HOUSE OF COMMONS

Environmental Audit Committee

Oral evidence: Technological innovations and climate change: geothermal technologies, HC 397

Wednesday 7 September 2022

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Watch the meeting

Members present: Philip Dunne (Chair); Duncan Baker; Sir Christopher Chope; Barry Gardiner; James Gray; Helen Hayes; Ian Levy; Caroline Lucas; Cherilyn Mackrory; Jerome Mayhew; John McNally; Claudia Webbe.

Questions 1 to 58

Witnesses

I: Dr Nina Skorupska CBE, Chief Executive Officer, The Association for Renewable Energy and Clean Technology (REA); Dr Ryan Law, Chief Executive Officer, Geothermal Engineering Ltd; Dr Corinna Abesser, Head of Geothermal Research, British Geological Survey; Gareth Farr, Head of Heat and By-product Innovation, The Coal Authority.

Written evidence from witnesses:

The Association for Renewable Energy & Clean Technologies (REA)

Geothermal Engineering Ltd

British Geological Survey

The Coal Authority

Examination of witnesses

Witnesses: Dr Nina Skorupska, Dr Ryan Law, Dr Corinna Abesser, and Gareth Farr.

Q1 **Chair:** Welcome back to the Environmental Audit Committee where we are joined for a one-off session, continuing inquiry into technological innovation and climate change, where this afternoon we are looking at the fascinating topic of geothermal technologies and the role they may be able to play in helping to meet our energy requirements. We have a distinguished panel before us today and I will invite each of them to explain the role they have within this segment of the energy, starting with Dr Nina Skorupska.

Dr Skorupska: Good afternoon. I am the chief executive of the Association for Renewable Energy and Clean Technologies, known as the REA.

Dr Abesser: I am the head of Geothermal Energy Research at the British Geological Survey.

Gareth Farr: Good afternoon. I am the head of the Heat and Bioproduct Innovation Team at the Coal Authority.

Chair: On the line we have Dr Ryan Law.

Dr Law: Good afternoon. I am founder and CEO of Geothermal Engineering, that we set up in 2008. Apologies for not being there is person today, but you caught me on holiday and I am phoning from the top of a lighthouse today. It is the only place with a signal.

Chair: At least you look stationary. It is not revolving around you.

Dr Law: No, not yet.

Q2 **Chair:** We as a Committee are looking forward to meeting some of your colleagues in Cornwall later in the week, so thank you in advance for hosting our visit.

I will start by asking some questions to Corinna to give us a sense of the scale of the opportunity here. We are aware that the core of the earth is hotter than the surface of the earth, but that is more or less where my physics finishes. Could you give us a sense of what the scale of the opportunity for harnessing the heat under the soil to meet heating and electricity demand in the future?

Dr Abesser: Yes, I can do that. Before I start with numbers, I suggest I give you some definitions that might help us understand what we are talking about in geothermal energy research. Geothermal energy is all heat stored beneath the surface of the earth. The majority comes from elements within the earth generating heat, so the deeper you go the hotter it gets within the earth. Generally, talking about geothermal energy, we distinguish deep and shallow geothermal systems.

There is no clear definition and you talk to different people and you have different limits for that. The way I will use it is shallow is less than 500 metre steps. Usually these are systems that require a ground heat pump, so they abstract heat at ambient temperatures, 12, 13, 14 degrees, perhaps up to 20 degrees. These temperatures need boosting so you can use them for heating in homes—you need about 45 degrees temperatures for that.

By this definition, technically, mine energy would sit within shallow geothermal but they are quite different systems in that they use large, anthropogenic aquifers that have been created by coal mining in the past. They are not a traditional ground heat pump in the sense of shallow geothermal. They should be regarded as something different.

Deep geothermal starts at 500 metres down and usually includes everything from direct heating, where you do not need a heat pump to boost it, to power generation. In terms of temperature ranges, we are looking at 45 degrees plus for heating; district heating that works. You can feed in the heat directly without having to boost with a heat pump. For power generation, we are looking at temperatures above 150 degrees. That relates to the depth you have to drill to.

Therefore, for a heating project you are looking to drill in excess of a kilometre up to three and a half kilometres perhaps. The reason why I mention that limit is the cost. At the moment beyond that point, it is not cost-effective to drill that deep just for heating, given the geothermal gradient and temperatures we have in the UK.

For power projects, Ryan is the person to speak about those, but you are looking to drill to depths of four and a half to five kilometres, because that is where we get temperatures hot enough for geothermal electricity generation. I am at the point where I can answer your question.

Q3 **Chair:** Before you answer the question, the temperature range in the shallow geothermal, up to 500 metres, is roughly what?

Dr Abesser: If you calculate it down to 500, it is just under 50 degrees Celsius. On average, the geothermal gradient is 28 degrees per kilometre in the UK. Then you add the surface temperature of 12 or 13 degrees on average, depending on where you are, so that is added up.

Q4 **Chair:** You are saying that used coal mine workings are in the shallow range?

Dr Abesser: Yes. Can I correct what I just said? I made a mistake in my calculations. It would be nearer 30 degrees at 500 metres.

Q5 **Chair:** You are saying that the temperature at 500 metres is around 30 degrees and it is approximately 28 degrees per kilometre beneath that?

