

Energy Security and Net Zero Committee

Oral evidence: [Keeping the power on: our future energy technology mix](#), HC 116

Wednesday 24 January 2024

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[Watch the meeting](#)

Members present: Mark Garnier (in the Chair); Vicky Ford; Barry Gardiner; Mark Pawsey; Lloyd Russell-Moyle; Alexander Stafford; Derek Thomas; Mick Whitley.

In the absence of the Chair, Mark Garnier was called to the Chair.

Questions 330 - 436

Witnesses

I: Alex Campbell, Director of Policy and Partnerships, Long Duration Energy Storage Council; Kate Gilmartin, CEO, British Hydropower Association; and Clare Jackson, CEO, Hydrogen UK.

II: Richard Arnold, Policy Director, Marine Energy Council; Ross Glover, CEO, Star Energy Group plc; and Martin Soltau, Co-CEO, Space Solar.

Written evidence from witnesses:

- [British Hydropower Association](#)
- [Hydrogen UK](#)
- [Marine Energy Council](#)
- [Star Energy Group plc](#)
- [Space Solar](#)

Examination of witnesses

Witnesses: Alex Campbell, Kate Gilmartin and Clare Jackson.

Chair: A very good morning and thank you all for coming along to this evidence session of the Energy Security and Net Zero Select Committee. Regular viewers will notice that I am not Angus Brendan MacNeil. The Chairman is unfortunately stuck on Barra, where I think that there is too much seaweed on the runway so he cannot fly down. I will be taking over and chairing today.

This is the fourth session of our inquiry into keeping the power on. Thank you to the witnesses. Perhaps you would like to give your name, rank and serial number. Alex, we will start with you.

Alex Campbell: I'm Alex Campbell. I am the director of policy and partnerships at the Long Duration Energy Storage Council, or LDES Council for short.

Kate Gilmartin: I'm Kate Gilmartin. I am the chief executive at the British Hydropower Association, which also has the Tidal Range Alliance underneath its banner.

Clare Jackson: I'm Clare Jackson. I am the CEO of Hydrogen UK.

Q330 **Chair:** Fantastic. Thank you very much. There is this great conundrum about how we are going to keep the power supply coming along. What we are interested in to start off with is the relative advantages of having energy storage versus coming along with more dispatchable energy, more traditional lines, or indeed more interconnectors. It would be very helpful if you could talk about what the benefits are to start off with of the electricity system and investment in energy storage versus those of building more interconnectors and dispatchable power.

Clare Jackson: From the hydrogen perspective, the long-duration energy storage and the dispatchable power go hand in hand. Some of the challenges that we will face as we have increased renewables on the grid and increased electrification of demand is that we will have longer periods of time where we have positive residual energy demand—greater levels of generation on the grid than we need. That is where hydrogen can come in and we can divert that power that would otherwise be curtailed into hydrogen production.

On the flip side of that, hydrogen is very easy to store in large quantities. We will also have an increased number of times when we have a deficit there, where we have more energy demand than we are able to deliver. That is where the hydrogen power dispatchable generation can come in. As we move towards this different residual demand shape, we will see an increase in the number of hours where we have excess supply.

The A4E study last year demonstrated that that could go from 1% of hours to 36% of hours between 2025 and 2035. That is where hydrogen



can come in. Similarly, we will see these big demand peaks, which, as with increased electrification of demand, could spike from, in 2025, being 21 GW to 22 GW, up to 73 GW of demand.

Hydrogen will not provide all that, but the place that hydrogen will be will sit within those load factors of between 5% and 25% to 30%. There is a combination there. The Climate Change Committee indicates that for 2035 we will need around 40 TWh worth of dispatchable power, and 30 of that can be provided by hydrogen and the rest from gas CCS.

Q331 Chair: I just want to ask one technical question. A number of people have raised the fact that the loss of energy in the conversion of electricity into hydrogen is about 27%, if I remember rightly—that order of magnitude. Do you see that as a problem or do you feel that is an excusable loss, given the fact that if you have excess power it does not matter how much you lose as long as you are securing some storage?

Clare Jackson: It is to do with what else you are planning on doing with it. Anything that you can directly electrify, you should. However, as I said, there will be these increasingly large proportions of time where we will have excess power on the grid. It is a no-brainer to use that to convert into hydrogen, which we can then store for the times that we need it. There are losses associated with that, but the greater loss is in curtailing and losing that energy all together.

Chair: Fantastic. Kate, do you want to answer the question?

Kate Gilmartin: It is not a case of either/or; it is a case of “and”. We need a portfolio of everything. In terms of dispatchable generation, we have hydropower. That is currently giving 900 GWh of storage and there is the potential for another gigawatt to be brought online, half of which would be conventional hydro—reservoir hydro—with that additional storage. It is worth pointing out that we need to look at storage across the transmission and distribution network as well. Over a third of our generation is connected to the distribution grid, so we need to think about storage at both transmission and distribution.

On interconnectors, we had a massive uptick in the amount of interconnectors brought forward through the cap and floor, which is useful but we should as a nation be looking at being a net exporter of energy. We have huge indigenous generation potential, which could be exported. Those interconnectors should not be there for balancing necessarily; they should be there for our export.

That brings me on to tidal range. There is great potential for a huge amount—20 GW potential of tidal range. Again, that is part of our indigenous generation with the possibility to export.

In terms of pumped storage hydro, we have four operational schemes. There is the potential for another 6.8 GW to be brought online—126 GWh. We have the long-duration energy storage consultation out at the moment, which we will be putting a response to, but I think it is a case of



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having a portfolio across the dispatchable generation, storage and interconnectors.

Q332 **Chair:** On the tidal range stuff, I remember meeting some of your colleagues who came to see me about it. I think that the strike price on the contracts for difference was £178 per kilowatt hour. That is quite high. Just to confirm it with you, is that reflecting the fact that it is relatively new technology? It is quite tricky with the sand and the grit and the salt—quite corrosive—where you put it. Do you anticipate that coming down to something more comparable to where the current market price is, which is about £90 per kilowatt hour?

Kate Gilmartin: Yes. We are doing a piece of work with Jacobs at the moment on the levelised cost of energy for tidal range. We are within the range of nuclear and tidal stream as well, so it is definitely within the rest of the generation mix. The key is that it is proven technology. We have La Rance in France. We have Sihwa in South Korea. This is nothing new. We don't need to think of this as an emerging technology; it is proven.

In terms of the overall cost as well, it is £60 billion for 15 GW, which offers much better value than, say, nuclear. It is about having everything in this mix. We need to have diversity. Diversity brings resilience. Again, it is not either/or, it is "and".

Alex Campbell: Thank you for inviting us. I should say that the LDES Council is a global association rather than British specifically. We do have members from the hydrogen and pumped storage hydropower side of things, and I fully support the previous comments.

Being brief in answering the question, in terms of the benefits, it is costs overall. We did a global level of analysis looking at the benefits of deploying long-duration storage in various different forms: something in the order of \$500 billion—in US dollars—per annum global savings by 2040 if the lowest cost pathway is followed, to give you a sense of the scale of the economic benefit we are talking about.

I will touch on energy security because I am not sure we explicitly talked about that beforehand. With LDES technologies there is less reliance on Russian gas or other geopolitical tensions, if it is all being produced at home; hopefully, you are fully aware of that. In terms of the raw materials that are used, in comparison with, say, lithium-ion, some of the novel types of long-duration storage do not require the same materials in quite sensitive parts of the world.

Environmental impact is something else to think about. If we invest in LDES instead of, say, expensive transmission grid upgrades, we can mitigate some of those concerns. It is not to say that we do not need to upgrade the grid, and we will need to build new pylons. I think we all understand that, but with sensible deployment of these technologies, you can minimise that. Similarly, you can minimise the deployment of wind and solar by doing it more efficiently. I mentioned the raw materials in



terms of energy security, but that is also a concern with the environmental impact. Very low impact material is used.

As for the speed of deployment, some of the newer LDES technologies, some of the battery-based ones, can be built very quickly. Some of our other technologies are big infrastructure projects and do take longer, of course.

Grid services is a final point. Again, I fully agree that all of the above are the ways we need to go about tackling climate change. Some long-duration energy storage technologies can provide vital grid services—inertia, black start capability and so on—which I am sure the Committee has heard about before. That is just another thing to put into the mix.

Q333 Chair: Before I pass on to Mark Pawsey, I will quickly ask each of you: to what extent does the system need more baseload energy? To ask that another way: what proportion of the system should be baseload energy?

Clare Jackson: From a hydrogen perspective, we are not really involved in delivering baseload. Our technology is more focused on peaking and—

Chair: I was thinking more that in order for you to be able to participate in this whole element, you do need to some extent baseload energy to make sure that you have enough power coming through so that you can convert it into hydrogen and store it for the future. Have you done an analysis on the level of baseload energy?

Clare Jackson: We have not done any analysis on the level of baseload energy that would be required for hydrogen production. Hydrogen production comes in a number of different forms. Some of that comes from the power sector in connection with more renewables, I would say. There is also an interplay with nuclear, and a lot of organisations are looking at producing hydrogen from nuclear power. Alongside that, we also have hydrogen from CCS—so not from our power sector but from gas. There are a number of different ways that you would produce hydrogen and the exact interaction of those is yet to be determined.

Chair: Kate, do you have any thoughts on baseload power?

Kate Gilmartin: Yes. In terms of the demand profile, as we electrify heat, transport and industry our traditional demand profile will look very different and will be a lot more flexible. The need for baseload is always very useful, but nuclear is there, it is not flexible, and it cannot really ramp up and down. Our need for baseload is very different from a centralised grid that we used to have. I would suggest that we need to look at our demand profile and how much flexibility we can embed in that demand profile. For example, if we decarbonised 6 million terraced homes with a smart local energy system, that gives us 12 GW of embedded flexibility. That is how the future grid will work. I think we have to move away from historical centralised grid and think about what our future flexible grid will need and whether baseload will be relevant.



Chair: Fantastic. Alex, do you have any final thoughts?

