
Carbon Connect Policy Paper: Low Carbon Gas Demonstration Projects

On Tuesday 10th January 2017, Carbon Connect ran a roundtable in Parliament entitled “Low Carbon Gas Demonstration Projects”, chaired by Callum McCaig MP, James Heappey MP, and Dr Alan Whitehead MP. This was the second of three evidence sessions held as part of the research process for the first report in Carbon Connect’s Future Gas Series. This paper has been produced as a follow up to this. While it was informed by the event it does not necessarily represent the views of those in attendance.

Numerous studies have highlighted the promising potential that low carbon gas has to decarbonise heating in the UK¹. The next step in making this a reality is demonstrations: small-scale projects showing, in practice, that it is achievable.

Biomethane and bioSNG

Projects for biomethane and bioSNG are relatively mature. Biomethane injection to grid is well established in the UK², and National Grid Gas Distribution (NGGD) are developing the world’s first commercially operating bioSNG plant making gas from black bag waste³. SGN recently completed a project in Oban, Scotland which showed it is technically possible to widen the gas quality limits in the Gas Safety (Management) Regulations (GS(M)R)⁴. This would reduce the costs of adding propane to ensure that biomethane reaches GS(M)R quality. Projects by NGGD and SGN are exploring new ways of accommodating new sources of gas on the distribution networks, to help optimise new connection capacity and reduce the need to add costly and fossil fuel based propane⁵.

Hydrogen

For hydrogen, demonstration projects are in their very early stages—but they are a necessary prerequisite if a government is to launch a rollout of hydrogen gas in the UK. Given the significant costs and implications of hydrogen in the gas grid, no Government decision can be made on it without robust evidence to confirm its technical feasibility, economic credibility, social acceptance, and above all its safety. Indeed, one of the most crucial pieces of evidence that must be provided by demonstrations is that the risk of injecting hydrogen in the gas grid is comparable to that of natural gas today. Without this, Government cannot commit to a hydrogen future.

Some operators of gas distribution networks (GDNs) have taken initial steps in the hydrogen space. For example, a project led by NGGD will carry out live trials of natural gas blended with up to 20% hydrogen on a private gas network. By demonstrating the safety of producing and blending hydrogen in the gas network and its compatibility with end-use appliances, this study can pave the way for changes to the GS(M)R which would permit the injection of hydrogen for blending into the grid⁶. Blending could be particularly beneficial in terms of balancing the electricity grid—surplus electricity could power electrolyzers, generating hydrogen for injection into the gas grid. However, blending offers small benefits in terms of greenhouse gas emissions reductions, as a 20% hydrogen blend equates to only a less than 7% carbon reduction. GDNs are enthusiastic to now begin demonstrations that provide evidence surrounding the safety of 100% hydrogen in the gas grid. There are, as of yet, no projects in the UK demonstrating this.

Next steps for 100% hydrogen demonstrations

The H21 Leeds City Gate study by Northern Gas Networks (NGN) has outlined a roadmap of development and trials that are needed to obtain the appropriate evidence on the safety of hydrogen⁷. Whilst there is a vast list of evidence that must be gathered from demonstrations, some core aspects of future demonstration work for hydrogen are clear:

¹ H21 Consortium (2016) Leeds City Gate; Imperial College London (2016) Managing heat system decarbonisation: comparing the impacts and costs of transitions in heat infrastructure ; KPMG (2016) The UK gas network’s role in a 2050 whole energy system

² ADBA (2016) Anaerobic digestion market report

³ Gray, J. (2016) National Grid opens pioneering BioSNG plant *Networks* 24 November 2016

⁴ SGN (2016) Opening up the gas market – final report

⁵ Gas NIC submission from National Grid Gas Distribution – Future Billing Methodology; Gas NIC submission from SGN – Real-Time Networks

⁶ Gas NIC submission from National Grid Gas Distribution – HyDeploy

⁷ H21 Consortium (2016) Leeds City Gate

- **Safety.** Before a live trial can take place, it is a matter of absolute priority that the safety of hydrogen, both downstream (i.e. appliances) and upstream (i.e. pipelines), is shown. The risks of hydrogen must be comparable to that of natural gas. Doing this would involve a two to three year programme of demonstrations.
- **Live trial.** A live trial of 100% hydrogen in the gas network could take place after this. SGN are looking to do feasibility studies over two years to assess three potential sites in Scotland in which the demonstration would test 100% hydrogen using a new purpose-built hydrogen network. This would build evidence in stages and culminate in a full 100% hydrogen demonstration involving fewer than 500 mixed-use customers over an extended period of time. The demonstrations would gather a wide range of technical evidence to support the viability of 100% hydrogen and ultimately feed in to a Government decision on the matter.
- **Carbon capture and storage (CCS).** Testing carbon capture, transport, storage and utilisation for hydrogen production by steam methane reformation (SMR) is essential to the viability of hydrogen.
- **Hydrogen appliances.** Worcester Bosch is aiming to have a prototype of a hydrogen boiler by the end of 2017, and expects to have sufficient hydrogen boilers for a potential live trial by the early/mid-2020s. Further research could also be conducted to explore the feasibility and benefits of dual fuel appliances, which can run on both hydrogen and natural gas, thereby potentially simplifying the switchover.
- **Customer engagement.** Converting millions of gas customers' homes requires excellent customer engagement, including proactive media campaigns to dispel potentially damaging publicity. SGN's Oban project trialled over twenty customer engagement methods, resulting in >90% access rate amongst customers. Such work can provide valuable lessons regarding accessing homes and collecting data with willing customers.