Dr Abesser: Yes. The gradient from the surface down to depths on average is 28 degrees per kilometre. If you halve that, that is 14, and

add the ambient temperature at the surface, it would be 14 plus 13 or 14 degrees, so nearly 30.

Q6 **Chair:** In terms of the capacity we have, can you address that?

Dr Abesser: The most comprehensive study on resources was done 40 years ago. It was paid for by the then UK Department for Energy and the European Union. This study appraised data available from the hydrocarbons industry and drilled some deep wells, one of which is the Southampton well that is still in operation. The target of that study was looking at the resource in the two main geothermal targets that we find in the UK. One is in sedimentary basins. That is aquifers, water bodies at depth where we can get temperatures in excess of 50 degrees C.

Taking all the sedimentary basins together in the UK, it was estimated we can get about 91,000 terawatt hours out of that. To give you the scale, that is about 200 times the current demand for domestic heating and hot water.

Q7 **Chair:** Is that a reservoir of heat or a renewable source of heat?

Dr Abesser: This estimate is heat in place, so that is what is currently held in these aquifers within the reservoir. That is being replenished, but that has not been accounted for in that estimate. The power generation potential has also been estimated and, at the moment, it is only economically viable to use part of the resource we have. The estimate I am giving you is for granite bodies that are heat generating, like those in Cornwall. Considering all the granite in Great Britain, the estimate is something in the order of 2,300 megawatts capacity for power projects. To give you a scale, that would be about enough for 3.5 million households electricity.

I have to say there is a caveat in these numbers. This is the resource. How much you can get out in the end will vary locally on the conditions in the deep sub-surface, which are not very well-known at this point in time. We can work with the resource but only locally can we estimate the reserve.

Q8 **Chair:** Did I hear that correctly? In gigawatt terms, that is three gigawatts. Is that right?

Dr Abesser: Yes, for power. One other point is that the earth gets hotter the deeper we go and, as drilling technology improves and gets cheaper, we can access deeper areas that are currently not economically feasible. If you drill down to 6.5 kilometres, the resource will be massively bigger but at this point in time that is not economically feasible.

Q9 **Chair:** That is really helpful, thank you. I will bring in the other witnesses before we open this further. That was a very good context setting.

Can I ask the other witnesses, starting with Nina, how feasible do you see it to exploit these resources? What are the main barriers to prevent it from happening?

Dr Skorupska: As the REA, we have represented deep geothermal technologies for quite a few years. The barriers are finding that support mechanism that would effectively unleash the capability. We produced a report in May 2021, by Arup, talking about the economic benefits for the technology. With Arup's views, we highlighted 12 heat projects per year over the next 30 years. We have just heard about what the capacity could be. The UK could expect to generate up to 15,000 gigawatt hours of heat annually by 2050.

To focus on the areas where we are highlighting the importance of decarbonising heat, this has been a technology that has missed the boat several times in terms of getting the right support. The non-domestic RHI never really fulfilled the ability to support deep geothermal heat. We missed the boat there. In terms of deep geothermal power, the CFD mechanism over the past few years has never allowed the technology to be supported and to take off. These are the things we are asking for and have made the case for in our report, which I would be happy to ensure you receive a copy of.

Q10 **Chair:** We would very much like to see that. I am sure we will get an explanation from other colleagues as to why that is the case. Perhaps Gareth can indicate, from the Coal Authority's point of view, if you have much of the shallow capacity, why has that not yet been exploited?

Gareth Farr: Thanks for the question. As Corinna illustrated, most of the coal workings across Great Britain will be classed as a shallow resource, say, 0 to 500 metres as a ballpark figure. There is some good news, in that we have started facilitating and working with local authorities and private companies to realise this resource for heating, and it only does heat. We are not talking electricity here from the flooded mine workings. There are plenty of schemes in construction in the north-east, with one heat network scale scheme.

I would echo previous comments. It has been noted that the loss of the renewable heat incentive perhaps caused a little bit of a trip in the momentum, and the contracts for difference is also something we have mentioned that could be useful if it could be applied to heat. There is a resource there and it is currently being explored.

Q11 **Chair:** In both cases they have not been eligible for any of these support mechanisms.

Gareth Farr: The support mechanisms that are working currently are green heat network funds and H-Net as well. Those have been successful in providing funding, particularly, to a scheme in Gateshead being run by the Gateshead Council, which will be a flagship mine water heat network scheme.

Q12 **Chair:** We will come on to more questions around that. Finally, from me, Ryan, could you indicate what have been the barriers thus far in getting your projects off the ground?

Dr Law: If I talk to our main project, the United Downs Project in Cornwall, which is the UK's first power geothermal project. Ultimately, for all these projects, it is a balance between risk and reward. It is not dissimilar in a way to the oil and gas industry and how that has developed over the last 100 years. At the point we are in the UK for electricity generation, it is very highly balanced towards the risk side and very little on the reward side. For electricity, we struggle to fund this project because it is the deepest well in the UK. It is 5.275 kilometres, and we had to go pretty much down the grant funding route to achieve that.

