

Environmental Audit Committee

Oral evidence: Small modular reactors in the transition from fossil fuels, HC 281

Wednesday 13 December 2023

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Members present: Philip Dunne (Chair); Caroline Lucas; Dr Matthew Offord; Cat Smith; Claudia Webbe.

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Witnesses

I: Tom Greatrex, Chief Executive, Nuclear Industry Association; Dr Gareth Headdock, Chief Science and Technology Officer, National Nuclear Laboratory; and Matthew Rooney, Head of Policy, Institution of Mechanical Engineers.

II: Simon Bowen, Chair, Great British Nuclear; and Donald Urquhart, Executive Director of Regulation, Office for Nuclear Regulation.

Written evidence from witnesses:

[Nuclear Industry Association](#)

[National Nuclear Laboratory](#)

[Institution of Mechanical Engineers](#)

[Office for Nuclear Regulation](#)

Examination of witnesses

Witnesses: Tom Greatrex, Dr Gareth Headdock and Matthew Rooney.

Q1 Chair: Good afternoon and welcome to this Environmental Audit Committee oral inquiry, where we are taking evidence as part of our technical innovations for climate change sessions. Today we are talking about the opportunity and challenges around small modular reactors in nuclear energy. I am delighted to welcome to our first panel—formerly of this parish—Tom Greatrex, who is the Chief Executive of the Nuclear Industry Association, Dr Gareth Headdock, who is the Chief Science and Technology Officer of the National Nuclear Laboratory, and Matthew Rooney from the Institute of Mechanical Engineers. You are all very welcome.

We have just concluded COP28, where there was a declaration to encourage the development of nuclear capacity to provide baseline energy for a number of countries around the world, including the UK. Tom, could you set out why you think there is an important role for nuclear as we decarbonise the global economy?

Tom Greatrex: Thank you, Chair. I should say that I have a bit of a cold and my hearing is a little bit impaired. If I need to ask you to repeat, I hope you will bear with me.

What happened at COP—not just the declaration that was signed on 2 December, in which 22 nations, later joined by a further two, pledged to triple the amount of nuclear capacity by 2050, but also the Global Stocktake, which was published earlier today for the first time and specifically cited nuclear along with other low-carbon technologies—is a good indication that a number of nations are looking to nuclear as one of the ways to help meet climate commitments, reduce emissions and increase energy security. Increasingly, that is the case with a number of nations that have previously had positions to either reduce the amount of nuclear in their mix or to not do nuclear any more.

There has been a change in attitudes, partly informed by the reality that getting to a net zero grid and to net zero beyond grid electricity is very challenging to do without nuclear as part of that mix, and partly because in the recent past energy security issues have become more prominent in public policy debates. I think those are the reasons why we have seen nuclear being much more part of that discussion in the more recent past.

Q2 Chair: Germany was notable in going in the opposite direction under its change of Government a couple of years ago. Has the industry seen any signs of Germany changing its position?

Tom Greatrex: This is slightly second-hand because it is based on media reports. With that caveat, I did notice at the weekend that the main opposition party in Germany—Angela Merkel’s party—is now reconsidering its position on nuclear. It has been a position of Germany and some other countries in the EU, like Austria and Luxembourg, to not



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have nuclear in their mix. That does not mean they are not using nuclear power, because the way in which power is transmitted around the grid means that there are times when Germany is using nuclear. Germany burns the most coal of any European economy, and a lot of lignite, as an alternative to nuclear in their mix. Their policy position is that way. There are many other countries in Europe, including France, Sweden and Finland, as well as the UK, which take a different view.

Q3 Chair: The UK obviously has not developed any new capability for some decades. The focus of this inquiry is looking at small modular reactors in particular. Dr Headdock, perhaps you could explain to us what is different between a small modular reactor and the large reactors that are currently under construction at Hinkley Point, and which we presume will be constructed at Sizewell C.

Dr Headdock: No problem at all. Good afternoon, everyone, and thank you for the opportunity to come and speak at this Committee.

Small modular reactors in the UK have a slightly different definition from the rest of the world. In the UK, a small modular reactor is basically a miniaturised version of the gigawatt-scale pressurised water reactor. Those reactors use the same fuel. They are light water cooled and moderated. In the rest of the world, there is a slightly different definition. If you look at the International Atomic Energy Agency, its definition is a reactor that has a power output of 300 MWe or less. So in the UK it is a very distinct category.

We then have another category for advanced modular reactors, which are defined by the use of novel coolants or fuels and generation IV technologies. What we are considering under SMR is miniaturised pressurised water reactors that are capable of being built in modules in a factory environment and then taken to site, assembled and deployed.

Q4 Chair: Does the Government competition running for the design of potential SMRs include AMR technologies, or is it confined to pressurised water reactors?

Dr Headdock: In the GBN SMR competition at the moment there are six technologies being considered, and they are all light water reactor technologies. If I remember rightly, there are five pressurised water reactors and one boiling water reactor.

Separately to that there is another competition, the Advanced Modular Reactor RD&D Programme. That is looking at the development of high temperature gas reactors, which is a version of generation IV technology that has been prioritised through the DESNZ-funded programme.

Q5 Chair: Does the differing definition that we have to other countries have any bearing in the event that we select a model that starts to be constructed and becomes operational here? Is there an opportunity for us to develop such technologies in other countries as well? Is this an exportable technology where we would be ahead of other countries, or



are we playing catch-up?

Dr Headdock: In terms of SMR development, there is absolutely an opportunity. One of the things about the UK nuclear environment is that our regulatory process is seen as a gold standard internationally. That is why there is such huge interest. We have a supportive policy environment, but the UK regulatory stamp is also very important and very valuable. If we develop technology here and deploy SMR first of a kind, that is a very exportable prospect for commercial organisations as other countries look to follow our lead.

Q6 **Chair:** Has the Government been clear about how many designs they are likely to take forward through this competition?

Dr Headdock: I think that is under assessment at the moment. I am sure it will be talked about later, with Simon's evidence, but there are six technologies being considered. Obviously, there has been considerable investment previously in Rolls-Royce SMR, but now there is a process running that is looking at the technical and economic merits of the six technologies listed through the Great British Nuclear process that is currently running.

Q7 **Chair:** Perhaps, in the next panel, we will get on to how that competition is evolving. In terms of other technological uses where a nuclear SMR plant can enable other activities, there are companies that are interested in having the security of supply from nuclear energy to be able to develop things like direct air capture or to generate hydrogen. Is that something that requires SMRs in order to happen, or is it an incidental benefit?

Dr Headdock: That is a good question. There are different use cases for SMRs and AMRs. The beauty of SMR technology is that you can, essentially, take these smaller reactors and build them onsite in packs. You may build four of them at a single site. What that then allows is co-generation. During the day, when you have peak demand for power, you can have the four reactors producing electricity and contributing to baseload. In the evenings, when power use drops off, in theory you could then have two of those reactors doing something else, exactly as you have described—an alternative nuclear application.

