

Scottish Affairs Committee

Oral evidence: [Hydrogen and carbon capture in Scotland, HC 83](#)

Monday 18 July 2022

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Members present: Pete Wishart (Chair); Andrew Bowie; Deidre Brock; Wendy Chamberlain; Sally-Ann Hart; John Lamont; Douglas Ross.

In the absence of the Chair, Deidre Brock was called to the Chair for the first session.

Questions 140 - 194

Witnesses

[I](#): Barry Carruthers, Hydrogen Director, ScottishPower; and Oonagh O'Grady, Head of Hydrogen Development, SSE.

[II](#): Sarah Potts, Hydrogen Commercial Specialist, Storegga; and Professor Andy Sloan FRSE, Managing Director of COWI, Royal Society of Edinburgh.

Examination of witnesses

Witnesses: Barry Carruthers and Oonagh O'Grady.

Q140 **Chair:** Welcome to today's third session of the Scottish Affairs Committee's inquiry into hydrogen and carbon capture in Scotland. Our Chair, Pete Wishart, has unfortunately been unable to attend this first session because of transport difficulties. I am sure many people watching this will understand that. I am Chair for the first session and I welcome the witnesses for our first panel. They are Barry Carruthers, who is hydrogen director for ScottishPower and Oonagh O'Grady, who is head of hydrogen development at SSE. Would you both introduce yourselves with a few short words about yourself and your organisation, and what you do in terms of carbon capture or hydrogen?

Barry Carruthers: As hydrogen director at ScottishPower, I hope you know that a lot of our work today is in the renewables sector and we find that green hydrogen complements the renewables. We started this business unit a couple of years ago and can now talk about the growth of a green hydrogen business.

Oonagh O'Grady: I am the recently appointed director of Power-to-X for SSE renewables, having previously worked as SSE thermals head of hydrogen development. SSE believes hydrogen and its derivatives, such as ammonia and other renewable fuels, will be an important facet of a net zero economy, providing flexible low-carbon energy for power, heat, transport and industry, and that the production of electrolytic or green hydrogen using renewable electricity can also maximise investment in onshore and offshore wind. In the power sector, low-carbon hydrogen can act as a fuel in power stations, replacing natural gas, but also still providing the flexibility that our existing systems provide. SSE has ambitions to develop, build and operate more than 1 GW of green hydrogen in industrial clusters and co-located with wind by 2031, and we have already kick-started this with two early developments at Gordonbush in Scotland and at Galway Harbour in the west of Ireland. We are also developing a number of CCS projects in the Humber region and also Peterhead carbon capture power station in the north-east of Scotland, both of which are looking to provide multiple gigawatts of low-carbon flexible power to the system in this decade.

Q141 **Chair:** Thank you. We have lots of questions from very keen Committee members here today, but I will start.

Both of your organisations, as we have heard, have large green hydrogen projects at different stages—SSE with Gordonbush and ScottishPower with Whitelee farm. Could you describe how these have developed, and any legislative or regulatory barriers you have faced along the way? As the SSE project is, I understand, at an earlier stage, perhaps you would go first, Oonagh.

Oonagh O'Grady: As noted, the Gordonbush H2 project is in the early stages of development. It will look to use a portion of the renewable energy from our 100-plus MW Gordonbush onshore wind farm. It will



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produce up to 2,000 tonnes of electrolytic hydrogen each year. After taking on board feedback received during consultation with the community, the project is undergoing a level of refinement. We are undertaking a series of surveys over the coming months, which will determine the final design of the development.

The project is developed around the Gordonbush wind farm extension, which does not receive any subsidy payments and is constrained more than probably any of our other sites in our generation portfolio. Therefore, locating the electrolyser behind the meter—utilising that curtailed energy—allows us to produce a lower cost of hydrogen production.

To give a flavour of some of the challenges we have worked through in the early stages of development, a particular focus has been on aligning the production, the offtake timelines and the volume requirements and in addition, the need for simultaneous support for demand offtake and infrastructure to be built. In particular, we have seen quite a lot of CAPEX support offered to the production element of projects but this is also required simultaneously for the offtake, transport and storage elements.

With regard to public acceptance of hydrogen production as a new technology, a number of the questions from the community and stakeholders have revolved around safety. As the hydrogen will be moved using trailers, trailer movements have also been key points of discussion.

With regard to looking imminently at certainty around reach to market and the revenue streams, obviously we very much welcome the UK Government's hydrogen business model. This is still in development and we will be looking for certainty on that to progress with our investments.

Chair: Thank you; and your thoughts, Barry Carruthers.

Barry Carruthers: Without going over ground and duplicating, you mention Whitelee farm, which in terms of the legislative and planning process is the one that is most advanced for us. It is currently with the local planning authority and has been for some time, but that is reflective of a first-off and quite often that is the case when you have a first-of-a-kind project going through. On both sides, there is always a lot of learning about the right questions to ask and the right way for us to answer them.

This particular project is co-located with a wind farm, so there are different aspects to be considered compared with other projects that we are looking at and will be going ahead with quite shortly in an urban environment. That obviously involves different questions, different aspects and different environmental studies.

It took us as an industry and as a sector many years to get comfortable with wind farm planning applications and consenting procedures, and it was the same for solar and now for battery storage. I think it is the normal evolution that green hydrogen projects are now going through that learning cycle with local planners, chief planners leading on to



consent and wider aspects. I would not necessarily call them barriers, just learning opportunities.

Q142 **Chair:** Nicely put.

You mentioned storage. Could I ask both of you what you plan to do with the excess hydrogen produced? If the plan is to store it, how will it be stored and what is the storage potential at those sites?

Barry Carruthers: Carrying on with the Whitelee scenario, I guess our starting position for all our green hydrogen projects is not necessarily to produce excess hydrogen at all. One of the great things about green hydrogen is that it allows you to turn on and turn off as operations require. At Whitelee farm, as part of the experiment—some of it is a technological and innovation step forward—we will be storing probably around 5 tonnes of hydrogen on site. When you think about our first phase of that project producing up to 4 tonnes per day, and probably more like between 2 and 4 tonnes per day, all you are doing is storing essentially a day or two days' worth.

We would drive our storage demands based on customer demands. For example, we have a 30 MW project north of Inverness, which will be looking at industrial demand from things like distilleries and local transport. If that customer is saying they have a demand for 3 tonnes per day but cannot afford business interruption, perhaps we will need to look at two, three, four or five days' worth of storage, maybe not all at the same location. It could be at a production site; it could also be with the customer, to give them reliability and resilience. As far as we are concerned, it is very much a customer and use-driven conversation, rather than us having a default reason to have storage on site.

Chair: Interesting. Oonagh O'Grady, from where you are standing, what are your thoughts?

Oonagh O'Grady: I echo everything that Barry Carruthers said. The storage solutions for projects are very much dependent on the balancing of supply and demand, and geographical locations as well. Storage solutions will be very specific to the projects.

As the hydrogen economy develops, centralised storage will be required as the economy develops out. In that regard, there will be a need to look at revenue business models for those types of storage as well as the connecting infrastructure to be able to get the hydrogen to the stores. Considering the long lead times for storage development, it will be important that there is urgent action on those elements to allow a scaling up beyond these initial projects.

Q143 **Chair:** I think you are saying that it will be very much driven by customers' requirements.

You mentioned the hydrogen business model, Oonagh. What sort of support might you be looking for from, say, the UK Government to achieve storage goals? Would you be expecting to see it in that model once there is some more detail attached to it?



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Oonagh O'Grady: Yes. The purpose of the hydrogen business model is to allow the offtakers to procure the hydrogen at the cost of the counterfactual, natural gas.

A separate business model will be required for storage development considering that to scale up offtake, you will need to scale up storage and transport. I suppose that while there has been a focus on the production business model to date, we would say that there also needs to be progress made on the hydrogen storage business model and the transport business model because they will need to grow simultaneously to develop a wider hydrogen economy.

Chair: To accommodate the scaling up; right. I see. Barry, any thoughts?

Barry Carruthers: Extending the point about the hydrogen business model a bit, while we do not see it, as Oonagh said, addressing storage per se right now, the hydrogen business model for us again should be customer driven; it should be aimed at the customer. There are schemes we can think of now in the transport sector, for example, that allow us to produce hydrogen, make it available for transport uses and thus be part of the transport schemes that help support it to make it cost-effective for the end user now. The hydrogen business model has to do that in non-transport applications, and industrial applications, and whether storage is part of that is a much wider piece.