Alex Campbell: From a purely technical perspective, we do not need baseload. You can run an electricity system power grid without a particular unit that is constantly generating. Indeed, there is no such thing as 100% reliable electricity generation.

Chair: Maybe the question should be dispatchable power.

Alex Campbell: The dispatchable power, yes—it is important. Unless you are going to hugely overbuild wind and solar you do need a degree of dispatchable, but it is a relative balance. It depends how much wind you have, how much solar and how much conventional hydropower. You bring all these things together, but there is no single magic number, I would suggest.

Q334 **Mark Pawsey:** I want to follow up on the point that Alex has just been making, and that is on the issue of whether we overbuild or we do not provide enough. We do not have a strategic route to where we are going. Kate has just reminded us that we do not really know what the demand profile is going to be. We also do not really know where this provision would need to be. How challenging is it? One of the things we will need to do is to prepare some recommendations in a report, so what guidance could you give us about the amount that would be necessary and where we ought to place it?

Alex Campbell: My simple answer to that, which I say to Governments around the world, is that you need to start doing your planning now for your electricity grids of the future. It will be near on impossible to get it perfectly right. We just need to all accept that. We need to make sure we have the flexibility built in. We have to make sure that we are not locked in to technological choices so that we cannot deploy new technologies in future, and that our markets are set up in such a way and our regulatory frameworks are set up in such a way. Again, going back to my previous point, it depends on the balance of the other technologies that you are deploying. How much are we going down the wind route, how much are we doing with solar, and how much nuclear, of course?

Q335 **Mark Pawsey:** Presumably, Alex, your organisation does not have a preference for one technology over another. I will come on to Kate and Clare, who clearly do. Where do you think we should be looking in terms of technology? Should we have a broad mix and hedge our bets or are there particular technologies that you see as being stronger than others?

Alex Campbell: Absolutely. From the LDES Council's perspective—so from long duration and energy storage—we are technology agnostic. We have members in all camps. We genuinely believe—and I have been working in this area for many years—that designing the system so that you can deploy different technologies is the most cost-effective in the long run and gives you that energy security. It is an important thing to



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do. We do not want to get locked into any one particular technological choice.

Q336 Mark Pawsey: Kate, you told us, I think, that there are four operational pumped storage sites and another four ready to come on. How much could pumped storage add to the mix? Tidal has not really got off. Many of us were supportive of getting the proof of concept at Swansea Bay. It did not happen. What obstacles do we have to get over to get something in place there?

Kate Gilmartin: With pumped storage hydro, yes, there is a pipeline of more than four projects. There are nine projects in the pipeline at various stages of development. That could bring on 6.8 GW of installed capacity with 135 GWh. We have the consultation. We are hoping that we can bring forward a cap and floor and get that pipeline moving, which would be a huge asset for the net zero transition.

In terms of tidal range, we want to develop a Government/industry partnership, a bit like the offshore wind commission in 2012. It is a great opportunity. It is within the price range that we need to have. It is timetabled energy generation. It is near centres of demand so we are not going to be constrained by the big transmission constraints that we currently have.

Broadly, I think we have to have the whole systems portfolio approach. The Future Energy Scenarios does that well. On your point about overbuilding, I do not think we have that issue because we have the Future Energy Scenarios. We have, hopefully, the FSO being directive around what we need to keep the lights on in the future. In terms of grid connection, we have a lot of constraints and connecting to the grid is a big problem. Overbuild is not going to happen for quite a long time because of those grid connection issues.

Q337 Mark Pawsey: You reminded us that tidal is not an emerging technology, it has been around a long time. I remember visiting La Rance in France when I was a schoolboy so that tells you how old that might be. Why have we not made more progress there and what do we need to do?

Kate Gilmartin: I think we have not made progress because the mantra has always been "levelised cost of energy", which is a blunt instrument for looking at the diverse energy generation mix that we need for a future grid. We need to look at resilience. We need to look at systems benefits, and levelised cost of energy does not do that. It just looks at the cheapest kilowatt hour. Often the cheapest kilowatt hour is not going to give the best value overall for future generations as well. That has always been a big blocker.

It is a big infrastructure project as well. It is a bit like nuclear; it has a long lead time. It has a lot of development consents to go through, which is a high CapEx. Without Government support and without that price stabilisation mechanism, we are not going to get the investment going



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into that as an industry that we need as a cornerstone of our decarbonised grid of the future.

Q338 Mark Pawsey: Clare, this Committee visited Fife, where we saw a wind turbine generating electricity that was converted into hydrogen, which was being used in home heating. We well understand that often wind turbines are turned off and it is almost a no-brainer to use that energy for a purpose, and you would advocate for hydrogen. How much can hydrogen contribute?

Clare Jackson: There are different elements of this. We are looking at the generation and we are looking at the storage. In terms of the amount of hydrogen storage that we are going to need, the Royal Society estimates that by 2050 we will need between 60 and 100 TWh worth of storage. At the moment, we have 25 GWh-worth in a salt cavern in Teesside, which incidentally has been running since 1972. If we invest in this infrastructure, it lasts a long time.

We can also sometimes get a little bit caught up with what the 2050 picture looks like. The reality is that—whether it is 60, whether it is 100, even whether it is 20—we need to get moving with some of this. The estimates around the amount of hydrogen storage that we will need by 2035 is roughly similar between our Hydrogen UK estimates, the Government's estimates and the National Infrastructure Commission's estimates. It is around 10 TWh. This is something that we need to get moving on quickly.

In terms of the dispatchable power generation, again the CCC in its estimates around the 2035 power system estimates that we will need around 17 GW of dispatchable power. Its modelling would demonstrate that about 14 of that would be hydrogen. At the moment, we have nothing in that area, so there is an awful lot to deliver in a short space of time. It can be delivered but we need to get a move on.

Q339 Mark Pawsey: What is your preferred use for the hydrogen that is generated? Is it to get into the gas network and to be used for home heating? Is it to be used for industrial purposes? Is it to be used to power turbines and create electricity? What would you do with it?

Clare Jackson: There are a number of aspects. The priority, particularly over the next decade, will be to decarbonise our industrial heartlands, to provide hydrogen for the industries that need it, and to ensure that we keep those industries in the UK and protect UK jobs. Alongside that, hydrogen will need to play a key role within the power sector. There is a large volume of hydrogen that will be required in that sector, and that needs to be prioritised if we are going to be able to decarbonise power by 2035. Alongside that, there will be big demand from things like large-scale transport applications such as maritime and sustainable aviation fuels. There will be a big pull on that hydrogen, which is why we need to increase production capacity quickly.



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Q340 **Derek Thomas:** Kate, can I start with you? As I read through the information I have, it seems that grid constraint is a real problem. It is not a new thing. What I am trying to understand is how much energy storage can do to fix grid constraint and save on constraint costs, and whether, in a weird way, the grid constraint also stops the investment in the storage. Does that make sense?

Kate Gilmartin: Yes. I suppose the constraints are many. We have a problem with curtailment, which happens when we have too much generation and not enough demand. We also have constraints in that we have to curtail because there is not enough grid capacity and where we put the storage in terms of where the curtailment needs to be—whether we have it behind or in front of the constraint as well. It goes back to the point about transmission and distribution. We have constraints across both networks. We need to have more storage because we can stop the curtailment of wind and use that pumped storage hydro, and then generate when the wind has dropped and we are ramping down on the wind but we are ramping up with the pumped storage hydro.

Q341 **Derek Thomas:** By creating that infrastructure, you capture the energy that cannot go into the grid because it is constrained and you can store it. There will be a time before that becomes a problem where the grid will have capacity and you can release that energy. Is that basically the dream?

Kate Gilmartin: Yes. You have things like the western high-voltage direct current link, so you can take that Scottish wind down to Wales and it can go into the grid there, for example.

Q342 **Derek Thomas:** Clare, you touched on this earlier but I wanted to understand it a bit more: does it make financial sense to install hydrogen electrolyzers to absorb excess electricity instead of paying the constraint costs themselves? Is that a better financial investment than the constraints—the fines, if you like?

Clare Jackson: Yes, for sure. This is where taking that whole system view is important—producing hydrogen and having an asset that you can then use when demand is high and generation is low, so you have the hydrogen working at both ends of the system. When we are talking about grid constraints, this is where hydrogen can also support by providing another infrastructure system by which you can move low-carbon energy around the country.

We often talk about the potential for exporting Scottish renewables via the medium of hydrogen. The reality is that the best export market for Scottish wind is England. There will be an energy deficit in England that can be provided by Scotland, but it requires investment in infrastructure, in things like Project Union, which will enable us to move energy from the north to the south. There is an awful lot that hydrogen can do in terms of some of the grid constraint issues.

Q343 **Derek Thomas:** Are you saying that you would literally move the



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hydrogen in a tanker from one part of the country—

Clare Jackson: I say you move it in through a pipeline.

Derek Thomas: Through a pipeline—and then you might be able to boost energy somewhere else where it is needed.

Clare Jackson: Yes. It is not just about the temporal aspect. It is also about the spatial aspect.

Q344 **Derek Thomas:** Do we have the capacity in the pipelines at the moment?

Clare Jackson: One of the things that National Gas is proposing is to build a backbone through the UK of a hydrogen pipeline that we would then be able to run the low-pressure systems off.

Derek Thomas: I am only smiling because it takes a long time to do things like that.

Clare Jackson: It does, precisely.

Q345 **Derek Thomas:** We talk about it! Alex, is the backlog in grid connections incentivising energy storage developers? Is it driving the sector?

Alex Campbell: Not for long duration, no. We touched on the reasons for that a little bit earlier. Similar to other forms of large-scale infrastructure, whether you are talking about transmission or nuclear or conventional or hydropower, there are high up-front costs. If you step back and take a system-wide perspective, it would make sense but you cannot go to an investor today and say, "Please give me some money. There is obviously a need in Britain. This will minimise their transmission costs". They will say, "Are you being paid for that?" and you will have to say—

Q346 **Derek Thomas:** Going back to Clare and your point about the helicopter-view system thinking, are we seeing where there is investment and development that it is where the grid capacity is available rather than where it might be needed? Are we seeing that?

