LCPDelta

Analysis of the Draft Heat Strategy for Wales

Report for Wales and West Utilities

OCTOBER 2023

Contents

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This report was commissioned by Wales and West Utilities.

LCP Delta was appointed to review the draft Heat Strategy for Wales, with a focus on the impacts on the overarching energy system impacts if the key measures were implemented.

The key questions addressed are:

- Are there gaps in the technology solutions?
- What are the key impacts of omissions?
- What is the impact of the strategy on peak demand and resilience?
- What will be the impact of the strategy on the gas distribution network?
- Are there major omissions in the cost analysis?

Executive summary

Sufficient analysis of all key options and their impact is not provided in the strategy

Overall, we would recommend that further research is required to provide a sound evidence base on which to substantiate these key policy recommendations. It is not clear why certain decisions have been taken, particularly when applying GB wide analysis to Wales. The strategy could have a significant impact on consumers, industry and the ability to achieve net zero targets and there does not appear to be sufficient analysis to back these important decisions.

The strategy promotes electrification, but there are specific technology omissions which could play a significant role.

- Whilst electric heat pumps play a fundamental role in the strategy, we see no acknowledgment of the contribution that hybrid or gas heat pumps (thermally driven heat pumps) could make.
- These technologies are continuing to evolve and could be considered as an alternative low-carbon retrofit solution where space is limited, whilst also contributing to the options for managing peak loads.
- The use of sustainable liquid fuels, such as HVO, FAME, rDME, is not considered but these could be equally suitable solutions for significant CO_2 savings in off-grid, hard-to-retrofit properties.

The use of hydrogen has been ruled out for all but specific high temperature industrial operations.

- There is no rationale for its exclusion – the strategy is based around CCC scenarios, but the Balanced Pathway sees a use case for hard-to-reach communities.
- Further evidence is required to substantiate conclusions which deviate from UK wide strategy around the use of Blue Hydrogen.

Full electrification has a number of consequences that have not been clearly addressed:

- The costs and logistics of decommissioning or repurposing the gas distribution infrastructure are substantial. The preferred option is not clear and, consequently, the associated funding required to implement is missing.
- Future Energy Grids for Wales estimates that electricity demand for Wales could triple, but it is not clear whether the need to build capacity or network reinforcement to accommodate this substantial increase in peak demand has been considered.
- Existing solutions for managing these peak loads, such as dispatchable gas generation, do not exist in a full electrification scenario, but the alternatives have not been clearly identified.
- The suitability of Welsh housing stock has not been addressed. A typical 90m^2 property will not easily accommodate a hot water cylinder, required for the efficient operation of an electric heat pump. The cost of bringing properties up to a suitable level of efficiency has not been considered.

Empirical studies do not yet align on a clear pathway for the future of heat, with various approaches still being assessed. This would suggest further research and analysis is required to draw an evidence backed conclusion.

Technology context

Key messages

The Strategy does not consider the range of heating technologies that are available to enable and/or reduce the cost of transitioning to low carbon heating

The implementation of Local Area Energy Plans will ensure a localised approach is taken to address the **transition to low carbon heating in each area**. Under this approach it is important that consideration is made to place-based conditions and the full range of technologies that are available that could help enable and/or reduce the cost of the low carbon heating transition.

The Strategy considers a pathway where **residential heating** is almost **fully electrified**. This is a deviation from the UK Government policy, as well as from other countries such as the Netherlands and Germany with a comparable heating mix. Whilst the future heating mix could be largely electric, this is unlikely to be the most practical/economical solution in 100% of dwellings (whether they would use fully-electric heat pumps, or resistive heating), and **ruling out other options** at this stage, without robust analysis looking across all energy vectors, **would be oversimplifying the issue**.

Wales has a significant range of property types, in both dense urban areas and very remote areas, with a huge variety of consumer types within those properties. There are also a number of **wider energy system considerations** that need to be factored into any decisions such as electricity grid constraints, hydrogen clusters, and **providing resilient supply to customers**.

By taking this approach, the **Strategy omits several alternative or complementary heating technologies** such as; hybrid heat pumps, the widespread adoption of low carbon fuels (such as hydrogen), gas heat pumps (thermally driven heat pumps) and thermal energy storage. This has significant impacts on the markets for those products; slowing innovation and limiting supply-chain growth. It is not an easily reversible decision without delaying net zero targets.

The Welsh strategy also relies on the **rollout of insulation and other energy efficiency measures.** Over the last decade, there has been a gap in effective policy to support the installation of insulation and double glazing. Whilst a fabric first approach is sensible there is currently not enough support in place to deliver this and it is not made clear how this will be addressed. Therefore, even if a fully electrified approach is taken there is **significant risk** that slow delivery of both energy efficiency installations and heat pumps will **mean net zero targets are missed.**

Insufficient evidence is provided to justify the **exclusion of these technologies** which are central to several scenarios developed by credible sources. A number of commentators, such as BRE earlier this year, have stated that there is a need for much **greater testing of a full range of technologies**, including hybrid heat pumps. Others, such as the Institute for Government, have highlighted the importance of **not taking a 'one-size fits all approach'** and providing long-term certainty through a 'a range of policy levers' that support a range of technologies and consumers.

Technology omissions (1/2)

Low carbon gas has not been considered in the residential setting

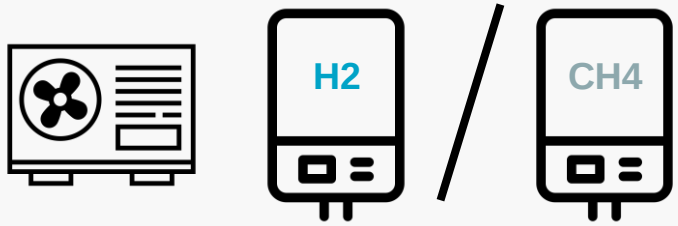
Low carbon gases (e.g. hydrogen, and biomethane)

Low carbon gases such as hydrogen could be a **versatile replacement** for high-carbon fuels used today and a competitive alternative to electrification.

