

Business, Energy and Industrial Strategy Committee

Oral evidence: Carbon Capture Usage and Storage, HC 1094

Tuesday 6 November 2018

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Watch the meeting

Members present: Rachel Reeves (Chair); Vernon Coaker; Stephen Kerr; Sir Patrick McLoughlin; Mark Pawsey.

Questions 1 - 45

Witnesses

I: Luke Warren, Chief Executive, Carbon Capture and Storage Association; Professor Stuart Haszeldine, Director, Scottish Carbon Capture and Storage; Kristofer Hetland, Senior Adviser, Project Management, Equinor; Nick Sturgeon, Energy and Competitiveness Director, Chemicals Industry Association.

Examination of witnesses

Witnesses: Luke Warren, Professor Haszeldine, Kristofer Hetland and Nick Sturgeon.

Chair: Thank you very much for coming to give evidence to our Select Committee today on the issue of carbon capture usage and storage. We have a large number of questions to get through in quite a short space of time, so we will start straight away.

Q1 **Stephen Kerr:** Perhaps I can start with Stuart. This is a very simple question. Why do so many authorities insist that CCUS is essential for the UK if we are to reach our 2050 climate change targets?

Professor Haszeldine: That is a very good and pertinent question because, unless we can answer that, the whole thing is pointless.

Stephen Kerr: Let us start at the very beginning.

Professor Haszeldine: We are interested in CCUS, which is about taking carbon emissions out of our economic system while still enabling us to use fossil carbon as an energy source, a feedstock for the chemicals industry or to help make our industrial products. CCUS has a value, not just in electricity of course. The conversation in the UK has often been just about electricity, but we now recognise that CCUS has a value in taking out carbon emissions in electricity generation, heat supply, feedstock for chemicals and fuels for transport. It has an application across the whole economy, which is part of the lowest-cost way of decarbonising the whole of the UK. It has that profound, wide-ranging economic imperative.

It also has a profound social imperative because, unless we enable people who work in the oil and gas industry, the chemicals industry and carbon-emitting industries to transition those jobs into a low-carbon economy, those jobs will disappear out of the UK and we will end up with something like 15% of our workforce stranded. It has a profound carbon justice aspect to it.

Q2 **Stephen Kerr:** Are there no alternatives? Let me be provocative: why do we not just plant more trees?

Professor Haszeldine: That is again a great question. Of course, trees can mop up carbon dioxide and take it from the atmosphere. One tree takes about two kilograms of carbon dioxide every year into that tree. For what we all individually emit in the UK, about 10 tonnes of carbon dioxide every year, each one of us would need three Wembley Stadium football pitches to balance the carbon dioxide that we emit in the year, because we all emit so much carbon dioxide. To do the arithmetic on the land area of the UK, even if three-quarters of it was forested and one-quarter was left for growing food, that three-quarters forest would just balance our



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transport emissions, not the other emissions for heat, products and materials. We emit so much carbon dioxide that we need additional catching mechanisms to trees. That is where carbon capture and storage comes in, with its large volume.

Q3 **Stephen Kerr:** We could do a lot better with trees, because our forest covering in this country is probably one of the lowest in Europe. It is something we could do better on.

Professor Haszeldine: I totally agree.

Stephen Kerr: I know, in Scotland, we are doing better than the average.

Professor Haszeldine: I have pushed the Scottish Government to double or even try to treble the forest area, but it will still not be enough to balance the carbon emissions. That is the point I am making. Both of these are great things to do.

Q4 **Stephen Kerr:** If we do not deploy CCUS, how does it impact our ability to get to net zero?

Professor Haszeldine: It is impossible to get to net zero or carbon balance unless you do carbon capture and storage. We can see the trajectory of the UK decarbonising very effectively. Since 1990, we are one of the countries that have decarbonised very well, but there are several unique aspects to that. First, we have closed down a lot of coal-fuelled power stations and carbon-emitting industries, so we have taken the easy actions to decarbonise, which are relatively low cost.

Secondly, we import a lot of products and materials from outside the UK. They emit carbon in other countries, but we blame those other countries for emitting that, whereas we should be taking responsibility. If you add that in, our carbon emissions per person are pretty much the same as they were in 1990. To get further down that trajectory of carbon reduction, we need to take more and more difficult actions, which is where carbon capture and storage comes in. Eventually, capturing carbon from air, so there are negative emissions, and putting carbon into trees and into rocks through weathering, will all have a cheaper cost than catching the last molecule of carbon dioxide emitted from every car or oil refinery. It is part of a package of measures, so the last 20%, from an 80% down to a 100% reduction, is where carbon capture and storage, and negative emissions, will be essential to get to net zero.