Q144 **Sally-Ann Hart:** Ms O'Grady, I understand that SSE is jointly developing the Peterhead carbon capture power station. How much funding has been invested to date and how much more will be required to ensure that it is operational by 2027?

Oonagh O'Grady: The Peterhead carbon capture power station would be Scotland's first power station equipped with CCS technology and as you rightly say, it is being co-developed with our partners, Equinor. Given the commercial sensitivities associated with it as a result of the ongoing UK Government process—the cluster sequencing competition—I cannot provide that number. However, I can say that we have invested heavily and committed to the project and that investment to date brings the project to a position where we have submitted a planning application, and we have also appointed a FEED contractor, with that contract just signed. We were minor recipients of funding awarded to the Scottish net zero infrastructure project in 2020 through Innovate UK.

Q145 **Sally-Ann Hart:** Are you confident that it will be operational by 2027?

Oonagh O'Grady: The operational date of 2027 and commercial operation by 2027 is very much dependent on the enabling infrastructure, which is the CO₂ infrastructure within that region. From a business model perspective, the dispatchable power agreement will support it being operational in 2027, but a key enabler to the project is the enabling infrastructure at the CO₂ store and the pipeline to enable it.

Q146 **Sally-Ann Hart:** Who is responsible for the enabling infrastructure?



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Oonagh O'Grady: The enabling infrastructure is a reserved Track-1 cluster within the cluster sequencing competition, and that is being developed by a consortium including Storegga and a number of their partners.

Q147 **Sally-Ann Hart:** Thank you. That is very clear. Mr Carruthers, is ScottishPower investing in blue hydrogen projects?

Barry Carruthers: No, we are 100% green hydrogen in all of our efforts. We have looked at various technologies. For us, it is a clear extension of what we are doing so far with our move away from fossil fuels in electricity generation. We have 100% renewable generation in our portfolio—onshore and offshore wind, solar, PV and now battery storage. Green hydrogen is the next zero-emission technology that we will build into that.

Q148 **Sally-Ann Hart:** I know that the UK Government is twin-tracking blue hydrogen and green hydrogen. You have taken the decision not to invest in blue hydrogen but solely in green hydrogen. Can I ask specifically why? I know you have said that it is to do with cleaner energy but obviously green hydrogen is two to three times more expensive than blue hydrogen so why have you decided not to twin-track?

Barry Carruthers: There are a few key points in this about how well it strategically sits alongside what else we are doing. There is also a philosophical point of moving to zero emissions. We still have speed, scale and security to worry about.

On the speed theme, we are in a climate emergency and therefore trying to do everything we can, as green as we can, as fast as we can; it is one of our strategic goals.

Because we are building our future—as everyone knows very well Scotland is a fantastic opportunity for us to create more renewable electrons—we have a lot more to do in terms of onshore wind and solar, for example, so the scale-up will help the growth of green hydrogen far more quickly than I think many would expect.

On security, we are building renewable energy assets and we will have that electricity for commercial agreements for 15 years, for example, but the assets will be there for 25 to 40 years. The cost of renewable electricity coming off those assets gives you price stability for 15 years and therefore anything that is relying on any kind of fossil fuels or natural gas and has that inherent volatility over a period, will not align with the three drivers that we are looking for: the speed, scale and security of what we are trying to do.

Q149 **Sally-Ann Hart:** Thank you. That is very clear. Ms O'Grady, I will ask you this question first. How involved is SSE in the clusters?

Oonagh O'Grady: SSE has been involved in the clusters from day 1. We have been members of the east coast cluster and Zero Carbon Humber as well as the Scottish cluster.



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We have invested heavily in collaboration within those clusters and have taken a leading role because we feel that collaboration and the sharing of information have resulted in a strong needs case between all the parties for the infrastructure that is required. That enabling infrastructure has been driven by parties coming together—parties that would normally potentially compete against each other—and will evolve into the most economic way to deliver net zero. As we would say within the Humber and east coast cluster in particular, enabling that enabling infrastructure, unlocks all our projects, so collaboration is the key from what we have gathered across our cluster involvement.

Q150 Sally-Ann Hart: Apart from the importance of collaboration and partnership working, which you have just mentioned, what else have you learnt from the process so far?

Oonagh O'Grady: Clarity and structure have been important. The clarity and structure provided by Government on how the clusters can collaborate from early on have driven initial investment into the cluster projects and the projects that those clusters have unlocked, but that clarity needs to continue and needs to be consistent. It was great to see the UK Government's commitment to four clusters by 2030 and to set out the cluster sequencing process, but now we need the same level of clarity around reserved clusters, Track-2 clusters and the future allocation of support to emitter projects that may not be in the initial rounds of negotiations. That is important because it will allow continued investment into the clusters and the establishment of a strong supply chain to deliver on those projects also.

Q151 Sally-Ann Hart: Thank you. That was very comprehensive. Mr Carruthers, how involved has ScottishPower been in the clusters?

Barry Carruthers: Not so much, so far, and I mean that in the hydrogen sense. Our green hydrogen starting point for the business has been customer led and that has led us into clusters—clusters in other areas that have not already had a foothold in terms of CCUS and blue hydrogen, for example. Looking at the clusters that we have seen naturally forming, one of the great things that we have found about green hydrogen is its geographical diversity. We will be working on projects from the very southern west areas of Argyll up to north of Inverness, to the central belt, and Dumfries and Galloway.

Although a lot of the narrative around the case for blue hydrogen in industrial clusters is very much driven by the cluster idea, to date interest in green hydrogen has come from people who need benefits beyond those regions. I think that what will now change is the scale of renewable electricity coming online, not just from onshore wind and solar but from offshore wind. We are looking at green hydrogen projects of multi-100 MW in their own right now. That does now lend itself at scale to coming into the industrial clusters you mentioned.

My apologies for not really answering a point you mentioned earlier about price. When you look at the three biggest drivers for green hydrogen—



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the cost of renewable electricity, the economies of scale that come from the plant you are building, and the electrical efficiency of the plant you are building—all three point in the right direction.

The pace and scale of cost reduction is now where we need to play a bigger part with green hydrogen because we have the benefits of ScotWind coming onshore. Now we are starting to develop multi-100 MW scale green hydrogen projects, and that is of industrial relevance.

Q152 Sally-Ann Hart: Do you think that the cluster model is not appropriate for green hydrogen, but more appropriate for blue hydrogen—or is that completely wrong and it is just the way it has developed?

Barry Carruthers: I think it is completely appropriate for green hydrogen. We are looking at several multi-100 MW sites: one in Scotland; one on the east coast of England. I guess “industrial cluster” has its own connotations as a phrase, but a cluster of aggregated demand has now led to a far greater scale of green hydrogen demand and therefore costs have reduced accordingly.

Q153 Sally-Ann Hart: Thank you. You have clarified that for me. You have explained about green hydrogen, and industry and demand. What have you learnt from the process that you have engaged with so far?

Barry Carruthers: Which part of the process?

Sally-Ann Hart: The cluster process.

Barry Carruthers: It is very much a case of education and awareness to start with. In our experience, that has come in many cases from the public sector leading that initial discussion to set the boundaries, whether it is refuse collection vehicles, buses or something else that is public facing and within the remits of local authorities. That has blossomed into aggregated demand from industrial clusters, manufacturing, textiles, distilleries and so on. On road transport, we need to do more in the HGV sector. Rail routes across Scotland will all be fully electrified, for example. Looking at ports as a clustering mechanism, they tend to be at the end of bus and rail routes, but they also need liquid fuels for themselves and for export potential. We are now seeing clusters around coastal areas. Again, that gives you aggregated demand. You are not looking at one fleet of 10 hydrogen bin lorries, for example; it will be four or five use cases, which gives you an aggregated cost of demand in coastal and rural environments. Of course, as you move into larger industrial sectors, that is adding a zero and an order of magnitude.

Q154 Sally-Ann Hart: You have mentioned that ScottishPower is not looking specifically at blue hydrogen but is focusing on green hydrogen. The UK Government is twin-tracking. Should the UK Government be encouraging blue hydrogen?