Alex Campbell: For long-duration storage technologies in particular, there is only a limited number of early-stage commercial projects that are on the grid. Those have been done for a variety of reasons, setting aside the existing pumped storage.

Q347 **Derek Thomas:** At the moment there is no perverse development where we are just developing what we need but only where the grid capacity is rather than across the—

Alex Campbell: Not that I am aware. I am not sufficiently an expert on the grid transmission charges in the UK. I would just make the point, though, that with things like novel batteries, of course, you can deploy them almost where you like. You would not put them in the centre of



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London, but they do not have the same constraints that other technologies do.

Q348 **Derek Thomas:** I think we will come on to that. Kate and Clare, do you have a view on what is driving this? Is the tail wagging the dog in terms of where investments are being made?

Kate Gilmartin: No, with pumped storage hydro it is geographically specific. We need the right geography to put pumped storage hydro in, especially the large-scale ones. We have smaller technologies that are high density, closed loop pumped storage hydro, which are less defined by where they need to go because they can use smaller hills. They tend to be smaller in megawatt capacity and, again, they look to connect at distribution rather than transmission.

With the range of technologies, we have to look at this portfolio. Each technology offers something different to the grid, but they are all constrained in what they deliver for the grid, whether that is generation profile or geographic constraint. That is why we need this spread of everything.

Clare Jackson: Hydrogen storage will be located where the geological stores are, whether that is salt caverns or what is currently being used as gas storage. The focus for us in getting that storage up needs to be in places that are located near to some of the industrial clusters.

Q349 **Chair:** When you talk about salt caverns, you are talking about a huge amount of storage capacity. This is more than the gasometers that we see dotted around left over from the town gas grid.

Clare Jackson: Yes. Currently, there is one salt cavern in Teesside that has a capacity of about 70,000 square metres. It is about 25 GWh-worth. There is around 2,000 TWh-worth of geological storage in the UK that could potentially be used for hydrogen. This is where this question of overbuilding is a bit of a moot point. There will be a huge requirement across Europe for energy storage and hydrogen storage. Europe is looking to import a lot of hydrogen. The UK, utilising its natural geological storage assets, could set itself up as an international trade hub for hydrogen and essentially sell some of that storage asset to Europe. So my concerns around overbuilding—

Chair: Fantastic. That is helpful.

Q350 **Lloyd Russell-Moyle:** With the salt caverns, as you were saying, that upper limit of the terawatt hours, that is if you use every single—

Clare Jackson: Yes.

Q351 **Lloyd Russell-Moyle:** Are there other uses for these salt caverns? Are you competing against other industries or other uses?



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Clare Jackson: Not that I am aware of. You can store hydrogen in them. I do not think there is anything else that you would want to store in them.

Barry Gardiner: CO₂?

Clare Jackson: For CO₂, I think there are probably better places to—

Barry Gardiner: Or a CCS project, which you will need for your blue hydrogen anyway?

Clare Jackson: I think the CO₂ storage is more likely to happen offshore.

Q352 **Lloyd Russell-Moyle:** How quickly can you scale up long-duration energy storage in the UK?

Clare Jackson: From a hydrogen perspective, the salt caverns take time to build. They have quite long lead times. The build times can be up to seven years, which again is why we are under a lot of pressure with the timelines in order to get these things up and running. Repurposing some of the gas storage, and flushing and preparing those can be faster.

Q353 **Lloyd Russell-Moyle:** How long does it take to repurpose gas storage?

Clare Jackson: That can be two to five years. That is excluding some of the permitting aspects.

Lloyd Russell-Moyle: That requires you to not be using it for gas storage in that period of time.

Clare Jackson: Yes, correct. For example, if you look at something like Centrica's Rough asset, you can use that for gas storage in the interim. Then you can convert that to hydrogen, so it is hydrogen-ready as a storage. This again is where I think we have seen some of the—

Q354 **Lloyd Russell-Moyle:** But all the gas storage, and I suppose in consequence the gas network, only becomes available once you have switched off gas. We are talking about hydrogen as a potential replacement for some of that gas, so there is an intervening five, maybe even 10, years where you have no gas and no hydrogen. How does that work?

Clare Jackson: For example, there are onshore assets that you can use for hydrogen storage to the point, as we move away from natural gas and towards hydrogen, you can start to build those onshore assets. Then when the point comes where you want to—

Lloyd Russell-Moyle: What do you mean by "onshore assets"?

Clare Jackson: Salt caverns: you can use salt caverns that are currently not storing anything.

Lloyd Russell-Moyle: The salt cavern—that is a seven-year lead.

Clare Jackson: Yes.



Lloyd Russell-Moyle: Why would you then need to change over on—

Clare Jackson: . It is not about changing over. It is about the scale. Take the Rough asset, for example. You could store 10-terawatt hours of hydrogen in there. It is a much larger asset and the scale associated with it—

Lloyd Russell-Moyle: What is a much larger asset?

Clare Jackson: The Rough. That would provide you with a lower cost of storage.

Q355 **Lloyd Russell-Moyle:** What are the barriers to doing this?

Clare Jackson: At the moment, there is no certainty over revenue, which is where the hydrogen storage business model comes in. We have an outline of that from the Government, perhaps not quite enough detail to be able to scrutinise, but the mechanism—

Q356 **Lloyd Russell-Moyle:** Why is there no certainty of revenue? We have just had to cancel one of the hydrogen projects because there is not enough hydrogen available in the market. It is an asset that is relatively well priced at the moment; why is there not enough certainty? We know we are going to need this going forward and the price at the moment is quite good on the open market, and there is scarcity.

Clare Jackson: One of the challenges around hydrogen is bringing these assets together at the same time. You need the infrastructure, the production and the demand at the same time. There is a lot of risk associated with those different parts of the value chain coming together. At the moment the market for hydrogen storage today—apart from compressed cylinders—does not exist for that large-scale storage. That is not enough for developers to be able to invest.

That is where the Government's hydrogen storage business model comes in. The mechanism is correct. We need perhaps a little bit more clarity over how much hydrogen storage they want to procure in the first allocation round, and perhaps some of the timelines on future allocation rounds. Up-front CapEx is big for these assets. They have long lead times. We need that certainty and security from the Government.

Q357 **Lloyd Russell-Moyle:** Alex, what energy storage options do we expect to see by 2030 that will be economical and where the price might come down?

Chair: Sorry—we are slightly pressed on time, so can we have quick answers?

Alex Campbell: We have a suite of technologies, including novel types of battery chemistry, which are being deployed today. They are available. Are they cost-competitive with lithium-ion over shorter durations? No. Over longer durations—yes. But the problem is we do not have the market for them, so that investor visibility of revenues similar to the situation with hydrogen, unlike offshore wind, where the deployment of



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contracts for difference gave investors certainty. They lent money to the companies, the companies built them and they brought down the costs of offshore wind.

Q358 **Lloyd Russell-Moyle:** Is it just Government certainty and a decent pricing plan from the Government that is needed?

Alex Campbell: I would say revenue visibility. Long-term revenue visibility is critical for these types of infrastructure, alongside robust Government targets. If the Government sets an ambition and provides that revenue visibility over a prolonged period of time—it works in other sectors, and it will work for long-duration energy storage as well.

Kate Gilmartin: Pumped storage hydro can come online in the next three to 10 years. Pumped storage hydro, according to Simon Gill of The Energy Landscape, can meet 80% of the wind cycles; they can be filled with 10 to 50 hours.

Q359 **Vicky Ford:** I'm not thick, but I am really struggling. I got a degree in maths, years ago. I won a national medal for physics decades ago. But I am struggling to get some of this. If I am struggling, no wonder others are. Why do we need medium duration as well as long duration?

Alex Campbell: It is a question of economics. The really long duration stuff is more cost-effective at long durations. You could use it to provide medium duration.

Vicky Ford: What do you mean? Put it in language I can explain to my constituents.

Alex Campbell: A technology that is cost-effective over eight hours, so 1 MW giving you that 1 MW for eight hours—

Vicky Ford: That is medium.

Alex Campbell: That is the beginning of long duration.

Vicky Ford: Long duration storage could be—

Alex Campbell: It could be 24; it could be 100. It could even be seasonal.

Q360 **Vicky Ford:** It could cover days or seasons—got it. When you look at medium—how do I cover today until the wind starts blowing again, this afternoon, hopefully?—should we be betting on one or two types of technologies or a range?

Alex Campbell: Have a range. Have a technology-neutral allocation mechanism. That way the market will tell you what the most cost-effective one is.

Q361 **Vicky Ford:** What is the most cost-effective one today?

Alex Campbell: You are going to hate this answer.



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Vicky Ford: You are looking over the next—

Alex Campbell: It depends in the range—

Vicky Ford: I know, but give us an idea of this. Our constituents care about the cost of electricity deeply.

Alex Campbell: If you have the geography, pumped storage hydropower is fantastic for that day—10 or 12 hours. It is great at that. But you need to have the particular geography.

Q362 **Vicky Ford:** I have been to the wonderful Welsh one that was built decades ago; why don't we have more?

Alex Campbell: I would suggest it is because of the lack of a long-term revenue visibility.

Q363 **Vicky Ford:** Is pumped storage cheapest? Then when you get into—

Alex Campbell: Cheapest in a particular site, in a particular place in time. If you are putting it in the south of England, then some novel batteries, compressed air, liquid air storage or heat all come into the mix.

Vicky Ford: And you still have not got to hydrogen when you are going down that list.

Alex Campbell: You can put hydrogen in the mix as well. I do not know about the cost today of green hydrogen. I do not think it is—

Q364 **Vicky Ford:** Let me go to Clare. Let's assume it is green hydrogen. How does the cost of green hydrogen with hydrogen storage compare to gas with CCS?

Clare Jackson: Hydrogen is a little bit like where offshore wind was 10 years ago. It is still in the range where it is quite expensive, so it needs that Government support.

Vicky Ford: It is expensive.

Clare Jackson: Government support to get deployment up and costs down. Again, where you are looking at gas—

Vicky Ford: Government support means taxing consumers even more on their electricity bills.

