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12th January 2017

Plan for a Smart, Flexible Energy System - A call for Evidence - Wales & West Utilities Response

We realise that this call to evidence was primarily targeted at the electricity sector - but we believe it is critically important going forward that we approach energy in a fully integrated way. This is the only way we will address trilemma challenges - and continue to provide customer with a secure, cost effective energy and low carbon energy supply into the future.

Wales & West Utilities is a licensed Gas Distribution Network (GDN) regulated by Ofgem, providing gas transportation services in Wales and the South West of England for all major shippers in the UK. We cover 1/6th of the UK land mass and transport gas to over 2.5 million supply points.

For our part we are at the forefront of efforts to decarbonise gas - we have to date connected the largest number of 'green gas' biomethane connections into our network - 16 connections providing enough energy to supply almost 100,000 households. To put this statistic into perspective, we have already connected more biomethane capacity than the projected output of the Swansea Bay Tidal Lagoon - at significantly lower cost.

We fully support the UK Government Carbon Plan principles that carbon reductions must be achieved at an affordable cost to homes and businesses, and not put security of supply at risk. Our own ambition is to increasingly provide smart, flexible, low cost and low carbon energy to our customers - and we continue to engage on current and future energy system developments at the UK and Wales level.

We attended the BEIS / Ofgem workshop in Cardiff on January 6th, and we acknowledge that the scope of evidence required here primarily relates to electricity at this time. We would however draw your attention to conclusions we believe are critical to a smart, flexible energy

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system for current and future customers. Our conclusions, which appear to be aligned to a growing volume of independent reports, are very much evidence based as opposed to rhetoric, and we would be happy to share this detailed evidence at the earliest opportunity.

The headline findings are outlined below - with the rest of this brief paper outlining these in more detail.

- ***The gas network transports more than 5 times energy at peak use times compared to the electricity grid***
- ***Whilst storage technologies are developing to support short term electricity balancing, the key issue is the efficient storage and flexibility of the energy system over longer periods of weeks and months.***
- ***Gas and the gas network currently provides the flexibility and storage that underpins the whole energy system***
- ***A key piece of research undertaken in Cornwall suggests the alternative costs for inter seasonal storage for the region alone would be around £36 billion***
- ***As more renewable (intermittent) electricity generation is added to the energy mix, the importance and value of gas as a reliable source of energy increases***
- ***The flexibility and storage benefits provided by gas will significantly enable the continued low cost development of renewable technology***
- ***We note the recent tabloid headline that renewable electricity provided 41% of electricity demand on Christmas day - with wind providing 28%. However, there were many more days during December where wind only contributed around 1%. Such fluctuation dramatically highlights the intermittency issues associated with some renewable forms of energy - issues that will only increase into the future.***
- ***On a final note, we recognise that fuel poverty is increasing. The continued use of gas, particularly the growth of 'green gas', provides a continued low cost and reliable energy supply for consumers in the transition to a lower carbon economy.***

We would be pleased to have the opportunity to discuss our detailed study evidence with you. We have not answered the detailed questions that are obviously targeted at electricity system issues - but rather provide evidence we have developed to effectively serve all energy customers now and into the future.

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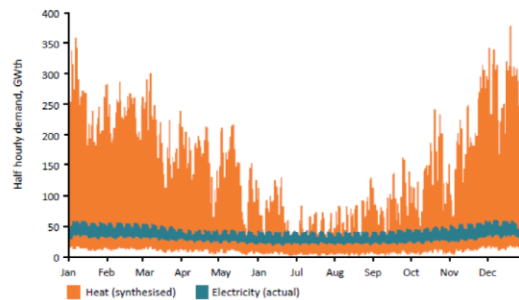
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Executive Summary

Key challenge: meeting peak demand

- Peak heat = 300GWs+
 - Peak elec = c.60GW
- Supply challenge
- Network challenge

Figure 2.4: Annual heat and electricity demand profile for 2010⁷¹



#HeatSummit

We must ensure that we examine the possibilities and potential benefits of the whole energy system and not fall into the trap of looking at electricity grid issues without understanding the total energy system potential.