On the reward side, for electricity the CFD structure at the moment has a reasonably reflected price for geothermal electricity, but, because it is an auction structure, there is no guarantee you will achieve that price. Therefore, we very much struggle to present to investors. As we are now in the process of running through planning permission for four other sites, it is very hard to present them with a coherent point of view of what the revenue is for a project, because we cannot guarantee a revenue under the current CFD structure as it stands.

There is no dedicated minima for geothermal so we are lumped in with an auction pot that at this point in time we cannot compete with. Right now, we have argued strongly for a minima for geothermal electricity projects to enable us to point to a coherent revenue stream for investors.

Chair: That takes us neatly to the questions from Sir Christopher Chope.

Q13 **Sir Christopher Chope:** Dr Law, you are doing four other projects. That is really exciting, similar to the one you have at United Downs.

Dr Law: United Downs was always a demonstrator. We wanted to prove that electricity could be generated in the UK and we have proved that, and we will go online next year. It was always our intention to develop, fund and increase the size of the next projects, but the revenue streams are a problem. There is no clarity on CFDs and there is no subsidy for renewal heat either.

Q14 **Sir Christopher Chope:** To what extent are those projects you have in line being supported by the private sector, or are you dependent upon grants? If so, what percentage of grants would you need to make them viable?

Dr Law: At the moment they are supported by the private sector, but that is to take us through planning permission. To enable us to drill all the deep wells, it is a substantial investment that private investors are very willing to take on. We will submit these projects into the next CFD round but, if there is no minima for deep geothermal, it is highly likely that we will not achieve the deep geothermal strike price and then we will not be able to privately fund the projects.

Q15 **Sir Christopher Chope:** Looking back at the United Downs project, if you were starting from scratch again now, would you be able to make

that viable?

Dr Law: I very much doubt it. Because it was the first project, we needed grant funding to enable that deep drilling to occur. We had to prove the resource functioned in the UK first before we could leverage 100% private funding into a project. That was a unique demonstrator that could only be part-supported by the public sector. The private sector would not have taken 100% of that risk.

Q16 **Sir Christopher Chope:** You refer to the issue about planning. The new Government is very keen to streamline the planning system so it does not impede investment in key projects. Can you give us an indication of how much time or expenditure is involved in planning for these four new projects and, if the Government were able to say that you can get planning consent without having to go through any processes, would that make any difference to the viability?

Dr Law: I do not know how detailed this picture is, and I do not know if you can see the wrinkles on my forehead from the last 12 months of trying to get through planning permission for these sites. Theoretically, our first site should be approved on 15 September when it goes to the strategic planning committee in Cornwall. That is next week. It has been an extensive—maybe "battle" is too strong a word—administrative process to achieve something that we feel is very much now in the national interest. I think any assistance to enable or help reduce both the uncertainty and the timing would enable projects to move a lot faster, because we started this process over a year ago and have already spent £500,000 on it.

Q17 **Sir Christopher Chope:** We are talking not just about public sector funding but also reducing the burden of public sector regulation.

Dr Law: Yes. I think that would help no end, because it is difficult to find sites that are suitable to do any sort of project, whether it is wind or renewable, so it takes a long time to find them. You need road access, grid connections, and maybe we will talk about grid connections later in this session. A lot of work goes into finding suitable sites. Then to have the burden on top of an unknown planning process, which can be delayed in some sense by even species that need to be moved from one corner of the site to the other, makes it difficult. It adds another level of uncertainty to a project.

Q18 **Sir Christopher Chope:** Can I ask the other witnesses: do you think there is enough financial support and do you support the plea for less regulation in terms of planning on these issues?

Dr Skorupska: Those are two very different questions. What the sector is looking for is a fair and level playing field, along with all other forms of renewable technologies and other clean technologies, to have a market instrument in order to support and persuade further investment into that. However, grant funding only takes you so far. We have some clear economic numbers to say, "Well, what could that be?" For planning,

every form of generation struggles to establish a clear path through in getting planning given to that. Whether it is onshore wind, solar, a gas-fired power station, there are hurdles that you have to overcome, so streamlining those planning processes obviously would be very welcome.

For deep geothermal, the locations of which are linked to the geological capabilities of what there is to offer, but we are fortunate that there are 12 projects ready to go that, if they had the support, could deliver renewable heat and some power by 2025.

Q19 **Sir Christopher Chope:** Have you set out somewhere what that support is and how much you need?

Dr Skorupska: In terms of the geothermal incentive that replaces the renewable heat incentive, which then paid an amount of money to cover that generation, that would give the investor community certainty to overcome that risk and take a project forward.

On a CFD, it is absolutely about having a minima because the costs that are coming through from different projects would compete with the other innovative projects, like tidal. It would come inn lower in terms of cost for that, and we have all that detail I could send to you in the report.

Q20 **Sir Christopher Chope:** Mr Farr, do you agree with what has just been said about that or do you have your own perspective?

Gareth Farr: I can only speak on the mine water heat side of things. Some of our planning constraints are less strenuous than for deep thermal wells. Based on the schemes we have facilitated, allowing these things to progress would only aid the local authorities and organisations who want to build them in reasonable time frames.

Q21 **Sir Christopher Chope:** Dr Abesser, how would your proposal for having a risk-sharing scheme pan out in the circumstances we have been describing?

