Scottish Parliament Net Zero, Energy and Transport Committee inquiry

Scotland's electricity infrastructure: inhibitor or enabler of our energy ambitions?

SGN Response

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About SGN

SGN manages the network that distributes natural and green gas to nearly 2 million homes and businesses across Scotland. We are committed to supporting the decarbonisation of homes, businesses, and communities in a safe, reliable, and affordable way.

Our strategy and long-term plan to deliver net zero focuses on replacing the natural gas in Scotland's gas networks with greener technologies, including hydrogen.

We believe that the most efficient, cost effective and quickest solution to decarbonising Scotland's economy will be based on whole system thinking across multiple sectors and including a range of different technologies.

We have focussed our response to questions where we have specific expertise and insight to offer the Committee and would welcome the opportunity to discuss further.

Wind energy

6. What are the key barriers to achieving the Scottish Government's ambition for onshore and offshore wind contained in the Draft Strategy; could the readiness of the electricity network to accommodate new projects affect the business case for the proposals?

The key barrier to delivery of the Scottish Government's ambition for onshore and offshore wind is the need to deliver significant upgrades to the electricity networks across Scotland and transport electricity from point of production to points of demand. Whilst technically feasible, challenges around delivery represent a risk to Scotland's net zero ambitions to make rapid progress to decarbonise transport, industry and buildings by 2030 and 2045.

One of the most fundamental issues that must be resolved is the planning and consenting barriers. There are a number of conflicting public policy questions which must be balanced such as ensuring national strategic infrastructure decisions are taken in a timely way but also respond constructively to local community concerns. A further historic challenge is that of delivering sufficient electricity network infrastructure in a timely way that also protects customers from the risk of bearing the costs of stranded assets. Underpinning these challenges is a need to ensure upstream, midstream and downstream value chains are aligned in order to give investors' confidence to support projects.

Failure to resolve these challenges means that energy consumers face ever increasing costs of electricity system management. Across Great Britain, these constraint costs are estimated at around £2bn in the coming years and are expected to rise by the end of decade without market, regulatory and policy intervention.

One of the key short-term opportunities to resolve the planning issues of infrastructure to support the further development of wind and hydrogen economy in Scotland is to streamline the planning process and ensure that decisions are taken quickly and give clarity to developers and investors. This could include changes to relevant planning policy and legislation, along with ensuring directorates such as MS-LOT and the Energy Consents Unit are properly resourced to support the influx of infrastructure planning applications.

7. Given the generation potential, and market ambition, is there a risk of oversupply if options for use of surplus electricity (e.g. green hydrogen production) do not become reality?

Given forecasts of increased electricity demand to deliver a net zero economy, it is unlikely that there is a significant risk of oversupply at a UK scale. However, there may be a risk of oversupply within Scotland's borders if the development challenges faced by electricity distribution and transmission networks are not at a pace to ensure "over supply" can be moved to centres of demand in the south. As well as the risk to delivery of net zero targets, this presents the additional risk of prolonging and increasing the costs to consumers of curtailment payments to manage the electricity system.

Green hydrogen production, which involves using renewable electricity to electrolyse water and produce hydrogen, can be a potential solution to address this issue. By utilising excess renewable electricity for green hydrogen production, the electricity can be stored in the form of hydrogen and used later when demand increases, providing a way to balance the electricity grid and avoid curtailment of renewable energy generation. Green hydrogen can also be used as a feedstock in various industrial processes, as a fuel for transportation, and for energy storage, which could create additional demand and help avoid oversupply.

However, if options for green hydrogen production from surplus electricity do not materialise, there could be missed opportunities to store excess renewable electricity and utilise it efficiently, potentially resulting in an oversupply of electricity in the grid. This could lead to economic, environmental, and operational challenges, including increased curtailment of renewable energy generation, reduced revenue for renewable energy projects, increased grid instability and increased customer costs of constraint payments.

It's important to note that the availability and viability of options for green hydrogen production from surplus electricity depend on various factors, including technological, economic, regulatory, and market considerations. Therefore, careful planning, investment, and policy support are needed to maximise the potential of green hydrogen production and utilisation to address the issue of surplus electricity and avoid the risk of oversupply in Scotland or any other region.

In the medium term, consideration of the net zero challenge on a whole system basis rather than specifically focussed on electricity networks, could open additional opportunities to decarbonise the economy more quickly, optimise energy production and utilisation, deliver socio-economic benefits across all parts of the country and reduce costs to consumers.