Stephen Kerr: So it is not credible for us to have a target of net zero without CCUS.

Professor Haszeldine: That is my opinion, yes.

Chair: Does everybody agree with that? For the record, I think everybody said yes. Thank you. That is fine. Do not worry; I have done it.



Q5 Mark Pawsey: What are the opportunities and challenges in developing what would be a new industry in the UK? Perhaps Mr Warren would like to start.

Luke Warren: I will start with what they are not. This is not a technical challenge. Around the world, we already have more than 20 CCUS projects that we are either operating or under construction, so there is no doubt that the technology works. Moving forward, the challenge we have is the need to develop commercial models for CCUS deployment. The analogy for what we need to be doing over the next 10 years is doing for CCUS what we have done for offshore wind. We have created a policy framework that has enabled Government and industry to collaborate in developing and deploying a technology, to bring the costs of that technology down, which has enabled wider-spread deployment going forward.

Q6 Mark Pawsey: Why has it happened elsewhere before us?

Luke Warren: It has largely been down to bespoke national circumstances. My colleague from Norway might want to talk about what has happened in Norway, where they have an offshore CO₂ tax. We are seeing, in places like North America, that they have had opportunities to use CO₂ for what is known as enhanced oil recovery. That has generated a revenue stream that has supported the capture of the CO₂. We do not have that opportunity now in the UK and, therefore, we need other policy instruments that can support the technology.

Mark Pawsey: Mr Hetland, that sounds like an opportunity for you.

Kristofer Hetland: In Norway, we have the experience of two storage sites from our offshore production. The driver and incentives for the industry were, no doubt, the CO₂ tax introduced at the beginning of the 1990s. From that, CO₂ storage for those two offshore fields has become commercial. We have stored the CO₂ for more than 20 years and we have long experience of safe storage of CO₂.

Q7 Mark Pawsey: Back to Mr Warren, we know that there are these four potential clusters. Which in your view is the most obvious one to go for in the first instance, or are they all broadly at the same level?

Luke Warren: There are five clusters in the UK that are likely to come forward in the near term. They are the east coast of Scotland, Teesside, Humberside, the north-west of England and south Wales. In my membership, we have representatives from all those clusters, so I would not want to pick a winner. It is important that we work with the Government on how they pick which of those clusters will be the first to come forward. The recommendation from the cost challenge taskforce is that we need to bring forward at least two clusters, operating by the mid-2020s, to put us on a pathway to deliver the amount of CCUS we need by 2050. The Government need to define, in partnership with industry, how they are going to select them. Cost is one element; another is to look at



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how to leverage those clusters, so that multiple sectors can access the infrastructure that is likely to be put in there.

Q8 Mark Pawsey: What level of support has there been from local authorities and LEPs to support these projects?

Luke Warren: Generally, the level of support seems to be very high. All of those five industrial clusters recognise that CCUS is a really important regional opportunity. It is a way in which industry in those regions can transition to a low-carbon economy and remain competitive. That is an area where the UK has some advantage over other countries within Europe and elsewhere that do not have access to that storage infrastructure. That is understood and is one of the reasons we have seen, across the board in the energy-intensive regions, an interest in developing this.

Q9 Mark Pawsey: To move on to energy-intensive regions, Mr Sturgeon, how can carbon capture usage and storage help prolong the life of some of our historically big carbon emitters?

Nick Sturgeon: There are step-change technologies to decarbonise the sector, but they have very long timelines. We are looking well beyond the 2030s, towards 2050, for them to kick in fully. In the meantime, to help us stay competitive and participate in the low-carbon transition, CCS could help a number of activities. In particular, concentrated sources of CO₂ emissions from ammonia and hydrogen plants could be assisted, and it would probably be the most cost-effective technology to help them to further reduce their carbon emissions.

Q10 Mark Pawsey: Is there a danger, in Professor Haszeldine's analysis, that, if our industries do not adopt these technologies, they will simply wither away? There will not be an opportunity for them to continue to trade in the UK.

Nick Sturgeon: That is correct, yes. The UK's carbon budgets and carbon reduction pathway are quite challenging. If we do not decarbonise along with them, we will see our costs related to carbon going up as the decarbonisation pathway progresses.

Q11 Mark Pawsey: Is there a concern that, if energy-intensive industries are, in some way, bearing the burden of this transition, they will not be competitive with other industries around the world? We already know that industries that use large amounts of energy argue that their energy costs in the UK are higher than elsewhere.

Nick Sturgeon: The UK is leading on decarbonisation and there are some challenging pathways there, so I agree with that. A big competitiveness challenge we see is on electricity costs where, for large users, our costs are 65% above the EU median. We are looking forward to seeing the Government respond to the recommendations of the Helm review on electricity costs.