As stated in the Strategy, UK Government is funding trials of low carbon hydrogen delivered through the gas network as a replacement for natural gas in some areas. However, there is **no consideration of this technology** for heating homes in Wales.

All leading boiler brands are active in developing hydrogen ready boilers in the residential market. At least three boiler manufacturers have **boilers in active field trials**, but it is expected that many of the followers will get there during 2023. The technical considerations from moving from natural gas to 100% hydrogen combustion in a gas burner is now well understood.

Biomethane is already widely used as a fuel source for heating across Europe, with even less modifications required to conventional gas burners for it to be suitable.



Hybrid heating systems

A hybrid heating system combines two heating appliances; an electric heat pump and a traditional central heating boiler (natural gas or hydrogen). This technology delivers the following key benefits to the energy system and households:

- ✓ **Flexibility –** With a hybrid system, the boiler can be used during peak times on the coldest days. This reduces the strain on the electricity network and mitigates the need for reinforcement. The boiler can also take the lead in domestic hot water production (leading to lower heat storage requirements within the home) and allow the heat pump to operate more consistently and efficiently for the provision of space heating.
- ✓ **Affordability –** Provide a lower CAPEX route to decarbonizing heating as removes the need for a complete system replacement.
- ✓ **Suitability –** Good fit for a wide range of insulation levels and in regions with low temperatures.

Despite the current lack of consistent government support in the UK**, some growth is expected** for hybrid heat pumps in retrofit in the coming years. Hybrid heat pumps are eligible for a sizeable government grant in Scotland.

Technology omissions (2/2)

Gas driven heat pumps, thermal storage and liquid fuels

Gas (thermally driven) heat pumps

This technology combines efficient gas combustion with a heat pump cycle within one device, utilising a gaseous fuel source and ambient energy together and thus giving an appliance efficiency well in excess of 100%.

While they are not as common in the UK residential market as they are in the commercial segment, gas heat pumps are another technology that **could provide options** for customers where fully electric heat pumps are not practical. Robur's gas driven heat pump offers an efficiency level of 174% and bill savings of 35% compared to a condensing boiler.

There is limited data available on the performance of these systems in UK households but they have the following advantages:

- ✓ Reduced peak electricity demand
- ✓ Efficiency savings against condensing boilers
- ✓ High temperature (e.g. 70°C output) and minimal drop in peak power output during the coldest periods (cf. electric heat pumps)

Thermal energy storage (TES)*

TES is a broad category of technologies that allows the user to store heat and therefore separate the timing of heat production and consumption. Potential benefits include:

- ✓ **Supporting the integration of heat pumps** – smart water tanks and heat batteries can provide instantaneous hot water and can be used as the primary heating system if combined with an electric boiler.
- ✓ **Flexibility benefits** – reducing energy bills for customers if combined with a time-of-use tariff.

There are several TES providers with early commercial offerings in the UK market

Sustainable liquid fuels*

This includes bioLPG, rDME, FAME, HVO, which could be suitable alternatives for some homes.

- ✓ **Transitioning fuel** – potentially cost effective and straightforward switch for off-gas grid buildings currently using oil.
- ✓ **Decentralised production** – Some biofuels can be produced locally, promoting local energy resilience.
- ✓ **Storage and flexibility** – Liquid fuels can be stored and transported meaning that they can be used as a backup or supplementary heat source.
- ✓ **Suitability** – Older buildings might be challenging to retrofit with modern electric heating systems. In such cases, liquid fuels could be a viable alternative.
- ✓ **CO_2 savings** – In the order of 80%+ when compared to conventional heating oil.

*TES and sustainable liquid fuels are mentioned in the Wales Heat Strategy, however very little information is provided on the role they could play.

Hydrogen Market

More evidence needed before ruling out options

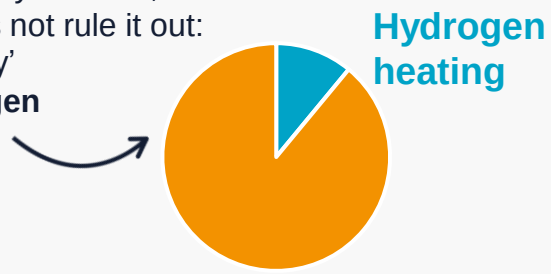
Hydrogen for heating, and other green gases, largely ruled out without sufficient analysis on the decision

The strategy seems to have dismissed the role of hydrogen for heating without appropriate analysis to evidence how this decision has been made. Although there is a broadly held view at this time that fully electric heat pumps will be the largest player in the future heating mix, it is too early to assume that we can rely on electricity alone and leaving out consideration of 'the rest' only leads to further uncertainty. Today, there are **over one million gas connected homes in Wales** and further analysis needs to be provided on how it will be determined which areas will stay connected to that grid.

There are a number of **assumptions** made around the hydrogen market and the role for hydrogen for heating, as well as the application of GB analysis to Wales, which we think need further consideration before ruling out options. These include:

1 CCC's Balanced Pathway

The strategy links to the CCC's pathways for decarbonisation in its argument for taking a fully electrified approach to heating in Wales. However, this is different from what the Balanced Pathway outlines, which shows a small role for hydrogen heating but, critically, does not rule it out: The CCC's 'Balanced Net Zero Pathway' forecasts **11% of homes using hydrogen for heat**. This would still lead to over 3 million UK homes running on H_2.



The CCC report outlines that hydrogen has the potential to replace fossil fuels in areas where electrification may not be feasible and cost-effective.