Domestic customers and industry require low cost, secure, low carbon smart energy for power, heat and transport. Therefore, one cannot omit the gas transmission and distribution grids from this evidence gathering exercise.

To date, much focus has targeted renewable electricity generation and this narrow focus has omitted to address the total energy system issues. Focus on smart and flexible electricity alone will not solve the UK energy challenges. The chart above clearly shows why we must focus on a whole systems approach including effective utilisation of the gas grid and interconnection with Europe.

The gas grid currently provides the storage and system flexibility that underpins the UK energy system.

As we move to more weather dependent and intermittent (whether planned or unplanned) electricity generation the scale of storage and flexibility required from our energy systems will increase further and this means that we must effectively utilise the gas grid as part of a sustainable smart and flexible energy system.

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The UK is fortunate to have an extensive electricity network and a world class, low cost, gas grid. There are also a number of innovative energy generators (biogas, hydrogen and weather dependent electricity generators) that would like to maximise the utilisation of the infrastructure. Technology advances, innovation and communications developments are providing opportunities that did not exist in the past.

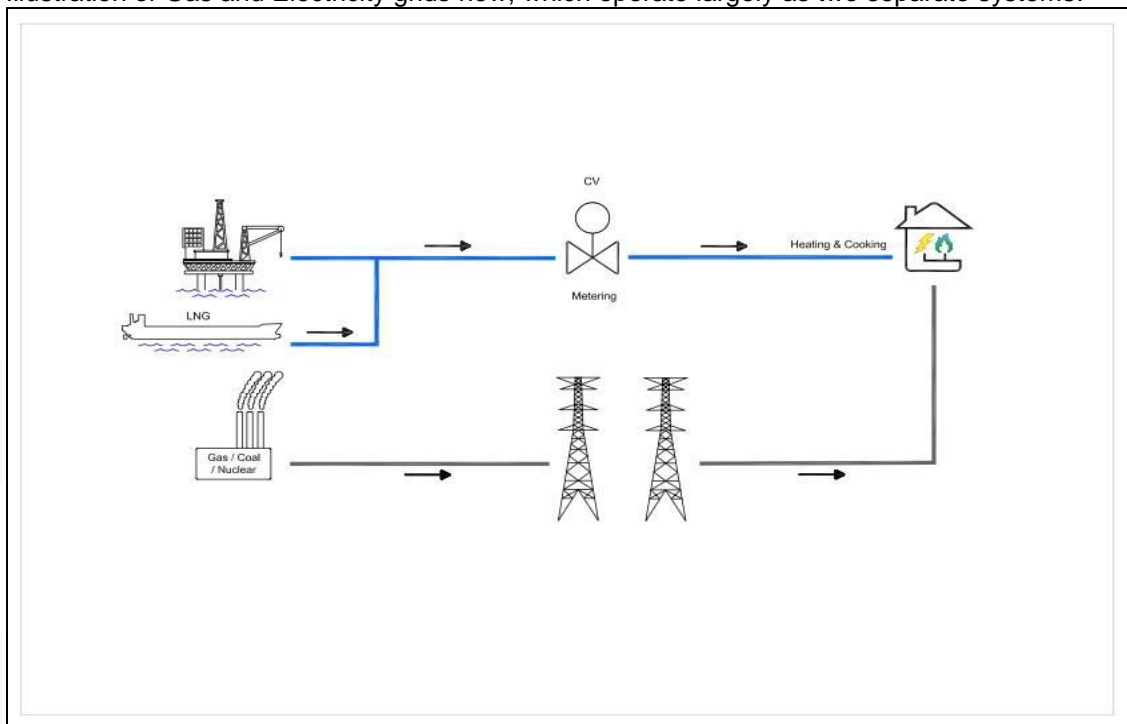
We see the imbalance of when weather dependent energy is generated and when energy demand is required alongside with the lack of affordable storage. There is currently no practical or affordable alternative to the inter-seasonal and daily total energy system storage requirements provided by the gas and the UK gas grid.