Dr Abesser: This comes from talking to the industry across Europe where these schemes are seen as essential to overcome the uncertainties presented by the geology, and until you have your first well you do not know what your temperatures and flows are. The risk-sharing schemes are intended to give investors the confidence that, if things go wrong, it will not be all their money going down the drain but there will a share.

What was quite obvious in Europe is that it is really just needed until the geology in that reservoir is better understood. It is the very first wells—like those that Ryan drilled—that bear most of the risk, because no-one has been at depth so the geology is not understood and, specifically, the properties you need. We call it permeability, which is how quickly the water can move through the rock, and also the temperatures.

An example is Munich, where this is now the deep aquifer beneath Munich that supplies most of the district heating now with the aim to be the sole

source for district heating by 2040. It was the first wells that demonstrated that there is fluid down there at the right temperature and it can be brought to the surface to operate district heating. Once the first few wells were down, the industry took over and the insurance incentives were no longer needed.

Q22 **Sir Christopher Chope:** You reminded us of the one in Southampton, in my then constituency. That is still operating. Is that making a big profit as a result of the investment there?

Dr Abesser: I think that is a question for the operators. The well is still going. I am aware that the pump had to be replaced after 30 years, which can be expected. It is still part of a larger district heating scheme but there are other sources in there, so you would have to speak to someone in Southampton for details on what the profits are on that well.

Q23 **Chair:** On the Munich example, can you give some other examples—perhaps you have in evidence but I do not know in my head—of the kind of supports available in other countries in Europe for this?

Dr Abesser: I have just done a review of this. The countries I reviewed are the Netherlands, France, Germany, Switzerland and Denmark. All these countries have an insurance scheme in place for risk-sharing, and they take different formats.

Q24 **Chair:** Government private insurance schemes.

Dr Abesser: The private ones were shown to fail during early market stages, so the ones I am talking of are all publicly funded by government, either regional or national government. The scheme in Germany is they offer a loan for drilling and building the infrastructure. The loan can be extended to cover additional drilling that is needed if the well isn't producing the flow. The example of Munich is that, for heating projects, all geothermal heating projects have been successful but in some cases they needed to drill a bit deeper or divert the well slightly to get the flows. That is what will be covered by that insurance.

The Dutch have a white-out insurance scheme along with a type of feed-in tariff, so the geothermal industry has access to both a tariff as well as an insurance scheme. The Swiss have gone right out with all the things you could get. You get grants, feed-in tariffs and insurance schemes and they vary for heat and power. They are adjusted to the costs that projects face, so there is a lot of learning.

Q25 **Chair:** Does anybody collate this information? Does the REA provide international—

Dr Skorupska: In our report we make reference to the British Geological Survey study about all the schemes that are available.

Q26 **Chair:** Is there a body of international comparisons you might be able to provide to us?

Dr Abesser: Yes, the latest piece of work needs to be written up in a way that I can publish. It was for a client.

Dr Skorupska: In the REA report we have a few references that would compare and contrast.

Chair: Sorry; I am eating into Barry's time, which will not be popular.

Q27 **Barry Gardiner:** Mr Law, if we look at the strike price for geothermal, I think it is the fourth lowest in pot 2, which is where it comes under. Yet, Eden was unsuccessful and there are tidal stream projects that had a higher strike price that went ahead. How do you account for that?

Dr Law: It is a very simple part of the mechanism. Even though the mechanism is theoretically an open auction there are technologies that have a ringfenced pot within pot 2, where they are guaranteed their strike price. That is exactly what we are arguing for, which is a ringfenced pot for deep geothermal where we are also guaranteed our strike price when we bid in for the CFDs. Tidal received its full strike price because it had a ringfenced pot.

Q28 **Barry Gardiner:** Great; that is really clear—thank you. Presumably, one of the recommendations that you would like to see from this Committee is precisely that: that there should be a ringfenced pot for geothermal?

Dr Law: We have been arguing for that for some time. We did not achieve that in the last auction. We would very much like to achieve that in the next auction.

Q29 **Barry Gardiner:** What price have you agreed to sell power from the United Downs project at?

Dr Law: How long do we have? I will try to reduce this. When we initially set a PPA price it was probably about four years ago. Recently—

Q30 **Barry Gardiner:** Sorry, just for people who may not understand, could you flesh out PPA?

Dr Law: Yes, absolutely—power purchase agreement, which is any agreement between an electricity generator and what is called an off taker, such as a utility company. More recently, over the last quarter, particularly the last month, we have been re-evaluating and are looking at much shorter-term power purchase agreements because of the fluctuation in the energy price. I do not think we need to discuss just how much that has increased in the last quarter—everybody knows it—but for short-term power purchase agreements, the price is now much higher than the theoretical strike price for deep geothermal.

Q31 **Barry Gardiner:** I am going to ask you again to do a little bit of explanation in terms of what a levelized cost is, just so that everybody who may be watching from the public understands. What levelized cost do you think would be achievable in a mature UK market?

Dr Law: If we are explaining levelized costs, effectively, it is the cost per either kilowatt hour or megawatt hour over the lifetime of a project. Geothermal is interesting in that it has a relatively high upfront cost, but it does last for a very long time. Even though we pay quite a lot to develop a project over the long term, the price per unit of electricity is relatively low.

