Scottish Affairs Committee Inquiry - Hydrogen and Carbon Capture in Scotland

Submission from PlusZero - February 2022

- PlusZero welcomes the Scottish Affairs Committee inquiry into hydrogen and carbon capture in Scotland.

- PlusZero believes that Scotland has the opportunity to become a world leader in the production and use of green hydrogen to achieve its net-zero targets.

- PlusZero aims to be a major player in the clean energy sector delivering market-disrupting solutions and making a significant contribution to the development of a thriving Scottish hydrogen technology sector. We currently produce green hydrogen in the Outer Hebrides, using this as a fuel for our portable clean power generators, which our customers use as a carbon and pollution-free alternative to diesel generators.

- During 2021, PlusZero established itself as one of the UK's leading full-service hydrogen innovators, delivering a series of pre-commercial high-profile trials of our carbon-zero green hydrogen based portable power solution at the Edinburgh International Festival and COP26 in Glasgow and Edinburgh Castle.

- We are now raising investment to allow us to rapidly scale our commercial clean power business, with intentions to build the first 50MW of electrolyser capacity at our planned large scale green hydrogen production facility in the Western Isles.

- We have provided our response to the Committee's key areas of interest below, which we hope will be of value to this important exercise. PlusZero would be pleased to provide further detail and insight to the Committee as it continues its work on this topic.

Inquiry response

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

PlusZero welcomes that the UK Hydrogen Strategy acknowledges the key role Scotland will play in delivering the UK Hydrogen Strategy ambitions. Scotland has some of the most significant onshore and offshore renewable energy generating potential in Europe for wind, wave and tidal, which can be harnessed to develop a green hydrogen production sector in Scotland that is of global significance.

Scotland also has significant engineering skills within its renewables and oil and gas sectors which can be harnessed to support a rapid expansion of the renewable electricity needed to power a large-scale green hydrogen production sector.

PlusZero is also encouraged that the Strategy refers to some of the ground-breaking hydrogen initiatives that have already been undertaken in Scotland by Aberdeen City Council, and the Orkney Islands Council and European Marine Energy Centre in Orkney.

Specifically, we welcome references in the Strategy to the opportunities for green hydrogen production across all three of Scotland's largest Island archipelagos – Orkney, Outer Hebrides and Shetland – and the UK Government's investment in the Islands Growth Deal to support these

developments. PlusZero has a well-informed perspective on the opportunity for Scotland's remote communities from the Islands Growth Deal as its Managing Director, David Amos, led the development of the Islands Growth Deal up to March 2021 after the Heads of Terms for the £335 million programme of investment was signed by the UK and Scottish Governments. Through this experience, PlusZero strongly considers that Scotland's remote Island communities can play a leading role in the development of the Scottish, UK and European Green hydrogen economy.

PlusZero's perspective on room for improvement within the UK Hydrogen Strategy is that it could be more ambitious for Scotland's green hydrogen sector. As this submission outlines, PlusZero's focus is on the realisation of the Western Isles green hydrogen potential. We firmly believe that the Western Isles is currently the most rapidly scalable green hydrogen production location in the UK, with the potential to reach GW scale by 2030 with the right investment and partnerships. Shetland and Orkney have similar large-scale production potential.

We believe it is not unrealistic to suggest that with a clear focus and partnership between the hydrogen sector and the UK and Scottish Governments, that the UK Hydrogen Strategy target of 5GW of "low carbon" hydrogen production capacity by 2030 could be met by Scottish Green hydrogen alone. This would allow for an increase in the overall UK target once other Scottish blue hydrogen, and UK green and blue hydrogen initiatives were added into the mix.

- *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?*

PlusZero believes that the critical bottle neck that will slow down the development of a vibrant hydrogen sector in Scotland and the UK is lack of green hydrogen production capacity.

PlusZero already has significantly more demand for our own green hydrogen fuelled clean portable power solution than we can support from current production capacity. As we scale up our operations, we are experiencing increasing demand for green hydrogen to support other projects deploying hydrogen fuelled technology across a range of transport, heat and power applications.

PlusZero believes very strongly that demand will follow supply, which is why PlusZero is in the process of raising £100m to build the first 50MW of electrolyser capacity at our planned Western Isles-based green hydrogen production facility. Government support mechanisms that can encourage business investment in green hydrogen production capacity would help accelerate the whole hydrogen technology supply chain.

PlusZero considers that there are several areas where UK and Scottish Government investment, paired with academic research, could support Scotland's journey to green hydrogen leadership.

- **Key component design, manufacture and assembly**

Scotland has skilled hydrogen engineering companies such as Logan Energy[1] that can design and integrate electrolyser stacks from Original Equipment Manufacturers into complete electrolyser units. However, there is currently no capacity within Scotland to produce the core electrolyser stack components needed to produce green hydrogen. Similarly, there are no Scotland-based companies that produce the high-pressure composite storage vessels that are currently essential to store and

[1] https://www.loganenergy.com/

transport compressed green hydrogen gas from production site to end user (whether by road, train or ship).