Recommendation 1

Government and Ofgem should actively support enthusiasm from GDNs to run demonstrations providing:

- The safety-based evidence to show that hydrogen represents a comparable safety risk relative to natural gas, in both downstream and upstream systems.
- Evidence supporting any mitigation measures that could be needed to ensure this is the case.
- Evidence on best practice for customer engagement and positive media.
- Evidence to support new innovative sources of low carbon gas

Recommendation 2

Government should provide small funding for a competition to explore the feasibility of dual-fuel hydrogen appliances which could simplify the switchover from natural gas to hydrogen.

Throughout these long-term demonstrations, there are key requirements which, if met, will ensure the effectiveness of their findings and their overall success:

- **A sustainable supply of hydrogen.** During demonstrations and a live trial, a continuous and resilient supply of hydrogen is essential to ensure that there is no intermittency in supply. This requirement favours sites which are located near hydrogen salt caverns or existing centres of hydrogen production, such as Teesside.
- **Standardised hydrogen.** The hydrogen supplied in demonstrations must be of the same standard as that which would be used in a rollout. GS(M)R does not cover hydrogen, so it is essential that GS(M)R is modified to refer to a newly developed IGEM standard which would set the gas quality of hydrogen for both trials and rollout.
- **Charging.** The cost allocation and customer charging model used in demonstrations should lead towards a model that can extend beyond the demonstration sites to prevent a change to charging during early commercial rollout. This is required to balance differentials in costs between early and late adopters of hydrogen, as well as balancing the higher fuel costs of hydrogen relative to natural gas and electricity.

Recommendation 3

- IGEM and HSE should continue the initial work to establish a new hydrogen gas standard which stipulates the gas quality for 100% hydrogen in the grid.
- Schedule 3 of GS(M)R standards should be moved into an IGEM standard in order to provide greater flexibility to relax restrictions upon the injection of low carbon gas whilst assuring its safety.

How can demonstration projects be funded?

The programme of works set out by the Leeds City Gate H21 study suggests an additional £100m is needed to fund demonstrations before a decision to proceed with a hydrogen rollout can be taken. The ways in which such vast sums of money are distributed need consideration. At present, the Network Innovation Allowance (NIA) and Network Innovation Competition (NIC) are the primary method for funding innovation in the low carbon gas space. However, there are doubts over the suitability of these funding pots for stimulating hydrogen demonstrations:

- **Lack of long-term direction.** The NIC and NIA are administered by Ofgem. Government certainty over the future of gas would help encourage Ofgem to fund demonstration projects for low carbon gas.
- **Funding available is insufficient to cover the required projects.** Electricity networks are disproportionately funded for low carbon projects, when compared to the scale of the challenges they face. The gas networks will need access to greater funds, to support this strategically vital work, as well as meeting their shorter term business requirements. This could be achieved by incorporating funding into RII0 GD2, increasing or establishing additional funds, or through merging the Gas and Electricity NIC competitions.
- **Not designed to fund projects related to SMR and CCS, CO2 networks, and CO2 stores or end-user appliances.** At present, these activities might be hard to justify under NIA and NIC, and therefore these funding mechanisms would need to be augmented to cover these projects.
- **Risk too high.** The current process can place too much risk on the network which can delay or discourage innovation. Mechanisms to de-risk projects can protect shareholders and therefore encourage them.
- **Not holistic.** Other sources of funding can be better suited for including a whole-system approach, such as including sectors like transport within projects.

Recommendation 4

- Government should signal support for hydrogen demonstrations in order to provide impetus for Ofgem and industry to support such long-term work.
- Ofgem should reform NIC/NIA to improve their suitability for hydrogen demonstrations.
- Government should provide coordinated financial support for projects outside the scope of Ofgem, such as CCS, as well as projects which involve synergies between energy, transport and other aspects of a hydrogen economy.

How can demonstration projects be best governed?

Government should, at an appropriate stage, provide leadership on the demonstration of hydrogen with the formation of an agreed coordination mechanism tasked with taking this programme of work forward. This has proven effective with previous transition programmes, such as the digital switchover. The coordination mechanism would involve experts from across the supply chain, such as producers of hydrogen gas and appliance manufacturers, as well as GDNs, and regulators such as HSE and Ofgem. It would also involve actors across the energy system (e.g. transport) to realise the full benefits of a move to a hydrogen economy.

Coordination is necessary in order to avoid gaps and overlaps in the research process, as well as ensuring that the research programme captures the best possible synergies. The coordination mechanism can ensure knowledge sharing and ensure all research feeds in to the wider body of evidence, but should still allow GDNs to operate their own projects independently. If successful with demonstrating the safety-based evidence to support a Government decision to convert to hydrogen, then this coordination mechanism could continue its work and oversee any future rollout.

Recommendation 5

Government and/or industry should establish a coordination body for 100% hydrogen demonstrations which consists of members from across the energy sector and gas supply chain, including GDNs, BEIS, Ofgem, HSE, IGEM, hydrogen appliance manufacturers and the CCS sector, amongst others.

Government leadership

The gas industry is eager to begin 100% hydrogen demonstrations. GDNs and the wider supply chain have the expertise to do so, but require Government leadership in order to provide the impetus and funding to support such work. If Government is to be in a position to make a decision on hydrogen in the mid-2020s, then support for demonstrations is required at once.