For example, by removing constraint payments and instead putting in place incentives for green hydrogen production, policy makers could support the rapid development of the green hydrogen sector in Scotland. To deliver this, a multi-institution approach to tackle the problem needs to be put in place including UK Government, Ofgem and the ESO/FSO, as well as Scottish Government.

SGN is currently undertaking market analysis to develop a credible scenario of the market potential for green hydrogen production from curtailed and constrained onshore renewables in Southwest Scotland. These scenarios are based on the rate of growth of renewable generation projects, and associated electrical infrastructure required to deliver, focusing on the Southwest of Scotland and build scenarios in the years 2025, 2030 and 2035.

This work will be delivered through a low, medium and high potential assessment.

Hydrogen and the electricity system

8. How much of the Scottish Government ambitions for 5 GW of hydrogen production capacity by 2030, and 25 GW by 2045 should come from green hydrogen?

The Scottish Government has set ambitious targets for hydrogen production capacity. The exact proportion of green hydrogen (produced using renewable electricity) that could contribute to these targets would depend on several factors, including technological advancements, availability of renewable electricity, market dynamics, and policy support.

If the Scottish Government aims to achieve a significant portion of its hydrogen production targets from green hydrogen, a significant expansion of renewable energy capacity to provide the necessary renewable electricity for electrolysis would be required. This would likely involve continued investment in renewable energy sources such as wind, solar, and hydroelectric power, as well as potential advancements in energy storage technologies to facilitate the availability of surplus electricity for green hydrogen production.

As has occurred with the development of the solar and offshore and onshore wind technologies, regular monitoring and adjustments to policies and targets may be necessary to account for changing market dynamics and technological advancements.

In order to fully understand the potential for green hydrogen to meet its targets, Scottish Government should consider sponsoring a whole system task force across hydrogen, electricity production and energy network operators that establishes a clearer view on the potential for green hydrogen and what steps are needed to bring its vision on green hydrogen to reality.

9. What are the key infrastructure barriers to building a hydrogen economy in Scotland and how should they be addressed?

Extensive new infrastructure will be required to deliver a resilient hydrogen economy. SGN is already leading the way in developing a strategic network of new hydrogen transmission pipelines connecting proposed hydrogen production and offtake locations across Scotland. The Aberdeen Vision and H2 Caledonia pre-FEED projects will complement National Gas's Project Union[1] to create, together with some repurposed existing networks, a hydrogen supply ecosystem across Scotland.

Developing network transportation options will provide opportunity to join industrial, commercial and potentially domestic demand for hydrogen, as well as provide a resilient backbone to regional hydrogen hubs across Scotland, as set out in the Scottish Government's Hydrogen Action Plan.

Critical projects are currently underway to deliver an evidence base to understand the potential for hydrogen transportation through Scotland's existing gas distribution networks, and it is important to maintain pace on these projects over the coming years.

Another critical infrastructure challenge to building a hydrogen economy in Scotland is the development of hydrogen storage capacity. Whatever the technology pathway to meet specific net zero sector ambitions, Scotland will need considerable energy storage for short, medium and long-term purposes. Hydrogen presents a credible net zero option to support the decarbonisation of industry, business, homes and maintain a resilient power system.

There will be significant periods of mismatch between renewable energy supply and energy demand, within-day, on cold winter weeks, and seasonally. And renewable energy constraint payments are forecast to rise to a peak of around £2.5 billion a year in the mid-2020s. Energy storage at scale is therefore needed to maximise the energy recovery from Scotland's vast wind and other variable renewable resources. Hydrogen storage will be a major and essential part of this.

Of the main electricity storage options, batteries are short duration and not at sufficient scale, and there are limited new pumped hydro sites. Hydrogen production and storage can also offer a solution to electricity grid constraints, enabling more renewable capacity installation, and maximising the usage of that capacity, with lower curtailment. The recent Long Duration Energy Storage report for BEIS concluded that longer duration storage solutions reduce net zero system costs by £13-24 billion a year, and that the largest savings arise from a combination of hydrogen storage and hydrogen CCGTs.

[1] SGN and NGT accelerate hydrogen plans for Scotland and southern England | SGN Your gas. Our network.

SGN commissioned engineering consultant DNV to undertake analysis on the requirements for hydrogen storage across the energy system. Our modelling for this project found that, to ensure continued energy provision in the coldest periods with very low wind generation (such as in early December 2022), hydrogen storage will range from 29-65 TWh – equivalent to 20-45 new salt cavern facilities with each facility comprising multiple individual caverns.