Given the billions of investment that will be made in the coming decades to realise Scotland's green hydrogen production potential, PlusZero suggests that it makes strategic economic sense for Government, Research and Enterprise Agencies to:

- Incentivise existing non-Scottish electrolyser and pressure vessel manufacturers to establish Scotland-based manufacturing sites that could meet the Scottish demand;
- Support the development and expansion of existing Scottish hydrogen engineering and systems integration companies so they can capture as much of the supply chain activity related to the development of a large scale Scottish green hydrogen production sector; and
- Support the development of Scottish companies that can design and manufacture core electrolyser stack technology and other essential components such as composite pressure vessels, allowing as much as possible of the supply chain value add to captured.

Drawing on learning from the onshore and offshore wind industry, PlusZero considers it vital that Scotland develops a manufacturing sector and supply chain that can support our abundant natural resource. Scotland has the potential to develop high-value components and expertise to embed a world-leading hydrogen sector, and should be encouraged to do so by governments to meet future economic prosperity and climate targets.

- **R&D to improve electrolyser design and efficiency**

Current electrolyser technology is inefficient, losing around 50% of the total electrical energy input as heat. While co-locating electrolysers next to demand sources for heat can improve this efficiency by using electrolyser heat to displace the use of fossil fuels for heating and or industrial processes, this will not be practical for many green hydrogen production sites.

The cost of electricity is a critical determining factor in the commercial viability of green hydrogen production. Therefore, improving electrolyser efficiency and hydrogen output per MW of electricity will significantly improve commercial viability, encouraging more investment in production capacity, and bringing down the cost of green hydrogen for users – in turn, stimulating further demand.

Governments should support academia and research institutes to work closely with the hydrogen industry to both improve the design of existing electrolyser technology and to bring forward new, more efficient technology (such as solid oxide electrolysers) that improve design and efficiency.

- **R&D to reduce hydrogen gas transport costs and identify alternative approaches for transporting hydrogen**

While hydrogen gas contains more energy by weight than the fossil fuels we currently rely on, it is also the lightest element in the periodic table and requires to be compressed to very high pressures (200 to 900bar) to achieve an energy density suitable for storage and transport as a fuel. This takes significant energy for compression (or liquification) which further reduces the overall efficiency of any hydrogen-based system. The high-pressure storage vessels are also expensive to manufacture and very heavy, which in turn increase the cost and energy required to transport hydrogen to customers.

PlusZero considers that further R&D is required to identify improvements in the efficiency and costs associated with hydrogen compression. More sophisticated solutions to compressed/liquified storage/transport systems would be of significant benefit to the sector.

There are also other mechanisms for storing hydrogen in a non-gaseous form, such as absorption within metal hydrides or liquid carriers, or chemical conversion into another more easily transportable substances such as ammonia. These and other approaches offer the potential for more efficient, energy dense and cost-effective transport of hydrogen compared to compressed or liquid hydrogen, but need R&D to become commercially viable at scale.

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

Currently there are only two Government mechanisms to incentivise investment in green hydrogen in the UK.

The first is the **UK Treasury 'super-deduction' tax incentive** for business investment, which is welcome, but which is only in place for two years from 1 April 2021. PlusZero would welcome a similar but longer-term tax incentive scheme, targeted at zero carbon energy system investments.

The second incentive is the **UK Government Department for Transport's Road Transport Fuel Obligation Scheme (RTFO),** which in certain circumstances allows green hydrogen production companies to claim RTF Certificates. These can then be sold in the RTFO market, delivering an income which subsidises production and allows the hydrogen sales price to customers to be reduced.

While the RTFO scheme is helpful in supporting some UK-based green hydrogen production investments, it was not designed specifically for this purpose. The RTFO contains limitations on the type of renewable energy sources that can be used for electrolysis and the purposes for which the green hydrogen can be used (decarbonising transport and non-road mobile machinery). PlusZero believes that it should be possible to deliver a stimulus that is better targeted to specifically support and incentivise the growth of the green hydrogen sector in all opportunity areas.

In addition to these UK Government schemes, the rapidly developing market for '**Carbon Credits**' has the potential to play a significant role in supporting investment in green hydrogen production if the price were to continue to rise and become more stable and predictable. Initiatives from governments or their agencies to support this objective would be valuable.

Conversely, **Carbon Taxes** could also play a role. Given the current stage of development and scale of production, distribution technology and infrastructure, green hydrogen is significantly more expensive on an energy equivalent basis than fossil fuels. While PlusZero's own experience indicates that there are many early adopter customers willing to pay the additional costs to enable them to decarbonise their activities, the extra cost compared to fossil fuels will act as a barrier for many.