Probably the best example is Iceland, Italy or the United States of America, where they have been operating geothermal power for over 60 years. Within the US at the moment the levelized cost per kilowatt hour is about 4 cents per kilowatt hour. The exchange rate has changed dramatically, so probably 3 pence per kilowatt hour now. That is a mature industry.

Q32 **Barry Gardiner:** That is helpful. Mr Farr, do you have an estimate of the levelized cost of geothermal heat from mine installations?

Gareth Farr: The short answer is I don't personally. We are facilitating these schemes going in, but there are two case studies that allude to what work has been done before. One scheme is at Seaham Garden Village, where we plan to supply heat from an existing mine water treatment scheme, where we bring heat to the surface. A report by Sustainable Energy in 2019 suggested the heat could be provided to 1,500 new build homes, which are being constructed by Durham County Council, at 5% below gas price at the time.

Another project that is more advanced with pipes in the ground, as I like to say, is at Gateshead. There is a similar statistic on its website, albeit both of those figures were done before significant changes in the fuel prices, so they may well be better. It gives you a ballpark.

Q33 **Barry Gardiner:** To all members of the panel now, do you think that geothermal projects in the UK are able to provide heat and power at a competitive price to the consumer in the near future and of course at a reasonable cost to the taxpayer? Maybe Dr Skorupska.

Dr Skorupska: Yes.

Q34 **Barry Gardiner:** Would you like to put on to that "yes" any explanation of what conditions the regulatory framework, the Government might be able to put in place that would help them achieve it more quickly?

Dr Skorupska: I think we are in extraordinary times, so the case that we made even just a year ago for supporting deep geothermal heat production stood on its own feet, but the companies were not ready to take advantage of the closure of the non-domestic RHI. It was going to be able to break through, but the closure of it—

Q35 **Barry Gardiner:** Renewable Heat Incentive; I am conscious of people who may be watching that do not the mnemonics.

Dr Skorupska: I perfectly understand. Again, it is around the opportunity and the financial rulemaking in the markets that the

Government are supporting, which would enable—as we have just heard from Dr Law—deep geothermal power to compete and deliver. It needs that financial support and certainty to overcome that risk perspective.

At the moment it would come well under any cost linked with heat or fossil gas—well below. It was below last year, but it is going to be well below now. On the power side, what do you want to compare the CFD strike price to what deep geothermal could achieve for a dispatchable form of power as well, which does not need carbon capture and usage and storage added on to and so on? The way that we price the power market means it has limited marginal cost in terms of that power on the megawatt hour.

Everything is pointing in a positive direction that the Government should enable us to use this locally developed, produced renewable energy now that people can take part in. The interesting thing will be the planning and also connecting up with heat networks. For power, it is straight into a power and connect into the grid system. That is always a challenge for any distributed power generation. For heat it needs a distribution network, and the Government are focusing on that, but it is now connecting all those dots.

Dr Abesser: Perhaps to add a bit of the European perspective. From what we have seen it was the long-term availability of incentives, and whichever they were, the importance was that the industry could rely on them being available while they are going through planning processes, and they are still available when their plant is operational in terms of the power. The other one was that there was a clear—

Q36 **Barry Gardiner:** What tax incentives are there in relation to the development costs of new geothermal?

Dr Abesser: In the UK?

Barry Gardiner: Yes.

Dr Abesser: Ryan might correct me, but I think there are not any, as far as I am aware.

Q37 **Barry Gardiner:** There would be, of course, for new oil and gas development. There would be for fracking, but you are saying there is none for geothermal?

Dr Abesser: Not to my knowledge.

Dr Skorupska: I am trying to think. They are just grants.

Dr Law: There is some standard industrial research and development tax rebates, but nothing specific as related to the oil and gas industry.

Q38 **Barry Gardiner:** Would that be a recommendation that this Committee might make, that it should at least be on equal terms?

Dr Law: At least, yes.

Dr Skorupska: At least.

Q39 **Barry Gardiner:** What about the insurance, Dr Abesser, that you mentioned was happening in Switzerland?

Dr Abesser: There is no scheme of that kind in the UK.

Q40 **Barry Gardiner:** Again, would that help the industry to develop more projects?

Dr Abesser: I believe it would. Another recommendation that I think I could make is, as I said before, our knowledge of the resource dates back 40 years and, while the geology has changed dramatically, I think we now have much better techniques to characterise where the sweet spots are. Some investment into data collection, and ultimately it will have to be drilling at some point to verify the predictions could be very useful as well, really just to help developers to see where opportunities are. It could be local councils who will not have a geologist to see where to go for their district heating network.

Q41 **Barry Gardiner:** We have a cheap, very long-term, renewable, non-polluting supply and we just need to ensure that we enable it to come to market?

Dr Skorupska: Correct. I could not have said it better myself.

Chair: Thank you, Barry. We have a quick question from Claudia Webbe before moving on.

Q42 **Claudia Webbe:** To follow on from the last point that Barry made, in the sense what you are talking about is a locally produced, locally supplied, efficient form of energy. What I am hearing is the difficulty is about how you measure that in today's economics. The benefits of that can hardly be measured in the economic world of today monetary-wise. Because there are other ways in which authorities are producing locally produced district heat networks up and down the country to what extent are you networking and engaging with those?