Therefore, if the Welsh heat strategy is going to use the Balanced Net Zero Pathway as a basis for their decision to take a fully electrified approach to domestic heating, a more detailed breakdown of the evidence used to determine the decisions to deviate from the pathway should be provided.

2 No mention of blue hydrogen

There is no mention of the role of blue hydrogen, with a pure focus on the role of green. The UK Government is planning for the production of blue hydrogen and it could be a useful **transition fuel** ahead of a larger green hydrogen production capacity. Whilst green hydrogen is likely to be the best long-term strategy, blue hydrogen, which meets the UK Government's **low carbon hydrogen** criteria, could support the scaling-up of the hydrogen market in the short term. This approach is also supported by the South Wales Industrial Cluster plan. This could drive **commercial development** of the necessary infrastructure, technologies and support **supply-chain** growth and in South Wales could support the creation of a CO_2 capability.

The strategy has not made clear what analysis has been done to divert from the UK's Government's approach to this. The UK Government is aiming to deliver up to 10GW of low carbon hydrogen production capacity by 2030, with at least half being green hydrogen, and therefore potentially up to 5GW of blue hydrogen. It will take time to ramp up green hydrogen and before ruling out blue and deviating from the wider UK strategy a **clear analysis needs to be carried out on the impacts of excluding blue hydrogen from the potential energy mix**.

Issues with the argument behind full electrification of domestic heating (2/3)

3 Comparison based on efficiency

The common argument against hydrogen for heat is largely based on hydrogen for heating not being as efficient as electric heat generation options. Whilst this may be true in a **direct comparison of the fuel efficiency at the point of consumption** it does not consider several complexities. For example, in some properties heat pumps may be **difficult or prohibitively expensive** to install which may mean that whilst hydrogen (or other low carbon gases) is less efficient in terms of fuel efficiency it could be the most practical option for that household. Furthermore, the considerations around the interseasonal storage of molecular / electric vectors must not be ignored.

One key challenge that may make heat pumps particularly challenging to install is the need for an **accompanying hot water cylinder** alongside it. The vast majority of UK homes have combined heating and hot water from their primary heating system and have either removed, or not been built with, a hot water cylinder. The average floor size for a UK home is 99m^2 and for many homes it will be a challenge to spare enough of that space to fit a hot water cylinder. Neither a boiler nor many hybrid heat pump products require operation with a hot water cylinder.

For many properties, this challenge will not be a barrier to heat pumps and trained retrofit coordinators will be able to advise customers on the design of the new system. However, for others the challenge of fitting the new system, alongside other factors such as their proximity to a hydrogen hub or availability of biomethane, may mean a gaseous heating system such as a hydrogen boiler, may be most appropriate. Therefore, the statement that hydrogen 'will remain a more expensive fuel than electricity' is oversimplifying the issue.

4 Cost of decommissioning the gas network

The cost of decommissioning the gas network was not mentioned as part of the strategy for ruling out hydrogen for heat. Arup's recent report for the NIC outlined that decommissioning the gas transmission network could cost £74bn and others have estimated this to be low on the low side for not including costs such as asset repayment or pension costs, and the distribution network costs also needs to be factored in. Therefore, this is an important cost to include in any analysis of ruling out hydrogen, or other green gases, for heating. Further research and testing is needed before any decision to decommission the gas network

5 Impact of full electrification on peak demand

It is not clear from the strategy whether the impact of all consumers relying on **electric heat pumps or electric heating on the electricity network** has been fully accounted for. The strategy does not address how it will meet the **additional new generation capacity and network reinforcement** needed. The electricity demand in the UK is expected to double, with the recent Future Energy Grids for Wales report estimating the Welsh electricity demand may triple. This will require significant reinforcement of the electricity networks and increases in peak demand. Furthermore, a shift to all-electric homes also necessitates a mass shift to electric cooking, which would add an additional 1-2kW+ electricity load to homes during peak times. **Hydrogen, or green gases, could play a role in reducing the peak demand during the coldest days in winter and offer options for hydrogen storage**. Further analysis of this can be found in pages 12-17.

Approaches being taken in other countries

German Heating Law 

Rather than focusing on a **single technology**, there will be a requirement from January 2024 for any heating system installed in new builds to use **65% renewable energy.** These heating systems could include:

- District heating
- Electrically driven heat pumps
- Direct electric heating
- Solar thermal, or solar thermal hybrid
- Hybrid heat pumps
- Heating systems using biomass, or green or blue hydrogen or derivatives.
  - Ahead of connecting to a hydrogen grid, a gas heating system that is convertible to 100% hydrogen may be installed without complying with the 65% renewable energy requirement

They are also supporting a localised approach where all municipalities must prepare their own heat decarbonisation plans by mid-2028 for smaller settlements and mid-2026 for larger ones

The German Strategy had previously suggested a stricter ban on gas or oil heating systems but have **subsequently gone back on this approach** and given a five-year grace period for systems that are irreparably damaged.

Netherlands 

Strong policy support is being provided for **hybrid heat pumps** and there is a clear ambition to decarbonise the gas grid, using **biomethane in the short term** and **hydrogen** in the long term. The financial support available for hybrid heat pumps has meant consumers can benefit from a short payback time of 3-4 years – which has garnered genuine buy-in from a portion of the Dutch market. The Netherlands, like the UK, has been very reliant on natural gas for natural heating, so there is a lot of **shared learnings** from each countries' approaches to decarbonising heat.

The Netherlands also has a strong focus on a **local approach** to decarbonising heat, allowing for a range of technologies and energy vectors. This allows local areas to plan based on what is most cost effective and best for consumers in that region. For example, the Amsterdam 'Transition for Heat' provides a promising example of the progress that can be made using a balanced approach, including heat networks and a sustainable gas network.