Our Vision

We envisage a whole systems approach, coupled with smart appliances as the way forward to deliver significant benefits for customers and industry.

The two diagrams below show how the existing electricity grid and gas grids are largely separate and used for heat and power separately but with some innovative linkages could be developed into an integrated system with renewable gas / hydrogen as key vector in maximising the use of renewable energy sources. Delivery of this vision could be the low cost, secure route to the sustainable energy needs of business and domestic customers.

Illustration of Gas and Electricity grids now, which operate largely as two separate systems:



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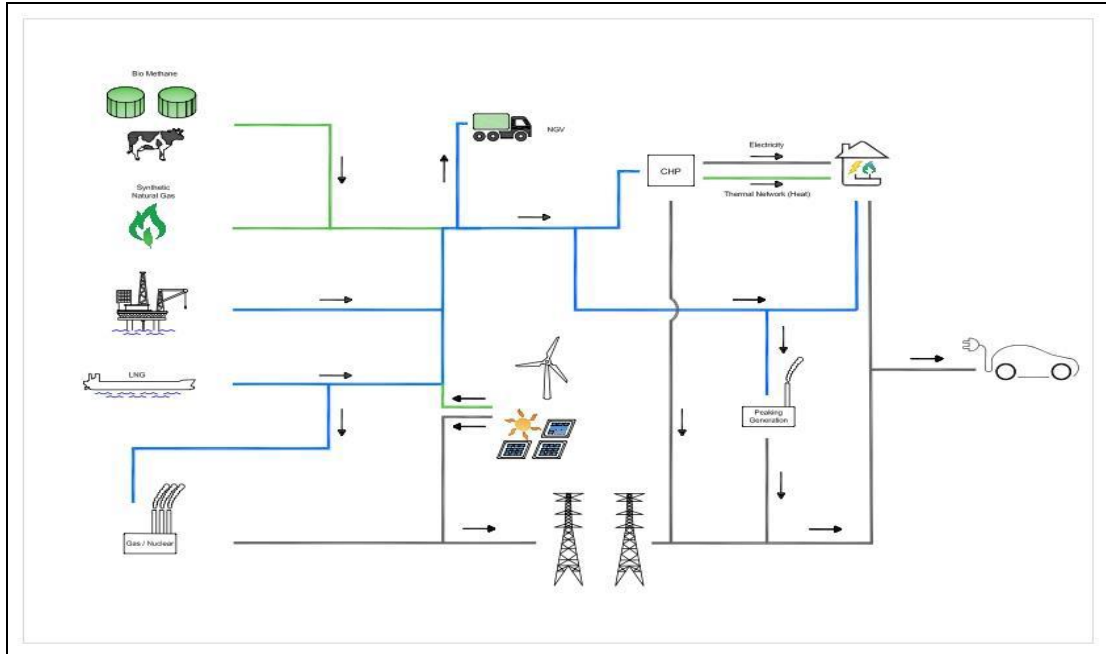
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Potential integrated Energy System of the future, maximising the benefits which each has to offer:



The advantages and future challenges of a more integrated gas and electricity energy system are:

Benefits:

- Reduced load on the electricity distribution and transmission systems, transferring the load and diurnal storage into the gas network, which could also assist with the inter-seasonal energy storage dilemma of green energy production through solar in particular
- The gas network provides the residual balancing for heat, light and power
- Minimised overall investment to secure the future?
- An integrated systems approach would facilitate lower carbon vehicles – both renewable electricity and gas vehicles
- Permit the utilisation of green gas solutions

Challenges:

- Improved coordination required between electricity and gas system controllers/planners architects
- Network codes would need reviewing, e.g. gas and electricity trading timelines are not aligned
- Optimization between transmission and distribution is needed
- Back up generation, peaking power plants would be vital to address intermittency

We recently completed two research projects and the headline outcomes from both projects are set out below.

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The detail project reports are available on the Energy Networks Portal and we would be delighted to take you through further detail as required. We have participated in other relevant work and a “further reading” section is included at the end of this document.

