



House of Commons Scottish Affairs
Committee: Hydrogen and carbon capture
in Scotland Moving from Strategy to Delivery

Written evidence from Hydrogen UK

1. Executive Summary
2. Hydrogen UK (HUK)
3. Responses to the questions asked by the Committee
4. What should be the focus of UK Government investment to ensure that Scottish industry, supported by Scottish research, is able to become a world leader in green hydrogen for domestic use and export?
5. Which market mechanism should be used to incentivise investment in producing low-cost green hydrogen?
6. Which market mechanism should be used to incentivise investment in producing low-cost green hydrogen?
7. What infrastructure, and investment in infrastructure, is needed for green hydrogen to be easily available for heavy transport and buses across the whole of Scotland?
8. What role should the oil and gas industry play in achieving a “just transition” to blue and green hydrogen in Scotland?
9. What training is required to build a hydrogen-ready workforce in Scotland? What is the long-term sustainability of the Scottish workforce for hydrogen power?

Executive Summary

Hydrogen UK (HUK) welcomes the opportunity to submit evidence to the Scottish Affairs Committee's inquiry on hydrogen and carbon capture in Scotland. It is Hydrogen UK's view that:

- The 10-Point Plan's 5GW production target represents a conservative view of what is possible in the UK and that the UK must look to be more ambitious, if it is to compete internationally;
- Hydrogen UK's analysis demonstrates that hydrogen demand is estimated to range from 40 TWh to 161 TWh by 2030, requiring installed production capacity of 5.8 and 20.7 GW;
- A twin track approach to the scaling up of electrolytic and CCUS-enabled hydrogen, with associated infrastructure investment, must be employed, as this will prove less costly, reduce risks, and ensure UK leadership in production and expertise;
- The UK holds world-class advantages in hydrogen production, distribution, application, and related technologies, such as Carbon Capture, Usage and Storage (CCUS), nuclear and offshore wind;
- Other economies are moving ahead in the development of hydrogen and the UK must respond;
- Government must take steps to allow the Scottish Cluster to proceed its development at pace if Scotland is to deliver on its target of 5GW of hydrogen by 2030.

In November 2021, HUK defined a set of policy objectives for Government and industry to come together on the following activities to ensure that hydrogen can scale to meet the future demands of a net zero energy system and meet the UK's ambitions in this sector:

- Scale production rapidly by making hydrogen business models available to producers by mid-2022;
- Stimulate demand for hydrogen by developing detailed and distinct policy and regulatory frameworks to create markets in end-use sectors;
- Provide links between supply and demand by establishing mechanisms to unlock capital investment in distribution and storage infrastructure;
- Develop the necessary training and support to ensure the UK has the skilled workforce to deliver on its hydrogen ambitions; and
- Ensure that no one is left behind by working with a wide range of stakeholders to build a hydrogen society.

Please note, Hydrogen UK are currently developing more detailed policy recommendations to Government, which will consider the UK Hydrogen Strategy and forthcoming policies and commitments from the Government. HUK is dedicated to supporting the Government and industry to collaborate and meet their ambitions in this sector.

Hydrogen UK (HUK)

1. Hydrogen UK (HUK), formerly the Hydrogen Taskforce, is the UK's largest trade association in the hydrogen sector. Our membership includes the industry's leading organisations that operate and innovate in and across this sector, including Arup, Arval UK, Baker McKenzie, Baxi Heating, BOC, BNP Paribas, Bosch, BP, Cadent, Centrica, DNV, EDF, Equinor, GHD, Green Hydrogen Solutions, ITM Power, Kiwa, Johnson Matthey, National Nuclear Laboratory, Northern Gas Networks, Ørsted, RWE, SGN, Shell, SSE Thermal, Uniper and Viessmann.
2. HUK represents organisations throughout the hydrogen sector, and across production, transportation, storage, and end use of hydrogen, acting as a unified voice for the role of hydrogen in the UK. It aims to enable the UK to become a world leader in the application and service of hydrogen, to deliver excellence throughout the supply chain and create a globally attractive export.
3. It has elected to submit evidence to this inquiry as it has a significant interest in the development of the hydrogen sector in and across the UK. Scotland, as a key part of the UK's wider energy system, has a critical role to play in development of the wider hydrogen sector.

Responses to the questions asked by the Committee

To what extent are the ambitions of the UK Hydrogen Strategy, published August 2021, adequate for Scotland?