Clare Jackson: Investment in the future.

Q365 **Vicky Ford:** We know carbon capture and storage is very expensive. How expensive is hydrogen with storage compared to gas with CCS?

Clare Jackson: If we are looking at the two, it depends on which range you want to produce power. Because the up-front cost of gas—

Vicky Ford: Is it cheaper or is it more expensive?

Clare Jackson: Hang on a minute. Gas CCS has a high up-front CapEx but lower OpEx. Hydrogen has lower CapEx—



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Q366 **Vicky Ford:** Let's look at payback period. I have also been an investment banker. Let's look at the payback periods in investment in these things.

Clare Jackson: . You have more up-front capital for your CCS.

Vicky Ford: Okay, so how many years' payback?

Clare Jackson: It depends on how much you are using it. This is where the load factors are important. For the power plants where you want to use them for longer periods of time—for a greater proportion of the time— anything over 30%, it is more cost-effective to use gas CCS. With anything between 5% and 25% to 30%, it is more cost-effective to use hydrogen because of the difference between the CapEx and the OpEx: Gas CCS, big CapEx, lower OpEx; hydrogen, lower CapEx, higher OpEx.

Vicky Ford: Basically, you are saying they are both really expensive.

Clare Jackson: I am saying they are more cost-effective in different ranges.

Vicky Ford: I am not convinced that I could convince my constituent down at the Dog and Duck to put hydrogen in a salt cavern safely if we have never stored natural gas in a salt cavern.

Clare Jackson: We have stored hydrogen in a salt cavern in Teesside since 1972.

Q367 **Vicky Ford:** Thank you. It is very helpful to know that. Alex, thermal energy storage—where does that come in? How do we encourage more of that?

Alex Campbell: That is a really important point. Globally, the potential for thermal energy storage is even more significant than electricity storage. It is being deployed at the moment around the world. Molten salt technology is used; there is gigawatts of it globally. We are seeing the deployment of thermal technologies in industries like food manufacturing, where they want a steady supply of high-quality heat, pairing that with renewable generation.

Q368 **Vicky Ford:** My understanding is that when the Government look at storage, at the moment we assume all the stored energy would come back as electricity rather than coming back as heat; is that right?

Alex Campbell: That is my understanding of the current—

Vicky Ford: How do we unlock that coming back as heat?

Alex Campbell: The current consultation is focused on electricity. I think you would need a new policy framework in order to support—

Q369 **Vicky Ford:** One of the important things this Committee does—probably the only important thing it does—is make recommendations. Are you saying to us it would be helpful if we recommended something about needing to look at—what recommendation would you ask us to make? Be clear.



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Alex Campbell: Absolutely support low carbon heat including through thermal storage. It is really cost-effective. We are seeing it being done commercially in some markets as test projects, as companies who want to move into this space are starting to test the waters. But it will need, as ever, Government policy across the piece.

Vicky Ford: Give me a really nice example of where you store that heat.

Alex Campbell: There is a food manufacturer in the Netherlands, I believe, who is has a power purchase agreement—buying renewably generated electricity and storing it in a heat block, for want of a better phrase. It is material on site, which is then playing it back out on demand to help with the cooking of food at a couple of hundred degrees Celsius, and that is storing over, I believe, about eight to 10 hours.

Vicky Ford: That is so much more efficient than trying to release it back as electricity.

Alex Campbell: With a number of heat technologies, you can transfer it back into electricity. But if you go straight to heat, then there are going to be efficiency gains for sure.

Q370 **Alexander Stafford:** Clare, a couple of years ago, Elon Musk said: hydrogen was “the most dumb thing I could possibly imagine for energy storage.” Why is he wrong?

Clare Jackson: It depends on how long you want to store energy for and in what quanta. For some of the technologies that Elon Musk is looking at, where batteries are a good shout—for those short durations and smaller amounts of energy, batteries are brilliant. But for that longer duration and large quantities of energy, hydrogen and chemical forms of storage are the option. Elon Musk is possibly right in some areas but, if you look at storage as the whole, you need batteries and you need hydrogen.

Q371 **Alexander Stafford:** Drilling down into blue hydrogen, in particular; what is the future of blue hydrogen? We want to go to green hydrogen. With blue hydrogen, there is generally going to be some CO₂ leakage, so it is not going to be 100% carbon neutral. We have to have huge CCUS plants built, which are going to add obviously to the cost. What is the future of blue hydrogen and should we be even looking at blue hydrogen? Should we be focusing on green hydrogen instead?

Clare Jackson: Absolutely, we need blue hydrogen. Blue hydrogen gets us the volume and it gets us the volume fast. The build-out rates for green hydrogen are going to be constrained over the next decade by supply chain challenges, which means if we have blue hydrogen alongside that, we are able to decarbonise our industries, and decarbonise our power sector faster. With the rate that we need to decarbonise, the combination of blue and green hydrogen is the best way to achieve that.

Q372 **Alexander Stafford:** Can we afford to do it? Because blue hydrogen



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generally needs a lot of natural gas to burn. Natural gas prices are quite high, and at the moment they are incredibly volatile with the various wars going on. Should we even be looking at a technology—blue hydrogen—that is going to be so volatile price-wise in a short period?

Clare Jackson: The fluctuations in the price of natural gas have impacted the CCUS-enabled projects. However, the strike prices and the costs that they are able to achieve are still competitive with the other technologies that are available.

Q373 Alexander Stafford: You mentioned that the strike prices are changing. Obviously natural gas is a lot more expensive than it was a couple of years ago. How has that affected the development of blue hydrogen and hydrogen generally? Has it retarded the progress of the hydrogen industry because of the higher gas prices?

Clare Jackson: I think that the higher energy prices—the energy security crisis in general—has sharpened the focus around the need for hydrogen and the need for energy storage. Perhaps some of the short-sightedness in the past around the need for energy storage—we have talked a little bit about Rough today—but the independent analysis shows that if we had redeveloped our gas storage, we would have saved £5 billion on consumer bills over the last two summers. That is £5 billion over the last two summers just from redeveloping Rough. I think that decline of energy storage in the UK has cost us.

Energy infrastructure is not sexy, but it is essential. As I said, the energy security crisis has sharpened the mind over the need for assets like hydrogen, if we want to be able to continue to increase our deployment of renewables while not completely crippling ourselves with grid-balancing costs, and if we want to provide that energy storage that we need to secure our future.

Q374 Alexander Stafford: You talked about availability in your various answers. How serious an issue is hydrogen availability and do we need to radically prioritise what we use hydrogen for—that is, just industrial uses? Obviously there are a lot of different trials going across parts of the country in the pipes and the like. Should we just be focusing on industrial usage or anything else?

Clare Jackson: I do not think that we can. We do need to ramp up hydrogen production as quickly as is humanly possible, but there are other use cases that we are going to need hydrogen for that will require a lot of hydrogen. For example, to test a 50 MW hydrogen turbine requires 4 tonnes of hydrogen an hour. That is nine tube trailers of hydrogen an hour just to test it.

There are large quantities of hydrogen that will be needed in other sectors where we know we are going to need it. We can't just sit on our hands and say, "We are just going to do industry" when we know we are going to need it in aviation and in the power sector. We have to start that work now. It puts pressure on the hydrogen industry to be able to ramp



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up production quickly. It also puts pressure on the Government to ensure that we are able to do that.

Q375 Alexander Stafford: Are we capable of producing enough hydrogen for our needs, or will we need to, if we move to a more hydrogen economy, import lots of hydrogen? You mentioned earlier on in the answers that Europe will be looking to us for storage. Will we need to be looking to other countries to import the hydrogen to store in our salt caverns?

Clare Jackson: Europe recognises that it needs to import around half its hydrogen. The UK has better resources for producing hydrogen. As I said, there is an opportunity for the UK to potentially, in the future, be an international hub—so there is some benefit in importing and exporting in the short term to wet the pipes and get that infrastructure going. But I think the focus needs to be on ramping up domestic production.

The Government set a target of 10 GW by 2030. That is ambitious but achievable. We have about 20 GW-worth of production capacity in our pipeline at the moment that could come forwards. But it requires us to click the “go” button and allow those projects to take FID very quickly.

Q376 Alexander Stafford: The round trip efficiency of green hydrogen is, I think, 18% to 46%—there are different quotes. That round trip efficiency is very low compared to other areas. Is it feasible to cost-effectively store green hydrogen?

Clare Jackson: The round trip efficiency involves, if you are wanting to turn it back into electricity—

Alexander Stafford: Which you mostly want to do.

Clare Jackson: I would say a lot of our applications do not. For all of our industrial decarbonisation, you are using it as hydrogen. If you are using it in our aviation or maritime, you are using it as hydrogen or a hydrogen derivative. There are some aspects where you would want to turn it back into power. But again, this is where we are using our curtailed energy-producing hydrogen, and then producing back electricity when we need it.

Chair: Vicky, I think you wanted to come in with something very quickly.

Q377 Vicky Ford: You are making a good case for hydrogen, but we still have constituents who are concerned about the safety.

Clare Jackson: Sure, we appreciate that.

Vicky Ford: That is a whole other discussion. But—hydrogen or ammonia?

Clare Jackson: It depends on the application. If you want to use it in maritime applications, you are probably looking at ammonia. You do not want to get ammonia too close to a consumer because of its toxicity. You would not use it anywhere like that. But certainly you can look at ammonia turbines. It also depends on where the hydrogen is coming to—



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whether you would want to convert it into ammonia. You do not necessarily want to do that if you do not need to. Green hydrogen will be a big constituent input into ammonia for fertiliser production.

Q378 Barry Gardiner: Clare, I am looking at the Government's recent announcements on hydrogen transport and storage. When it comes to storage, they say that their minded positions—the ones that they favour—are a revenue floor to mitigate demand risk for storage providers and an incentive to maximise sales to users, and a mechanism to give the subsidy provider a potential share of the upside. Can you explain that to me?