Barry Carruthers: That is a decision for the Government. I would not like to say what they should or should not be doing but we need to be careful to support the end users. All I can say about that is that I have never had a single conversation with a customer who has ever said, “I



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am not interested in green hydrogen; I am looking for blue". That might be purely a reflection of all the customer conversations I have had, because they know that we specialise in green hydrogen, but public sector tenders that we have answered and been involved in have all asked for green hydrogen, even in the international environment. We have met with many German delegations and Dutch delegations, and they have all been asking about the interchange of green hydrogen across borders and how we can export.

At some point, clearly there will have to be decisions around policy mechanisms and funding pots, but for us, the best thing we can possibly do for green hydrogen is to show that the cost is coming down far more quickly than anyone expected and show the speed of movement. We say about our projects that it might be six to 12 months of development, then into planning consent, and then probably 18 to 24 months for construction, so pressing "go" today on investments and projects, we should have them up and running by Q3 to Q4 2024. It is about showing deliverability and the localisation of jobs and their creation, because these are 25 to 40-year assets that create a lot of local employment along with the renewables that they bring with them. It is incumbent on the green hydrogen sector to be proactive, not necessarily to fight against a parallel track.

Sally-Ann Hart: Ms O'Grady, do you think UK Government should be encouraging blue hydrogen?

Oonagh O'Grady: We believe electrolytic hydrogen will play the prominent role in the long term, given its ability to maximise renewable electricity, and it will be a renewables-led energy system. However, the focus in the short term needs to be on developing a low-carbon hydrogen economy through supporting production, offtake and associated infrastructure and storage, and blue hydrogen is a way of driving that needs case. It gives us early impact.

A key point, very similar to Barry's, is that Government policy should ensure that green hydrogen can be competitive in the early stages and secure support to ensure that it grows simultaneously alongside the blue economy. This is about an energy transition and the steps to take to reach the ultimate end goal, and therefore we see a role for both blue and green hydrogen, but ultimately we see electrolytic hydrogen playing the prominent role.

Q155 **Andrew Bowie:** Ms O'Grady, I will come to you first. The Scottish cluster and Storegga said in their written evidence to this Committee, "The UK Hydrogen Strategy notes that the UK is focused on the export of hydrogen-related manufactured goods, expertise and skills, rather than the export of hydrogen itself". What do you think the ambition of the UK Government should be around the export of hydrogen? Do you think we are heading in the right direction?

Oonagh O'Grady: Given UK and Scottish geology, geography and climate, the UK is well placed to be able to export low-carbon hydrogen.



In order to do this, the focus should be on first developing capabilities and technologies within the UK. We have done a really good job of that as an industry working with the Government to date, so there is definitely a viable and credible product available for export. Consideration in the first instance needs to be given to the role that low-carbon hydrogen can play in reducing Scotland's and the UK's emissions in line with our net zero ambitions, as well as looking to develop the infrastructure that would enable the production of hydrogen getting to those export locations or hubs and being exported.

Another aspect that is probably also required is the consistent regulatory infrastructure that will be needed to ensure that any low-carbon hydrogen credentials for hydrogen are appropriately valued and can be consistently applied between markets, so that as we look across borders to other countries, a consistent product is being exported and imported, and the specifications that have to be met are very clear.

Q156 Andrew Bowie: How does our hydrogen strategy compare to other comparable countries?

Oonagh O'Grady: Having been involved in the industrial clusters and having had the opportunity to go to other countries and speak about the progress that the industrial clusters have made, I think the UK is seen from a policy perspective as very much leading the way. Looking at the cluster sequencing competition, the process that the US Government, for example, are applying at the moment to develop hydrogen hubs looks very similar to the UK's cluster sequencing competition and early initial collaboration. Having been there talking about the progress that I think industry and Government have made here, definitely the UK is seen as very much a leader in the policy sphere of hydrogen and CCS in general.

Q157 Andrew Bowie: We are leading in the policy sphere, but the Scottish cluster and Storegga have said that we lack ambition in our plans to export, and that means we need to invest somewhat in our infrastructure or our economies to get us to that stage. What should the UK Government, the Scottish Government, and the private sector be investing in? What should we be doing to make sure we can be more ambitious in that regard?

Oonagh O'Grady: To date, the focus has been on production and the business models to do with production. If I were to look at two other aspects—I think Barry Carruthers has mentioned this already—they would be support for the offtakers and the fuel switchers, because without them, there isn't an industry need. We need both sides of it.

Another point is to do with transport and particularly storage. For hydrogen and particularly green hydrogen, we need storage. Only in its infancy will we be able to appropriately match demand and our production and supply. We need hydrogen storage to enable the scaling up of a hydrogen economy.

To summarise, it is very much a focus on incentivising the offtakers, and investing in transport and particularly storage.



Q158 Andrew Bowie: Mr Carruthers, we were talking there a lot about blue hydrogen, not green hydrogen, but when we get to the stage that we are exporting hydrogen, which is where we all want to get to, should the focus be predominantly on blue, because that is where the investment seems to be going right now, or should we also be looking at green?

Barry Carruthers: For export—perhaps Oonagh knows better than I do—I think we might struggle to export blue. I do not know of many countries that are asking about it or finding it appealing to effectively import somebody else's carbon footprint—our carbon emissions—in some products.

I have already mentioned the massive appetite from Germany. A very high-level study, which was incredibly enlightening, was done by us with Scottish Enterprise, Highlands and Islands Enterprise and a few partners last year, including some on the German side. It highlighted an urgent but also premium demand coming not just from the German market but mainland Europe in general, and forecast that 60% to 70% of their future hydrogen demand would have to be imported.

When you start to talk about export, it has to be at scale. It is only when you start to produce 100 MW, 200 MW, 500 MW at a single site that you get economies of scale. You start looking to produce liquids at that point, such as ammonia, and clean forms of CO₂, biogenics, including methanol—ammonia and methanol are traded all over the world, every day. If you want to be in that market, the route to exploring export is through looking at our core infrastructure, the economies of scale, and the shipping interactions we have with large ports such as Amsterdam and Rotterdam. However, I do not think it is one or the other. There is no downside to Scotland's indigenous demand for more cost-effective green hydrogen if you have a scaled-up facility that can also export.

Q159 Wendy Chamberlain: As part of our inquiry, we recently visited Germany and Methil. One of the key issues around hydrogen and renewable energy generally is reliability. Does the low-carbon hydrogen business model that the UK Government have announced mean that reliable hydrogen production is possible?

Oonagh O'Grady: The UK Government's hydrogen business model is designed to support low-carbon hydrogen production projects that meet the low-carbon hydrogen standard, and therefore sets a threshold for associated emissions. This means that projects directly connected to renewable generation grid-connected projects that meet that low-carbon hydrogen standard and CCS-enabled blue hydrogen projects will be able to secure support through the business model.

The variety of energy inputs used to produce hydrogen can help ensure year-round production, particularly in the early stages if there is a lack of hydrogen storage infrastructure, but—not to labour the point—storage will be critical with regard to the security of supply for hydrogen, which will be really important to incentivising fuel switchers and offtakers. That



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investment in storage and the progression of storage projects will be key to ensuring year-round security of supply.

Q160 Wendy Chamberlain: The initial focus is on low carbon, but delivering reliability is a by-product of that. Thank you very much.

Mr Carruthers, what is your view? Are we moving to a space where reliable hydrogen production will be possible, whether for domestic or commercial use?

Barry Carruthers: One of the pillars of our strategy is to build in geographically strategic locations because we do not want to be shifting molecules around if we do not have to. Having that clustered and strategic spec gives resilience to the production of green hydrogen. Also, it is not always sunny or always windy in one part of the country, so having a diverse resource of renewable energy supply is important.

One of the great things about green hydrogen being electrolytic is that you can put your electrolyzers where you need them to be. That allows us to have direct connected renewable electricity. If you have an electrical infrastructure and you can grid connect, you can always get renewable electricity one way or another through that infrastructure. We do need to invest more in that, but that is how we shift electrons around, and it is only when that does not work or there is a better way to do it that you have to shift around a gas or a liquid.

We have various projects that will have, for example, a strategic tie-in between a 50 MW project on the west coast and a project in the north of Scotland, and if one of those projects goes down, there will always be a way to use road, rail or perhaps pipeline in the future. Of course, depending on the use, if it is a liquid it could be moved by shipping, which could be used for liquid fuel transfer as well. It is a bit like the age-old argument about renewable electricity in general; you can pretty much guarantee that it will be windy somewhere and sunny somewhere, particularly today obviously. It is part of our strategy to have geographical coverage, which starts to answer the reliability and resilience question.