1. The Bridgend Study

The Bridgend study provided us with significant insight into customer behaviours, needs and ability to engage with new technologies. We note this is a key theme in the call for evidence.

The Bridgend study highlights that large scale electrification of heat is not practicable pre or post 2020.

Our vision of “a Whole systems approach” to energy indicates that electrification of smaller vehicles and conversion of larger vehicles to natural gas may well be beneficial in terms of cost, carbon and security of supply. The carbon benefits are clearly linked to the underlying carbon intensity of electricity and therefore may not be beneficial until post 2020.

The headline conclusions from our Bridgend Study are as follows:

- The alternative “renewable heating” options are currently too expensive with significant in house modifications required for them to be deployed
- Electrification of heat would not actually reduce carbon if deployed now due to the carbon intensity of electricity
- Due to the scale of heat demand, electrification of heat would require an electricity network circa 4 times the capacity of today’s UK electricity network and therefore be unaffordable and impractical. Therefore Customer security of supply would be put at risk
- Over 80% of consumers have no “spare” funds to invest in heat alternatives
- The transition time to move from one heating source to another at scale can take up to 20 years
- The use of renewable gas reduces carbon significantly and removes the need to retrofit or upgrade existing energy distribution systems

2. Cornwall Energy Island Project – a total energy system simulator

Wales & West Utilities has supported a study to create a detailed energy supply/demand simulator in order to understand the impact of renewable electricity generation on the gas network.

A key outcome from this project has been the identification and quantification of storage and flexibility required as we move to increased renewable but intermittent electricity generation. Again, this is a key theme with the call for evidence.

We used the premise of creating a “renewable Cornwall” as a model to set out what the future would look like, using the outputs from workshops with local people. Using these outputs, the simulator started by charting hourly usage (demand) for heat, light and power over the period January to December 2015. It then added the available energy supply profiles, e.g. for wind,

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solar and geothermal. (Geothermal energy is heat from hot rocks deep underground). When the two charts were combined, the simulator was able to identify the balance (or imbalance) of supply and demand, and look at real time data.

The simulator enables investment needs to be identified, including generation costs and storage costs and then can estimate the resultant cost to the consumer for various options. Any mix of renewable energy sources can be simulated, along with options related to the availability of storage. The simulator was used to model two future scenarios: a storage option, in which storage could be used to balance seasonal, daily or hourly demand; and an over-generation option, where generation could be scaled up to meet winter demand without the need for significant storage. The key headlines of the project are captured below:

The approach to the research:

- Gather information on heat, light and power demand and supply for Cornwall
- Ensure annual and peak data points are included
- Build an energy model to show the costs, security of supply and environmental impacts of different “energy mix” options
- Independently test the model inputs and outputs
- Share model outcomes / learning with policy makers
- Apply model to UK and other regions

Key conclusions of the research:

- Only 6.5% of heat, light and power needs are currently being met from renewable energy generation
- If the renewable generation % increases, huge additional storage is required at a cost of £36bn per annum
- The cost of current non gas storage is so high it cannot be considered as viable option to support renewables
- The gas network is providing secure, low cost and flexible within day and inter seasonal storage that cannot be feasibly replaced
- Utilising the gas network with natural gas alternatives will save consumers significant amounts of money compared to alternatives
- The wide range between Winter / Summer demand and within day ranges of energy demand require long term use of the gas network