4. The UK Hydrogen Strategy, published in August 2021, set out several important commitments intended to develop the hydrogen sector with a view to supporting the UK's overall objective of achieving net zero by 2050. This contrasts with the ambition of the Scottish government to reach net zero by 2045, and the role set out for hydrogen in the Draft Hydrogen Action Plan (currently under consultation).
5. HUK sees both plans as being broadly compatible, but that there are areas in which the approach set out in the Scottish Government's Draft Hydrogen Action Plan significantly diverges from the UK Hydrogen Strategy. For example, the Scottish Government's plan calls for 5GW of low carbon hydrogen production in Scotland by 2030 – whereas the UK Government's low carbon hydrogen production target for the whole of the UK is 5GW by 2030, which is incompatible given commitments already made to hydrogen production projects in England.
6. HUK believes that the approach set out in the UK Government's Strategy is broadly compatible with its stated objective of making the UK net zero by 2050. While the UK Hydrogen Strategy was not designed with Scotland's objective of achieving net zero by 2045 explicitly in mind, the strategy laid out is consistent with Scotland achieving net zero before the whole of the UK.

7. HUK notes that very rapid growth in hydrogen production will be required in the 2030s to meet anticipated demand. The Scottish Government's forthcoming Hydrogen Action Plan and the UK Hydrogen Strategy each have ambitions for significant capacity of installed renewable and low-carbon hydrogen production, and the CCC's Sixth Carbon Budget estimates demand for hydrogen to be more than 200 TWh by 2050 in the Balanced Pathway. As outlined in our own analysis,¹ the UK could need up to 475TWh of hydrogen by 2050 to deliver net zero; this would leave a 435TWh hydrogen gap that must be delivered in the 20 years between 2030 and 2050.²
8. We would also note that there is considerable potential for the hydrogen sector to increase production capacity faster than envisaged by the UK Hydrogen Strategy, which we and our membership made clear to UK policymakers throughout 2021. HUK has developed three scenarios that outline what could be delivered in the UK by 2030, based on different assumptions.
9. In the highest growth scenario, which was developed by combining the 2030 ambitions of all the known hydrogen projects in the UK pipeline, and assuming they all deliver 100% of their production targets, the UK could have a production capacity of over 20GW by 2030 – four times the target in the UK Hydrogen Strategy. Other scenarios also forecast production capacity greater than the 5GW target can be achieved, and we are confident that a more ambitious production target for the UK is feasible.
10. We are therefore confident that the sector can meet the production targets of more ambitious plans such as Scotland's forthcoming Hydrogen Action Plan if the right policy framework is in place. That policy framework requires an effective business model which incentivises hydrogen production; further development and implementation of policy to stimulate end-use demand for hydrogen; and establishment of a regulatory regime that promotes investment in hydrogen distribution and storage infrastructure.
11. Focusing on the principles and scope of the Emerging Energy Technologies Fund (EETF) in Scotland's forthcoming Hydrogen Action Plan, we recommend that Scottish Government continues to collaborate with the UK Government to ensure full alignment with the funding principles noted in this plan with the final outputs arising from the August 2021 UK Government consultation process on a) Hydrogen Business Model; b) Low Carbon Hydrogen Standard; and c) Net Zero Hydrogen Fund (NZHF) and specifically, the eligibility and project assessment criteria associated with the NZHF including the Low Carbon Hydrogen Standard which specifies requirements for both electrolytic (including renewables and nuclear) and CCUS-enabled hydrogen.

What should be the focus of UK Government investment to ensure that Scottish industry, supported by Scottish research, is able to become a world leader in green hydrogen for domestic use and export?