Q161 Wendy Chamberlain: You talked about it being windy somewhere. Often it is windy in Scotland and curtailment payments are part of the way that the grid currently manages excess wind. That seems, from what we have heard in the inquiry so far, to be about ensuring that the grid is not overloaded, rather than reducing the cost of renewable energy. Is that correct? Has curtailment helped to manage the market cost?

Barry Carruthers: There are a few aspects to that. First, there are no regrets about investing in the electrical infrastructure, which clearly helps to get more cost-effective renewable electricity around the country. That is something that we should be doing. Conceptually, we all get the idea that producing hydrogen whenever there is a constraint or a curtailment is a good way to use wind, absolutely, but we have to remember that the hydrogen production would have to be on the constraint side of that part of the network. It is perhaps not quite as simple as conceptually we



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would all like it to be. Internally, we have spent a lot of time looking at this—at everything from the commercial side to the regulatory side and the technical side. There is definitely something in it for the future. However, I think there is a philosophical starting point difference that our challenge as we see it is not just to produce green hydrogen in the hope that it can be moved somewhere. If you start with the end use case, you will always have a far better business case and a lower cost of hydrogen if you can ensure you can get renewable electricity to that electrolyser when the customer needs it, and that you are not relying, for example, on constraints or curtailments.

Q162 Wendy Chamberlain: So you are responding to demand from the customer. I think you have come to my last point, which is on curtailment. You have mentioned storage several times. Is the lack of storage one of the reasons that using curtailment is difficult—because at the end of the day you are utilising the wind, but you still have to have somewhere to put the hydrogen? Secondly, regarding the demand aspect of hydrogen, are the Scottish and UK Governments doing enough to make sure that all this hydrogen production that will potentially come online will have an end user point?

Oonagh O'Grady: I will take the first question. Renewable energy is intermittent. It will need to be backed up on the system with other forms of low-carbon power, hence we are developing power CCS projects, but that intermittency is exactly why storage is required, particularly for electrolytic green hydrogen. The answer to the first question is yes.

On the second question, I think it probably has been noted a few times today that the focus so far, and understandably, has been on production with regards to business models and CAPEX support, but let me drill just a little bit deeper into why support is required for the offtake segment. Yes, the hydrogen business model facilitates the offtaker receiving hydrogen for the cost of its counterfactual, if that is natural gas. However, just because the hydrogen offtaker is getting the difference between those two counterfactuals, there is still CAPEX investment for fuel switching. For example, in order to make power stations capable of taking high volumes of hydrogen, significant CAPEX expenditure, which is not covered by the hydrogen business model, is required. Similarly for other industries that may have infrastructure lock-in, incentivising fuel switching to the hydrogen business model is a good step forward, but it also needs to be supported by CAPEX investment support for the offtaker.

Q163 Douglas Ross: Mr Carruthers, you mentioned earlier some of the issues you had experienced with planning and you put that down to the fact that these were the initial applications coming forward. Is that a failure of companies such as yours for not building that in sooner? Is it a failure of local authorities not training elected members enough? Is it due to a shortage of planning staff? This is something that we need to look at because we do not want these problems to continue. Where do the problems arise and how do we overcome them?



Barry Carruthers: We have work to do on all sides. It is not about blame to be apportioned to any one side. There is a resourcing issue, but that is not just about hydrogen; it is also about the volume of activity, and not just renewables and hydrogen but non-energy sector applications that must be flooding into local authorities every day. We can do more about the way we co-ordinate and resource it.

We all need to have an overlying consideration for speed. If we want to have fleets of council bin lorries converting from diesel to a clean form such as hydrogen, local authorities will need some lead-in time to order the vehicles, and secure the CAPEX, and in order to do that, they need to know the refuelling stations will be there—something we are actively working on—and each of those steps might take a year for this, two years for that, a year for this. If at the first hurdle we are taking longer than we would all like to with the planning and consenting regime, it will compound in the timeline, so before you know it our 2030 targets for all of this are in jeopardy.

For me, it is less about any kind of fundamental shift in the process; it is about resourcing and knowledge. I think there are some things that we can and should be doing collaboratively, such as a planners' roadshow for example on green hydrogen. What does it look like? It is probably not as big and as scary as many people think. They can go in other environments. They can go next to wind farms. But in order to speed up that process, we will all have to throw sufficient knowledge and resource on to the table so that when we put in an application, it will not take 16, 18 or 24 months, but more like six or eight months, and that is a benefit to everyone for things like pollution reduction. It is just a piece of work that has to be done collaboratively between ourselves, the Energy Consents Unit and, I would think, a collective of chief planners, for example.

Q164 **Douglas Ross:** That will be a challenge, because right now, as councils are struggling with budgets, which tend to be annual budgets rather than three-year budgets and which come from Westminster setting its Budget annually, and then Holyrood and down to local government, there is not really an opportunity to plan for the 18 months or two years ahead that you are looking for. How big a block could this be on the ambitions to roll out hydrogen more generally?

Barry Carruthers: There are two aspects to it. There is the piece about hydrogen. I know even all our conversation has been about hydrogen, but when you think about green hydrogen, the green part comes from having the new wind farm and the new solar PV. If we do not align the timescales within the context of climate emergency, and if we just keep turning the handle on what we have been doing and what we can do, we will slow down the roll-out of green hydrogen and the decarbonisation of transport and industry purely because of things that you would like to think are largely in our control.

We can change the processes and the governance we follow, and the bureaucracy that we all try to make sure is correct and in place. It is



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really hard to control things like international supply chains, commodities and costs, but there are things within our gift—to sit around the table and try to reduce the consent process from 18 months to 12 months. There may be some simple steps in there, but I think we have to do it collaboratively. That is a genuine offer, of course. We need to look at what we can do to make things slicker and more streamlined, so that we reach the answers more easily and create a shorter timeframe to get from questions to answers between ourselves and local authorities, which would reduce the overall requirement for resource, because people would not need to sit there for three weeks looking at something they did not know was coming.

No doubt, resource will be a struggle on both sides—as you say, for local authorities and planning departments—but we can also help ourselves. In the next period, we will be saying, “We have been through the first one here”—particular the Whitelee example, but we have many others, including one with Highland Council very soon. There is no point in learning the same thing every time you go to a new local authority. You should only learn once, shouldn’t you? The collaborative chief planner/green hydrogen renewable developer forum is the way in which we can try to find those synergies.

Q165 Douglas Ross: I speak as a former chairman of a planning committee in a local authority. One of the things that understandably delays things is if you get a significant number of concerns or objections. Ms O’Grady, I think you were saying in your first answer that the main questions from the public that you were dealing with were about trailer movements and safety. Understandably, when someone reads on a local planning website that there is an application for something that is fairly novel that they have not heard much about, significant safety issues will be raised. How do you think you are performing in addressing these concerns? What are the public’s main issues around trailer movements and safety, and how do you seek to address them?

Oonagh O’Grady: The first thing to note is that we have to take the stakeholders and the community around any development exceptionally seriously, be it a hydrogen facility or a wind farm, and work with those communities as SSE has done for a number of years now. We pride ourselves on putting a lot of investment, effort and resources into doing so. That allows us to have a right to operate and to develop.

I won’t go into the specifics of the project or some of the discussions we have had with stakeholders, but we have consulted, listened, and gone back and looked at our project. As we do with any project during concept refinement, we will take comments and points made by the community on board.

Safety is a No. 1 priority—

Q166 Douglas Ross: Before we move on to safety, are you saying that trailer movements are specific for that application? Is it a volume issue that you are speaking about? I know you don’t want to go into too much detail but



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I am a bit confused.

Oonagh O'Grady: No. With regard to any project, in the early stages hydrogen will be moved by trailer and therefore trailer movements are one of the newer types of consideration that have to be brought into play when engaging with our communities. We may not have dealt with those issues before, outside of the construction phase. This is more about in the operational phase, and therefore they are one of the new things that we are discussing with the communities and local stakeholders.

Moving on to safety, I think it is very much, as Barry said, about learning from existing development. For example, in SSE we have been operating co-owned natural gas facilities for quite a significant amount of time at our Aldbrough gas storage facility, and it is about leveraging that experience for any of our developments; we are leveraging the experience of our existing assets.