The use of incremental carbon taxes on fossil fuels is a potential mechanism that will encourage companies to continually review their use of fossil fuels and consider alternative clean fuels such as green hydrogen as they become more widely available.

- *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?*

As above, PlusZero considers that there is a critical need for investment in green hydrogen production capacity. Ideally, establishing production capacity close to demand sites for heavy

transport (transport hubs and high-volume routes) should be incentivised as far as possible, as it will significantly reduce the transport costs associated with moving hydrogen from production to demand locations, and improve the overall energy efficiency of the system.

However, given the location of much of Scotland's renewable energy assets, much of Scotland's production assets will be some distance from heavy transport demand locations. Investment in infrastructure is therefore needed in order to move hydrogen around the country. The following are considered to be the initial key requirements.

- **Marine-based transport infrastructure**

Given the role that the Outer Hebrides, Orkney and Shetland (and other Scottish Islands and Coastal areas) play in generating renewable energy, transportation of large volumes of green hydrogen (initially compressed, but potentially liquified or in other carrier methods as volumes increase) will be required.

This will require investment in port infrastructure to support the safe handling of green hydrogen. Custom-built bulk carriers or adapted ships will also be required to carry containerised hydrogen storage or transport systems.

- **Transport by rail network**

Given the weight of the pressure vessels that transport compressed hydrogen in bulk, the rail network could be a cost effective and low-carbon route for moving large volumes of hydrogen from remote production sites to areas of high demand both in Scotland and the rest of the UK. Such a solution would require investment in rail depot infrastructure that supports local storage, loading and unloading of containerised hydrogen storage units into rail transport, and/or gas transfer on and off specialist hydrogen gas transport rail trucks.

- **Pipelines**

Pipelines could also offer a cost-effective mechanism for moving large volumes of hydrogen from production to demand sites. Pipelines would operate at much lower pressures than is required for other transport mechanisms for hydrogen gas, and therefore reduce the energy needed for compression compared to other current transport means. For heavy vehicle use, the hydrogen would ultimately need to be compressed to 350 bar at the local level, but the overall system efficiency is likely to be better compared to transporting large volumes of high compression hydrogen by road or rail.

The UK Government is already supporting work by the Gas Distribution companies to determine the feasibility of switching the existing UK gas grid from natural gas to hydrogen, which would allow a very significant existing infrastructure asset to potentially be used to support the roll-out of a hydrogen economy. However, the existing grid was developed to move natural gas from the North Sea to UK cities and therefore is not ideally located for many of the likely new green hydrogen production sites. In some circumstances, new investment in local pipelines may be cost effective to transport green hydrogen from large scale rural production sites to centres of demand.

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

Scotland's oil and gas industry has played a vital role in delivering energy security and prosperity for the UK since the discovery of the North Sea reserves. The industry has very significant engineering,

operational and financial management/investment expertise and access to capital that should be harnessed to accelerate the development of a world class green hydrogen sector in Scotland.

PlusZero is already working in partnership with leading companies from the oil and gas supply chain and benefiting from access to their expertise.

- *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?*

Scotland's supply chain already has many of the general industrial and chemical engineering, design and operational skills needed to support the development of a hydrogen economy, but the experience of the workforce in hydrogen directly is limited.

With a few exceptions (such as Logan Energy in Wallyford), Scotland lacks companies with any experience of designing and manufacturing the equipment (electrolysers, compression, gas storage and transport, refuelers etc) that will be needed to support a thriving Scottish hydrogen sector. Similarly, on the application side, there are only a handful of Scottish based companies, such as Alexander Dennis, Arcola Energy and PlusZero that are developing the products that use green hydrogen to decarbonise the sectors we support.

If Scotland is to capture as much of the economic value chain associated with the development of a hydrogen economy, then it is essential that Scotland's educational establishments work with industry to deliver the specific hydrogen technology-related courses and skills development necessary to create a workforce that can support the growth of our existing companies in the sector and attract new companies to invest in Scotland.

The focus on creating a low carbon transport development hub at the Michelin Scotland Innovation Parc in Dundee is an example of the kind of industry, government and educational partnership that will play an important role in identifying and addressing the hydrogen skills shortage. PlusZero considers that there is significant space to support similar cross-sector 'centre of excellence'-type initiatives.

The University of the Highlands and Islands Lews Castle College in Stornoway has also been very proactive in linking with industry and developing the first three SQA-certified hydrogen technician courses. This type of local hydrogen specific technical training will be critical for PlusZero's own workforce expansion plans in the Outer Hebrides, and the Lews Castle team are to be applauded for their foresight.

Scotland already has a very strong Modern Apprenticeship structure in place and this should allow for the rapid development of a technically skilled workforce if the right course content can be developed in partnership with industry over the coming years.

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