12. The UK Government should take several steps to ensure Scotland becomes a world leader in low carbon hydrogen use and export.
13. First, as discussed elsewhere, the UK Government needs to put in place the policies and financing mechanisms to maximise hydrogen production. This extends to the actual energy sources required to produce green hydrogen. The publication of business models which incentivise hydrogen production, using a Contract for Difference (CfD) model, is an essential early step in 2022 and delay to this key measure could result in significantly lower confidence from investors and the public, leading to constrained access to private finance for projects and developers in the UK and Scotland.
14. Second, it is vital that the UK Government takes steps which allow the proposed Scottish CCS and Hydrogen Cluster to proceed its development at pace. This project is vital for Scotland's hydrogen sector, as it would include a significant hydrogen production plant as well as providing sequestration facilities needed for blue hydrogen that will serve to decarbonise key industries and communities in Aberdeen, Glasgow, and the Scottish Central Belt, such as INEOS' Grangemouth facilities.
15. Third, encourage the domestic use of hydrogen. Scotland is leading the way in the development and demonstration of end-to-end hydrogen production, distribution and use in home heating, through the H100 Fife project that will decarbonise heat for 200 homes (equivalent to saving 2,208kg of CO₂ per household each year). This project is led by HUK members, SGN, Cadent and Northern Gas Networks, with the support of Wales & West Utilities, Ofgem and the Scottish Government.
16. Fourth, the UK Government should consider a range of possible policy levers across the many potential uses of hydrogen in Scotland and the UK. We have set some of these options out in Table 1.

1. Hydrogen UK, Hydrogen in the UK: Moving from Strategy to Delivery, 24 November 2021 ([link](#)), page 8.
2. Ibid, page 6.

Table 1: Hydrogen UK – End Use Sector, Applications and Possible Policies & Regulatory Support.

End use sector	Applications	Possible policies and regulatory support
 Heat	100% hydrogen boilers	<ul style="list-style-type: none"> • Mandating hydrogen-ready boilers • Setting carbon intensity target for the gas grid • Green gas tariffs • Inclusion of hydrogen within the Green Gas Support Scheme • Expanding trials of hydrogen heating
	Hydrogen fuel cell mCHP	
	Blending	
 Transport	Cars	<ul style="list-style-type: none"> • Public procurement schemes • Vehicle subsidy support schemes • Bring forward phase out dates for fossil fuels in larger vehicles • Greater support for trials of aviation and maritime applications • Targets for hydrogen refuelling stations
	Vans	
	Buses	
	HGVs	
	Maritime	
	Aviation	
	Rail	
 Industry	Multiple end-use of applications across production of steel, glass, ceramics, chemicals, cement, transport, pulp and paper, food and drink, and textiles.	<ul style="list-style-type: none"> • Introduce Carbon CfDs • Public procurement scheme • Carbon border adjustment • Tradeable performance standards
 Power Generation	Blending into existing gas CCGT	<ul style="list-style-type: none"> • Inclusion of hydrogen within capacity markets • Government guarantees • CfD payments
	100% hydrogen CCGT	
	Flexible markets	

17. It is HUK's view that further investment in distribution and storage infrastructure is also vital to establish Scotland as a leader in the use and export of hydrogen. The variability of renewable energy sources such as wind and solar means there is a need for large scale storage of clean energy which can only be produced when the weather allows.
18. Storage assets will be required for managing both daily and seasonal demand variation and for storing hydrogen that could be produced at times of high renewable and nuclear electricity output which would otherwise be curtailed. The amount of hydrogen storage required will depend on the eventual demand-side profile but is likely to be around 5TWh by 2030. Storage assets have long lead times and, therefore, developing support mechanisms that enable investment in storage should be a key priority. Therefore, a commitment to establishing bespoke economic regulation that will be needed to bring forward large-scale hydrogen storage is required by the end of 2022.
19. Likewise, distribution that links supply and demand is a crucial element of the hydrogen value chain. Early-stage projects will require new dedicated hydrogen infrastructure to transport hydrogen from the point of production to early-stage end-users. Early investment in this infrastructure is therefore a necessity, but will also encourage new production projects, stimulate innovation, and stimulate interest amongst potential end-users.
20. The UK is also home to one of the most extensive gas grids in the world, with 85% of homes and businesses connected. Decarbonising and leveraging this asset and connecting renewable and nuclear power generation and end-use energy demand, should be a key priority. This decarbonisation should begin now with blending of hydrogen and natural gas, which would help position Scotland and the UK as leaders in gas grid decarbonisation. Blending provides a large, stable off-taker for hydrogen, allowing production to ramp up and benefit from learning and economies of scale. Without clarity on what level of blending will be allowed and when, large scale hydrogen production projects which may initially want to blend a significant quantity of hydrogen, in Scotland and elsewhere, will be hampered in terms of concept design, project delivery and the associated investment case.
21. Policy is key in addressing these issues, as currently there is no mechanism that enables networks to invest in hydrogen infrastructure. It will be necessary to establish a regulatory regime that supports first-of-a-kind hydrogen infrastructure and creates successful commercial models to support the storage that will be required if Scotland and the UK are to lead in the use and export of hydrogen.