For example, the ground source heat pumps that derive from water heat or even in London with the underground waste heat and use of that. To what extent are you networking to bring value to these cost arguments?

Dr Skorupska: In terms of the comparison with other technologies, it is not a case of an either/or. It is an "and", and working with the local authorities. For instance, Stoke are ready to sign the agreement of connecting up their plans for a heat network with one of our member's projects, but they literally just missed the window of the Renewable Heat Incentive support mechanism. It was a calendar issue. The project would have gone ahead based on that support mechanism and pulling all the dots together. That is a case of showing what is the appropriate delivery of a project that suits local requirements.

First, it is to make the local governments aware of what resources they have, which is part of the studies that the British Geological Survey are showing, and then working with developers like our members, who are willing to bring those projects to bear and then tie them up with where that particular type of heat or power suits an industrial setting, a commercial setting, a new build setting, that takes advantage of that type of heat opportunity.

It is bespoke. I am very aware of the London opportunities and the Southampton ones, and they are all fitting in with what is required and what can be delivered most cost-effectively. It is putting the case and allowing the local authority to choose what is the right approach, but unless we have the framework to enable this technology to come forward, they do not have it as a comparison to consider it. That is the action that we are asking for the Committee to go forward, to help enable those support mechanisms to give deep geothermal that chance to deliver.

Dr Abesser: If I could add to that. BEIS is asking us for data on costs for the schemes so that they can advise local councils if it is a cost-effective option. We are not at the point where those data exist in the UK, so having that early support to understand the economic case of a deep well for heating, when the value streams come together, then there is better decision-making by local councils. At this point they would have to take our word for it that it is a good option. They cannot work it out on paper.

Chair: Again, international comparisons might be helpful in informing that work.

Q43 **Ian Levy:** I will direct my first question to Mr Farr. I am the Member of Parliament for Blyth Valley. I do not know if you know the area that well, but we have a lot of mine workings that are disused now. To put it on the record, I do know that Northumberland County Council is seriously looking at how we release that heat from the mine workings. What sort of economic benefits do you expect from water geothermal systems to bring to former mining towns and cities the likes of Blyth Valley?

Gareth Farr: That is an excellent question. To put the larger resource into context, we estimate that one in five of the addresses in the United Kingdom is upon the wider coalmining reporting area. Although we have not narrowed down how many of those could use mine water heat, one of our recommendations is that, of course, we could work to that point and lots of stakeholders, like your good self, ask us where the opportunity is. One thing holding us back is potentially opportunity maps. It sounds simple, but that is something that we could deliver.

The obvious economic benefits are that as we transition to low carbon heat people will need to have jobs in the renewable sector. There are a couple of us sitting here, but also all the way down to sorting out the servicing of the heat pumps, installing of the bore holes.

There are wider socioeconomic benefits as well and you have these strong historic mining areas, such as the Blyth area. It connects people to their recent history or further back history, and it does allow for a sense of pride in their place and a way of seeing some carbon redemption for what was a higher carbon intensity thing. You do find that people have a lot of pride in these things. It is also the memory of these structures that people took a long time to make and can be reborn and have an afterlife or a future life.

Q44 **Ian Levy:** They are part of the community and to see that grow again and develop heat would be fantastic.

Gareth Farr: It is a big story and I guess there is value across the board from social to financial.

Q45 **Ian Levy:** If I could spread that question out a bit further to the rest of the panel, levelling up is very high on the agenda now. Barry has touched on a bit of what we could do to support or what support is not there. Do you see this as being a levelling up agenda that we could push with, and if so, what support could be given by the Government in the way of policies? Is there anything we could do right here that could support you?

Dr Abesser: In terms of opportunities, from a geological point of view, we have a lot of overlap between the geology, including coalmines, and big cities in the north-east and north-west. It would certainly link up well with the geology, the levelling up agenda.

Something in terms of heat development that I think is holding geothermal a little bit is that you would need a heat network. Those two developments almost need to be linked up and it is good to see that the Government are supporting heat networks and making sure there is sufficient support for those. The geothermal source and developing that without the heat network will lose a huge amount of the benefits that could be gained.

The point that previously was made, for many of the areas we have some data, but it would need a bit more investigation to tickle out the sweet spots as to where the best areas are in terms of the geology and linking up into cities.

Dr Skorupska: In our report, and taking it into the round of what we do understand, the forecast is that growing the deep geothermal sector and supporting this industry we could have about 10,000 jobs and a further 25,000 indirect jobs. The interesting part of the jobs is that, for example, last summer I had eight webinars talking to the professionals of the oil and gas sector about their fear of what that would mean for them in the future if renewables was the only future. We emphasised that we needed those skills to be transferred over, to be able to develop them and grow them in all these different areas. The deep geothermal industry benefits from all that expertise of geochemist, geoscientist.

Dr Law: On that, on the levelling up agenda and particularly talking about deep geothermal, the United Downs site where we have developed this project is within a whole area called United Mines in Cornwall. That used to be one of the richest square miles on earth because of the intense amount of mining that occurred, because of the minerals in the rock, and one of the reasons we are developing deep geothermal technology within those areas again is because of that unique geology. When we were developing that project these old mining areas have become incredibly depressed. Everybody thinks that Cornwall is just a marvellous place to go on holiday.