Of course, the primary product from a nuclear reactor is heat, and that heat can be used in different ways. That could go to run a hydrogen production facility or, like you say, some form of direct air capture or district heating. You can look at alternative products. The beauty of small reactors is that you can keep the core running at 100% power but switch the application. That is the operational flexibility of having packs of smaller reactors, rather than one big reactor.

Q8 **Chair:** One of the other areas that people are understandably concerned about is the waste product from nuclear processes. Because they are smaller, there is presumably less waste. Is it more manageable, or do the same considerations apply but on a different scale?



Dr Headdock: In terms of the waste from small modular reactors, because in the UK definition they are essentially miniaturised versions of the larger reactors, the waste considerations are very similar. They use the same fuel and very similar core designs. Waste considerations are very similar to a larger-scale PWR. The assessment is that no real difference is expected between larger-scale PWRs and smaller-scale SMRs.

Q9 **Chair:** As the existing fleet runs off, if it is being replaced by a larger number of smaller facilities, does the geological solution remain the same, albeit at perhaps a reducing volume if there is less waste being produced?

Dr Headdock: Yes. When you look at the overall radiological load from waste from a nuclear reactor, 99% of that is in the spent nuclear fuel. Because the nuclear fuel used in an SMR is very similar to what we are used to, for example, from Sizewell B—our only operating PWR at the moment—we are used to that fuel. We know what that looks like, we know how to manage it and we know how to store it. Then it is down to the decision on the long-term, ultimate disposal route. Of course, that is where the considerations for a geological disposal facility come in. SMR development, under this definition, will certainly not add load to that.

Q10 **Chair:** Mr Rooney, could I ask you about the industry capacity to cope with a rejuvenation, if that is the right word, of nuclear fleets? Do we have the engineers to be able to build what the Government intend to do?

Matthew Rooney: We have a shortfall at the moment, and that is not just in the nuclear industry—it is across the whole engineering sector. Engineering UK puts out statistics on this on a yearly basis, saying how many tens of thousands of vacancies there are out there.

One of the good things about the long development time of nuclear fission and small modular reactors—and nuclear fusion, if you go down that route as well—is that you can train people up in time. They could spend their whole career in one facility, developing one nuclear reactor. If we invest in skills now, we can catch up, but we do need to do some work.

Q11 **Chair:** I think this has been an important feature of the NIA, Tom—trying to prepare for the growth. Are companies hiring now, or is there too much uncertainty for the training programmes required?

Tom Greatrex: They are to some extent. Although we have a high-level target for nuclear capacity of up to 24 GW by 2050, at present we do not have a programme. Having a programme is what will stimulate and encourage the supply chain to invest and make serious efforts to get people in place to be able to deliver to that programme. Of course, if you do not have projects to work to, you are anticipating or asking people to make a big jump, which is very difficult to do. Once there is more clarity



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about our programme, I think you will see that the supply chain will be more active in seeking to address some of the gaps there are currently.

- Q12 **Caroline Lucas:** I have some questions on cost, but before I get to them could I pick up the point with Dr Headdock about waste? In written evidence, we have seen research from Stanford and British Columbia that estimates that SMRs would be likely to produce 1.7 times more spent nuclear fuel than gigawatt-scale reactors. Could you explain why that would be the case?

Dr Headdock: You are absolutely right. Then there is the paper from Kim, from Argonne Laboratory in the US, who claims something completely different. Last year, the paper from Crowell caused quite a lot of interest in the calculation or the assumptions that are made in calculating this. There is a lot of debate around this at the moment, and it has highlighted to me that there is not a consensus.

What we are trying to do at the national lab is to understand the assumptions that have been made in those papers, challenge some of those and try to figure out what is going on here, because there is conflicting data. That has opened the debate, but ultimately a lot more work is needed in that area to understand this. At the moment, the information we have suggests that there is no significant extra load in terms of waste products.

Caroline Lucas: There could be.

Dr Headdock: It needs more study, I would say.

- Q13 **Caroline Lucas:** Thank you. Coming on to costs, how do the costs of building SMRs compare to the costs of building conventional nuclear reactors?

Dr Headdock: That is a good question. It is more a question for the vendors than for me, but you can see numbers out there at the moment from the vendor organisations. The number quoted by Rolls-Royce SMR is £1.8 billion for their 470 MWe—

- Q14 **Caroline Lucas:** Having that in comparative terms would help me, because I don't know how that compares to the cost of a conventional nuclear station.

Dr Headdock: The EPR we are building at the moment, Hinkley Point C, has construction costs in the 20 billions. That is expected to drop significantly for the next one, which will be at Sizewell hopefully. It is difficult to compare when you are building the first of a kind versus the nth of a kind because costs drop dramatically.

- Q15 **Caroline Lucas:** From the reading I have done around it, is it not the case that we simply do not know? It was interesting that DESNZ has said that "until SMRs have been deployed commercially it is not possible to test or quantify these potential savings". We do not know if it will be



more expensive or not.

Dr Headdock: You have cost indications at the moment. You are right that we have not built any SMRs yet, so everything is an estimation at the moment.

Tom Greatrex: The only thing I would add is that the proposition on SMR is about economies of volume versus economies of scale. If they are factory-produced modules that are bolted together, there is consistency in the build. You do not build a factory to build one thing in any walk. If you build a factory and you have a series of units ordered, that helps to spread the cost. That is the proposition that makes the cost burden different between a larger-scale reactor and an SMR.

Q16 **Caroline Lucas:** Does that not also make it incredibly difficult to know whether the thesis that this will be cheaper actually stacks up? Unless you have quite a supply chain and a lot of these reactors coming online, you will not know whether you will get lower costs as a result.

Tom Greatrex: Only in so far as you do not know that with any other factory. When you factory-produce, mass-produce or continually produce, rather than one-off each time, all the evidence shows that that reduces cost over that period. Yes, you are right that it has not been done with SMR as yet, but that is the proposition.

Q17 **Caroline Lucas:** Stephen Thomas, the emeritus professor, says that claims that production line techniques could compensate for lost economies of scale is moot and would be expensive to test. He points out that setting up a new SMR assembly line would be costly and would need a significant number of SMR units to be produced in order to prove the case that it would be cheaper. Investing in SMRs to that extent would be financially very risky, and any company seeking to manufacture and sell SMRs would need to establish an entire supply chain to sell the scores of reactors needed to achieve the economies of replication.

Tom Greatrex: That is exactly the same as any other. I know that Steve Thomas is very sceptical of nuclear generally in all his work, but if you were talking about a factory to build a new type of motor vehicle, it would be the same thing: you would not build it just to build one. Investment is required to build the facility to then be able to replicate and build units. You need a number of units to be able to realise the benefits.