Relevance for the Welsh Heat Strategy

The heat strategy does not make clear what analysis has been used to determine its approach to decarbonising heat. There is a lot to be learned from other governments, with similar heating mixes, who are taking a more **technology agnostic, place-based approach**. Taking a very siloed approach at this stage of the transition, such as ruling out gas heating and the potential transitional role of biomethane, may lead to needing to change track later as more evidence becomes available. Allowing a more localised approach, that allows for a range of technologies, including ones that aren't yet on the market, is a lower risk approach to decarbonising heat.

Impact on peak demand and system resilience

Key messages

There is no industry consensus on the optimal heating mix in GB. As such, all technology options should remain open.

Many industry stakeholders have developed analysis quantifying the impact on the energy system of different heating decarbonization pathways. This **system-wide modelling is challenging**, and results are highly sensitive to assumptions around how the system will evolve, how technologies will develop, future costs and consumer behaviour. As such, **conclusions vary** and there is no consensus amongst industry on the optimal pathway.

This variation is illustrated by recent modelling from Aurora and Imperial College London reach very different conclusions on the most cost-effective heat decarbonisation pathway.

There are a number of other stakeholders such as Energy Systems Catapult, Climate Change Committee, National Grid ESO and UK Government that have estimated the impact on the power system of heat decarbonisation pathways. Each of these studies are consistent in their approach; testing and analysing different heat decarbonisation scenarios. It's clear from this approach that a **wide range** of different decarbonisation pathways **are plausible and being considered**, each of which with varying roles for electric heat pumps and hydrogen.

In addition, where the Welsh heat strategy has relied on research carried out by third parties it has not been made clear what analysis has been used to understand the applicability of GB or UK wide research on Wales specifically. There are a number of factors, such as housing mix, energy generation sources and existing infrastructure, that need to be taken into account when using any wider analysis for the Welsh heat strategy.

Heat accounts for a significant proportion of the energy demand in Wales and the strategy has not made it apparent what analysis has been carried out to understand the impact of the strategy on peak demand. Electrifying heat will require more capacity on the electricity grid, as well as many other steps, to ensure that peak demand can be met and cold winter spells don't lead to reduced resilience. Hydrogen heating is one of the technologies that can be used to reduce the strain on the electricity grid, and the cost of its reinforcement. It is not clear how it has been determined that hydrogen heating, or other routes to reduce peak demand and maintain a resilient supply, have been factored into the decisions made in the heating strategy. It's also not apparent what resilience standard the heat strategy is aiming to achieve, e.g. a 1 in 20 event.

We have compared the heating mix presented in the Wales Heating Strategy, with three Net Zero compliant 'Future Energy Scenarios' developed by National Grid ESO. This analysis clearly shows some of the key implications for the energy system associated with a fully electrified heating pathway.

Potential heat decarbonisation pathways

Analysis of 3 Net-zero compliant scenarios developed by National Grid ESO

National Grid ESO have developed two Net Zero scenarios that demonstrate a significant role for hydrogen in both residential and industrial heating. Both of these scenarios were discounted from the draft strategy without clear rationale.

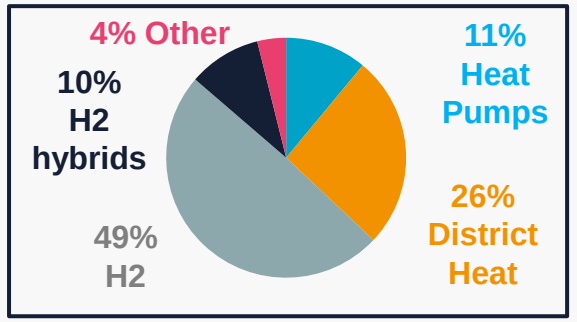
System Transformation

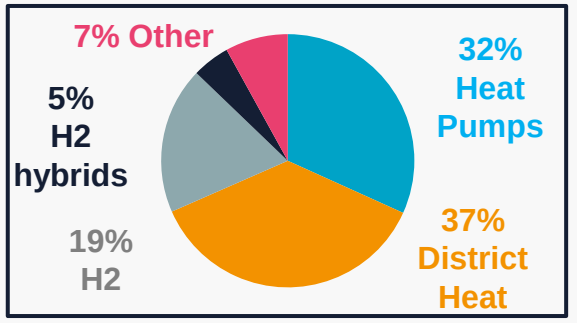
In this scenario, hydrogen use grows in industrial clusters initially from the mid-2020s which sees the installation of hydrogen ready boilers and appliances. By 2040, the gas network is completely repurposed to deliver hydrogen. In 2050, almost 50% of residential heating demand is from standalone hydrogen boilers, whilst hybrid (hydrogen) heat pumps account for 10% of demand. Heat pumps play a more limited role, representing around 10% of demand.

Leading the Way

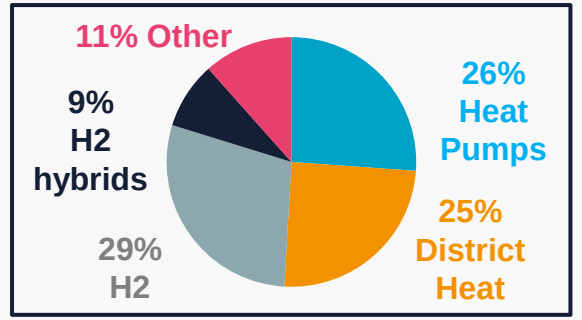
In this scenario, the development of local hydrogen networks starting from industrial clusters leads to an increase in hydrogen boiler and hybrid heat pump installations for residential and commercial customers in these areas from 2028. However, availability of hydrogen remains limited by location, and so electrification is still the most common route for decarbonization. By 2050, 18% of residential heating demand is from hydrogen boilers, whilst hybrid (hydrogen) heat pumps account for 5% of demand.