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Q12 **Mark Pawsey:** How do you see the burden on business from this additional technology being minimised, so that it does not have a drastic effect?

Nick Sturgeon: The key thing is cost. The cost will be lower for ammonia and hydrogen, as I mentioned, but there still needs to be a funding model for transport and storage to get that technology to work. That additional support will be needed. For some other areas, for example petrochemicals, the cost of CCS is particularly high at the moment and too high to pursue the current technologies. It is around £80 to £140 a tonne of CO₂ to cover the capital and operating costs of the current amine-based capture technologies. They need to look at other technology.

Q13 **Mark Pawsey:** When you say “they”, do you mean the industries and the businesses?

Nick Sturgeon: I mean the businesses perhaps along with the Government and the taskforce. The challenge for those who do not have the immediate opportunity to follow CCS is how CCS is funded. We do not want to see part of our sector paying for the decarbonisation of emissions in the other part.

Mark Pawsey: You are suggesting that the costs should be split.

Nick Sturgeon: There needs to be a way to fund the cost that does not impact other energy-intensive industries’ competitiveness.

Professor Haszeldine: I will try to help. A lot of this conversation is about how we provide a pull for CCS, because a lot of the time we are talking about a push through a mandate: “You must decarbonise”, “You must do this” or “must do that”. BEIS could also think about how to create markets for CCUS. The whole conversation about creating a market for low-carbon products has been entirely missing. For example, you could create a market for the procurement of low-carbon concrete. That would then create a demand for low-carbon cement or products going into the concrete.

Q14 **Mark Pawsey:** How are we going to distinguish which products are low-carbon and which are not in this scenario?

Professor Haszeldine: They have to be certificated in some way. It should be fairly straightforward to work out if a plant operator has captured some or all of its carbon. The point is that it can then recover the cost by producing a low-carbon product that will attract a rather higher price. For example, at the moment some petrol companies are experimenting with a voluntary carbon offset. You can buy petrol and then pay a little extra to offset the carbon. Surprisingly, a large percentage of customers want to do that. On Government procurement, any Government-funded buildings or construction could use low-carbon concrete, which would embed plastics or carbon products into the



concrete and create a low-carbon concrete. That would attract a premium price, but not increase the price of the overall product.

- Q15 **Mark Pawsey:** You use the expression “you could”. Does that mean these are simply ideas or is there anywhere in the world where these ideas have been implemented?

Professor Haszeldine: The analogue I would give is California, where there is a low-carbon fuel standard. The state Government of California say that they want the emissions from their fuels for vehicles to be X amount; then X reduces by 10% next year, 10% the following year or whatever, so there is a trajectory towards a continual decrease. They are rewarding companies that can supply that decarbonised fuel. That again is a premium price but, over a period, a trajectory, it gives businesses the time to develop their decarbonisation activity, and there is a secure market to sell into. At the moment, in a way, we are asking companies to develop a low-carbon polythene or ammonia, but it is unclear who is going to buy that low-carbon product.

I just want to say another thing. We might come back to this. I have proposed several times a way of smearing this out across the whole economy, because the point is well made that we cannot pick on individual manufacturers or industry actors and expect them to decarbonise irrespective of everybody else. We need to find a way of spreading the decarbonisation out and aggregating it across the whole of the economy. That is where decarbonisation certificates could be used, as was discussed briefly by the Oxburgh review and the CCUS taskforce as well.

- Q16 **Sir Patrick McLoughlin:** We are told that countries like Norway and the US are much further ahead at developing CCUS. Would you agree with that?

Professor Haszeldine: They are clearly much further ahead at producing practical projects that are operating. Norway has had its Sleipner project working since 1996, very famously. Norway has invested in carbon capture research facilities. It has invested in the Snøhvit project in the north of Norway, and it has the current Northern Lights project, which I expect Mr Hetland will be able to tell us about extensively.

Through partial Government subsidy, both the United States and Canada have managed to create actual working carbon capture, transport and storage projects, which work at commercial scale. In that sense, they are ahead. I am interested in the way that Canada has now moved to a carbon tax and rebate across federal Canada. They are trying to charge a tax of several dollars per tonne of carbon dioxide, and then will refund that into research and development to create those low-carbon industries. That is an entirely different process to what we are going through.



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Luke Warren: Touching on my earlier comment, other regions have been more successful with the first projects, but the UK can add value and gain some competitive advantage around the commercial model. To maximise the value of CCUS, we need to develop a regional infrastructure for CO₂ handling, the transport and storage of CO₂, and enable that to be accessed by multiple sectors, whether power, chemicals, iron, steel or cement.