Q18 **Caroline Lucas:** That does make it more difficult, because we are not comparing SMRs with vehicles; we are comparing them with static conventional nuclear power stations. To that extent, it is fair to say that it will be hard to make an estimate of which will be more costly, precisely because you would need that supply chain in order to be able to—

Tom Greatrex: A significant amount of the supply chain is the same supply chain for gigawatts as it is for SMR. They need pumps, and they need valves; lots of the components are similar. Indeed, there are some forgings, for example, that could be done in the UK for SMR that could



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not be done for large-scale reactors. Quite a significant amount of the supply chain exists; it is not that you are building it from scratch. I think it is more a discussion around the benefits of large-scale replication. If you are building units one, two, three and four of EPR, by unit four the cost will have reduced from unit one. You are doing that to a greater extent with units of SMR, because you have consistency of build and they are factory-built modules that are then assembled on site, as opposed to the whole reactor being built on site.

- Q19 **Caroline Lucas:** The point I want to get to is that modularity does not necessarily make up for loss of economies of scale. One of the examples that has been given in evidence we have seen is that, if you were looking at all eight orders for the modular Westinghouse AP1000, all of those have gone over budget as well. All I am trying to establish is that there is nothing about modularity that automatically means it will be cheaper than economies of scale.

Tom Greatrex: No, but modularity gives you a fairly obvious degree of consistency in build, and it is well tested in lots of other arenas that using modular construction techniques helps to improve efficiency and effectiveness of build, but you need to have a level of volume of orders to be able to justify the expense of building the factory.

- Q20 **Caroline Lucas:** Exactly. There is a leap of faith you will have to make that there will be enough demand to be worth making that many orders, in order to get your prices down.

Tom Greatrex: Going back to the first point I made, the signals there are, not just from the UK but from around the world, for interest, MOUs and potential orders in SMR are significant.

- Q21 **Caroline Lucas:** You said just now that Professor Steve Thomas is well known for being sceptical and critical of nuclear power. That indeed is true, but I think you would probably agree that the "World Nuclear Industry Status Report" is not hostile to the industry.

Tom Greatrex: No, I do not.

- Q22 **Caroline Lucas:** Let me tell you what they say, because one would have thought that something called the "World Nuclear Industry Status Report" would be—

Tom Greatrex: That is what it is called. If you look at who wrote it—

- Q23 **Caroline Lucas:** Let me just tell you for the purposes of Hansard, so we all know what we are talking about—I have the quote in front of me, and other people probably don't. They say: "small modular reactors, by virtue of the fact that they are designed to generate less electricity than standard reactor designs, will necessarily face greater economic challenges. When compared to large reactors, SMRs will be more expensive per unit of installed capacity and produce more costly power". Which bit of that is wrong?



Tom Greatrex: For the benefit of Hansard, the authors of that report—which I think is an annual report—are a group of nuclear-sceptic academics. There is a World Nuclear Association report that looks at the status of nuclear across the world. The titling of the report you mention is often used to present it as though it is completely objective, and it is not. I just want to make that point. I do not necessarily agree with the conclusions or the statement you have just quoted from that report.

Q24 **Caroline Lucas:** Do you disagree with it?

Tom Greatrex: The point is that if we are going to have small modular reactors as part of our mix or globally, it will be the case that you need a certain number of orders to justify the expenditure in the facilities to build the modules. That is the test. That is what we do not have at the moment. But, as I said before, there is a high amount of interest in SMR technology, not just in the UK, but globally, including among a significant number of the 24 countries that signed the declaration at COP. SMR will be part of their pathways to net zero in the future.

Q25 **Caroline Lucas:** I just want to pick you up on one thing. In answer to the Chair earlier, you pointed to the agreement that was made at COP and said that nuclear will help us to meet our decarbonisation targets. To the extent that that is the case, in your view, in the UK, can you explain this to me? We already have a Government that has a target of decarbonising the power supply by 2035. If Labour were to form the next Government, they would be even more ambitious, with a 2030 decarbonisation target. Given that the soonest that we will get more nuclear power up and running is probably going to be the early 2030s, being incredibly ambitious about it, how does nuclear help us to meet that target?

Tom Greatrex: Getting to net zero is not a one-off point in time in 2030 or 2035. It is something you have to endure. We have a significant amount of nuclear capacity at the moment, which is starting to come offline and will stop generating electricity by 2030 and into the 2030s. You need to replace some of that capacity. It is quite possible that you could have a largely decarbonised grid in 2030 but not in 2032 or 2033 unless you get on and build some more of that low-carbon, reliable, secure baseload capacity that nuclear gives you.

Q26 **Caroline Lucas:** The timing of reaching that decarbonisation is incredibly important. Given that decarbonising the electricity system is one of the easiest things in the menu of stuff that has to be done to get to net zero, the importance of getting that done ASAP really matters, and so the fact that we might get to it later—

Tom Greatrex: It is also the case that some of that low-carbon capacity you might have in 2030, 2028 or 2027 may well not be there in 2035 or 2040.

Q27 **Caroline Lucas:** To the extent that a lot of it will be based on renewables, there is no reason to think that would not still be there, and



indeed more.

Tom Greatrex: You know as well as I do that installed renewable capacity has a generation life, as much as a nuclear power station has a generation life. All of the capacity that we currently have generating low-carbon electricity as we speak today, with the exception of Sizewell B, is unlikely to be generating capacity in 2050.

Q28 **Caroline Lucas:** That brings me on to my last question, if that is all right, Chair. It is about the relative costs of SMRs and other low-carbon energy sources that we have been talking about in comparison with other nuclear. Estimated electricity prices from SMRs have been increasing, and I think that you would agree that there is an awful lot of evidence suggesting that renewable energy will be a cheaper and a quicker way of meeting targets than nuclear.

Matthew Rooney: I could come in on that. We need to talk about system costs because the electricity systems of the future in most countries will be dominated by solar and wind, as they are the cheapest on a levelised cost basis, as you say. As you get to increasing penetrations approaching 100% solar and wind, the system costs increase quite substantially. You need some type of firm power to provide 20% to 30% of that.

Small modular reactors are one option, but they will be competing against other options, such as nuclear fusion, carbon capture and storage, biomass, and large-scale energy storage. Most of those technologies are in their infancy as well. Yes, nuclear will have to compete against other, comparable technologies, but not necessarily against solar and wind.

Q29 **Caroline Lucas:** You mentioned firm power. I will put something to you that Michael Liebreich, the CEO of Bloomberg New Energy Finance, said: "Firm power"—or what is sometimes called baseload, which is a bit different, but it is the same kind of thing—"which cannot be switched off when you don't need it will be as much of a problem as variable power which cannot be switched on when you do." We actually need flexibility and huge quantities of all types that are much more flexible.

Matthew Rooney: Yes, I would agree with that, but I think that nuclear power can play a role. Michael Liebreich himself has suggested that nuclear power could be used to provide hydrogen most of the time, but then be switched to provide electricity to the grid at times of high demand. There are different ways to set up an energy system and an electricity system where nuclear can still play a role, even though the baseload economic model will become increasingly difficult to keep going.

Tom Greatrex: It is also important to note that PWR reactors are perfectly able to, and indeed in some parts of the world do, load-follow. They are not inflexible, and nor are SMR technologies inflexible necessarily. The way you choose to operate them in the system might be



different, but you can load-follow with PWR nuclear, be that large scale or SMR.