Again, with regards to all this, this is developing an industry from scratch and the clear point here is the need to be transparent, open and clear with all stakeholders involved, including our communities.

Q167 **Douglas Ross:** I don't want this to sound too critical, but we are here to challenge our witnesses. I get what you are saying about starting an industry from scratch, but you are head of hydrogen development, Mr Carruthers is hydrogen director; you are basically in charge of this. Has enough been done in the run-up to educate the public or stakeholders, or are you going from a standing start and now encountering these problems? Could more have been done long before we reached this stage to better educate and inform people about this?

Oonagh O'Grady: First, this is about all developments; it is a matter of an ongoing education for everybody. The most important thing is that we have clear, transparent messages to our stakeholders and communities. Yes, this is a new industry, but we are very conscious that these are new technologies, and that we have to be very clear and transparent with the communities and other stakeholders that we interact with about these technologies.

Barry Carruthers: This might sound anecdotal, but it is not; I think it is very pertinent. Last year, we started something called the Scottish Schools' Hydrogen Challenge. It was a collaboration with Smart Cities, the Scottish Cities Alliance. We went from Glen Urquhart, right across the highlands, across the north-east corner, to Dundee, Stirling, Edinburgh and Glasgow, and ended up just before COP26 with a grand final in Glasgow. We engaged with more than 7,000 school pupils—12 to 15-year-olds—in workshops. They built cars out of Lego, but we gave them a small hydrogen fuel cell and they learned how to use hydrogen right there in the classroom. They did it in city and regional finals on Fridays, but when we were doing the classes during the week, we also had drop-in sessions for the public and for teachers, and local councillors came along. It was the start of the engagement.



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Has it touched everyone across Scotland? Not yet, but it is a start because it was more than 7,000 pupils and more than 40 schools, and that was just over a seven to eight-week period. We plan to roll that out further, particularly when we have projects in the area. Of course, we should make it real for people and tell them what it will mean for their community. I think that is the start for the sector—when you can get into STEM subjects, into secondary schools and to teachers, and then all of a sudden seeing hydrogen buses driving around is not new anymore.

Q168 Douglas Ross: Energy crosses devolved and reserved areas. Do you feel the engagement is good with respect to representatives in both the UK and Scottish Governments, and do the two Governments work well together on this issue or could there be some improvement?

Barry Carruthers: On the hydrogen side, we have a tremendously close relationship with Scottish Government, because a lot of our projects are focused in Scotland. However, we have had some good interactions with the BEIS net zero and hydrogen team, because we have a growing portfolio of projects in England and Wales. I should mention Ireland as well—in Northern Ireland. It has been different because a lot of the structure and targets—not just the hydrogen business model, but things like the support schemes coming out of the Department for Transport—are all coming from the UK Government, but the team in the Scottish Government under Stuart McKay, with the hydrogen action plan, have been well consulted among the hydrogen community in Scotland for a Scotland focus as well. We have great relationships on both sides. It is clear that we have different mechanisms on both sides. Our challenge is to navigate and bring them together.

Oonagh O'Grady: I agree with Barry Carruthers and echo from an SSE perspective that it is similarly important to ensure that UK policy becomes an enabler and not a blocker to the initiatives in Scotland.

Q169 Chair: Thank you. I want to ask a quick question. We do not have very long before the next panel comes along, but I would like to ask about the grid. I think Barry Carruthers mentioned it. Does the grid need improvement? That is certainly the conclusion that we drew in our previous report on renewable energy in Scotland. In the couple of minutes remaining, could you elaborate on whether the grid is a barrier to the production of green hydrogen in Scotland?

Barry Carruthers: It is a barrier if we don't invest further, but it is an enabler if we invest. We have the growth of onshore wind and solar to come online, and there are particular areas where we could grow hydrogen production into it. Local communities and rural areas as much as anywhere would benefit from that. The model of large, cost-effective clean hydrogen production will need to be green grid connected, because you will want to be able to bring renewable electrons from various places whenever it is windy or whenever it is sunny, and that will give us the lowest cost of green hydrogen, which means lower operating costs for transport and industry. It is a benefit to everyone interested in hydrogen to have greater enabling infrastructure in renewable energy, the case in



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point being Scotland. That is gigawatts and gigawatts of renewable energy to come online. That has to unlock green hydrogen all across Scotland at large scale, and for that of course we need the investment in the electrical infrastructure. For me, it is a fundamental part.

Oonagh O'Grady: Again I echo what Barry Carruthers says. Investment in infrastructure is critical to achieving our renewables targets, but obviously green hydrogen has a potential role to play as an alternative offtaker for renewable electricity.

Q170 **Chair:** The UK Government's response to our report was that, in effect, network regulations are a matter for Ofgem as the independent regulator. I take it that this is something you regularly take up with Ofgem. I am seeing nodding.

Barry Carruthers: I will not speak for Oonagh, but we both have regulated parts of our business as distributed network operators and transmission operators. I am sure the regulated side of the business, SP Energy Networks, has that conversation daily and looks forward to it.

Chair: You too, Oonagh?

Oonagh O'Grady: Yes.

Chair: Okay, brilliant. Thank you so much to our witnesses for participating in our inquiry. Your experience and knowledge on this issue are very much appreciated by our Committee members here today and our Clerks. Thank you very much.

With that, our Chair has now arrived, so I will hand over to him for the second panel. Thank you again to our witnesses.

Pete Wishart took the Chair.

Chair: Thank you, Deidre, for taking the reins.

Examination of witnesses

Witnesses: Sarah Potts and Professor Andy Sloan.

Q171 **Chair:** Thank you very much for joining the Scottish Affairs Committee as part of our hydrogen in Scotland inquiry. For the record, could you tell us who you are, who you represent and anything by way of a short introductory statement that would be appropriate?

Sarah Potts: I work for a company called Storegga as a hydrogen commercial specialist. Storegga is the developer of carbon capture and storage, low-carbon hydrogen and direct air capture opportunities, and is the lead developer of the Acorn cluster, on which I am working. Storegga also has a pipeline of other decarbonisation projects being pursued around the globe.



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Professor Sloan: Good afternoon, Chair and Committee. My name is Andy Sloan. I am here representing the Royal Society of Edinburgh. My day job is managing director of a company called COWI and I run the UK arm. It is a Danish consulting business that is heavily involved in the development of renewable energy and infrastructure globally. I am also a visiting professor at the University of Strathclyde in Glasgow, from where I speak to you this afternoon.

Chair: We will put you down as heavily qualified to give us evidence in this inquiry. Thank you both for your very concise responses.

The first question in this session is from Deidre Brock.

Q172 **Deidre Brock:** Welcome to both our witnesses, Ms Potts and Professor Sloan, and a particular welcome to Professor Sloan as a fellow of the Royal Society of Edinburgh, which is in my constituency, so it is a great pleasure to see you here.

Could you run through what you feel are the appropriate policy incentives to maximise the potential of private companies' hydrogen production and associated carbon capture in Scotland? Ms Potts.

Sarah Potts: From my perspective it is a combination of accelerating the development of the hydrogen projects and hydrogen production, but also stimulating demand. It is about looking at the system holistically and developing a hydrogen economy together.

From a policy perspective, the UK hydrogen business model and the net zero hydrogen fund are both critical at supporting that hydrogen investment, particularly in production. The variable premium model takes away the current price risk for consumers, which is extremely important, to encourage them to switch from other fuels, but it also provides the revenue protection that we need until hydrogen market demand is developed or is more mature.

Listening in to your other session, I was glad to hear that transportation and storage was a key theme. To drive investment in the sector we must make sure that the demand and the market can be connected. Without that transportation and storage infrastructure, and policies to support that and support that investment, it might not all hang together. Those policy decisions around things like blending and the domestic heat policy decision feed quite heavily into some of these investment decisions around production.

BEIS are developing a hydrogen business model for transportation and storage, but we do not know the timing of that yet. That will be key to incentivise and support private investment in this sector. Lastly, we need further incentives to support the end users and mature demand, because switching from the current fuels, such as natural gas to hydrogen, does require investment in new capital expenditure. It also requires companies to do their own feasibility studies, check that their processes are compatible with hydrogen and learn how to operate under those conditions. Support to incentivise and support that transition is also important in making sure that the hydrogen economy can hang together,



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and therefore that producers and private investment have the confidence to go ahead.