What has come out of the cost challenge taskforce in the UK is a real step forward in thinking, where there is now a proposal for a separate funding mechanism, potentially using a regulated asset base approach to developing a transport and storage infrastructure, which enables it to be accessed by multiple emitters of CO₂. That is potentially a game changer and is exactly the model that needs to be rolled out across the UK, going into Europe and around the world. That is where the UK has some advantages in perfecting and understanding that commercial model.

Q17 Sir Patrick McLoughlin: When do you expect the Department to move further forward in announcing what schemes it wants to back?

Luke Warren: The cost challenge taskforce presented its report to Government in July, and one of the key recommendations there was that the UK should be seeking to develop at least two CCUS clusters by the mid-2020s. The Government have committed to come forward with their deployment pathway, which will set out their ambition and the steps they will take to realise it by the end of the year. We are expecting this to be imminent. We hope it will come forward in the next few weeks, and then we will have a good understanding of whether there is a shared ambition between Government and industry to progress this agenda.

Q18 Sir Patrick McLoughlin: Do you think the Government are on target to do that, from what you are hearing from the Department?

Luke Warren: Claire Perry has shown real leadership on this issue. In her time at BEIS, she has worked very hard to understand this. Our understanding is that she is now engaged in a conversation with colleagues across Government to understand what the Government's formal ambition will be. We hope it matches the recommendations from the cost challenge taskforce.

Q19 Sir Patrick McLoughlin: A little earlier, Nick said—correct me if I am wrong—that this development would come into its own by the 2050s.

Nick Sturgeon: I was talking about longer-term step-change decarbonisation technologies. They would take longer to bring in than CCS. What CCS could help industry to do, if it could be done in an affordable way, is to participate earlier in the low-carbon transition, stay with the pathway and make some contributions to pathway reductions from 2030 onwards.

Q20 Sir Patrick McLoughlin: Do the rest of you agree with that kind of target or would you say that approach is too slow?



Professor Haszeldine: It is too slow for me, because we saw a report from the Meteorological Office last week showing that the impacts of climate change—remember this is the whole purpose behind doing this—are clearly apparent even in the UK weather system. Summers in the past 10 years have been on average one degree warmer than they were 20 years ago, and winters are two degrees warmer, so we are seeing the effects of climate change more rapidly than was ever predicted by the models. We are also seeing that actions to decarbonise are often happening more quickly around the world than has been predicted, particularly with renewable energies.

If there is a pull to develop markets for CO₂ storage, to decarbonise heat and make low-carbon products, the decarbonisation activity can happen much more rapidly than we would think. I am concerned that BEIS falls into the trap of being under-ambitious, if it feels satisfied with two projects during the mid-2020s. I was one of the people on the CCUS taskforce thinking that we want as many clusters and regions around the UK as can qualify themselves. It is not a competition to be first and second, and then it is over. It is about how to bring forward those five clusters individually, when they are ready. They have to fulfil a certain set of criteria to build the infrastructure, exactly as Luke Warren has said. Once that infrastructure is ready, we can start CO₂ flowing through those pipelines and into storage. They can emerge one after the other after the other. It may be that, by 2030, we have five operating clusters around the UK to spread the benefits around the industrial regions of the UK.

Q21 **Sir Patrick McLoughlin:** Would you agree that the two areas of California and Norway are the places making the most advancement?

Professor Haszeldine: I would include Canada as well.

Q22 **Sir Patrick McLoughlin:** You say their tax is very new, though.

Professor Haszeldine: They are experimenting with the carbon tax now, but they have made a lot of progress through persistence in the past eight to 15 years, by having a systematic long-term strategy to support research and development at industrial scale.

Q23 **Sir Patrick McLoughlin:** One of the things that the Chemical Industries Association would presumably say is that it does not want to put its industry at a disadvantage against other international industries, because you are very much dealing with an international market. Is that your concern? Is that what you are seeing happen? If you take what is being said about Canada and perhaps Norway, although it is not so much a competitor, how would you deal with it?

Nick Sturgeon: Competitiveness is a key issue here. Energy-related and carbon-related costs are our biggest competitive challenge, so our concern in looking at these new technologies is to ensure that they can be done in an affordable way, supporting and helping us to decarbonise, while remaining competitive. That is a key concern, yes.



Q24 Vernon Coaker: Can I just say how refreshing it was that Stuart Haszeldine mentioned the reason we are all here and why this is really important? Climate change is happening all around us and we need to get a grip. The Government want to keep the option of deploying CCUS at scale in the 2030s, providing that costs come down sufficiently. The obvious question is what “sufficiently” means. We could all spend half an hour on that, but what does “sufficiently” actually mean? Have the Government given you any idea? How would you define it?