Clare Jackson: Essentially your revenue floor is basically the minimum revenue that a developer needs in order to make the project viable. However, what we also—

Q379 Barry Gardiner: How are you going to know that? Because surely it depends on the things that you are pointing out before on—

Clare Jackson: It depends on the CapEx and the OpEx of that particular storage asset. That can be something that is calculated by the developer that is then put to Government as, "This is the revenue floor that would be required for this particular asset." Then you basically have a gain share mechanism, which means that if you are able to sell that storage at a greater price than that floor aspect, the Government would take some of that and the producer would take some of that.

It basically incentivises producers to sell. Not at the bottom level price, but encourages them—basically you get some price discovery and you also incentivise them to sell it at a higher rate, which saves money for the Government.

Q380 Barry Gardiner: Take me through the RAB model, because they are saying that they want a regulated asset base alongside an external subsidy mechanism. The regulated asset base is going to help you with your up-front investment costs in constructing these facilities.

Clare Jackson: The regulated asset base model is for the transport infrastructure—that is looking at the pipelines—and the regulated asset base model is very similar. It is the same model that is currently used for our gas pipes today.

Q381 Barry Gardiner: That is the transport side. I still do not quite understand where you are making your money on the storage side, because it is in the interests of the storage provider to keep as much in there as possible for as long as possible, is it not? Yet what we want is a fairly good throughflow because we want to be using this stuff, not keeping it locked away.

Clare Jackson: That mechanism would not incentivise what you are discussing there—the cap and floor mechanism. People would pay for the storage assets. It is not about locking it away. It is about access to that



storage. Essentially what the Government scheme does is to provide the revenue certainty to the storage developer while also incentivising them to sell that storage at a higher price. But it essentially caps the revenue that the storage developer can make out of that asset.

Barry Gardiner: This is almost like a contract for difference in reverse.

Clare Jackson: It is a little bit different. It is trying to incentivise some similar things, but it is a different asset. The way that it is produced is different. I feel like I am explaining this badly.

Q382 **Barry Gardiner:** It is tough stuff, as Vicky said. Let's move on to the investment. Is what the Government have set out going to be sufficient to incentivise the scale of investment that we need?

Clare Jackson: Our view is that the mechanisms that they have chosen are the correct ones. We do not necessarily have—

Barry Gardiner: Because they chose them in consultation with you, didn't they?

Clare Jackson: Well, you know.

Barry Gardiner: You would say that, wouldn't you?

Clare Jackson: Well, they are very in line with the mechanisms that we use today for similar gas assets—which work. The difficulty at the moment is we do not necessarily have enough detail enabled to be able to know exactly whether they are sufficient. There are things that are missing at the moment that we would like the Government to do. We do not know how much storage they are planning on allocating in this first round. We do not know what the timelines are of future rounds.

Barry Gardiner: That is going to be signed off in 2025.

Clare Jackson: Yes, the applications open this year but we do not know how much they are planning on allocating.

Barry Gardiner: We do know that by 2030, they say they want to have produced 10 GW.

Clare Jackson: That is hydrogen production. This is about storage and the transport infrastructure. They have not put a number on how much hydrogen storage in terms of that capacity that they want.

Barry Gardiner: What do you think it should be?

Clare Jackson: We think that we are going to need about 3.5 TWh by 2030 and around 9.8 or 10 TWh by 2035, which is not far out of line with the Government's own projections. But what we would like are targets and ambitions in the same way that we have with the production target—the production ambition.

Barry Gardiner: Going to the recommendations that this Committee should make that might be helpful—



Clare Jackson: I think what would be helpful for us is for the Government to produce a timeline and a pathway as to when it wants to allocate hydrogen storage, which will help developers in terms of planning and those bits and pieces. Also, one of the challenges that we have as an industry is that the Government decided last year not to put in place any interim measures, which means that some of the DevX and the planning that we would have hoped to have done has not been done.

Barry Gardiner: DevX?

Clare Jackson: Development—doing the feed studies. We understand the Government have capacity constraints internally, but that puts a little bit more pressure on the industry to have those storage assets available and operational in the timeframes that the Government requires.

Q383 **Barry Gardiner:** Is there going to be enough time from 2025 to get the hydrogen storage up and operating by 2030?

Clare Jackson: Operational by 2030 to 2032—that kind of timeframe: it is possible but we need to get moving. We are very pleased that the Government have kept to its timelines to date on the transport and storage business model timelines. But we will need to get significant amounts of storage allocated in the next few years in order to meet that.

Q384 **Barry Gardiner:** Let's say we move to warmer winters. Could the Government end up paying for warehousing storage as a reserve?

Clare Jackson: The hydrogen storage is not just required for—

Barry Gardiner: Indeed, but it is one of the factors that would impact on usage, is it not?

Clare Jackson: Hydrogen storage in those large volumes is particularly useful for heat sector or power sector. But even if we get warmer winters, we are still a long way off. Even if we are at the lower end of what we need, what we would build in the next 10 years—

Barry Gardiner: You never know—we might do an insulation scheme that means that we do not use as much energy in our homes. God help us: that would be novel, wouldn't it?

Clare Jackson: Amen! Let's have a bit of that going on, for sure. But the residential demand is a proportion. We also have industrial demand, transport demand, all of these other things that require an element of hydrogen storage.

Q385 **Barry Gardiner:** Finally, I was interested in what you were saying in response to the question on hierarchy: using it for cement production, ceramics, glass and so on, and the steel industries. Is the current projection of where the storage and the transport facility is going to be focused around where that primary need for the high-intensive uses are?



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Clare Jackson: If you look at the pipeline of some of the storage projects that would hopefully come online first, they are situated near those industrial clusters.

Q386 **Barry Gardiner:** Finally, given that I have one more minute: you were talking about the need for blue hydrogen and the costs. You have the cost of the gas and the cost of the capture, use and storage, and you have the depreciation in your energy, the reduction in the energy, through the whole process. How much do you get out and how is it cost-effective in terms of percentage of your additional energy input to your actual output?

Clare Jackson: You are going to hate this answer, but it depends on a number of factors. We can get some written submissions to you around some of the ranges, if that is helpful, and some of the cost implications.

Q387 **Barry Gardiner:** I think it would be, because you say we have lots of gas and we need to get on with it, and we are not going to have enough green hydrogen because we are going to be constrained in our renewables for other purposes, aren't we?

Clare Jackson: Again, that is one of the advantages of blue hydrogen. We need to build out our renewables. We also need to electrify a lot of things, which means there is going to be demand on those as well. We need to build out our green electrolysis capabilities but blue can support that, particularly over the next 10 or 15 years, but also beyond that.

Q388 **Barry Gardiner:** What is the cost per unit comparison between green and blue?

Clare Jackson: I will be able to tell you that later this year. At the moment, blue is a lower cost form of hydrogen than green, but that will switch.

Q389 **Mick Whitley:** My question is to Kate. If the Government set a model that we need a tidal range, how long would it take realistically to complete a full-size project in the UK?

Kate Gilmartin: It depends on how far the project has progressed, but we estimate for design and consent around three to five years, and then another five years for build.

Q390 **Mick Whitley:** What barriers are you most likely, and how many years could they add to the development time?

Kate Gilmartin: I think most of the barriers would be overcome through that design-consenting process—obviously environmental considerations, working with the Crown Estate, and so on. That includes any barriers within that consenting process. We like to think that at least three to five years design consent, and five years for build.

Q391 **Mick Whitley:** What do you expect the eventual cost of electricity from tidal range to be in comparison with other sources of low-carbon



electricity?

Kate Gilmartin: We have not published the report yet from Jacobs, which is looking at the levelised cost of energy of tidal range, but it sits within certainly nuclear tidal stream among those administrative strike prices that are being offered on CfD for tidal stream and wave—for example, it is cheaper.

Q392 **Mick Whitley:** What are the steps you would like to see from the Government to support the development of a tidal range?

Kate Gilmartin: Again, a bit like pumped storage hydro, it is all about having that price stabilisation—that revenue mechanism that people can build a business case on and from which investors can get that confidence. Again, we are thinking that the regulated asset base, as per the Thames Tideway, and using the model that was brought forward with Thames Tideway with Ofwat, but working with Ofgem to do something similar. It is about forming that Government-industry partnership.

It is about looking at where the projects are and at which are the best to come forward, and looking at the long-term future generations. These assets are there for 120 years. Also it is a case of the co-benefits—for example, looking at flood defence. We can put flood defences in and they are just a tax burden, but actually if you can make them into tidal range they are a revenue generator as well.

There are all sorts of co-benefits—largely UK supply chain and so on. Offshore wind is an example. We have had that process from 2012. I think one of the things that did not happen with offshore wind was around the supply chain; the supply chain went offshore. We have to have that industrial strategy with Government to make sure that if we are building an industry, we are making sure the job skills stay within the UK, so we get the maximum benefit of a new industry.

Q393 **Mick Whitley:** Bearing in mind that the Government pulled the plug on the on the Swansea lagoon, what would be your opinion on attracting private investments if the Government are reluctant to meaningfully get involved in tidal range?

Kate Gilmartin: We need that Government backing because of the regulated asset base. It is all about bringing down the cost of capital, and that will attract and have that long-term mechanism to bring investors in. It is about creating that partnership. Without the Government giving those signals, it is hard to get investors to see that this is a route forward. It is absolutely critical that we have that Government support.

Q394 **Mick Whitley:** What I am asking you is: what vibes are you getting off the Government in terms of tidal range?

Kate Gilmartin: It said in the Energy Security Bill that it needed to be aggressively pursued. I think that was in July 2022. Since then, we have only had the well-developed criteria announced just before December as



part of appendix C. That has been the only move from Government. We only have one full-time person working on this in DESNZ; there is a big resource issue, given that this is a big potential opportunity. We need to have more resource within Government to help bring that forward as well.

Mick Whitley: It seems to me that what you are telling me is that there is a reluctance from the Government.

Kate Gilmartin: There is certainly not a huge enthusiasm when we think of the potential benefits that tidal range could bring as that cornerstone of a decarbonised future grid—that assets are going to be there for 120 years and have huge amounts of co-benefits.