Which market mechanism should be used to incentivise investment in producing low-cost green hydrogen?

22. Hydrogen business models are the revenue support scheme that will make hydrogen production projects economically viable and enable investment in large-scale projects. The CfD model proposed by the Government has been very successful in scaling deployment and reducing costs of renewable generation technologies, such as offshore wind. Applying this to hydrogen production assets, and other energy sources such as nuclear which can be used to produce hydrogen, will be critical in enabling production to achieve similar scale and bring cost down over the next decade.
23. The Government has consulted on the proposed scheme, which is welcome, but it is vital that momentum is maintained, and the business models are made available by mid-2022 at the latest. Delay to this key measure could result in significantly lower confidence from investors and the public, leading to constrained access to private finance for projects and developers in the UK and Scotland.
24. The availability of hydrogen business models is key to early-stage projects entering the delivery phase. HUK considers that the timely availability of business models, whilst not sufficient in themselves, are a prerequisite to unlock the wider hydrogen value chain and will have significant knock-on impact on other key steps on the road to net zero. Therefore, HUK calls on the Department of Business, Energy and Industrial Strategy's (BEIS) to move swiftly from consultation to implementation.
25. It is estimated that by 2050 the UK will require between 225–475TWh of hydrogen production to meet net zero, roughly equivalent to the total energy demand serviced by the electricity domain in the UK today. Developing production capacity and associated infrastructure at that scale, and in the timeframes needed, is achievable but will become increasingly challenging with delays to the first large-scale production projects, which could result from lack of a suitable business model.

What infrastructure, and investment in infrastructure, is needed for green hydrogen to be easily available for heavy transport and buses across the whole of Scotland?

Transport is a key potential end-use sector for hydrogen, with possible applications across cars, vans, buses, and heavy goods vehicles (HGVs), and in the longer term in rail, maritime and aviation. HUK analysis forecasts that transport could constitute up to 12TWh of hydrogen demand by 2030.

Table 2: Hydrogen UK – The UK Government’s 10 Point Plan as compared to Hydrogen UK’s Three Scenarios.

		Government 10pt plan	Scenario 1 Low	Scenario 2 Central	Scenario 3 High
Production - installed capacity (GW)		5	7	14	22
Blue - CCUS Enabled			5	8	13
Green - Electrolytic			2	6	9
Demand - TWh		42	44	90	151
Industry			26	40	57
Blending for domestic and commercial heat			6	14	31
Power			9	27	37
Transport			1	5	12
100% domestic and commercial heat			0	0	6
Other (e.g. CHP, ammonia)			2	4	8
Impact					
Carbon abatement (MtCO ₂ e)		42 (cumulative)	13.7 (annual)	16.9 (annual)	29.1 (annual)
GVA - £bn			7.2	14.2	23.6
Jobs		8000	29,700	58,500	96,800

26. Regarding the physical infrastructure needed to make green hydrogen readily available for transport purposes across Scotland, the most immediate is a significant investment in refuelling stations. Excellent work has already been undertaken by HUK member, BOC, with Aberdeen City Council to deliver commercially viable hydrogen refuelling at the council's Kittybrewster site, with the capacity to produce 360kg of renewable hydrogen daily, enough for a fleet of 15 buses to travel up to 350km per day. HUK has not yet conducted analysis of the scale of investment and number of refuelling stations required, but the network will require substantial expansion to make significant progress in decarbonising the bus fleet.
27. Investment in this infrastructure will need to be supplemented by a range of policies to boost demand for hydrogen transportation, which could include public procurement schemes, mandating or incentivising use of hydrogen vehicles, vehicle subsidies and acceleration of the phase out date for fossil fuels in vehicles.
28. In SGN's North East Network & Industrial Cluster Development Summary Report they point out that conversion of the natural gas network to hydrogen in Scotland can deliver a significant contribution to Scotland's net zero targets, particularly as it can create a ubiquitous fuel to decarbonise all sectors, including those that cannot be achieved by electrification such as aviation, heavy transport, rail and marine.
29. SGN's pathway maximises current infrastructure and sets out how they can deliver a repurposed network to help meet the Scottish Government's ambition to have over 1 million homes converted to using zero or low emissions heating systems by 2030. A new main hydrogen pipeline would link St Fergus and Grangemouth and would link up the existing natural gas national offtakes. An export pipeline would extend the main hydrogen pipeline south to connect with the future hydrogen system in England.