Luke Warren: You are right; the Government have said they want to have the option to deploy at scale in the 2030s, subject to costs coming down sufficiently. That was the question that was put to the cost challenge taskforce. We therefore said that at least two clusters are critical there, and there are three reasons for that. First, developing at least two clusters gives you infrastructure that enables you to scale, because you can then bolt other emitters on to this. Secondly, when you share infrastructure, it enables you to bring costs down substantially for follow-on projects, as they are effectively sharing that infrastructure. That will be a major cost-reduction lever. It also helps you to understand the cost of a technology and where the future cost-reduction options will come.

What we see is that, in the 2030s, you are developing this infrastructure, which puts the Government in a position where, if they really want to go big on CCUS, they have the enabling infrastructure, understand the commercial model and understand the cost reductions. That is the recommendation that has gone to Government and we will have to see if Government respond to it. At this point in time, we cannot define specific cost-reduction targets for every sector that may want to deploy CCUS. We just do not have that evidence in front of us, at this point in time.

Nick Sturgeon: We support the need for cost reduction. As I mentioned, there are some activities such as ammonia and hydrogen production where concentrated CO₂ is already captured. The costs are quite low for abating those streams. In other areas—I mentioned petrochemicals—the costs would be much higher. How far you need to reduce costs perhaps depends on how much cost you are prepared to impose on consumers, energy or domestic, or to fund directly from Government. That is the flip side of it. For energy-intensive industries where there are higher abatement costs, we would be looking for some funding models to help to implement CCUS.

Kristofer Hetland: I have a comment on this from Equinor, as an energy company. As we have learned from the real investments we have made in the UK, even if you have a rather ambitious roadmap on costs, deployment is core. We need to learn from real large projects. What we have seen on wind has been incredible compared to what we thought, and it is also necessary on CCUS that we learn from real large projects.

Q25 Vernon Coaker: It is interesting, because the Government and the wind industry set a target for the reduction of costs. Would it be helpful in this



area if the Government were to set a target? Would that drive it on?

Kristofer Hetland: When it comes to costs, you have different applications. You have some capture facilities for energy-intensive industries that do not have any alternatives. As an energy company, we see for power that CCUS is excellent together with wind, because it can balance the load for us. It can balance the difference between supply and demand. As such, CCUS fits the wind portfolio. We have a lot of wind, in general terms. If you do that, you will not have a baseload system. If you compare new nuclear plant with wind or dispatchable power, as we have with natural gas power plants, they are three different products. It is a little different; we do not like the comparison of leveraged cost of electricity, because we think we should look at this with a total holistic view, as the total society. Then we can see that this technology is needed.

Q26 **Vernon Coaker:** That is very interesting, because it brings me to what I wanted to ask Stuart. What other ways are there to assess the economic viability of CCUS? In what ways could you assess it, other than cost? Are there other ways we should be looking at this?

Professor Haszeldine: That is a little hard for me because, in a way, it is about the cost of not doing CCUS. The cost of not doing it, as you alluded to earlier, is the climate and environmental damage cost, and the cost of jobs that may fly from Britain if we carry on increasing our carbon price, as part of Europe, next to Europe or however that works. The shadow carbon price that can be placed upon carbon dioxide emissions round the world is often taken to be something like \$40 or \$60 per tonne of carbon dioxide for the damage that does, but we in this country do not pay for that. It is rather like throwing our rubbish into somebody else's backyard and saying, "It's not our problem any more". That is what we are doing. We are putting our carbon dioxide up into the atmosphere and it is having climate effects elsewhere in the world.

The cost of not doing it is this gradual degradation of global food growth, population movement, climate and weather events that damage more activity. You can see that in the weird weather in the Philippines, or hurricanes in Mexico or the southern United States. All those climate damage events are happening at an increasing frequency.

To go back to the cost part, cost reduction is a never-ending pot of gold at the end of the rainbow. Cost reduction can always happen. The oil industry in Britain has recently gone through a period of cost reduction. After the Wood review, it has managed to lower the cost of producing oil from the North Sea. The possibility of that cost reduction did not stop the oil industry from emerging. It did not stop it from developing, but it discovered on the way through that it is possible to reduce costs in unexpected and different ways. The cost of renewable electricity is not quite a fair comparison. It is a good idea to have some sort of target, but just saying it is the cost per kilowatt hour or per tonne of CO₂ is too simple. It is about the cost of the whole system and that is what we are



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trying to emphasise. The infrastructure is important. From the capture through the infrastructure to the storage, that whole-system cost is important and this is ready right now.