Q395 **Chair:** Let me follow up on that point. At the end of the day, with any economy like the economy we have in the western world, ultimately these investments need to have a return on equity and a return on capital employed. When you talk about support from the Government, are you talking about subsidies from the Government in order to come in and basically make the cost of capital cheaper for the commercial investors—or are you talking about the Government acting as a guaranteed buyer of the energy into the grid, and come out of it so you have certainty about taking a product to market? How do you see Government support working?

Kate Gilmartin: The point with tidal range is that we know exactly how much it is going to generate and what the profile will be. Contracts for difference is all about paying for that generation and the Government hedging, for the benefit of the consumer, on that generation. The regulated asset base is a bit like nuclear; it is about making sure that the costs are minimised over the construction period, and Government making sure that they are able to do that and to bring forward something that is going to have a long-term benefit.

Q396 **Chair:** Are you suggesting the regulated asset base requirement is something that can get in the way of a commercial investment?

Kate Gilmartin: No. It would enable that commercial investment to come forward. It is that underpinning security for investors to know what they are getting into because these are long build-out projects, a bit like nuclear.

Q397 **Chair:** In terms of your investors coming into help build one of these things, they are looking at whether there could be a pension fund—or perhaps whether it is ideal for a pension fund. What questions are they asking you in terms of the guarantee that you can have a market at the end of it? What are they looking for in terms of the landscape of the energy market in 10 or 15 years? All this could come to nought if nuclear fusion—let's say, hypothetically—suddenly became a reality next year. Suddenly the whole thing would change. We have another panel coming on in a minute with emerging technologies.



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There are a lot of variables in all of this. The Government, as an investor of last resort is one thing, but as subsidising commercial investments is another. I am trying to figure out what exactly it is you are asking of the taxpayer in all this.

Kate Gilmartin: The Government are leveraging in the private investment, essentially. They are giving confidence to investors that this is a technology that will be supported, and that the generation will have value over the long term. Most investors know that that generation will have value. I take your point about cold fusion; it is always 40 years away. Tidal range is near that baseload but the key is it is near to centres of demand. You are circumventing the massive issues we have in terms of transmission constraints.

Investors are keen, but they are not going to put millions into development finance unless they can see a route forward for the sale of the electricity and the risk around the build time.

Chair: That is helpful. That brings an end of this session. Thank you all very much for your time. We will have a two-minute break while we change the panel over.

Examination of witnesses

Witnesses: Richard Arnold, Ross Glover and Martin Soltau.

Chair: Good morning, everybody. This is the second panel of this morning's evidence session on keeping the power on. We have three more panellists. Name, rank and serial number—starting with you, Richard.

Richard Arnold: I am Richard Arnold, policy director of the Marine Energy Council. We represent the UK's tidal stream and wave energy industries.

Ross Glover: Good morning. I'm Ross Glover, CEO of Star Energy, and I am here today to talk about deep geothermal energy.

Martin Soltau: I am Martin Soltau. I am the co-CEO of Space Solar and the co-founder of the Space Energy Initiative. We are developing space-based solar power.

Q398 **Chair:** In the order of full disclosure, I should declare that I have a non-financial interest in the space-based solar power industry; I am a non-executive director of Space Solar, and also chair the advisory board of the Space Energy Initiative. But I stress that these are non-financial interests. I do this for the love of the future of humanity.

Richard, may I start with you? We are getting close to 2035. A lot of interesting technologies are coming along. Are we doing the right thing



by chasing these new technologies when we are this close to the deadline or is there time for you guys to get your ducks in a row quick enough to be a major part of that net zero?

Richard Arnold: Absolutely, we have time. We are asking Government for a 1 GW target for tidal stream by 2035 and 300 MW of wave by 2035. The UK potential is upwards of 30 GW for both technologies. It is not a case, I think, of where we should be pursuing these emerging technologies. We know that the UK future energy mix is going to be dominated by wind and solar. That is going to be the backbone, but it is not going to get us all the way there. You are going to need emerging technologies. You are going to need answers for what you do when the wind does not blow and the sun does not shine. We think that tidal stream will; it is entirely predictable. It will have a key role. Wave is incredibly abundant. You think about the economic opportunity of the net zero transition. I think it would be foolish not to pursue it.

Chair: It is very predictable, but it is not dispatchable.

Richard Arnold: It is firm power. With tidal stream, you know what you are going to get and when you are going to get it, but it is not dispatchable like a traditional gas plant. From a system viewpoint, if you developed a few different tidal sites in the UK with tidal stream technologies, it would essentially have almost a baseload effect because we would always be producing at a certain time. There is a study that has shown that after developing three sites for tidal stream, there would only be four hours in a year where tidal stream was not producing somewhere.

Q399 **Chair:** There is another quick point about this. The UK is quite unusual in as much as I think the Chepstow bridge is the second biggest tidal range in the world after somewhere in Newfoundland. The rest of the world does not have such big tidal ranges. Is this a UK peculiarity?

Richard Arnold: Tidal stream is not concerned necessarily with tidal range. Tidal stream is focused on the speed of the currents.

Chair: Like the Firth.

Richard Arnold: Yes, exactly. We have about 11.5 GW potential, but that could be much more because there is a lot of action and a lot of research and innovation happening in low flow tidal streams. There could be a lot more than that. Globally there is over 100 GW—maybe around 150.

There is a study going on at the moment that is going to conclude by the end of this year, and it should give us a good indicator there. But the places where this is being developed—Canada, Japan, Indonesia, China—are places with very ambitious net zero targets and a need for a predictable renewable energy.

Q400 **Chair:** Ross, you are more dispatchable with geothermal. Again, are you going to be playing a significant part in this by 2035?



Ross Glover: I think the first thing to make clear is our view that deep geothermal energy is heat provision, not electricity provision. It is very boring. It is dispatchable and dependable; it has been around since the 1890s. It supplies heat or has been supplying heat for decades in the likes of Paris and Munich. We believe there is a huge opportunity in the UK to import a proven technology into cities where heat could be supplied to hospitals. We are working on a number of hospitals at the moment, supplying heat into universities and to general urban areas.

The opportunity is huge. Decarbonisation of heat is one of the forgotten parts of the energy system. Deep geothermal is a very dependable, predictable method of doing that. It is very local—I think that is a key thing to stress; it happens in a community.

Q401 **Chair:** Out of interest, when you are going down and taking the heat out, is the heat being replaced from further within the Earth's core or are you cooling the area? Are you taking the energy away from that area?

Ross Glover: We are extracting energy, but there is an almost infinite source of energy. It is derived from the Earth's core. When we talk of deep geothermal, we are talking extracting that heat from over 1,000 metres down, potentially even up to 5 km down. In respect of the quantities of heat that we will be extracting, it is an infinite source of heat.

Q402 **Chair:** Martin Soltau, the challenge is: can you have baseload dispatchable power being beamed from space by 2035?

Martin Soltau: Yes, we will have both developed commercialised and be scaling out rapidly by that stage. Space-based solar power conceptually is straightforward. It is about having very large solar panels high in space where they can see the sun the whole time. Thereby you can convert that to microwaves and beam it down to Earth-based receivers, so you can get this firm, continuous and dispatchable power.

It is a transmission system as well, so you can export it; it is incredibly flexible. We have heard about how the uncertainty of the net zero pathways requires this more flexible and certainly dispatchable power. A big part of it is the cost. This is going to be, by independent studies, one of the most affordable types of dispatchable and baseload power. We are providing gigawatt scale. NASA have been studying this on and off.

Q403 **Chair:** I think Barry Gardiner is going to come in a bit later with some more detailed questions on this. There is an element of this that is relatively new for a lot of people who come across it. Very briefly—I do not want to take other people's time up—what is the global competition in what appears to be this very new technology?

Martin Soltau: Japan and China have policy-led programmes. They are putting experimental systems into space in the next three years. Caltech in the US has just finished a year-long, very successful experiment in space. The US military are also experimenting. The UK in many respects



has a policy leadership position here. We have the most capable market-leading technology. We have a supportive Government, joined up between the energy and space sectors. We have an enterprise with the supply chains and partners ready to go.

That is pretty unique in the world. But others are accelerating their programmes. It is a recognition that space solar power is essential, and is now already viable both technically and economically.

- Q404 Derek Thomas:** Ross, can I come back to you on the geothermal and heat? Why heat not power? In Cornwall—I am a Cornish MP so I have a bit of an effort on geothermal—there are some ambitions and planning applications in place, where there is the intention of generating power to go straight into the grid. The argument they have is that you can run turbines all the time—sun and wind do not make a blind bit difference—so it gives that consistency. Where there is good capacity, it can help to deliver the energy we need. Your suggestion, I heard, is that that probably is not the answer. Is that what you are saying?

Ross Glover: In Cornwall, it is absolutely one of the available solutions to generate electricity. That is not necessarily the case in the rest of the country. Cornwall has very specific geology, which allows you to do that. The rest of the UK does not, apart from a few very specific areas. What the UK does have is the geology in much wider areas to allow the generation of heat energy—specifically within urban areas where that heat can be used properly.

- Q405 Derek Thomas:** That is helpful because I often wonder—I get pushed back a lot when we talk about geothermal for power. But you are saying for an upscaling across to meet the nation's needs—not necessarily as I am describing but for a local solution—that could be quite interesting and feasible. How large a role could geothermal energy play in our energy mix, and what percentage of energy heat would come from that?

Ross Glover: It depends on policy. We have a number of recommendations in that regard. It is an application relatively specific to urban areas—the satisfaction of heat demand within urban areas. Take, for example, Munich: currently 40% of homes in Munich are supplied by geothermal heat. There are large elements of the heat demand in Paris being satisfied through geothermal heat. As we look to cities and towns in the UK—Birmingham, Manchester, Newcastle, those types of cities—there is the potential to supply significant proportions of heat into those cities.

- Q406 Derek Thomas:** Given that it is so cheap, I went to visit a high-rise block of flats where that has just been delivered by Kensa, and it is so cheap. It is not costing the tenants anything. Is it feasible to say we could, with the policy and the right determination, deliver that heat to every particular urban home across the country if we set our minds to it to provide geothermal?