- Q30 **Caroline Lucas:** The last point is that, again, in terms of some of the written evidence we have received, a report by Steigerwald et al, 2023, which I expect you are aware of, looked at 15 different scenarios and concepts, and none of the 15 SMR concepts tested by this group of academics was able to compete economically with existing renewable technologies, not even when taking into account variability and integration costs. I want to push you on that. If we are looking at the distinction and choice between renewables and nuclear, renewables are an awful lot cheaper, as well as being quicker.

Dr Headdock: It goes back to points that have already been made. If you look at LCOE for, in theory, competitive technologies, you can make that number equal pretty much whatever you want by the assumptions you make in that calculation.

As Matt said before, if you look at total integrated energy costs, energy systems modelling shows that the more nuclear you incorporate, the more your overall integrated energy system cost decreases. That is because your overall generating capacity drops. Of course, if you have intermittent power, your minimum level is keeping the lights on, so the amount of capacity you have to put on the grid is that much more significant.

- Q31 **Caroline Lucas:** You will have battery technologies and ways of storing—

Dr Headdock: Where I was going with this, particularly around SMR technology, is the point I made before. You can imagine a scenario where you have packs of reactors, and those packs of reactors can do different things. If the different thing that those reactors do happens to be a new nuclear product, if you like, that is storable, that is a complete game changer.

- Q32 **Caroline Lucas:** Is that up and running anywhere? Can we point to that?

Dr Headdock: Exactly. The thing that springs to mind here is that you could have two of your four reactors, whatever it is, doing hydrogen production during low-peak periods, and of course you can store hydrogen—

- Q33 **Caroline Lucas:** But is that being done anywhere? That is my point. These are hypotheses.

Dr Headdock: We are part of a project called the Bay Hydrogen Hub, which looks at nuclear-derived hydrogen—taking the heat from an existing nuclear reactor, coupling that with an electrolysis technology that allows you to produce hydrogen from the heat from the reactor. There are various technologies. In Japan, they are looking at connecting a nuclear reactor and the heat from that to drive a steam methane reforming process.



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Caroline Lucas: Is it commercially available now?

Dr Headdock: It is being developed now. As we sit here now, there is a thermochemical pilot plant in Japan.

Caroline Lucas: It is not commercially available now.

Dr Headdock: Steam methane reforming is, absolutely. It is the way hydrogen is made. The nuclear technologies are available. We need to couple them. There is a lot of research and activity in those coupling technologies to make sure that the downstream process industries that are crying out for decarbonisation are able to take advantage of the new nuclear product, which will be heat.

Q34 **Caroline Lucas:** Like so much in the nuclear debate, it is jam tomorrow—one day we will get to this point where it is will be too cheap to metre and so on, and it never is. This is my very last point. What conclusion would we draw from the fact that the only commercial SMR project in the whole world to actually have a site and a technology that have completed a comprehensive review by a credible safety authority has just been abandoned? That does not give us much hope, does it? I am talking about the one in Utah.

Tom Greatrex: There is one in Darlington, Ontario, you may not be aware of. There is more than one. There is one in China.

Caroline Lucas: There are two, so 50% of them have just been abandoned.

Tom Greatrex: No. There is a different one in China that has just started operating.

Dr Headdock: If you want to talk about hope, I think that we have an incredibly exciting position in the UK at the moment. We have supportive policy, programmes, the technologies that are in the GBN competition, and an AMR programme. It is critical that we get to our first-of-a-kind reactors, which will then allow the fleet deployment to happen in timeframes that can affect our energy security and net zero ambitions. That is happening now.

Q35 **Caroline Lucas:** We also have Hinkley C, which was supposed to cost £18 billion, and which will now cost £33 billion. It was due online in 2017 and it is already 10 years late. Many times we have been told that there is a happy future for nuclear in the UK; it has not happened, and I do not think it is going to. Thank you, Chair.

Dr Headdock: A point on Hinkley. I was there a couple of months ago. There were 10,000 people on site. If you look at the scale of the engineering activities that are being achieved there, it is absolutely miraculous.

Caroline Lucas: Double the price, 10 years late. I rest my case.



Tom Greatrex: It did not start construction until late 2016, so I am not quite sure how it could have been online in 2017. We did not start construction until late 2016.

Caroline Lucas: It was due to be on earlier, as you know.

Q36 **Cat Smith:** I have a couple of questions on regulation and siting. Perhaps I could turn to Mr Greatrex and Mr Rooney first. Could one of you summarise the regulatory processes that nuclear reactor vendors go through?

Tom Greatrex: You might get some more on this from the next panel with the ONR, the regulator, but the generic design assessment for a reactor design is a process undertaken independently by the ONR, for SMR as it is for large-scale reactors. Rolls-Royce SMR is part of the way through that process, and I think that others are entering that process. That is something that any reactor from anywhere that will be deployed in the UK has to satisfy before it can be deployed.

Cat Smith: Do you have anything to add, Mr Rooney?

Matthew Rooney: I do not have much to add. The Office for Nuclear Regulation is in the next session, and they might have a bit more detail.

Q37 **Cat Smith:** They probably know which question I will ask in the next session. Would you share with the Committee what elements make a site ideal for SMR deployment? Are existing nuclear power sites optimal? What challenges do things like climate change—rising sea levels and extreme weather events—pose? Do they pose a challenge when it comes to siting and regulating SMRs?

Matthew Rooney: The first thing is public acceptance. We know that people who live close to nuclear power stations are more accepting towards nuclear power because they might have relatives who work in the nuclear power station, or they might be more familiar with the technology. We know that there are communities around nuclear sites that are being decommissioned, or that have been decommissioned, who are crying out for a new large reactor or a small modular reactor to be sited in their community.

On the longer-term aspect of what makes a good site, these sites can be useful because they have existing grid infrastructure. You do not need to create a whole new grid infrastructure, with pylons and so on, which are not very popular with local communities.

Your point on climate change is a good one, because our nuclear power stations are typically sited on the coast. The large ones, and even the small ones, might have to last 60 years—Hinkley Point C, maybe 80 years. We need to design these facilities to withstand, potentially, 1, 2 or 3 metres of sea level rise if we have the worst-case scenario of climate change.



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Q38 Cat Smith: How confident are you when it comes to worst-case scenario planning that it is going to be enough? I say this because we have examples from the Environment Agency of things like flood defences that were meant to protect the community for 100 years, but that are breached two or three years later. How conservative are you being?

Matthew Rooney: I have not looked into the detail, but as long as the reactors are designed with the upper scale of sea level rise and flooding that we are expecting in the second half of the century, that should not be a problem.

Q39 Dr Offord: I want to build on the discussion you had with my colleague, Caroline Lucas. You mentioned that there are 10,000 people on site at Hinkley Point C. For the construction of something like a small modular reactor we need different people at different times. What kind of skills are required for the construction of an SMR?