The whole central spine is very underdeveloped and has a lot of poverty because of all the jobs that were lost when the mining industry collapsed. When we started the project, we were quite careful to track how much we would spend locally, and we ended up spending over £2 million within a 10-kilometre radius of the site. These are all decent jobs, everything from construction through to technicians.

There is a great agenda because of the links between, whether it is mining for heat or power, that link between geology and what we did in the past and what we can probably achieve in the future. Very strong links and the more encouragement we can get to develop the whole spectrum of the geothermal industry the better.

Q46 **Ian Levy:** I am very keen to meet up with you later on. As I said, I am meeting up with Northumberland County Council to move this agenda forward.

Gareth Farr: You are very welcome to. I would be delighted.

Q47 **John Mc Nally:** This is a question for Gareth. I am particularly interested in the management of wastewater taken out of the coalmines, particularly given I am MP for part of Falkirk and Central Scotland. I know that is a costly and constant cost for the local authority in the work to pump out the mines, I believe somewhere between 15 degrees C and 20 degrees C.

Discussions that my colleague had, the MP for Dunfermline and West Fyfe with the University of Strathclyde, suggested that we could be utilising saltwater for a district heating system, as we have mentioned earlier. Could that be linked to solar farming to increase the temperature so that we could then superheat that water, put it back into coalmines so that it could be kept as a store for the colder months, particularly in our area? Is that technology already developed?

Gareth Farr: That is a brilliant question. Thanks, John. First, the Coal Authority do pump and treat water in over 70 mine water treatment schemes across Great Britain and where suitable of course we can use that water to harness heat, as you described. We would welcome that.

We have talked a lot about power and heat today, but the other side of heat sometimes is heat storage or cooling and the large anthropogenic or

humanmade structures like coalmines, but also other geologies, but that is outside my remit. What coalmines specifically and geology per se offer is that it could be used as a geobattery or a thermal store. Have we done that in the UK yet? In the coalmines, no, but the BGS's UK test bed in Glasgow is testing that out, but it has also been tested in Germany and elsewhere. We are discussing with large commercial partners the potential of doing it at scale. It would be exciting to use the ground as a large thermal battery in whatever geology.

Chair: We are now going to move to Cornwall with Cherilyn Mackrory.

Q48 **Cherilyn Mackrory:** I am aware that we are trying to finish quite quickly, so I will do this bit quite quickly. For the record, I am the local Member of Parliament for where Dr Ryan Laws' geothermal United Downs site is. I have stayed well clear of any funding and planning questions today.

Can I start with Dr Abesser? What I can do as a local constituency MP is talk about the perception of what might happen with any seismic activity compared to what really happens. Can you outline for the Committee industry-wide what we can see with seismic activity?

Dr Abesser: There is a possibility that geothermal operations induce seismicity, so cause small earthquakes. The seismicity effectively is a rapid movement of fractures in the deep subsurface because of the water injection. It is not specific to geothermal, so other industries such as oil and gas or wastewater injection all induce small events.

As you probably know from Cornwall most of them you will not feel at surface, and I only have numbers from Eden Geothermal who in doing their testing monitored their site and observed 300 events, but really only one of those was heard and felt. I do not know if you heard or felt it.

There is that risk, but it can be mitigated against by measuring the seismicity throughout any activities and then monitoring it constantly and taking actions accordingly by stopping operations or reducing waterflows or the like.

Q49 **Cherilyn Mackrory:** Would you say a unified regulation framework is necessary to help with these issues, bearing in mind there are other industries that also must cope with this?

Dr Abesser: Consistency will help regulation as well as public perceptions.

Q50 **Cherilyn Mackrory:** Ryan, can you explain some of your real-life examples and the engagement you have had with the local community around this issue? As I say, perception is often different from what people write to me about.

Dr Law: Yes, so as I think you probably know at United Downs, we did a very extensive education and community engagement operation. The principal part of that was education, starting at primary schools through

to universities on what geothermal is, but also what induced seismicity is and how it occurs throughout the world and throughout the UK constantly.

We also installed some very smart devices in some of the local schools to get the kids very excited about monitoring seismic activity throughout the world in real time, and then when it came to running injection tests at United Downs, we did cause probably over 1,000 induced seismic events. I think one of them was felt at the surface, but again proved to be similar to Eden. We had a very tightly controlled monitoring network in place and most local residents did not notice a thing.

Overall, the strongest part of what we did was to engage as many people as possible in the process. It is more lack of knowledge that creates fear of something that will never cause any damage anywhere in the UK and may occasionally be felt. We must do that on all of the next sites for planning, the same engagement process, the same education to make sure that people understand what it is that we are doing.

Q51 **Cherilyn Mackrory:** Can you expand on any other environmental issues that you have had to deal with and what technologies you used to mitigate those?

Dr Law: Yes, we have not really had any other environmental issues. We have to deal with the fact that when we are developing the wells 24/7, we have to drill day and night so be very conscious about noise control and how we manage that to ensure that we stay beneath all regulated levels and we did that at United Downs and I think we had one complaint on noise over a seven-month drilling operation, 24/7. That was because a truck left its reversing bell on.

