achieve – if real progress on heat pump deployment is not anticipated until after 2036, then this analysis suggests that widespread adoption of heat pumps as the solution to domestic heat decarbonisation will not be feasible within the limits of the supply chain and workforce capacity. As a consequence, other means of decarbonising heat networks will have to be sought to meet the 2050 targets.

2. The gas network risks becoming uneconomical to operate – if heat pump deployment does proceed as required to meet LAEP targets, and Ofgem doesn't make anticipatory changes to the price control framework and/or GDN's license agreements, then gas networks will have to socialise their costs across a rapidly declining client base, which can only be commercially viable for so long.

Conclusion

This analysis has examined the implications of the heat pump deployment targets in LAEPs across Wales. It demonstrated that, without accelerating heat pump deployment immediately, and reaching maximum deployment rates as soon as possible, LAEP heat pump deployment targets will be very difficult to achieve. But, even then, it suggests that across the majority of LAs, the achievement of the 2050 targets would necessitate rolling-out heat pumps faster than both the current gas boiler replacement rate and the heat pump deployment rates targeted by the CCC in the Seventh Carbon Budget.

Unfortunately, choosing heat pumps as the predominant technology to decarbonise the heat network, across most scenarios, in the majority of the LAEPs, seems inconsistent with the commitment of LAEPs to finding place-based solutions to locally-specific issues. Since not all LAs have the resources or expertise to challenge the content of the LAEPs, using such a blanket approach risks stakeholders within localities targeting a false reality at the expense of working towards a more appropriate solution. As a minimum, it is suggested that LAEPs have at least one holistic scenario that presents an alternative route to heat network decarbonisation which is less reliant on heat pumps. In this way, if it becomes apparent that the widespread adoption of heat pumps is no longer achievable by 2050, then the holistic route can be adopted as an alternative that could still deliver on greenhouse gas emission reduction targets.

The analysis has also shown that the next price control period, 2031-2036, is when heat pump deployment could really start to impact GDNs, as heat pump deployment becomes more widespread. This could have a significant impact on the business models of GDNs and is likely to require regulatory changes that recognise this impact within the licence conditions that Ofgem places on them. Just as importantly, energy planning authorities need to recognise the constraints that Ofgem places on energy networks through licence conditions and price control frameworks and ensure that future energy system visions are achievable within these constraints, or, if not, that resource is allocated towards lobbying for modifications to these agreements/frameworks, to ensure that the changes can be delivered.

Even though the analysis suggests that there are some fundamental issues with LAEPs in their current format, their commissioning, by the Welsh Government, is undoubtedly a step in the right direction for the realisation of local decarbonisation goals. Although, while the plans have merit, the analysis suggests they will require refinement if they are to guide local decarbonisation efforts. Recommendations for how LAEPs, and energy planning more generally, could be improved – so that later iterations, or other forms of energy plan, do more to drive through the changes needed to witness decarbonisation at a local level – can be found in the full report.

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