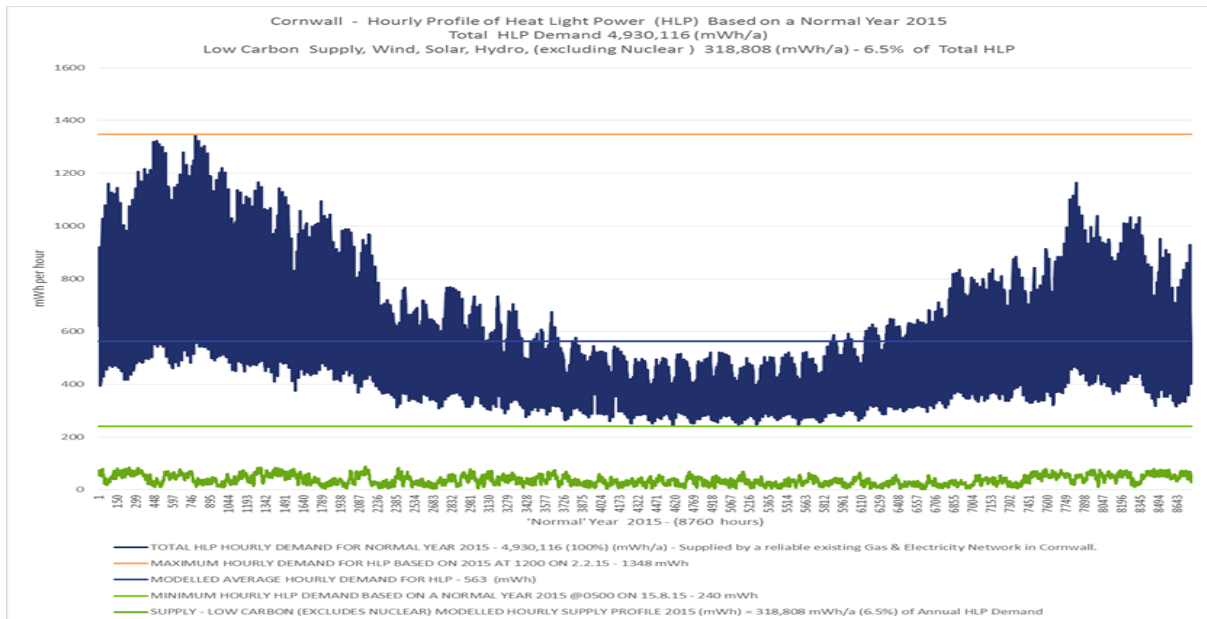
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Conclusions and next steps

We envisage a whole systems approach, coupled with smart appliances as the way forward to deliver significant benefits for customers and industry.

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The UK is fortunate to have an extensive electricity network and a world class, low cost, gas grid. There are also a number of innovative energy generators (biogas, hydrogen and weather dependent electricity generators) that would like to maximise the utilisation of the infrastructure. Technology advances, innovation and communications developments are providing opportunities that did not exist in the past.

We see the imbalance of when weather dependent energy is generated and when energy demand is required alongside with the lack of affordable storage. There is currently no practical or affordable alternative to the inter-seasonal and daily total energy system storage requirements provided by the gas and the UK gas grid. Our next steps include:

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- Collaboration through ENA gas futures group utilising academic and external specialist expertise
- Continue to develop objective evidence / case studies and demonstrators on:
 - Lower carbon gases such as biomethane enablers / hydrogen
 - Integrated heating, power & transport solutions
 - Demonstrators for hybrid energy appliances
 - Customer attitudes and behaviours
 - Collaborative projects at local level – E.g. Cornwall Energy Island
 - Continued focus on energy efficiency and education
 - Recognition that different solutions may better suit different communities

Further reading

Whilst we provide headlines of our own research in this call for evidence, there is a growing body of evidence being developed by respected and independent bodies. The list below is not exhaustive but contains some key evidence highly relevant to smart systems and flexibility. We know that BEIS and Ofgem probably have received this information but provide the list just in case you have missed it:

- Adam Smith Institute – Solar Power Britain's impossible dream
- Policy exchange – Too hot to handle
- KPMG – 2050 Energy futures scenarios
- Dr Keith Mclean – Energy system decarbonisation LNCI 2016 presentation
- Jon Slowe – What should we do about the future of heat LCNI 2016 presentation
- The ENA Smarter Networks portal (contains all network reports on innovation funded research)
- Climate Change Committee – Next steps for UK heat policy

We hope you have found this response valuable and should you wish to discuss any aspect of this response please do not hesitate to contact us.

Yours sincerely,



Steve Edwards
Director of Regulation and Commercial
Wales & West Utilities

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