Dr Headdock: It starts off as a civil construction project. The initial stage is about preparing the site and the services. It is mainly a civil construction programme. The prospect with small modular reactors is that you then have a very specialised nuclear build within a factory environment. You essentially have a production line with all of the metal joining processes and welding required to make the system components. You transport that to site and put it together. The disciplines that you need flex up and down as you go through the various phases, from civil, to the nuclear island build, through to commissioning and operation.

Q40 Dr Offord: As part of that whole process, different skills are needed at different times. Where would the Government best place investment to boost skills in particular areas?

Dr Headdock: Across the entire construction lifecycle. It is a difficult question for me to answer, but I think there is a general need for continuity. That is what I hear all the time. Making sure that the 10,000 people involved in the Hinkley Point C build have another project to move on to. Continuity from Hinkley Point C to Sizewell, if you speak to EDF, is absolutely critical to maintain those skills. That draws in more people as they see this developing and the benefits that arise from these new nuclear builds.

At NNL, we have seen that there is a huge need to attract the best scientists and engineers that we possibly can for the technical skills required for the nuclear bit. We have seen a stimulation of that recently through the nuclear innovation programme the Government have sponsored. It is across the entire cycle.

Q41 Dr Offord: Similarly with the supply chain, are there any vulnerable areas? Maybe post Brexit, because of the war in Ukraine or for a host of other reasons, are there any problems that the industry faces?

Dr Headdock: It is difficult for me to answer, to be honest. That question is better aimed at the construction companies and the utility.



Q42 **Dr Offord:** Okay. I will move on to Mr Rooney to ask him about the national grid. Is it simply ready to transmit electricity generated by SMRs? What is the specification and extent of the new grid infrastructure required for SMRs?

Matthew Rooney: Like I said on the previous question, if the SMRs are built on existing nuclear sites, a lot of the grid infrastructure should be in place. There are proposals to replace coal-fired power stations with SMRs, where the grid infrastructure would be in place. SMRs and nuclear power stations fit within the existing paradigm of the national grid, so they will require less integration than what we are moving to, which is more solar, more wind, battery storage, and two-directional travel—charging your car and having your car feed electricity back into the grid. That is where the challenge will be, because we need new codes and standards as it is a completely new way of doing things.

Q43 **Dr Offord:** Finally, to all of you, the word “hope” was used a few minutes ago—hope for the industry and a successful future. To someone who is sceptical about the industry, how would you promote confidence in the industry?

Tom Greatrex: I think that you need to start with the need for what we produce: clean power that is not impacted by the weather, other than at the extremities. That is an integral part of any credible modelling of how you get to net zero across the world that many countries—at least 24—have signed up to do a lot more than they perhaps imagined a while ago.

With a programme, you have a very exciting industry with a lot of opportunities for skills development and for economic activity, which comes as a by-product of producing good, clean energy. That is what we need to decarbonise our grid electricity, but also, beyond that, other, harder-to-decarbonise sectors of the economy.

Q44 **Dr Offord:** I accept that premise but, for example, if you came to me and said you would like to build an advanced modular reactor in Hendon, in my constituency, how would you sell that to the people of Hendon?

Tom Greatrex: That the people of Hendon—as the people of the entirety of London, as the people of the entirety of England and the entirety of the UK—need clean, reliable power, and that is a contribution to it.

Q45 **Claudia Webbe:** What are the potential benefits to the UK of exporting small modular reactors, and what are the challenges?

Matthew Rooney: I can talk about that. We did a report on nuclear fusion a couple of years ago, and we looked into the market for fusion in the 2040s and 2050s. Fusion is broadly on the same deployment timescale as advanced modular reactors. Based on our analysis, we thought that the market for electricity globally will be 600 GW per year. If you said a quarter of that has to be firm power or flexible power, you are looking at 150 GW. That would be 300 Rolls-Royce SMRs.



There will be a big market around mid-century for clean power that can be dispatchable. There is a large export market there potentially, but SMRs will have to compete against other, similar technologies—large-scale storage, fusion, maybe hydrogen, carbon capture and storage.

Q46 **Claudia Webbe:** What are some of the challenges?

Matthew Rooney: The challenge is bringing down costs, making small modular reactors the cheapest form of firm power. At the minute, it is an open question. We do not find out until we start building stuff, but if SMRs can out-compete comparable dispatchable low-carbon electricity, then the market will be large.

Q47 **Claudia Webbe:** Is the UK well placed in terms of timing and its ability to take on some of those benefits?

Matthew Rooney: The UK is well placed among western nations, where it is in a similar position, with similar industrial capacity and a similar skill level. China, it must be said, are well ahead of every other nation. China is building every single type of reactor you can imagine. However, I do not think many countries in the west will want to import Chinese technology, for political reasons. So, in general terms, and the panel would agree, we are well placed with comparable western democracies.

Tom Greatrex: The process that we have in public policy to get to the point of the GBN competition being done with a degree of urgency and rapidity is something that other countries around the world have remarked on positively. We have a number of technologies being considered, including a UK reactor design technology—the Rolls-Royce design technology—which could potentially be exportable, as technologies from other parts of the world could be exportable to the UK. There is an opportunity. It is not that we are starting from a low base compared to other western nations, as Matt says. There is an opportunity there at the moment and in the immediate period, as long as we get on and decide to do it.

Dr Headdock: I think that there is huge advantage to the UK in being seen as innovators. We talked about the skills challenges, and in terms of scientific and engineering reputation, if we are quick with this now and we get first of a kind reactors on the ground, the reputational enhancement for the UK is not to be overestimated. That would attract the best and the brightest into the energy sector. If we are then seen to be exporting technology to the world, that enhances that reputation, which I think that would be incredibly important for us.

Q48 **Claudia Webbe:** With some of the challenges, are we best placed in being able to deal with some of the security risks that might arise? I assume that there will be radioactive waste management. How do we deal with that? Are we well placed to deal with that? Are we well placed to deal with issues of proliferation? What do you have to say about some of that?



Tom Greatrex: First, as Gareth said in his previous answers, they are no different to the issues we deal with already with our existing fleet and large-scale reactors. All of those considerations on security and so on are part of the generic design assessment process the ONR do for any reactor design. It has to satisfy very high independent standards on that. I am sure that Donald will talk to that in more detail in the next session. None of that is new or different. As Gareth said earlier, PWR SMRs are a small-scale version of a similar technology, so it does not present any particular challenges that we are not already adept at dealing with and have not been adept at dealing with for many years.

Q49 **Claudia Webbe:** Let me get this straight: SMRs have not been built yet in the UK?

Tom Greatrex: In the UK, no.

Claudia Webbe: But we are still well placed.

Tom Greatrex: Yes. We have a process for technology assessment and selection to decide which we will build. That is under way at the moment. There are a number of other nations that are similarly placed. You would argue that in Canada they are slightly more advanced because there is a project at Darlington with an Ontario Power SMR, which is the first one that is sited and ready to start construction, but broadly we are in a similar place to a number of other countries, yes.

Q50 **Claudia Webbe:** I think you mentioned the net value, but could you pin that down for me? What do you think the net value of SMRs might be to the UK economy?