All of these either environmental concerns or specific geothermal concerns can all be managed. They are all part of a development process. The key thing with any site, because United Downs is one but there are many others, is to engage the community in the process. There is nothing specifically difficult that we cannot manage.

Q52 **Cherilyn Mackrory:** Mr Farr, slightly different issues that might come from your work, which is the climate risks of subsurface methane escaping into the atmosphere while extracting water, and also whether there is a risk of subsidence if water is not returned to the subsurface reservoirs.

Gareth Farr: The useful point to make is of course that drilling into abandoned mine workings for the purpose of removing water is not new. You will be glad to know that the Coal Authority have been doing it for decades to maintain mine water levels to protect drinking water aquifers. As part of that we already have good guidance on how to mitigate gas risks and I am pretty sure that the HSE will deem all boreholes drilled into the coalfield to have appropriate risk measures in place.

The same goes for subsidence. Of course, with a lot of these mine water heat schemes they are not consumptive, so we are taking the water out briefly and putting it back in, so there is no change for the most of them in the net balance of the water resource in there. We are not continually dewatering for these heat schemes.

Those risks are there, and they are mitigated via our permitting and heat access agreement approaches. I should say for all the movement of water extraction from underground the environmental regulator, whether it be the EAC or NRW, are also involved and we work closely with them to make sure that every activity is done to the highest possible standard.

Q53 **Duncan Baker:** To be quick I will cut across Dr Law and Mr Farr and ask as a collective question, clearly schemes such as these are going to have enormous regulatory, compliance and licensing implications to get any such projects off the ground and running. In your experience, Dr Law, with what you have done with the United Downs deep geothermal power project, can you give us a sense of how difficult it was and the regulatory and licensing issues that you came across and then equally, Mr Farr, your experience with mine water geothermal?

Dr Law: The United Downs was not as difficult as you might think because it was the first project in the UK to run through planning permission and the UK is a bit of an outlier in the sense that it does not have a licensing regime for geothermal. Geothermal, unlike pretty much every other country in Europe, does not have the equivalent of an oil and gas licensing scheme, where you can effectively buy licence areas.

Because there were no licences and because it was the first one the process of permitting was only arduous because we were creating new processes as we went along, so we had to deal with the Environment Agency in terms of drilling the well and we had to work closely with Cornwall Council on what conditions would be required under a planning process. However, that was an outlier because it was the first one.

For these current sites that are running through planning now it is becoming much more difficult, and I do think there is more of a need to have a coherent, defined strategy for how planning should be treated for these projects.

Q54 **Duncan Baker:** Mr Farr, same question and how can it be simplified in terms of the regulatory and the licensing? Dr Law is saying that it is not as complicated as perhaps initially thought. When you are dealing with mine water geothermal schemes can the process of getting those up and running be simplified and what are the challenges ahead for people?

Gareth Farr: Similar to what we have just heard, the processes are in place but at the moment a client must apply for the water resources side of the things from the regulator and the permits to access the workings from the Coal Authority, as we own them. We are definitely working closely with the regulators to try to make these things as smooth as

possible. Can they be better? Things can always be better, but we are certainly working towards that point.

One thing we are trying to do is to ensure these things are sustainably licensed, so you do not get thermal feedback loops between multiple schemes.

Q55 **Duncan Baker:** Lastly to Dr Abesser, we have heard in our evidence sessions before that the biggest issue that people have come across is that heat is not considered as a natural resource. Many have called for it to be licensed as a natural resource, so what effect would that have on the regulatory treatment and investor confidence in geothermal technologies if heat was deemed a natural resource?

Dr Abesser: Are you asking if it was licensed would it increase confidence?

Q56 **Duncan Baker:** Yes.

Dr Abesser: Again, I draw on what I have seen in Europe and what I have heard from the industry in the UK. I believe it would increase investor confidence because you have an amount of heat you can draw down over time and by the licence you are ensured that no one else will come and set up a scheme next to you and steal your heat.

Q57 **Chair:** Thank you, colleagues, for tightening up. I have one final quick question for Dr Abesser. I know that the British Geological Survey has done work in 2013 on assessing shale gas reserves onshore. Has there been any work done since then in assessing reserves?

Dr Abesser: No, there has been no national assessment of reserves or update of the work that we have done in 2013. There are smaller studies in the UK looking at certain areas and I believe they are going to be published next year. BGS had some involvement in those as individual scientists, but not as an organisation.

Q58 **Chair:** You were asked to do some work for the Government as you referred to earlier on the seismic impact. Has that been published yet?

Dr Abesser: No, we were asked by BEIS to produce a report on new evidence on the risk associated with shale gas development and that report after external review has been submitted to BEIS and it has not been released. Any questions should be directed to them.

Chair: We will be asking the Minister about that when he appears before us. I would like to conclude this session by thanking our witnesses, Ryan Law for taking time out of your exotic holiday on a lighthouse. We look forward to meeting your colleagues later in the week in Cornwall. I thank Gareth Farr from the Coal Authority, Dr Corinna Abesser from the British Geological Survey and Dr Nina Skorupska from the REA.