I just want to give you one example of the project that Luke Warren alluded to in north-east Scotland. The Acorn project is ready. It has gone through four cycles of evaluation, from the design of the capture to decarbonise industry at St Fergus. The pipeline already exists to go offshore to the storage site, which is well known and evaluated. That is now at a cost of something like £450 million, which is half or a third of the cost we would have done it for two or three years ago. The interesting thing is that it will become more expensive through time, because the cost of that project can change from £450 million down to £300 million, which is a cost saving of £150 million, by reusing existing pipework offshore. With the decline of the oil industry, that pipework will be taken away and decommissioned. Today, I have an email from Shell, the owner of that pipeline, saying that their plan is to decommission that pipeline. It will become more expensive if we wait for two or three years.

Q27 Vernon Coaker: That is interesting. Luke, on that, then, if you are talking about policy delivery mechanisms, should transport and storage be treated as national infrastructure, as electricity pylons or gas pipes are? That would bring down the cost of developing projects if it was done like that. Is that a good idea, bad idea or not practical?

Luke Warren: That is absolutely the right approach and a big step forward from the approach that we have taken previously in the UK. We have taken the view that the market will develop the infrastructure. Actually, the recommendation from the cost challenge taskforce is to look at this through the other end of the telescope, and focus on developing the transport and storage infrastructure as a public good. Then you suddenly start to unlock decarbonisation options across multiple sectors in the economy.

Vernon Coaker: Do you mean in the way Stuart was just talking about?

Luke Warren: Yes, absolutely. This also links into your comments on cost. Historically, when we have looked at cost, we have tried to find a simple pounds-per-megawatt-hour number. That is inadequate to understand the costs of the energy system. You need to be looking at energy system models that look at how the UK transitions to a low-carbon economy. That is very clear. The Committee on Climate Change has said that, if you had access to CCUS, you could halve the costs of delivering your carbon budgets. Those conclusions have also been found by a number of other organisations, so we need to look at this from the energy system as a whole, rather than just a narrow, specific technology.

Q28 Vernon Coaker: That is very interesting. Do you feel as though you are pushing at an open door here or are people throwing up their hands and saying "too difficult"? What sort of reaction to that have you had so far?



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Luke Warren: The world has fundamentally changed since the end of 2015 and the Paris agreement. Companies and Governments are starting to understand what net zero actually means in practice. Once you start thinking about how to drive emissions down to those levels, you keep coming back to CCUS being critical. That is starting to be internalised within companies and Governments, and the conversation has been re-energised. People are trying to find solutions here. It is a much more positive conversation than it was perhaps five years ago.

Professor Haszeldine: For the record, I totally agree with what Luke has said about the infrastructure and the whole energy system being what we need to develop.

Q29 **Chair:** Can I ask a question of Mr Hetland? I wonder what lessons we can learn from other countries, particularly your experience of Norway, about making CCUS more economically viable.

Kristofer Hetland: First, the importance of Norway is that we are used to having a close private partnership with the authorities and the Government. That is important. In Norway, they do not only support projects; they also take a direct stake in projects. Close co-operation is important.

For the oil and gas business, incentives to do investments have been introduced. There is also willingness from the Government to look into the decarbonisation of some industries in Norway. The Government are supporting studies of storage sites, transportation and capture facilities at a couple of industry sites. We have exactly the same challenge in Norway as the UK: that the incentive structures to continue investing in this are not yet settled. There is still a discussion in Norway between the commercial players and the Government.

Q30 **Chair:** Is it very different then? You said the Norwegian Government are taking a stake in the investment in CCUS in Norway. That is different from here. Will that hinder development in this country?

Kristofer Hetland: I do not think so. The support systems you have, with either direct capital contributions or contracts for difference on power, are a sufficient way of doing it.

Q31 **Chair:** The precise nature does not matter.

Kristofer Hetland: No. Historically, the Norwegian Government have had a stake in the oil and gas industry.

Q32 **Chair:** Can I ask a question of Professor Haszeldine? You spoke earlier about it being essential for us to have carbon capture and storage to meet our Paris obligations. Obviously not every country in the world is going to do CCUS, because there are not opportunities everywhere. How important is CCUS globally to meet those obligations?

Professor Haszeldine: Again, the global analysis is that, as part of the least-cost pathway for large industrial nations that use a lot of fossil



fuel—Canada, the United States, Mexico, Australia, China, most European countries—CCS is an essential part of that pathway. For countries that use very little fossil fuel in central Africa, which are perhaps dominated by hydropower and renewables, CCUS is much less important.

Q33 Chair: How important is it for countries like Holland, the US or Australia, and will they meet the obligations?