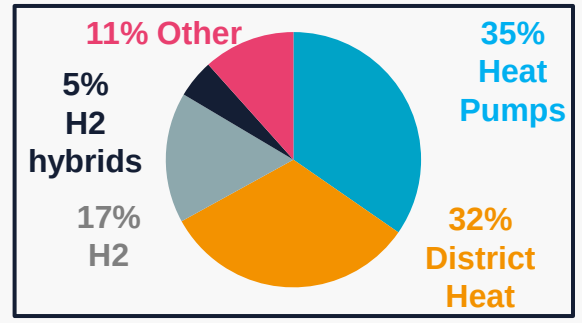
2050 Residential heat mix (TWh)

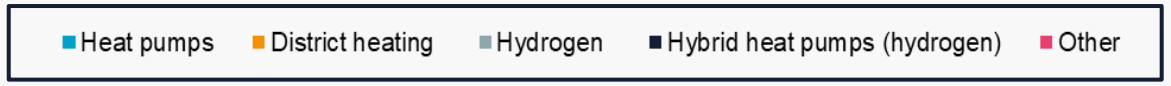




2050 Non-domestic heat mix (TWh)







*Direct electric heating included in Heat Pumps

Potential heat decarbonisation pathways

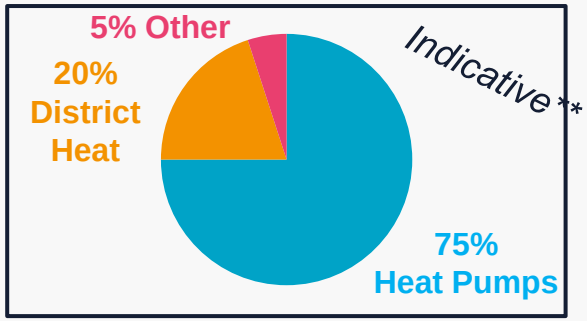
Analysis of 3 Net-zero compliant scenarios developed by National Grid ESO

The Welsh Heat Strategy and the 'Consumer Transformation' scenario depict a pathway where there is no role for hydrogen in residential heating and a limited role in industry

Welsh Heat Strategy
Residential heating is expected to be almost fully electrified, delivered via the installation of heat pumps and heat networks. Smart controls and increased energy efficiency will help mitigate the impact on the electricity network. There is no role for hydrogen heating. High temperature and low temperature electrification and hydrogen is expected to have a role in industrial heat.

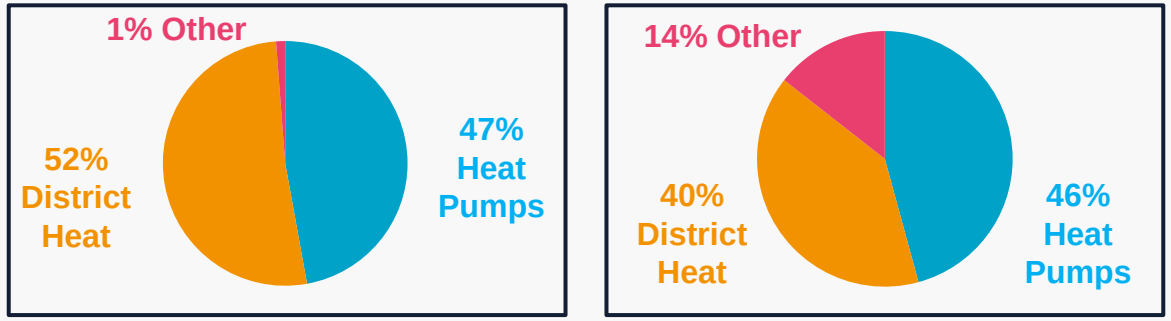
Consumer Transformation
In this scenario the use of ASHPs and GSHPs is widespread, reaching over 23 million installations in homes by 2050. District heat networks are used in some areas, supplying 6 million homes, with hot water from large-scale heat pumps piped to homes. Hydrogen use in this scenario is limited, as there is no hydrogen used for residential or commercial heating

2050 Residential heat mix (TWh)



2050 Non-domestic heat mix (TWh)

Heating mix not provided, however there is a role for low temp, high temp electrification and hydrogen in providing industrial heat.



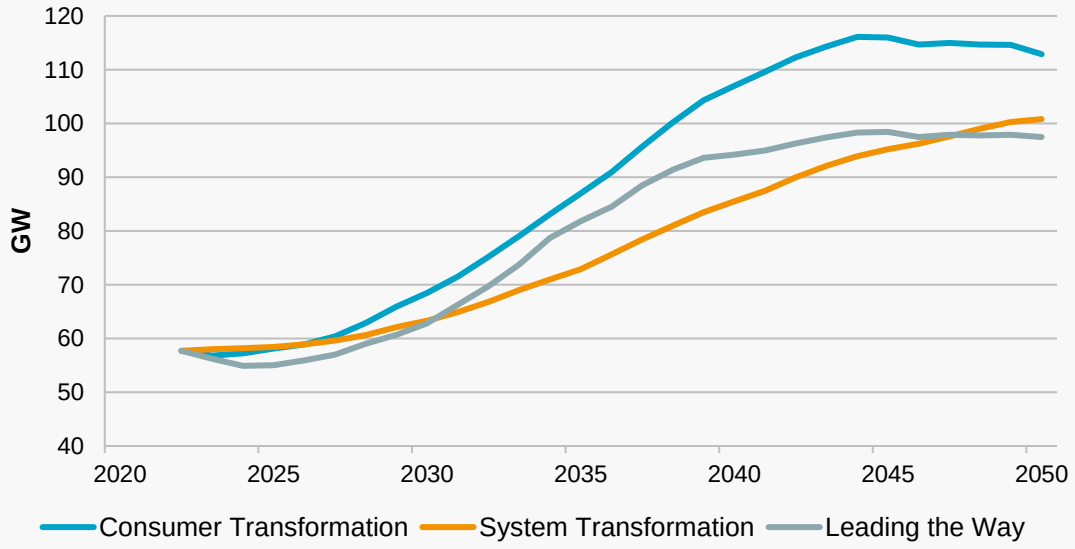
*Direct electric heating included in Heat Pumps
** Underlying data not provided in Wales Heat Strategy