Not surprisingly, scenarios with hydrogen heating require more hydrogen storage. However, electrified heating scenarios would also require more electricity generation, storage and transmission infrastructure.

These investments can be very large indeed. Looking at Europe as a whole, a recent study by Eurogas found that in an electrification scenario, electricity transmission and distribution infrastructure investment would need to be €106 billion a year, compared with €63 billion a year in a balanced electricity and decarbonised gas scenario. A balanced scenario would therefore save €41 billion a year on power grids, with only an additional €2 billion a year needed for gas transmission and distribution infrastructure.

Physical hydrogen storage is needed in the UK and Scotland with resilient interconnectivity between storage sites, production facilities and demand locations.

Hydrogen pipelines are likely to be built across the North Sea, but they will only be a partial solution. The region will need hydrogen at scale at the same time, and wind generation can follow a similar pattern across the region in cold winter weeks.

Unlike electricity, hydrogen can be transported across oceans, and so it has the potential to become a globally traded fuel, benefitting from production in regions with very cheap renewables. But, as with LNG, it will take some time for the physical infrastructure to be developed, and net zero cannot wait.

Only geological hydrogen storage can deliver at the scale needed, within the timescales for net zero. The only hydrogen storage options at TWh scale are geological, and these options also are far less energy-intensive than compressed or liquified hydrogen storage above ground, or conversion from a hydrogen carrier such as ammonia or Liquid Organic Hydrogen Carrier (LOHC).

Refinery operators have shown for many years that salt caverns can store industrial grade hydrogen safely, respond quickly to meet within day demand fluctuations and provide long term storage – this makes salt cavern storage a flexible and technologically ready solution capable of managing multiple customer requirements.

Depleted hydrocarbon fields could offer much larger storage volumes than salt caverns and would be more suited to seasonal demands for hydrogen or for security of supply in high-demand periods.

Geological hydrogen storage should be supported through a viable business model now, to ensure it comes online in the 2030s. It can take up to a decade for new geological storage to be developed, meaning that numerous salt caverns will need to be developed in parallel, and that work needs to start now so that the required capacity can come online in the 2030s, as hydrogen production and demand is scaled.

In the Netherlands, Gasunie is already developing four salt caverns for hydrogen storage, with the first cavern planned to be open in 2026 and the other three by 2030. The capacity of the first cavern is around 200 GWh – a thousand times higher than the UK's largest battery storage installation.

Hydrogen storage should be stimulated through a viable business model, such as a Regulatory Asset Base (RAB), which is used for electricity and gas network and other infrastructure investment in the UK and elsewhere. A regulatory model using a Regulatory Asset Base (RAB) would allow investors to recover the reasonable and efficient costs of their investment (including a reasonable return on investment), whilst ensuring costs to end-users are minimal (reflecting efficient costs), thus supporting the economic viability of hydrogen storage regardless of the heat decarbonisation pathway.

10. Ofgem are "working with government, industry and consumer groups to deliver a net-zero economy". What changes have recently been made to support the delivery of net-zero? What more could be done to support a regulatory regime that delivers decarbonised energy supplies affordably?

SGN support the changes proposed around the Future System Operator and the regional system planners. These institutions need time to be established and to have the capacity to become effective decision makers and until that time, we believe that Ofgem need to hold accountability and support strategic investment. If Ofgem transfers decision making responsibility too quickly when the capacity is not established, then there is a risk that poor or delayed decision making will be the result and this must be guarded against.

We believe that Ofgem need to recognise the ambition of devolved governments when it comes to hydrogen and to recognise that policies may differ by government and the ability of different parts of the UK to contribute to net zero in different ways. Flexibility to support the delivery of regional policy ambitions should be a key part of Ofgem's and the FSO mandate. In particular, SGN would highlight a specific concern that hydrogen policy may be focused on industrial sources and large nodes of hydrogen production, rather than more distributed hydrogen development that is expected to be more characteristic of the Scottish economy. We would encourage Ofgem to engage in these alternative development models at regional level.

We welcome the Future System Network Regulation consultation as an important area of debate, it is important that Ofgem are clear on the outcomes that they are looking to achieve and fully consult and explain the proposed changes in a timely manner to avoid disrupting investor confidence at this critical time.

We would encourage Ofgem to look at the current RIIO process and focus on how improvements can be made within the existing regulatory structure, as our view is that substantial improvements can be made without needing to resort to new - and potentially disruptive - regulatory models.