Professor Haszeldine: The Netherlands has recognised CCUS as very important. They have taken a public position in the past two years and part of their national strategy is to undertake CCUS at something like 20 million tonnes a year of CO₂ storage by 2030, so it is an essential part of their national plan. They are in a similar position to the UK, in that they have carbon capture ability onshore from industries and power plant, and storage close by beneath the North Sea. There are large, very secure and easy-to-monitor stores that are safe and you can rely on.

Australia is a very different country, because it changes its position with its Government, in my observation. They rely a huge amount on exporting very large quantities of coal. Even in Australia, we have recently seen an acknowledgement that that may not be sustainable for long. Australia is considering making hydrogen out of its coal, doing carbon capture perhaps but exporting the hydrogen, so going into a clean fuel supply business. Equinor is venturing into the same possibilities for producing gas and decarbonising the gas.

Q34 Chair: Lots of other countries are experimenting and looking at the options here. What opportunities do we have to be a world leader at this and to export stuff in the future, importantly?

Luke Warren: The UK competitive advantage here is, first, our geological storage. We have geological storage equivalent to the other EU 27 countries combined, in the order of 70 billion tonnes of CO₂ storage. We have the opportunity to develop a significant industry domestically, which could be very attractive, moving forward, for industries that are looking to place new capital investments in a carbon-constrained society. The ability to manage your CO₂ emissions cost-effectively could be an interesting proposition, but it also opens up the opportunity for us to import CO₂ and provide a storage service to other countries that do not have access to storage. That is one area where we have competitive advantage.

The other big area is that we have a world-class oil and gas industry, which has exactly the supply chain needed to deploy CCUS. There are opportunities to diversify our oil and gas supply chain. In the same way that parts of the oil and gas supply chain have diversified into offshore wind, they could also start to diversify into CCUS.

Q35 Chair: Do you think that anything is missing in the taskforce report? I do not know the extent to which you fed into it, but do you think it has missed any tricks or opportunities?



Professor Haszeldine: The creation of the market, the pull, is not quite articulated in that report. A means to enable the reduction in cost is a means to enable how CCUS could occur, but there is still no profit or money-making motive in the end. I will give one more example. Having totally agreed with what Luke says about the oil industry transition, we also have the possibility to decarbonise our heat. About half the energy we have outstanding to decarbonise is heat.

There is a very interesting proposition developing in the UK between at least three of the regional gas companies: between Cadent in north-west England, northern gas networks supplying the north and east of England, and Scottish gas networks supplying Scotland, southern England and Northern Ireland. They are all interested in whether we can transition from supplying methane through those pipes, which emits carbon dioxide burned in our houses, and changing them to transport hydrogen, which will reuse the billions of pounds of infrastructure assets we already have in the ground. We will decarbonise that and could start to do that in the early 2020s.

Q36 **Chair:** Are you saying that the taskforce report did not adequately address that?

Professor Haszeldine: There are cross-departmental blockages that the taskforce did not quite get to. At the moment, it is not legal for any of these companies to put hydrogen into that pipe network, so the Government need to change the Gas Safety (Management) Regulations 1996, which are enacted through IGEM, the Institution of Gas Engineers and Managers. They need to permit hydrogen to be put into those pipes. Unless that is done across Government in the next year or so, those industries will enter their regulatory period of cost control, because they are regulated assets, and be constrained and stuck. We will lose five or seven years there, because they are potential large customers for hydrogen produced from methane, taking away CO₂. They can potentially have a large impact on this, which has not yet been recognised across disciplines in BEIS.

Kristofer Hetland: I will make a comment on the report. What we have learned from the oil and gas industry about "one North Sea" we should take into consideration when we look at CCUS, and try to strengthen co-operation between the Norwegian and UK Governments on this. There are a lot of synergies crossing borders and learning from each other. We have the North Sea Basin Task Force, which is a governmental body set up for this, and I think we can strengthen this co-operation in the future and not look at each other as competitors.

Q37 **Sir Patrick McLoughlin:** To come back to what Stuart was saying a second ago, presumably the regulations you are talking about were brought in for a very good reason, possibly on the back of Cullen. Why would there be a block on doing what you have suggested? What would be the reasons they are not covered by regulation at the moment?



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Professor Haszeldine: They are covered by regulation. My understanding from talking to senior people in the gas supply and transport industry is that the Gas Safety (Management) Regulations were brought about to enable a very tight specification based on North Sea gas coming out of the ground. It was basically very, very pure methane. As our supply of very, very pure methane from our own resources and our Norwegian friends declines, we are now importing gas. We are also generating biogas and we could produce lots of hydrogen, but the specification on that network is so tight that we cannot feed those extra things into it.