Tom Greatrex: It is hard to answer that, because it depends on how many orders you get, how many units you build and where you build them. There are potential economically beneficial advantages that come from being able to export that technology and build it in the UK. You have the supply chain and the jobs and economic activity that are the contributing factors to that endeavour.

As we see with large-scale reactors, although the skills mix will be different—some of it will be factory-based but some of it will be on site—the opportunity for economic activity in parts of the United Kingdom is potentially significant. That is why, with Rolls-Royce SMR, for example, there was a lot of interest in the tender process for where the factory sites would be.

Q51 **Claudia Webbe:** Have any estimates been done on the net value of export and all the benefits that go with that export, as compared to the build cost, waste management costs and so on? Have any estimates been done of what the net value might be to the UK economy?

Tom Greatrex: I am sure there have.



Matthew Rooney: I am sure there have. We looked into some numbers for fusion, but I am not familiar with the exact numbers on small modular reactors.

Q52 **Claudia Webbe:** Would it be possible to look at that and furnish the Committee with that information?

Matthew Rooney: There are numbers from Canada. The Canada nuclear lab looked into their SMR programme and said it could be worth up to 150 billion Canadian dollars.

Tom Greatrex: Rolls-Royce has done studies on the specific technology, but I do not have the figures to hand. I can write to the Committee Chair with those.

Chair: That would be very helpful. Thank you.

Q53 **Claudia Webbe:** That would definitely be helpful. Can I ask a final question about jobs? How will the deployment of small modular reactors impact job creation? Do we have enough workers with the appropriate skills to take these jobs?

Tom Greatrex: I think that there are three bits to this. There are the jobs involved in the factory units, where the modules are constructed; there are jobs involved in the onsite construction—effectively, putting the modules together; and then there are the operating jobs at the reactor when it is built. Some of those are construction, some are engineering and some are operation. There is a mix of different skillsets across all of those.

Do we have enough people in construction generally at the moment in the UK? No. But we know that there will need to be a lot more and a lot more infrastructure being built over the next period. There is a challenge there for the entire economy.

In terms of operational jobs at the reactor when it is built, when you are building one, you know when it will be built. So there is an opportunity and an ability to train people up to do that. In relation to Hinkley Point C, for example, the people who will operate that reactor—when it is operating and generating electricity—are going through the process of being ready to do that at the moment. We also have people coming from existing stations to be able to operate them. I don't see that as an insurmountable challenge. I think that the bigger bottleneck challenge will be around construction civil engineering, which is a big factor for the entire economy at the moment.

Matthew Rooney: If you look at where the existing nuclear sites are, they are dotted around the country in north Wales, the north-east, the north-west and Scotland. You are providing high-skilled, high-paid jobs in areas where these might be in short supply.

Q54 **Claudia Webbe:** Do you have any sense of whether there are enough



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workers with the right level of skills? How do we get that understanding?

Tom Greatrex: Until you know what you will build and where, it is hard to determine if you have enough people. We know that if you have a programme, people will invest in the supply chain to meet that programme and the opportunities that come for the supply chain. If you have a programme and you know you will build, say, eight SMRs, you will need eight times x number of people to operate them, so you need to be able to get those people. Would you have them now, today? No. That does not mean we cannot get them in the timeframe that they are required.

Matthew Rooney: Yes. The Nuclear Skills Strategy Group is looking into mapping where the skills might be required. Sir Simon Bollom has been commissioned by the Government to lead the nuclear skills taskforce to look into this exact issue and will be reporting next year.

Dr Headdock: Maybe I could give you a real-world example. I was up at Hartlepool yesterday talking to local council leaders. At the Hartlepool nuclear site—where there are two advanced gas-cooled reactors—there is an operations staff of more than 500 people responsible for running that power station.

Those reactors will come offline before 2030. There is then a process to go through of defueling as the reactors move into decommissioning. But the vision is that the excellent set of staff that have been built up, successfully running that plant over decades, will transition over to some form of advanced reactor built at that site.

Each of our operating sites has a similar vision. We have a highly skilled operational workforce in the utility in the UK who will transition over because we will develop advanced reactors. The next fleet deployment of reactors will happen in an appropriate timeframe will allow that. We already have a very skilled workforce, and we will need more in the future.

The whole debate around this now being considered a green technology and being here to address our energy security issues and to deliver net zero is attracting more and more people into the sector. You have quite rightly pointed out that we will need more of that going forward.

Chair: Thank you very much. That concludes our panel. I would like to thank Gareth Headdock, Tom Greatrex and Matthew Rooney for joining us today. We will move swiftly on to the next panel with the regulators. Thank you.

Examination of witnesses

Witnesses: Simon Bowen and Donald Urquhart.

Q55 **Chair:** Welcome to Simon Bowen, who is the Chair of Great British Nuclear, and Donald Urquhart, who is the Executive Director of



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Regulation at the Office for Nuclear Regulation. We are expecting one or more votes during the next hour. We do not know quite when they will come, but I am afraid that we will almost certainly be interrupted. However, we will resume.

I will kick off. We were learning about the competition being run at the moment by GBN on behalf of the Government. Could you outline the rationale behind having a design competition and the decision the Government made to have one? The Minister talks about having a competition that would be three times the pace of any other competition going on at the moment. Could you give us an explanation as to how this is happening, whether it is being done more quickly than others and whether that itself imposes risks?

Simon Bowen: Thank you very much for the opportunity to come to talk to the Committee. This starts with the energy security strategy announced about 18 months ago and the desire to progress an SMR programme and to create a new nuclear programme and a body that could lead that—hence the formation of Great British Nuclear.

We did a report that looked at all the global systems, sought input from every nuclear nation that is building, and looked at infrastructure within the UK to work out how we might do this. We talked to a number of countries that are either thinking about or running selection processes. We concluded that, to determine which technologies we should run with, we needed to do a selection process. We set out a supplier qualification process, which allowed us to down-select down to six, and as you have seen that has been well covered in the press.

To the questions you asked the panel earlier, did we consider advanced modular reactors—the AMRs—as well? Yes, we did. But the way we decided to go with the six that we have gone with is that our prime objective was about energy security and the journey to net zero. Energy security means that you need to go for the technologies that are closest to being commercialised and that we can operate at scale. We looked at both of those—hence the reason we chose the ones we did. We did not set out to differentiate between SMRs and AMRs. We said we have a set of questions and policy demands to answer in the energy security space. Those six best served that.

The next stage of the selection process is to issue the procurement documentation. That will allow us to do much more detailed due diligence on the various designs to determine how close they genuinely are to commercialisation and, critically, to analyse the costs they believe they can deliver their units to and at what pace, with the aim of hitting the final investment decisions that the Government have talked about in around 2029.

We are looking very much at the technology at the moment—the technology vendors and the procurement that is out there at the moment. We will look at technology vendors, development of design,



through to completion of the regulatory assessment with the ONR, and then the ability to place contracts to allow us to go to commercial operation. That is an outline of the process.