Impact on peak electricity demand

Analysis of 3 Net-zero compliant scenarios developed by National Grid ESO

Widespread electrification of heating could increase peak electricity demand by 10% by 2050, relative to scenarios where there is a greater role for hydrogen.

Electricity system peak demand (ACS)



As discussed earlier, the inclusion of hydrogen in the heat mix will reduce the level of heat-led electricity load and demand at peak times. A reduction in peak system demand can lead to the following benefits;

- Reduce the amount of network reinforcement required
- Reduce the amount of generation capacity required
- Reduce the carbon intensity of electricity generation

With a transition away from gas, it is not clear whether **traditional methods for dealing with peak demand**, such as dispatchable gas plants, remain as an option in the Welsh strategy. Other options noted in the strategy include smart controls and energy efficiency measures, however no evidence is given on the contribution these solutions will have on lowering peak demand. Greater use of hydrogen boilers would **diversify the energy source**, reducing overall electricity demand. Hybrid technology could help the system manage demand during peak demand.

System impacts

Additional analyses

There are several other empirical studies that analyse various heat decarbonisation pathways. Results from these studies demonstrate that there is no consensus on the optimal heat pathway.

In October 2023, **Imperial College London** published analysis which showed hydrogen as a viable option to decarbonize heat cost-effectively. Specifically, it concluded that in a scenario where 2/3rds of households use hydrogen for heating system costs were £5.4bn/year less than in a scenario where heat is full electrified.

In December 2020, the **Climate Change Committee** published the Sixth Carbon Budget report. This report analysed the impact of four different decarbonisation pathways, each of which depicted a different heating mix. In three out of four scenarios, hybrid heat pumps play an important role, whilst in the 'Headwinds' scenario, it is assumed there is widespread conversion to hydrogen with 71% using the fuel to heat their homes.

Aurora modelling indicates that annual average system costs are 27% higher in a scenario where there is fast deployment of hydrogen boilers relative to a scenario where hydrogen is not used for heating. This is despite ~10% lower electricity peak demand.

DESNZ published the Electricity Networks Strategic Framework which sets out how the electricity network will be transformed to accommodate decarbonisation and demand growth. Economic modelling indicated that in a scenario whereby heat and transport is largely electrified, system peak electricity demand is almost 50% higher compared to a scenario of low electrification. This could increase electricity network costs by £30bn (10%) - £60bn (20%) depending on the capacity of the low voltage distribution network.

Analysis by **Energy Systems Catapult** as part of the Future Energy Grids for Wales project showed that by 2050, hydrogen is the greatest contributor to meeting heat demand at peak times, across all regions in Wales and both modelled scenarios. The report states that meeting all Welsh building heat demand, via electrification may not be cost-effective and supports continuing to explore options to minimise the impact of decarbonising heat on the electricity grid:

> *Whilst network operators should prepare for a substantial level of heat electrification, it is important to understand how other technologies and approaches can be leveraged to manage peak demand, and how a combination of these technologies may align within a local area.*
>
> **Future Energy Grids for Wales report, ESC**

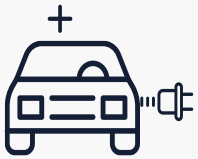
System impacts

Constrained electricity grid

The strategy assumes an electrified approach to heating can meet net zero targets but this will rely on a **significant ramp up** of renewable electricity generation. This will require a significant increase in renewable electricity production as well as grid reinforcement to allow it to reliably reach consumers' homes.

Based on the Draft Heat Strategy for Wales is it not clear that the grid impact of a fully electrified approach has been fully considered. **Grid capacity in Wales is already significantly constrained**, and this will be exacerbated by the increase in demand for electricity, for a number of uses including heating.

House of Commons Committee Report (October 2022) highlighted the stresses experienced by the Welsh electricity grid.



There are reports of issues being experienced as a result of the surge of electric vehicle drivers on the road, with grid capacity being a blocker to installing rapid car charging. Major renewable developer, RWE, cited the electricity network capacity as 'the largest single constraint preventing the deployment of renewable energy generation in Wales'.

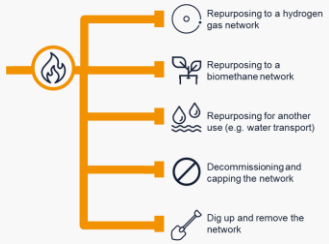
> *It is already near impossible to connect new renewable and storage projects in Wales due to the current constraints on the distribution and transmission grids.*
>
> **Written evidence submitted by Centrica plc for the Welsh Affairs Committee inquiry into grid capacity in Wales**

A clear, **whole system level plan** will need to be developed to overcome the constraint issues on the Welsh electricity grid if electricity demand is set to double and significantly more renewable capacity is needed to met net zero goals. The Welsh heat strategy puts a strong emphasis on the role of electrification **without providing sufficient detail** as to how these barriers will be overcome.

Cost and savings assumptions

Cost and savings

The Strategy doesn't appear to consider the cost of decommissioning or repurposing the gas network



Analysis by **Arup** for the **National Infrastructure Commission** in their report Future of Great Britain's Gas Networks recognised that the strategies and methods for decommissioning and disconnecting customers from the gas network are uncertain.