Q38 **Sir Patrick McLoughlin:** You are suggesting the only reason it is there is historic, which is no longer relevant.

Professor Haszeldine: That is correct. Scottish gas networks have changed the gas specification for Oban in western Scotland, for 20,000 or so households. They had to get a special derogation from those gas networks to do that, so they could truck in liquefied natural gas. If we are to convert our larger system to supply even 5% or 10% hydrogen, we need to change that regulation. I am told that needs parliamentary approval, rather than just being by the regulator for the industry.

Q39 **Sir Patrick McLoughlin:** It might be useful if we had some more information on that. If you could provide us with some more information it would be quite useful.

Professor Haszeldine: I will certainly send that.

Q40 **Chair:** I agree. Maybe, Professor Haszeldine, you could send us a brief note with a little more information. There is just one little question from me: where do you think this blockage is coming from?

Professor Haszeldine: It is due to the historic backdrop of us being a lucky country to have an oversupply of North Sea gas. We regulated a very tight specification for that, and we have not taken account, looking forward, of how our gas supply is changing.

Luke Warren: This is around what is missing from the cost challenge taskforce. This is the start of a process, rather than the end of a process. The taskforce makes a number of recommendations about areas on which both Government and industry will need to collaborate, moving forward. If we are going to be successful on this CCUS journey, we will need sustained Government engagement in this sector, but we will also need sustained parliamentary engagement on this, because these are large infrastructure projects that potentially take decades to develop. This is not a programme that can be undertaken lightly; it will require deep collaboration.

Chair: Hopefully we are setting the tone for that engagement at this meeting.

Q41 **Sir Patrick McLoughlin:** Have you made any recommendations to the



National Infrastructure Commission on this, because it was looking at power storage, if not necessarily this kind of storage?

Luke Warren: One of the challenges the National Infrastructure Commission had is the very narrow scope of its assessment. They were only able to look at heating and the production of hydrogen, so they completely missed some of the other opportunities for CCUS. That may have impacted on how they viewed CCUS. They were quite clear that more work needs to be done on CCUS for heating and the production of hydrogen. They were less focused on CCUS in the power sector, and we have had a bit of engagement with them around that analysis, because they have perhaps underestimated the role it could play there.

Q42 **Sir Patrick McLoughlin:** They report directly to the Treasury.

Luke Warren: That is why we are keen to meet with them.

Sir Patrick McLoughlin: Exactly, I thought it might be.

Q43 **Chair:** Have you not yet met with them?

Luke Warren: We engaged with them ahead of their report and have had some follow-up conversation, but it is still a live conversation.

Q44 **Chair:** That may be something we follow up on as well. I want to ask, finally, about this theme of the confidence you have in the Government. You have all been positive today, but there have been a couple of times when you have been marched up to the top of the hill only to be marched back down again with the cancellation of previous policy support. To what extent does that discourage investment or engagement on this occasion?

Professor Haszeldine: You are right to identify going to the top and back again, or being led to the threshold and scooped out. From an academic point of view, and from a university and research point of view, there is a slight weariness that we are running on the spot, in some ways, even if we have done as much as we can do. We now need real projects to get on with. From my contact with potential developers in the widest sense of the industry, from electricity to industry to pipeline to engineers, there is profound scepticism that the Government have to be seen to be doing something, rather than just talking about it, because several large companies have been led to the threshold, laid out large amounts of their own money and then watched it be burned in flames.

Q45 **Chair:** Luke Warren, you were very positive before about Claire Perry as the Minister here, her engagement and support for this. Do you share any of Professor Haszeldine's concerns or do you think that people are taking this as a new opportunity to engage?

Luke Warren: I share Stuart's concern here. Our membership includes a number of companies that were involved in those earlier rounds, and they feel somewhat bruised by the experience. We are in a world where we are looking to build confidence on both sides. That is why we put a lot of emphasis on the importance of having an ambitious deployment



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pathway, because that is the first chance for the Government as a whole to signal whether they are committed to this agenda. We will be looking at that very closely.

The analysis that has been done as part of the cost challenge taskforce shows that we cannot leave this much longer. Despite the excellent progress on renewable energy, CCUS still looks like it is going to play a critical role and we do not have that much time between now and 2050. It may seem a long way away but, when you are trying to develop infrastructure, it is the day after tomorrow. There is actually a real need for concerted effort now. Claire Perry understands that, so let us hope the rest of the Government get behind that ambition.

Chair: Thank you very much, all four of you. It has been a really interesting session and we appreciate your time. We look forward to following up on some of the specifics we have mentioned today, as I am sure this is an issue that we will return to with Ministers and experts. Thank you for your time today.