Professor Sloan: At RSE we see hydrogen is a rapidly emerging key area of interest and we think if harnessed it to its full potential hydrogen will help Scotland to meet its decarbonisation targets, create high value jobs and support the just transition. To do this, we think that the UK and Scottish Governments must identify which applications to prioritise to scale up the underlying technologies and develop the market.

There are five areas that we think public and private together can drive onwards. The first is establishing a value chain consortium, by which we mean sector coupling, and this is to both finance and deliver hydrogen fuel projects, creating both supply and demand, and this is key.

We also look at the role of institutional investors and large energy companies like colleagues that you listened to previously, because they can bring in long-term and patient capital funding to fund green hydrogen projects and e-fuels, so it is policy around being able to support them and their good work. We need to recognise that the public sector can create a push effect for green hydrogen and e-fuels via regulation and legislation, such as, as Sarah said, the obligatory admixture of blue hydrogen into the gas network.

We need to further recognise that the public sector can create a pull via subsidies and incentivisation to create and enhance demand for green hydrogen and e-fuel. We think there is something in the space of new procurement models to accelerate the green transition as well.

My experience is working with a Scandinavian company means that so many of my experiences are of what we do in Scandinavia, and there are many observations and examples that I can give you in the next hour to underpin these four or five points.

Q173 **Deidre Brock:** My ears pricked up when you said, “new procurement models.” Can you expand a little on that?

Professor Sloan: Let us take a domestic example. In COWI, we are interested in the spread between infrastructure, infrastructure development, big infrastructure developments—not necessarily hydrogen—but also aligning that to the green economy going forward, because we are not going to be able to decarbonise our large infrastructure without recourse to green fuels. For example, the Lower Thames Crossing is being built at the moment. National Highways see this as a pathfinder project in which 19% of the embedded carbon within that project is related specifically to the diesel that would be used during the construction processes. Novel procurement, for example, in that process could be used and is planned to be used to drive down the carbon footprint by working collaboratively with potentially other sectors to create hydrogen fuel close to the project site to decarbonise. We rather like to think of procurement models in a broad sense to drive the decarbonising agenda.



Q174 **Deidre Brock:** That is fascinating. Thank you very much for that. I look forward to hearing your expansion of some of the other points as we go on.

To both of you, what is the level of demand for low-carbon hydrogen in Scotland? Is this something you have identified, and which sectors are you seeing it mainly come from?

Sarah Potts: Acorn Hydrogen, part of the Acorn cluster, last year approached many potential end users and customers in the area, and we received over 800 MW of expressions of interest of demand. That came from high energy consumers such as the distilling sector, but other industrial consumers of natural gas, plus heat and power networks such as hospitals and universities—large consumers of energy. There is a lot of interest and appetite for hydrogen from industry, particularly in sectors where electrification does not offer a solution at present. Certainly, we also see material demand from other sectors such as maritime and transportation growing over the next decade. Of course, if there is a positive decision on hydrogen for domestic heat, that results in gigawatts of domestic demand in Scotland. Certainly, that ambition to decarbonise 1 million homes puts some of these numbers into perspective. If those targets are going to be achieved, that will require hydrogen as part of the mix.

In terms of the scale of that demand and how quickly that will progress, the demand is clearly there. The main issue would be the pricing point and that is where the business model is so important, because end customers are struggling with extremely high energy prices at the moment. They would like to move to hydrogen as quickly as possible but that will be dependent on economics and being able to afford to do that. The variable premium model means that they are protected from that premium, certainly in the initial stages, and they can be reassured that their energy prices should be linked to their current fuels.

Professor Sloan: I agree with everything Sarah said. There is a demand in Scotland. I think we need to work hard to create the market much more. If we create the market, providers will step in and start to provide the hydrogen. There is a fundamental difference between blue and green hydrogen. Blue hydrogen production relies on natural gas and all of that suffers from the global pressures and availability, heightened by the war at the moment, and then there is large-scale carbon capture and storage.

RSE's position is that blue hydrogen should be continued, but the focus should be on green hydrogen and developing that market, because we think there is more certainty in achieving a price point that is acceptable. We are interested in how we develop that market, and that plays to the first point of my points I made at the start. This is around value chain and consortia looking at sector coupling. You will have seen that the Scandinavian renewables companies are linked with Edinburgh airport now to try to decarbonise Edinburgh airport. We also see the Hydrogen South West consortium in the Bristol area, which brings together easyJet, Airbus, GKN, Bristol port, Bristol airport and others in a cluster of



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collaboration to both manufacture and create the market, and fuel that demand.

One of the most dynamic projects that we see at the moment is Maersk—the biggest shipping company in the world—which has just ordered 14 ships from the far east and these ships are all bi-fuel, so they can run as a conventional ship but can also run on green fuel. They do not have the supply chain to provide that fuel yet. They are investing heavily in their own partnership to develop that, but they are deliberately going out and creating a global network in green fuel, so that they can drive down their carbon footprint and contribute to wider society in decarbonisation. These sorts of sectorial tie-ups between different companies and businesses are what we need to see much more of in Scotland and the wider UK.

There is another one, Green Fuels for Denmark in Copenhagen and the HØST project in Esbjerg. I can give you details of these. All of these are produced on high volume green fuels to create the market, and if the market is there, providers will step in.

Deidre Brock: Please do send us details of those projects. We would be very interested to see them.

Q175 **Andrew Bowie:** Thank you both, Sarah and Andy, for coming to us this afternoon. I will direct my questions to Sarah and ask about the Acorn project. I should declare an interest: Pale Blue Dot is based very much in the heart of my constituency, so I know all about the Acorn project and indeed St Fergus is just a few miles north of where I live and represent. I am not going to ask any details about that, but what I will ask is what has being a reserve cluster meant in practice for the Acorn project, and where is Acorn at the moment?

Sarah Potts: As you know, Acorn was very disappointed to not get Track-1 status. Therefore, being a reserve cluster has meant a significant amount of timing uncertainty in terms of how the project progresses. Uncertainty is never good for investment decisions when you are talking about significant amounts of investment. The project is very keen to progress; we are very ambitious in terms of the timeframe that we would like to be on stream by, and we are therefore moving ahead with our plans across all of the different modules on Acorn. We understand that there is going to be an announcement around the Track-2 status and timing very shortly and that will give us more confidence to continue along that path. Clearly, further timing uncertainty would result in more delays to the project and the abilities to come onstream.

Q176 **Andrew Bowie:** Have you continued to engage with the UK Government and, maybe more importantly, have the UK Government continued to engage with the Acorn project?

Sarah Potts: Certainly. We are engaged across all the different parts of Acorn on all the projects. We are heavily involved in various workstreams that BEIS have ongoing around the development of the different policies and incentives to drive those programmes and initiatives. Clearly there is an interest in Acorn coming through for the Track-2 as well.



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Q177 **Andrew Bowie:** Talking about Track-2, you mentioned—I think we are all aware of this—that there should be an announcement regarding Track-2 coming soon, but there were concerns over the delays to the Track-1 clusters. Have you been given any indication that this has had a knock-on impact in terms of the decision on Track-2, and does that worry Acorn?

Sarah Potts: As far as I know, we have not received that information specifically directly ourselves. We are nervous about the Track-2 timeline and potential further delays, but we have not heard anything to confirm or contradict the anticipated date that we will be getting some kind of news.

Q178 **Andrew Bowie:** How confident are you in the process? How confident are you that Acorn as a project will one day come to fruition in its fullest form, as we would like to see it?

Sarah Potts: We are very supportive of the Government ambitions to get after developing CCS clusters and bring them onstream in 2030. We are very much aligned with that ambition, although we would clearly like it to go faster and further than the current timelines and scale of the opportunities on the table.

Q179 **Andrew Bowie:** For the interest of the Committee and everybody watching, what was it about the Acorn project that meant it did not get the go ahead compared to the other two? Where did it fall down in comparison to the two that did get the green light?

Sarah Potts: I am not qualified to give you a comprehensive answer on that question. Certainly, we can get back to you with our understanding.

Andrew Bowie: Thank you very much, Sarah, and thank you, Chair.

Q180 **Chair:** I am sure that is something we will want to explore with the Minister when we see him in front of this Committee in a few weeks' time. On Acorn, I do not know if it was Sarah who said this, but it is a quote from Storegga that says that, "Tracked Cluster developments, the first Acorn Hydrogen plant can be online in 2027." Would that be dependent upon being part of Track-1 or is that your anticipation of getting Track-2 and the natural development of the project?