In terms of the industry norm, if there is one, the IAEA would say it is around 39 months to do a process like this. Ontario Power, who are the only country that has run a selection process, have run this in about 30 to 36 months, depending on which way you cut it, so we are running very fast. That is because the market is moving incredibly quickly and, because of the energy security crisis that we have faced and face, we have an imperative to get baseload power on the bars as quickly as we can. Therefore, we do need to move as quickly as we can.

The other critical issue that we are mindful of is that this is a global market and everybody in the nuclear community worldwide is playing in it—multiple countries in eastern Europe, as well as France, Italy and the US. This is becoming a very competitive market, so we need to move at pace.

What are the risks you take with that? Of course, you must apply the rigour of the procurement process. What we are trying to do is ensure that we do in parallel activities that we would normally do in series. Do I think the risk is substantially increased as a result of us reducing this timescale? No, I don't, because we will provide sufficient time for the vendors to respond and then, depending on the response, we will modify the timescales of the procurement process that we follow to ensure that we end up with a robust process and outcome.

Finally, what could that outcome look like? We have talked about between one and four technologies. My personal belief is that we need more than one, simply because these are not proven projects. The technologies—the nuclear technologies—are proven and are well-recognised as being proven technologies, but we have not built any of these before. To mitigate the risk in build, we should build, in my opinion, at least two. Also, once you get into the fleet of operation, it mitigates the risk and it gives you better grid resilience so you do not end up with what could be seen as class defects that take the whole of your fleet down. That is something that France has suffered quite recently.

Q56 Chair: Thank you. That is a very helpful summary. In terms of the timelines of the phases, you are looking to get to the final investment decision in 2029.

Simon Bowen: Yes.

Q57 Chair: How does that relate to the 39 months? That sounds as though you have given yourselves more than three years to get to that point.

Simon Bowen: The more than three years is to down-select and to get to a point where you start the design process, so the 36 months is from the, "I have an idea. I would like some nuclear power, and I would like



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some SMRs," to, "I have selected them." We are doing it considerably quicker.

Q58 **Chair:** Let's say it is two, which seems to be your preference. Would you select those in sequence or at the same time?

Simon Bowen: To be determined and agreed, but our current view is that we would down-select from the current six to probably four sometime during the spring of next year. Then we would make our final selections— somewhere between one and four, but my opinion being two—sometime in the late summer or early autumn.

Q59 **Chair:** Could that be affected by a general election?

Simon Bowen: Possibly, yes. I guess that that all depends on when the election is called and so on. That is a question for the policymakers and people who have much more experience of dealing with that than I have.

Q60 **Chair:** Decision making by you will be on the technology, but presumably you will need to speak to the Energy Department for a decision to be confirmed, and it will be a departmental decision as to who to go with eventually.

Simon Bowen: Yes, absolutely. Government will determine policy, and we deliver the programme. At a point where we are ready to make decisions, we will make recommendations to Government to say, "Here is what the selection process tells us. Here is how many we would recommend." Then it is a debate between the Cabinet, Treasury and our Department to determine how many they want to go with and when we can place those contracts.

Q61 **Chair:** You have highlighted how you have chosen to go with SMRs rather than AMRs because the technology is closer to market. Do you have the resources as an organisation to operate at this pace for the current competition?

Simon Bowen: To be clear, what I said was that we have chosen SMRs because we believe that the technologies we have looked at are closer to market. We believe that AMRs could well accelerate, because there is a lot of work going on elsewhere. Do we have the resources? We are building the resource set that we need to do it, and we are confident that we know how we are going to do that. The answer is not yet but, yes, we know how we are going to do it.

Q62 **Chair:** When you get to the point of selection, what is the continuing role for GBN? Would you potentially run a competition for an AMR subsequently?

Simon Bowen: Can I come to the AMRs in a second? The role of GBN is to deliver Government's new nuclear programme. Government decides policy. We deliver the new nuclear programme. In broad terms, we will not consider Hinkley Point, and we are not considering Sizewell C at the moment. Those will be projects that we will interface with but not have



any control or oversight of. This will be determined by policy, but our current thinking is that anything other than that naturally sits within a new nuclear programme, and therefore GBN should have oversight of it.

What does GBN do? GBN will set up the development companies that will develop the sites, will likely be a founding shareholder of those and will have an ongoing role in the development of the development companies. It will then look to set up future development companies to support the SMRs. If Government policy dictates we will move to using more gigawatt reactors, we would likely run the selection process for that. We would also run any selection process for AMRs and support any market-led programmes.

Chair: That is very helpful. Thank you. We are going to have to break for votes now, I am afraid, so I will just call us to a halt.

Sitting suspended for Divisions in the House.

On resuming—

Q63 **Chair:** I had just finished my line of questioning. I am going to move on to Cat Smith.

Cat Smith: As you probably gathered from the first panel, I have a couple of questions around regulation and planning. Mr Urquhart, what regulatory processes must SMR vendors complete, and how do those impact the winners of the GBN's SMR competition? I am trying to get an idea of what the challenges are.

Donald Urquhart: We have a couple of ways in which people who want to construct new reactors can approach us, whether it be gigawatt-scale reactors or small modular reactors. One is through the generic design assessment process, which is a voluntary, non-statutory process. Its purpose is to provide confidence at the early stages of looking to build a design that there will not be major regulatory risks to its construction and operation in the future.

It also serves the purpose of building confidence in potential investors that the reactor is viable to build in the United Kingdom. It is a three-step process, with an initial process where we set up things like export controls and charging agreements, get to understand the maturity of the design before we begin to assess its safety and security.

In the second stage, we do a fundamental review of safety. Are there any major showstoppers that immediately tell us that this reactor is not viable as it is now? If those two things pass, there is the option to move to a more detailed assessment of the design, where we look at it from probably 20 to 30 different specialisms' perspectives—mechanical engineering, which you heard about earlier, civil engineering, radiation protection, waste management, decommissioning. All those aspects are considered.

Q64 **Cat Smith:** You look at the whole lifecycle?



Donald Urquhart: The whole lifecycle is considered. It is separate from the competition that GB Nuclear are running. The way that people enter the generic design assessment process is they apply to DESNZ. DESNZ then take a view on whether it wishes us to conduct a GDA and, if it does, it writes to us to ask us formally to do so.

There is another route by which reactors can be constructed. There is no requirement for GDA to be done. An organisation that has a site, a design, an organisation and arrangements to comply with a nuclear site licence can apply to us directly to be issued with a nuclear site licence. From that point on, we would permission the construction operation of the reactor through our statutory regulatory processes. We basically operate those two routes.

The other thing I should have mentioned is that we do the generic design assessment in collaboration with the relevant environment agency—so, for England, the Environment Agency; for Wales, Natural Resources Wales; and SEPA in Scotland. Of course, there is no intention to build new reactors in Scotland, so it is mainly EA and NRW that we deal with.

Q65 **Cat Smith:** Are there any benefits the vendors can get from the GDA process?