What role should the oil and gas industry play in achieving a “just transition” to blue and green hydrogen in Scotland?

30. The oil and gas industry has a pivotal role to play in achieving an equitable energy transition to hydrogen in Scotland.
31. The oil and gas industry currently supports over 300,000 jobs across the UK, the majority of which are in Scotland. Over decades, the industry has supported the development of a skilled workforce and supply chain that is experienced in producing and distributing gas to customers. This expertise can be leveraged to support the development of hydrogen solutions and the transition away from dependence on fossil fuels whilst protecting high value jobs within the sector. For example, experience within the sector could be used to produce blue hydrogen via CCUS, convert and maintain hydrogen pipelines and safely handle and distribute hydrogen. The oil and gas industry can, therefore, play a key role in ensuring a just transition to a hydrogen sector which utilises many of the same skills.

32. The oil and gas industry and adjacent research bodies also have a strong track record of building on existing expertise to create innovative solutions to new challenges. For example, the industry has leveraged its knowledge of subsea exploration and maintenance of offshore machinery to enable the UK to become the world leader in offshore wind technology. This growth in the offshore wind sector has been supported by Government policy, through the Offshore Wind Sector Deal, demonstrating how government and industry can work together to reduce costs and build a world leading industry. There is now an opportunity to use that same expertise to develop a world leading hydrogen production industry and ensure a just transition.
33. Delivering a just transition is as important for the workforce as it is for customers. With almost two million customers on the gas network in Scotland and a need to maintain levels of service for customers in the energy transition, the H100 project offers a glimpse into the future, minimising disruption through network-led system transformation through hydrogen.

What training is required to build a hydrogen-ready workforce in Scotland? What is the long-term sustainability of the Scottish workforce for hydrogen power?

34. Hydrogen presents a significant opportunity to the UK, and Scotland specifically, to deliver economic value and highly skilled jobs. In 2020, we developed an Economic Impact Assessment demonstrating that investment in hydrogen could unlock £18bn in GVA and support 75,000 jobs in the UK by 2035.³ Hydrogen is also gaining increasing momentum internationally, with many countries recognising the critical role that it will play in reducing emissions.
35. Hydrogen will play a critical role in reducing emissions and delivering highly skilled jobs. This will only be possible, however, with a cohesive, coordinated, and forward-looking drive to expand and develop the workforce's hydrogen skills.
36. The UK, and in particular Scotland, has a strong existing domestic workforce that has many of the necessary skills and is primed to capitalise on the opportunity presented by hydrogen. However, these workers will need to be upskilled in areas specific to hydrogen.
37. The development of a strong Scottish hydrogen economy would grow the UK's ability to be a world leader, attracting domestic and international investment, and develop exportable skills and technology. Investing in hydrogen supports innovation and will help secure a strong UK-based production and industrial economy, and the jobs and skills that come with it.
38. The UK Government should also look to address its grassroots educational programmes by supporting degrees and courses relevant to the hydrogen sector.

39. It is imperative that this skills gap is addressed with some urgency, as it will take a minimum of seven years from commencing tertiary education, qualifying and practical experience for a young worker to be sufficiently skilled to add value to the market. For the existing relevant workforce, it will take a minimum of two years from commencement of learning and practical experience for a worker to be sufficiently re-skilled to add value to the market. There is a broad base of relevant engineering skills in the oil and gas workforce, but not in sufficient numbers for the energy transformation programme required to meet net zero by 2050.
40. Lessons should be learnt from similar major infrastructure programmes, such as the Government's Smart Metering Implementation Programme. In this case, significant time was required to achieve a critical mass of skills and experience to deliver the programme at scale.
41. Government and industry should take note of these and other programmes' experience in cross-skilling, up-skilling and developing new skilled workers.
42. HUK is committed to working with the government to deliver a comprehensive jobs and skills programme aimed at ensuring that the workforce is ready to deliver on our hydrogen ambitions.

March 2022

3. Hydrogen UK, Economic Impact Assessment, 12 August 2020 ([link](#)), page 3.



8 Fenchurch Place,
London,
EC3M 4AJ

Phone: 0121 709 5587

Website: <https://hydrogen-uk.org/>