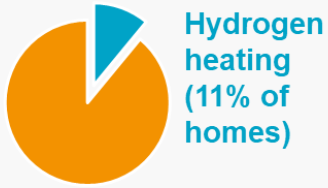
Arup's study makes assumptions regarding the balance of upfront investment to remove and make safe network assets and on-going expenditure and liability based on current approaches. The table below shows the cost of decommissioning the gas network, transitioning domestic customers, and total transition spend under the High, Balanced, and Low hydrogen scenarios.

	Decommissioning[1]	Domestic customer transition	Total transition spend
High	-	£7.5bn	£46bn
Balanced	£17.0bn	£17.6bn	£59bn
Low	£25.2bn	£22.9bn	£70bn

The Heat Strategy for Wales makes no reference to these costs or how they will be funded.

Arup also identifies that a whole system plan for decarbonisation does not yet exist, and it is necessary to close the evidence gap in implementation planning for the transition. This would include determining the consumer journey and how it can be optimised in a cost-effective way, and future system resilience & reliability through transition.

It is unclear how the CCC's assumptions have been used in the Heat Strategy for Wales



The Heat Strategy for Wales refers to the Climate Change Committee's Sixth Carbon Budget, when estimating the costs of decarbonising heat in various sectors of the economy.

However, whilst the Heat Strategy for Wales assumes heat pumps will be the primary method of heating and that hydrogen is not used as a heat source, the CCC's 'Balanced Net Zero Pathway' (which is used as the basis for cost estimates) forecasts 11% of homes using hydrogen for heat. **It is unclear what effect this disparity in heating mix assumptions will have on costs estimates.**

We anticipate that one effect of this alteration to the heating mix could be an increase in peak winter demand for electricity meaning a secondary, but potentially material, effect on electricity system resilience and reliability. These costs should also be factored into the analysis for the Heat Strategy for Wales.

Balanced Net Zero Pathway

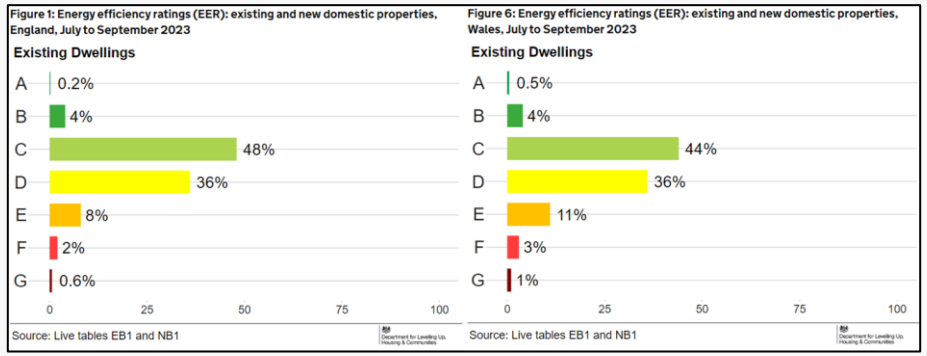
Hybrid hydrogen scenario in homes, with 11% of homes using hydrogen for heat. Limited use of biofuels in homes. Heat networks fully electrified. Non-residential buildings heat and catering demands mainly electrified with some hydrogen.

[1]: The decommissioning costs in the Arup report include only National Transmission System (NTS) and Local Transmission System (LTS) costs. The cost of decommissioning the lower pressure networks is excluded.

Cost and savings

Accounting for building stock efficiency and upgrades

The Heat Strategy for Wales references the Future Generations Commissioner for Wales Homes Fit for the Future: The Retrofit Challenge report, which notes that "*Wales has some of the oldest and least efficient housing in Western Europe and so action to improve the quality of this stock will be essential*" and that levels of fuel poverty remain stubbornly high at 12%.



Data from the Department for Levelling Up, Housing & Communities confirms a lower average energy efficiency rating for existing and new properties in Wales compared to England.

The CCC's Sixth Carbon Budget accounts for a higher level of fuel poverty for Wales than England and that to improve all fuel poor owner-occupied homes to an EPC rating of 'C' by 2030 requires investment for these homes of around £2 billion a year to 2030 reducing to £1 billion a year to 2050.

The Strategy needs to account for higher costs for efficiency upgrades in Wales compared to England and ensuring funding plans are in place.

Further clarity on funding mechanisms is necessary

The Strategy identifies several areas where funding is already in place, such as UK Boiler Upgrade Scheme, hydrogen trials, Heat Network Efficiency Scheme. However, there are several areas where the Welsh Government needs to identify or support stakeholders to access funding, such as for access to low carbon heat networks. As identified for gas network decommissioning, there are areas where funding impacts are completely omitted from the Strategy.

The balance of funding between UK and Welsh Government and private or investment funding also needs to be clarified. Without this clarification there does not appear to be a credible basis for implementing this policy.

Further clarity is required on the effect of a heating mix almost entirely dependent on electricity

A target heat mix based almost exclusively on electricity increases the dependency on achieving renewable electricity targets to achieve zero carbon heating.

The direct costs of this heating mix also need to be further analysed, given the dependency on cost assumptions that do not use this heat mix.