Ross Glover: There is the potential to do absolutely that in specific areas. We talk very specifically about deep geothermal. Shallow



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geothermal is a very similar technology. You need to boost the heat that you get from shallow geothermal. With deep geothermal, we know of good areas in the UK and not so good areas in the UK. The way to attack it would be to go to the good areas first and then go to the less well-known areas afterwards. With the good areas, there is absolutely, or there should be, an ambition to try to satisfy as much of the heat demand as possible with a local renewable heat source.

Q407 Barry Gardiner: Could I piggyback a little bit on that? You said that Cornwall was specifically good for that because of the geology in the area. Tell us what makes Cornwall so good for deep geothermal? I presume it has a thinner crust or something.

Ross Glover: When I say Cornwall is very good for deep geothermal, I think that is specifically for electricity generation purposes. The reason for that is that it has a higher geothermal gradient than the rest of the UK, and that is specific to the granite geology within that area. As you drill deeper anywhere on Earth, it gets warmer. In Cornwall, it just gets warmer a lot quicker or at much shallower levels. Typically around the UK you are talking, I think, 30°C per kilometre that you go into the Earth. In Cornwall that is a significantly higher number.

Barry Gardiner: What is the number in Cornwall?

Ross Glover: I do not specifically know. We can supply that to you in writing.

Derek Thomas: Our forks get hot.

Q408 Barry Gardiner: Nobody else is as good as you, I know. Where else around the country? Sorry to use the word "hotspots", but where are those literal and metaphorical hotspots?

Ross Glover: When I am referring to hotspots, I am referring to hotspots that would be potentially suitable for electricity generation again.

Barry Gardiner: For deep geothermal.

Ross Glover: For deep geothermal rather than heat provision. There is an area in Weardale, which is hotter than normal. There are other very specific hotspots, but there are not large areas like there are in Cornwall elsewhere in the country. That is why we feel that there is a general application for deep geothermal for heat provision purposes. You do not rely on those very specific hotspots.

Q409 Mick Whitley: My question is to Richard. How large a role do you expect tidal stream and wave energy to play in our energy mix by 2035 and in the longer term?

Richard Arnold: I think by 2035, we want to put tidal stream and wave on the pathway to get to 6 GW of both by 2050. It is not going to play a massive role. Is never going to overtake wind or solar, but what it will do is provide a distinct service to the energy system. We have spoken



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already about the predictability of tidal stream, but there is also an exciting opportunity within wave to co-locate wave energy converters with offshore wind sites. There is a lot of work happening at the moment around getting to a cost-effective net zero energy system. There is an opportunity for wave and wind to share infrastructure and lower the cost for both projects.

Q410 Mick Whitley: Another question for you, Richard: where around the UK coast is tidal stream and wave energy most likely to be deployed, and is the deployment in these spots likely to ease or exacerbate existing grid constraints?

Richard Arnold: For tidal stream, it is north Scotland, north Wales, south and west Wales, and south and west England. Wave is slightly more dispersed. There is a bigger potential pipeline for wave. In terms of existing network constraints, it is obviously a massive issue for all renewables. Grid operators do need to be supported to invest—to strategic invest—to increase the capacity to accommodate these technologies.

But we are not the ones—yet—bringing on gigawatt-sized projects. There may be issues there in certain places, but they would not be exacerbated by us. They would be exacerbated by a lack of investment.

Mick Whitley: By who—the Government?

Richard Arnold: The price control for a long time did not allow for strategic investment in network infrastructure. In the Energy Bill, Ofgem has been given a net zero mandate. That looks like it is going to change. There are lots of positive noises around network investment, so we will continue to support that.

Q411 Mick Whitley: In a lot of discussions I have had with figures in the industry, scepticism has been raised about the suitability of CfD schemes for financing large gigawatt scale tidal range generation schemes. Given the high up-front capital costs, do you believe that we need to be looking for alternative financing arrangements like the regulated asset-based model?

Richard Arnold: The biggest challenge for us has been a lack of clarity, and the changing in terms of whether there is a route to market or not. We were only given a ringfence in 2022, and I think the UK Government should be commended for that. It showed real leadership in setting that ringfence, and we are now on track to get 100 MW of tidal stream in our waters by 2035.

Our ask would be to keep the CfD, but to provide clarity and certainty that there is going to be that ongoing route to market for tidal stream. It is not the perfect mechanism, but a perfect mechanism does not exist. What is holding the sector back is that lack of clarity about that ongoing support.



Q412 **Chair:** On some of the barriers—I know Vicky Ford is going to be picking up on the regulatory barriers—I am curious. I used to be a district councillor down on the corner of the River Severn and the River Wye, and obviously there was a lot of talk about potentially having this Severn barrage and all the rest of it, doing a lot of this energy production. In the end the mood became quite—not negative about it, but quite despondent because of the environmental issues, and a lot of environmentalists were raising important points about it. I agree with them but there is always going to be a clash between environmentalists and what we would like to do in terms of generating energy. Do you find that is a problem?

Richard Arnold: Our biggest challenge, I think—not to get all People's Front of Judea—is that tidal range and tidal stream are very different technologies. We are not intrusive. We are not putting lots of concrete into our seas and waters. What we are doing is simply putting in a turbine—rather than having it harnessing the wind, just the tides instead. There has been a lot of monitoring that is undertaken internationally. There have been no examples of any collisions. In fact, it has been shown to have positive unintended environmental consequences.

Our biggest issue is that people think when that we talk about tidal stream, we are talking about tidal range. Getting that understanding is a challenge.

Chair: You are looking at current rather than tide.

Q413 **Barry Gardiner:** The tidal range is just pumped storage by another name, isn't it?

Richard Arnold: Exactly.

Q414 **Barry Gardiner:** Mr Soltau, I want to talk to you about space solar. The sun does shine all the time, despite what everybody says about renewables, eh? Your job is to harness the energy that is out there in space and, through microwaves, bring it to the Earth. How does that help us with global warming? What you are doing is taking heat energy that would not be trapped into the Earth's atmosphere and specifically pumping it into the Earth's atmosphere. While it may be a cheap and dispatchable form of energy, it seems to run counter to the basic principle that we do not want more energy trapped in the Earth's atmosphere, because that is precisely what is causing us problems in the first place.

Martin Soltau: I understand the point, but actually the amount of additional heat is absolutely inconsequential and is far less than the waste heat produced by fossil fuel stations or even terrestrial solar panels. Terrestrial solar panels on Earth are about 22% efficient, so 78% of that is waste heat. Space-based solar power produces far less waste heat. The rectenna on Earth is about 90% efficient, so in fact while the heating is completely inconsequential for both technologies, it is actually far less for space-based solar power.



Q415 **Barry Gardiner:** Yes, but the waste heat from solar panels, to use your example, is energy that is already trapped within the greenhouse of the Earth's atmosphere. The energy that you are bringing in is not; it is additional to it.

Martin Soltau: If you put, say, solar panels in the desert, which is a big scheme, you are changing the albedo of the desert. The reflective surface that would normally radiate heat back into Earth is now an absorptive surface, so solar panels generate more heating of the Earth. It is a small amount compared to trying to avoid carbon dioxide as a greenhouse gas but it is substantially less for space-based solar power, very much less.

Q416 **Barry Gardiner:** You could presumably provide the Committee in writing with exactly what the incremental heating effect is and compare it with the other technologies you have outlined.

Martin Soltau: Yes, I am very happy to do that. It is one of our frequently asked questions. I know it is a slightly different point, but the carbon footprint for space-based solar power is about half that of terrestrial solar—about 24 grams of CO₂ per kWh. There are all sorts of environmental impacts for all technologies, and this is good across a range of those considerations.

Q417 **Barry Gardiner:** Let me ask one of the other questions I suspect you are often asked. We all know that we should not put tinfoil into a microwave, yes? I am not suggesting that any airline operator is flying us around in tinfoil. However, you are beaming these microwaves down to the Earth. Will we have to fly around them? What will it do to air traffic control systems? What are the potential dangers?

Martin Soltau: Yes. First, the intensity of the radiation at the peak is just a quarter of the midday sun. It is very low intensity. The design starts from safety—making it safe. We anticipate that because the frequency is totally different from communications and navigation, there will be no impact on civil aviation. Nevertheless, these systems need to interoperate, and we already have a Government-led regulation and standards forum looking at all these regulation issues from spectrum to safety and environmental.

Q418 **Barry Gardiner:** My briefing says that the risk to aircraft has not been evaluated. You have just told me that the risk to aircraft communication systems is zero. You just said there is no risk. What are the evaluation studies that have been done? Do we have them as a Committee?

Martin Soltau: As I said, the frequencies are very different from the beaming frequency we are using in navigation and communication.

Q419 **Barry Gardiner:** I understand what you are saying. You are saying that theoretically there should not be a problem. I am asking if any studies have been done to evaluate whether in fact there is a problem.

Martin Soltau: I am not aware of detailed studies. A while ago, NASA looked at a range of these topics. These studies absolutely need to be



done and the committee has been set up by the Government to explore all of the legal and regulatory aspects.

Q420 **Barry Gardiner:** Let us go on to those regulatory aspects because the allocation of radio frequency bandwidth is going to be rather important, isn't it? That is a matter for international negotiation. You have already said that Japan, China, and the US are looking at this as well. Who is taking a lead on the negotiations of the allocation of bandwidth?

Martin Soltau: Ofcom has already started to engage with the International Telecommunication Union about that spectrum. As a global community, the ISM bands—the industrial, scientific, medical bands—at 2.45 and 5.8 GHz have been selected. Our initial conversations indicate that they would be sensible to start off with, but we would probably be allocated a dedicated frequency. You make a very important point, because these negotiations take a long time. It is great that the Government have already started this process and we have some good, supportive engagement with the ITU.

Q421 **Barry Gardiner:** Given that China and America are involved in this and at the moment they do not often see eye to eye, what will be the difficulties of those negotiations—or rather, what impact will that difficulty have on the timescale for getting a result so that you can begin dispatching this energy in a timeframe that will help us meet our net zero targets?