Sarah Potts: We are still hopeful that even with Track-2, we can still deliver our first hydrogen in 2027. It is a tight timeline, and it does not allow us much time for further delays.

Q181 **Chair:** That certainly is a tight timeline, being five years away. What would you require for that timeline to be met?

Sarah Potts: In terms of the project, we are well advanced. We have just been out to tender for the front-end engineering and design. As you know, the types of technologies that we are planning to use for Acorn are well proven, so we are not talking about a significant amount of technology risk involved in the processes for the hydrogen generation. That therefore means that we can have confidence around the timeline for the front-end engineering design and confidence for the EPC associated with that. What we need is the confidence that we can achieve



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and apply for the hydrogen business model in the timeframe that we would need to get the final investment decision, and also that Track-2 status and timing confirmation.

Q182 Chair: Could we hear from Professor Sloan on this issue? For the whole north-east it has been quite a complicated and disappointing history when it has come to carbon capture and storage, and we know the disappointments of the last 10 or 15 years. Do you have any observations and are you confident that now that we are at this place, we are going to eventually go ahead?

Professor Sloan: I am not over the detail on where the project is. I have watched from afar, but it would certainly be fantastic for Scotland if it went ahead.

Q183 Douglas Ross: Good afternoon. I will start with Professor Sloan. You cited a number of examples. Maybe you can go into some more about Scandinavia and some learning that we can take from there. Our previous panel stated that the UK was leading the way in many aspects of hydrogen. Do you agree with that statement, and could you outline where you think we could learn further from Scandinavia?

Professor Sloan: I do not necessarily agree that we are at the forefront. From my perspective and the RSE's perspective, we see hydrogen and the hydrogen economy in two parts. One is the societal benefits that will flow from this in terms of the economy. The other fact is that we are in the middle of a climate emergency—the temperatures where you are today, for example. We need to double down on this. This is happening now, and we need to move much quicker, we think.

The Danish Government set up 14 public-private partnerships across the entirety of this economy covering construction, shipping and aviation, and the aim of these partnerships was to initiate and engender investment in green technology. Coming out of that, Denmark is about to invest over €20 billion in an energy island, for example, in the North sea. It is the first one of its kind; it is 10 GW of offshore wind, and 10 million homes will be powered by that. The island will produce green fuels for shipping. The interesting part about this was that there was cross-party support in the Danish Parliament for this Bill to be passed. The Government will own 51% of the island and they are going out to tender for the other 49% of investment. That approach gives long-term security to the private investors from a development perspective and a market perspective—the makers of the electricity and the fuel, and then the shipping, aviation and industrial companies that are going to use that fuel. That long-term planning is something that we do not see quite so much of in the UK.

Q184 Douglas Ross: Interestingly on that point, it was the planning that our previous panel highlighted that the UK was doing very well in. Were you able to listen to the previous evidence?

Professor Sloan: In and out.



Q185 **Douglas Ross:** Our witnesses were saying that the planning that the UK is doing is very advanced and is leading the way, and that other nations that come after adopt very similar approaches.

Professor Sloan: ScottishPower and SSE are developing in the UK, so in the day-to-day interaction with the planning authorities, they would be closer to the action than me, Mr Ross. From an international or a Scandinavian perspective, the scale of ambition from everyone involved in this industry is different. It is almost a societal belief that the hydrogen economy is here and is driven through every part of the economy. We see investment from the big pension businesses allying with the airline company SAS and Maersk to create these cross-sectoral partnerships to drive this forward, with politicians in the mix enabling the process much more than perhaps we see here, or perhaps I am missing it.

Q186 **Douglas Ross:** It is interesting that two panels half an hour apart are taking quite a different response to that.

Going back to your points and then I can take in Sarah as well, in terms of public perception where do you think the public are with hydrogen? We had a fascinating visit as a Committee, and the public still think of hydrogen and think of disasters and major events, rather than something that is going to benefit them. Is enough being done to reassure the public? Where is the public based on any information you have in terms of their knowledge about the benefits of hydrogen?

Professor Sloan: In our response to the Scottish Government's action plan on hydrogen, one of the recommendations from the RSE was that research and development needs to be invested heavily in this area. One area that was highlighted, and we highlighted this to the Scottish Government, was that social scientists and social scientists' research is an important element in this because we need to achieve a broad acceptance of hydrogen in society to make this acceptable. You are right that there is a section in the past of danger and uncertainty associated with this. We need to show that hydrogen is a proven technology and up the awareness of the applications and the broad societal benefits. At the moment, the RSE thinks it is quite variable and social scientists can identify the barriers that undermine this or understand the behavioural change that we need to go through as a society. I think that needs to run parallel with all the clever science and engineering.

Sarah Potts: If I look at it in terms of the average person on the street, I think hydrogen is a bit of a mystery. I had this experience personally; I have tried to explain what I do and I get a lot of blank faces. There is clearly a need to educate and engage the public on this topic to get them more comfortable with hydrogen. Most people still see 2027 and those dates as being quite a long way away, and a lot of decisions that do not feel a reality. When I talk to businesses, and Storegga is much more of a B2B organisation, companies seem to be very comfortable with hydrogen technologies. The burners for hydrogen have been around for decades. It is not as if this technology is completely brand new. Therefore, there is a lot more comfort around hydrogen as an alternative fuel for their existing



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businesses, but a recognition that as part of that transition there will need to be additional health and safety training for their employees to bring them on that journey.

For the public, hydrogen is still very much a mystery and we will need to engage with them to the end of the decade to bring people up that learning curve and let them know that the risks are being carefully managed through policy and regulation.

Q187 Douglas Ross: You mentioned more the commercial aspect in terms of greater acceptance. An issue I have is how we are going to affect those most in need in Scotland. We have seen some of the initial sites where there are trials and they are more urban areas, yet the constituency I represent in the north of Scotland, in Moray, has many more remote and less accessible areas that would immediately benefit from this. Are we going to go through, as we always do, the process whereby we pick the low-hanging fruit? The greater number of people you can get on to hydrogen, be it individually or commercially, is in the bigger, built-up areas, but those who may benefit most are in the more remote and rural areas, and once again they will be the last to see the benefits. Professor Sloan?

Professor Sloan: That is a very good point. The RSE, in our submission to the Scottish Government, made the point that island and remote economies around Scotland need fuel security, and that is quite apparent at the moment in particular. Our recommendation was that the UK Government consider how these remote communities, island communities and rural communities can be supported to grow localised hydrogen economies and promote energy independence—taking the hub concept and looking at that on a smaller scale. If you take Orkney, for example, which I believe has just commissioned the design of its first hydrogen-fuelled or ammonium-fuelled ferry, that local hub is something that cannot be lost in the drive for a hydrogen economy. If it were all based on the hydrogen coast, as it is now called, or across the central belt, we would be missing a trick.

In all of this, we must consider the island and more remote communities within Scotland, because a lot of them are juxtaposed beside where the energy is going to come from, with the vast and fantastic investment in wind around all shores of Scotland. It would be a shame if they missed out on this, so RSE is totally behind the development and protection of rural communities, and local hubs for the generation of hydrogen.

Douglas Ross: Ms Potts, you are nodding again.

Sarah Potts: I agree with everything that Andy has said. A just and fair transition is very important to Storegga. It is not something that we have specific opportunities to announce and share, but it is certainly something that we are building into our opportunity pipeline—leveraging the fact that hydrogen can be produced in a more geographically diverse area, and that we want to see the communities where that hydrogen is



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produced directly benefit from that production and it not just being shipped into tankers and driven past their doorways.

As Andy said, there is a real opportunity to look at hydrogen in more island and distributed energy networks and to provide more self-sufficiency for smaller rural communities.

Q188 Douglas Ross: We have spoken a lot today about the investment that will be required for long-term projects. Are we doing enough to train the future workforce in hydrogen in Scotland? What kind of numbers could we be looking at? Is there just going to be a shift from people in the oil and gas sector coming in to work in hydrogen, or is there a massive need to increase the number of people with skills through school, college, university, apprenticeships and so on? Ms Potts, is the industry ready to deal with that, and does it have plans for that at the moment?