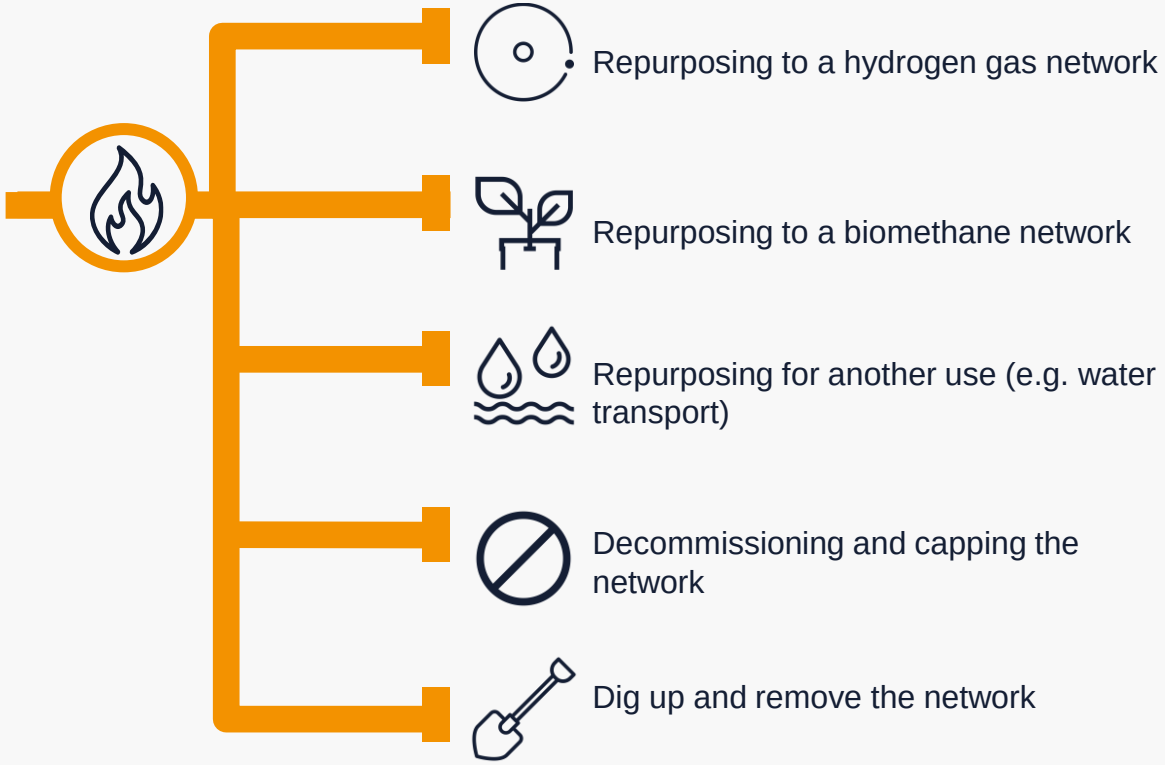
The impact of peak heat, which drives much of the distribution network reinforcement requirement, on the cost of ensuring system resilience and reliability using this heating mix also needs to be factored into the analysis for the Heat Strategy for Wales.

Impact on gas distribution network

What happens to the gas network?

The Heat Strategy does not cover the implications for any decisions on the future of the gas network

The UK has an extensive gas network, with the around 265,000km of distribution pipelines. Deciding its role in the future energy system is a critical milestone in the pathway to net zero. Based on the research to date, we are not yet in a position to know the best path forwards for this. There are a number of options which include:



Deciding to decommission either all or sections of the gas network is a huge decision and will be based n many factors including the role of hydrogen and other green gases, cost and safety. Making decisions on the limited role of hydrogen now has significant implications for the gas network in Wales. Ahead of any decisions more analysis, taking into account whole-system implications, needs to be carried out.

The recent Arup report on the future of the UK gas network highlighted the *'high degree of uncertainty with regard to transition research to date, both in terms of technical assumptions and cost assumptions'* and recommends further research on a number of areas, including on disconnecting domestic customers from the gas network.

There has been analysis on the cost of decommissioning the gas network. For example, Arup's recent report for the NIC outlined that decommissioning the transmission gas network could cost £74bn and others have estimated this to be low on the basis that costs such as asset repayment or pension costs have not been included. Distribution network decommissioning costs will also need to be factored in when considering ruling out hydrogen for heat. There are still too many unknows to accurately forecast this cost, but any heat strategies will need to take very significant decommissioning costs into their assessment of whether to completely electrify.

Conclusion

Further analysis should be provided ahead of finalising the strategy

As set out in this report, there are a number of areas where we believe further detail needs to be provided ahead of the final version of the heat strategy.

There is limited analysis provided in the strategy on how the approach to heating has been made. There is no 'one size fits all' approach to decarbonising our energy system and if options are to be ruled out then there needs to be substantial, whole-system level analysis to reach that decision. Ahead of the final strategy we consider that there are some fundamental questions to be addressed:

What analysis has gone into the decision to exclude hydrogen and biomethane boilers, hybrid heat pumps, gas driven heat pumps, thermal energy storage and sustainable liquid fuel systems from the heating mix in Wales?

When using sources such as the Climate Change Committee's 'The Sixth Carbon Budget' and the National Grid's Future Energy Scenarios, what analysis has been done to ensure any UK or GB findings are applicable to the Welsh heat strategy? What is the effect of using these documents but then varying underlying assumptions, such as the heat mix?

What role could blue hydrogen play in the pathway to net zero heating in Wales?

How has the impact on the gas network, and the potential cost of decommissioning, been factored into the heat strategy for Wales?

What is the impact of fully electrified heating on peak demand and resilience? What would it cost to reinforce the electricity network?

What will be done to overcome the electricity grid capacity constraints that are already being experienced on the Welsh network? How will this issue be managed as demand increases?

The strategy taken in Wales will have a significant impact on consumers and the ability to meet decarbonisation targets. Taking a siloed approach at this stage could hinder industry progress and prevent, or significantly delay, any changes in approach later on. Therefore, with the evidence available at this stage keeping options open for the heating mix is a lower risk approach to net zero.

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