Martin Soltau: We are working through that at the moment to develop that road map with timescales with the Government. An international forum has been established where the Chinese, Japanese, Americans and the British are all coming together to work through these issues. It is an important point.

Q422 **Barry Gardiner:** Is there a target time in mind for those negotiations, and is it adequate for making a material difference to our energy supply?

Martin Soltau: Yes. Our road map for developing the technology, commercialising it and rolling it out is within a decade. From the initial discussions, we believe that that is commensurate with the regulation timescale. I think that it probably will need different thinking within the regulation community as well, and one would hope that because of the importance of net zero and space solar power becoming well-established as an incredibly capable solution, the regulation processes could be completed within that timescale.

Q423 **Barry Gardiner:** Finally, on cost, our Government say that we can do the first gigawatt-scale space solar power station at a cost of £10.5 billion, which is compatible with other technologies, I accept—nuclear, for example. But the European Space Agency says it is closer to €20 billion. That is substantially greater than we have estimated it. Who is right, and why?



Martin Soltau: The UK has the market-leading concept. The cost of these systems is highly dependent on the specific amount of power it produces per unit mass of the spacecraft. That is one element. The assumptions directly impact the cost estimates. In particular, the assumptions around the cost of launch are a big factor. Launch is an area that is maturing very rapidly. Reusable rockets are essential to this, and already we can see that the SpaceX capability with Starship will bring the launch costs well within what we need to have affordable space-based solar power.

Q424 **Barry Gardiner:** You are confident.

Martin Soltau: Yes.

Barry Gardiner: I wish you all the best. Thank you very much.

Q425 **Mark Pawsey:** We have advocates of three technologies that are clearly not widely used in the UK yet. Mr Arnold and Mr Glover have reminded us that their technologies do exist at reasonable scale elsewhere, but Mr Soltau, yours is very new. My question is about Government support that each of you need to get things moving. We know that wind only worked with a Government subsidy and incentive in the early years. Mr Soltau, you have had, I think, £4.3 million for research. Mr Gardiner has just told us about the possible €20 billion cost of getting it underway. What does Government need to do for something to happen?

Martin Soltau: The Government need to support the early stages of this. We have had a lot of conversations with private finance. The cost of the development for the first six years to get to a substantial proof of concept in space—beaming megawatt power from space, which is our tipping point—is £800 million. The Government need to find ways to support that. It does not need to pay for all of that, but it needs to come in early, take a lead and then the private finance will come in behind it.

Q426 **Mark Pawsey:** Technologically, in areas of expertise, we are ahead of the game. Is that what you are saying?

Martin Soltau: Yes. We have the market-leading concept and we have all of the capability within the UK in photonics, robotics and power beaming. It will be an international endeavour. We are working with international partners, but the UK can play a leading role.

Q427 **Mark Pawsey:** Okay. Mr Glover, what interventions would you like to see from Government to enable more widespread use of geothermal?

Ross Glover: It is twofold: first, policy and a larger push on general decarbonisation of heat. That should trickle down through planning policy and into energy policy. Secondly, you mentioned that Government subsidy was successfully used in wind and solar industries, dramatically driving down costs. We are after something similar. Some form of Government subsidy would provide some leadership spark.

Q428 **Mark Pawsey:** May I suggest that the cost of drilling a hole is the cost of



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drilling a hole? How would you achieve the economies of scale, for example, that wind has achieved by the volume of production?

Ross Glover: The more holes you drill, the better you get at it, the faster you do it and the less it costs. It is as simple as that. There is private capital interested, but some form of Government subsidy—we would recommend a feed-in tariff-like arrangement—would be the spark to get this industry going.

Q429 **Mark Pawsey:** Mr Arnold, you said earlier that CfD was not the perfect mechanism to accelerate tidal. What is?

Richard Arnold: I think that a feed-in tariff would be great as well. I would quickly note that tidal stream has already produced 60 GWh in the UK. We have 10 MW already deployed. There are cars in Scotland being powered just by tidal stream. Whatever support is there, we require a commitment to keep that in for a good duration. Much like wind, which went down the cost reduction curve, we can see that happening for tidal stream. There have been great reports that forecast and show that through economies of scale, volume, and accelerated learning, we can achieve significant cost reductions rapidly. I make the final point that around a third of the cost of tidal stream in allocation round 4 was to do with insurance. That is because there is a lack of understanding and we are still learning. We can quickly see where costs can be reduced.

Q430 **Mark Pawsey:** Okay. Is the supply chain ready?

Richard Arnold: The supply chain needs to grow to realise the UK's potential, but that is a massive opportunity. There is still an opportunity to embed UK content in projects being deployed here and around the world. Our members, Nova Innovation and Orbital Marine, have deployed their tidal stream devices with over 80% UK supply chain spend.

Q431 **Mark Pawsey:** Do we have manufacturers who are ready to deliver?

Richard Arnold: Yes. They are ready to scale up.

Q432 **Vicky Ford:** Thought: I hope that if the Government does invest in any of this innovative technology, they do so with an equity stake so that if they are as fantastically successful as these three guys say, the taxpayer gets their money back. Can we note that for discussion as a possible recommendation? You can give me your comments, but my actual questions are about regulatory capacity. Is our regulation—and our regulators and agencies—keeping up with the speed at which this is happening? Quickly: one, two, three—yes or no?

Richard Arnold: No, but with caveats.

Ross Glover: No, and it is planning-led.

Martin Soltau: Not yet, but in progress.

Vicky Ford: Okay. In which areas? Planning?



Ross Glover: Correct: planning-led, permitting-led—those sorts of areas.

Q433 **Vicky Ford:** Okay. Would you suggest to this Committee that one of the recommendations we should make is about speeding up regulatory blocks?

Ross Glover: Yes.

Q434 **Vicky Ford:** Maybe you would like to give in writing some specifics about the areas. In order to get rid of some of these barriers, sometimes it is helpful if the Government sets targets for different technologies, because by setting targets, it means that behind the scenes everybody gets pressured to meet those targets, and thus regulators and regulation have to keep up with the targets. Would targets help? If so, who should be responsible for monitoring and measuring progress towards them?

Martin Soltau: Yes, targets would greatly help to be commensurate with the development of both the technology and the regulations. Who should be involved? I think that for space-based solar power, it needs a Government programme office to be responsible.

Ross Glover: I agree. Targets would be a good thing around the decarbonisation of heat. I think that they should be pushed down from central Government into local Government as well. I would say that because we are an indigenous, local energy source.

Vicky Ford: Although you have also said that every local authority is different and Cornwall is very different from London.

Ross Glover: No, I do not believe that there should be any less drive to decarbonise heat dependent on your location.

Richard Arnold: Yes, targets would absolutely be helpful. One of the reasons for us is that the way the CfD works is that a budget is announced annually. We only find out if we have a ringfence annually. We do not yet know this year whether there will be a ringfence for tidal stream or for wave energy. We do not know next year. It is difficult when you are trying to encourage investment into this sector when they ask, "What is the deployment pipeline?" We have had tremendous success the last two renewable auctions, but we do not know for certain yet whether there will be a ringfence in this year's renewable auction. By the Government setting a target, it would indicate that they will support the sector to get there and get down the cost reduction curve.

Q435 **Vicky Ford:** Back to what I said at the beginning: given that all three of you are asking for Government—taxpayers—support in cash, as I understand it, at least in the geothermal and the space, do you think I am reasonable to say that if Government is putting in high-risk money into an area where you are getting venture capitalist high-risk money, they should be looking for an equity stake if it all plays out?

Martin Soltau: I think that it is a great idea. I think that we would value either equity or grant.



Ross Glover: I would like to make a couple of points around that. The local geothermal heat provision gives direct benefit to taxpayers immediately. It gives them predictable power prices for generations. On that, you can base business cases; you are not susceptible to huge swings in global gas prices; and you know what your energy price will be in 20 years' time. It creates skilled jobs locally. It invigorates a UK supply chain that is ready to go, but frankly is largely deployed overseas at the moment. I think that the benefits of Government support would give direct benefit locally to taxpayers.

Barry Gardiner: Spoken like a true CEO.

Q436 **Chair:** Fantastic. We are a little bit ahead of time. I will give each of you 30 seconds to make one final pitch. Richard, what have we missed out on? In 30 seconds.

Richard Arnold: I think that when we talk about risk in the net zero transition, the bigger risk is that the UK does not learn its lessons from what happened with Denmark and wind. Denmark essentially stole our lunch. We were ahead in the '80s. There is no reason why we should not be exporting wind turbines all around the world, but we are not—not to the same degree that Denmark is. With tidal stream and wave, we know that the UK has world-leading resource and maritime expertise. We know that this technology works. We are already harnessing energy from wave and tidal stream. Now we need consistent Government support so the UK can benefit in the long term from exporting its expertise around the world.

Chair: The Government needs to seize the initiative. Ross—30 seconds.

Ross Glover: It turns to the missed opportunity point again. The Government, or the country, has a huge opportunity here to decarbonise the hard-to-decarbonise areas of the energy system. It can do that at a very local level, giving the benefits that I talked about in my last answer. It is dependable. It is proven elsewhere. We are not inventing something new here. This has been delivering energy for generations elsewhere. All we are asking is to take the view that this is applicable to the UK urban environment and UK geology.

Chair: Fantastic. Very helpful. Martin—30 seconds.

Martin Soltau: Space solar will be incredibly capable. It can play a hugely valuable role in the mix with the dispatchability and export, and it can be commercialised and scaled up within net zero timeframes. The first point is: get cracking. We need to keep this as an option for net zero. If we delay, we lose it as an option. The second point is: be entrepreneurial. We cannot expect private finance to take undue risk. Government must come in at the early stages to derisk this and quite quickly private finance will be able to come in behind that. It is a huge benefit-to-cost ratio. The third point is: back UK jobs. The UK has a leadership position at the moment in many respects, but others are



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accelerating their programmes. We must retain that economic benefit for the UK and not let it go abroad.

Chair: Fantastic. Thank you all very much indeed. PMQs are in five minutes. Thank you all very much for coming along. That is the end of the meeting.