Sarah Potts: I am certainly no expert; I caveat my answer with that. Certainly, I see at the moment the growth of the hydrogen economy not as a direct replacement for the traditional hydrocarbon sector, but as a build on top of that. Scotland has a fantastic opportunity on its doorstep or in its house, both in terms of offshore and onshore wind, certainly exceeding the local demand. That creates huge export potential. I only see that it is going to be a very large industry in the future.

In terms of growing jobs and expertise, the answer is yes, but on how much we are doing at the moment and whether that is enough, I am afraid I do not have the information that is good enough to provide to you today.

Professor Sloan: Are we doing enough? I do not think so. I think the universities are trying hard to recruit and doing sterling work, but we are playing in a world economy here. This is not a Scottish issue in terms of the skills that are required. We have vacancies in our business globally across Europe—over 150 people of skill in this area—so we would employ them in any country in which we are based. They are extremely hard to come across. I agree with Sarah that it is not just a transfer of skills across from oil and gas; that is too simplistic. Obviously a lot of process engineers can come across, but there are a lot of different skills, particularly when you start looking at CCS in the mix.

The whole skills piece is an extremely challenging area for us as a country, because of the global nature of this work. From a personal perspective, not an RSE perspective, it is quite difficult to get people into the country at the moment to work on these. We employed five people this week all on visas from India, Sweden and all over to come into the UK, not just Scotland, to work in this sector. It is challenging. These people are highly skilled and highly mobile.

The overarching thing is that if we can attract these people to Scotland, one thing that must come out of it is the investment for bringing people into the country and the training we need to see the benefits flowing down into the Scottish economy. We need an ecosystem for this



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investment to self-perpetuate so that there are supply chains developing other businesses and start-ups, and we see a benefit from the opportunity that presents itself to us with this hydrogen economy. After all, Scotland is in an enviable position of potentially being the wind powerhouse of Europe. We need to capitalise on that in Scotland, bring the jobs to Scotland and train our youngsters and keep them in Scotland. That is a monumental challenge.

Q189 Chair: A few people have raised concerns about the safety of hydrogen, but I do not think anybody has raised any concerns about the safety of carbon capture and storage, which may come as a bit of a surprise given that we are stuffing god knows how many mega-tonnes of carbon dioxide in disused oil pipes under the sea. Are there any risks associated with CCUS? If there are, what are you doing to mitigate them? Maybe Ms Potts can help us with that.

Sarah Potts: Are we confident that carbon capture and storage will do what it says on the tin? Yes. We are using reservoirs that have held hydrocarbons for millions of years, previously enabling us to exploit them in the past. Therefore, these reservoirs will also be able to capture and retain carbon dioxide within underneath what we call the seal or the cap. We are very careful about studying and making sure that we select the right kind of reservoirs, and there will be monitoring plans in place for the duration of each of the asset lives to make sure that the reservoir is still performing as we would expect.

Q190 Chair: You describe it as a reservoir. Could you explain how this looks and appears for those of us who find it difficult to grasp these concepts?

Sarah Potts: Essentially, the stores themselves are in the North sea depleted oil and gas reservoirs. That means that there is rock, which is permeable, which has holes in it, which can store both hydrocarbons but also CO₂. There is already CO₂ within those reservoirs. The reason that those hydrocarbons or the CO₂ does not escape from that rock is that there is a cap of a different type of rock over the top, which is impermeable, which means that the hydrocarbons or the gas cannot escape from that going upwards. Think about a Crunchie bar with all the honeycomb in the middle with the little pockets and that is encapsulated in the chocolate. Think about that Crunchie bar filled with CO₂ and the chocolate keeping the CO₂ from escaping from those holes.

Q191 Chair: That might just about make our report—if you think about it as a chocolate bar full of candy holes. I think that is just about the best description we have had. Thank you for that.

Given the importance of this and also the importance of hydrogen storage, should we be starting to think about this as a national asset?

Sarah Potts: From my position certainly. Looking at it from a hydrogen standpoint, we envisage that over 20% of the UK's energy needs are going to be delivered through hydrogen. For energy security purposes, and to ensure that industries can continue and people can continue to get around, hydrogen assets will need to be considered a national asset.



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From a CO₂ perspective, if we are serious about meeting our climate change targets—and sequestering CO₂ is going to be a big part of that—that CCS infrastructure is as important as the energy production infrastructure, from my perspective.

Professor Sloan: In terms of the safety side of things, the area that needs to be worked on is the oversight, the governmental Environment Agency oversight. I hear in several countries question around the rules of the game in terms of vouching for the safety of CCS, particularly large-scale CCS, that we need to abate, and, as Sarah says, the sequestering of large volumes of carbon dioxide. There is still work to be done on how we ensure the safety and let it be known that these things are safe to bring everyone in society with us. That is important and we should not ignore that point.

I will add that with carbon sequestration and hydrogen as a storage vector, and with the move for long-term pump storage, with the advent of the Coire Glas hydroelectric project and Drax investing in Cruachan, all of these added together have the potential for Scotland to become a bit of a storage powerhouse within Europe. All these things need to be seen in the round, so it is not just one thing, but the whole spectrum of storage that we see. I can see hydrogen as part of the mix of storage within Scotland, as does the RSE.

Q192 **Chair:** Lastly from me and for this session—a little bit more about investment. I know you touched on this briefly with Deidre Brock, but what sort of assurances are needed from the UK Government that both blue and green hydrogen are going to be significantly investable in the future? What do they need to do to give confidence for people to invest?

Sarah Potts: Certainly this is where the hydrogen business model and the net zero hydrogen fund are so important. Being able to provide that revenue support to investors, while the hydrogen market develops, provides investors with what they need to be able to put the billions of dollars of investment needed to back these projects. Without that—without being able to sell volumes of hydrogen in the long term or enter commercial frameworks for CO₂ removal and storage—it is very difficult to get these projects off the ground. The risk appetite of investors is not that high. I think that is where the business model and the other incentives that provide that revenue support are absolutely essential for getting the hydrogen economy off the ground.

Q193 **Chair:** I see that BEIS has published a document called “Hydrogen Investor Roadmap”, which maps the various projects going on at the moment. The view from them is that the potential is quite enormous, with 40 or 50 projects. Is that something that we need to see—this hands-on approach from Government?

Sarah Potts: Very much so. The other key point that I wanted to make today was that it is not just these policy decisions that are important. The regulatory changes that back up the policy decisions, and ensure that those regulatory changes are delivered in the same timeline and



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developed in parallel with those policy decisions, are essential because there is no point launching a policy and then having several years while everybody figures out, "So what? How does this work on a day-to-day basis?" We need to know as much as possible prior to investment about how the hydrogen system will work, from the producer through the transportation and storage, and directly to the consumer. All those different elements need to be stacked up for projects to get off the ground.

Q194 **Chair:** Professor Sloan, do you have any views on what the UK Government could do to encourage more private investment?

Professor Sloan: There are two areas. One is using the public sector to create a push effect on green hydrogen fuels, and using regulation and legislation to do that—for example, in terms of the obligation to admix blue hydrogen into the gas network so that they can use it for boilers and cooking. The Swedish Government have implemented a regulatory mandate to reduce the content of fossil fuel in gasoline, diesel, aviation fuel and so on, and there is a stepwise penalty if they do not reduce the amount of fossil fuel within a blended mix. For example, if you talk about the big reason for blue hydrogen being to dilute the natural gas within the gas network, there is lots of research and development that we need to do to find out what that mixture is. Some people suggest about 20%, but in Sweden there are regulations, penalties and bonuses on that slope, so there is a push there.

Then the pull effect from public sector is through subsidies, and looking at public purchasing to create and enhance demand for these fuels. It may be that some kind of contract for difference in the price of hydrogen could be considered. It has not been considered, as I understand it, by the Scandinavians at the moment, but they are certainly looking at things aligned to this to put a value on it and get the pricing point right.

Chair: I am grateful. Unfortunately we have not had time to go into the CFD-type model that has been used and also some of the very interesting remarks that have been made about blending, but perhaps we could come back to them at some point in the future. It is certainly important to this Committee.

If there is anything either of you could help us with, with either of these things, we would be very grateful for any further evidence. I think you could tell we found this whole session and whole inquiry fascinating, and we look forward to seeing where we go next with this in terms of the interesting issues that arise. Thank you very much for being patient and understanding about the change of venue for taking this evidence session. I think you can understand it is rather busy down here just now, but thanks for attending the Scottish Affairs Committee this afternoon.