Donald Urquhart: The real advantage they get is early confidence that the design is going to meet UK safety, security and environmental requirements. The other benefit is that they get input from us if it does not. We can advise them where their submissions need to be strengthened.

We also offer advice. We are not just there to regulate; we are there also to advise. We will offer helpful advice to help them meet the standards that are required in the UK.

As I mentioned earlier, one of the issues with building new reactors is the cost of those reactors, and knowing that the regulators are broadly comfortable with the reactor design helps to de-risk potential investors' stakes in that sort of process. There are some real advantages.

The big advantage for us is we get to influence the safety, security and environmental safety of those designs very early on, so it has a public safety and worker safety benefit as well.

Q66 **Cat Smith:** Other than Rolls-Royce, are any other SMR vendors beginning this process?

Donald Urquhart: We just began a second SMR generic design assessment last week, and that is for the Holtec design. As I say, we are in the very early stages, and Holtec has asked us to do a two-step GDA, not a three-step one. All going well, we plan to have that complete by March 2025. That is what we are aiming for. That is quite a big ask.

Q67 **Cat Smith:** Is the ONR resourced well enough to cope with having



multiple vendors doing a GDA at the same time?

Donald Urquhart: That is a great question. We have been working closely with GB Nuclear and with the Department for Energy Security and Net Zero to understand the forward demands on us. The Environment Agency have been doing the same. I have capacity at the moment to run three or four GDAs concurrently. We do not have infinite resources, and we do have an industry to keep safe in the meantime, but I am comfortable that we are ready to regulate the GDA processes as we move forward.

Q68 **Cat Smith:** If you had to prioritise between multiple vendors, for example, would you look to give priority to those that had been awarded the Government contracts perhaps via the SMR competition?

Donald Urquhart: The designs that we have coming through are part of that competition. We will act on the outcome of the competition and ensure that the selected technologies are carried forward through GDA. We still have capacity to do additional GDAs, so if other vendors want to use the process, and the Department for Energy Security and Net Zero is happy to support it, as I say, we could conduct three or four GDAs at any one time.

Q69 **Cat Smith:** On a slightly different topic, can I ask a few questions about waste? There was a recent study suggesting that SMRs would produce a greater volume of radioactive waste compared to conventional nuclear. Will the ONR introduce novel regulatory procedures to transport waste from the SMRs and for decommissioning at the end of their lifetime, or are you looking to use the model that currently exists?

Donald Urquhart: What we ask of applicants to a GDA is that they identify, quantify and explain what waste streams they are going to generate, and that they demonstrate to us that they are not generating any orphan wastes—wastes that we do not know how to handle.

As I think you heard from one of the previous panel members, the wastes that are going to be generated we are pretty used to dealing with. Routes are available, but ultimately we will look for a geological disposal facility to deal with the higher hazard of those wastes. That is something that has been carried forward by the Nuclear Decommissioning Authority.

Q70 **Cat Smith:** Thank you for that information. Mr Bowen, what is the role of GBN when it comes to regulatory and siting processes? What role do you play?

Simon Bowen: Could I offer a couple of comments on what Donald has just said? In determining which companies we went forward with, one of the criteria we used was, are they in a regulatory process somewhere within the various nuclear territories internationally? That was one of the key criteria.



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That is important, first, because it gives a signal of how far advanced those designs are. Secondly, the ONR is doing a lot of work across the various regulatory regimes in different countries to see how we can, not harmonise or normalise, but make use of the assessments that have been done in different countries. We see that a key ability of ours in terms of delivering a programme and accelerating a lot of the regulatory processes is based in that international collaboration. I am sure Donald can expand on that, but that is a very important part of this.

The second point I would make on regulatory is that we are doing a lot of work with the ONR on how you accelerate the GDA process. We are looking at various ways where you absolutely do not compromise the safety and security of the designs, but there may be different ways of doing things to get you to the same outcome, and using international assessments is one.

We must take the same good, hard look at the environmental and DCO processes, because the level of input and assessment that is required currently, the objective of energy security and net zero, and the global imperative of climate change do not quite fit together. What I mean by that is that those assessments are not set in the context of delivering energy security and the journey to net zero.

Again, it is not about trying to short-circuit; it is about saying that, when we are doing those regulatory processes, we must ensure the decisions we make are cognisant of the journey to net zero and, critically, our ability to deliver at pace for energy security. We must try to work out ways to do all those elements quicker, because it is one of the areas in the UK that we must accelerate. Otherwise, we will fall behind in terms of our objectives and the international competition.

In terms of the final point on siting, we said as part of the GBN report that because we have strategically nationally important sites—the eight sites named in the current policy statement—we need to secure access to those sites and match technologies to them. Once we have the procurement over the line early in the new year, we will then, in parallel—we are already doing this—turn our attention to which sites we want to secure, and they are existing nuclear licence sites, for very good reason, and which technologies would fit best with those. When we get to the end of the procurement process, not only do we then have a vendor, but we have a development company set up that is matched to a site so that the project is ready to go. That is our role and how we do it.

Where does GBN fit in the regulatory process in that? We will set up the development company that goes for the DCO and the EA approvals and the regulatory approvals, and we will own the nuclear site licence in partnership with other companies. That is going to be our role long term. I hope that helps.

Donald Urquhart: Can I add a comment? Simon mentioned pace. As a regulatory body, we recognise the ambition to move quickly on this. It is



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obviously very important. Our primary focus is public and worker safety—that is what we do. But, as Simon said, if the designs that are chosen are mature designs we understand, and the organisations that are the designers have high-quality safety documentation, that will allow us to speed up.

Also, if work has already been done in the international arena, we can take credit for it. We will not just take it off the shelf and trust it absolutely. We will do an element of due diligence on it, but that certainly allows us to go faster, and our ambition is to go faster, while making absolutely sure public and worker safety is secured.

Q71 Cat Smith: You have both been very clear about the need for speed here. What do you both think is going to be the biggest risk to things being slowed down? What are the biggest challenges?

Simon Bowen: I think the availability of skills. It was touched on by the last panel members. We have a lot of work to do to develop the skills and capability that we need. What is clear is that the delivery model that we currently have, which is that each organisation has its own capability, is probably not going to work. We are going to have to decide—and this is part of the nuclear skills taskforce that I sit on—what we are going to do to collaborate so we can make the best use of the skills that exist within the industry. So No. 1 will be the availability of UK skills.

The second thing will be our ability to help the ONR get access to the international community, and Donald is better speaking to that. I do think, though, that there is a lot of work required. If you take Sizewell, for example, we have 44,000 pages in a DCO application. That is just enormous. How do you deal with that quantity of information? There must be a better way. It is more than double what was done at Hinkley Point. The planning conditions are similar in terms of the scale of the increase.

We must do some work on what, in the context of energy security, our journey to net zero and trying to tackle climate change, is a proportionate approach that will make sure we absolutely deliver on our environmental regulations and environmental conditions, as we have to, but we must do it at pace. It is one of the main things I worry about in terms of our ability to deliver 24 GW by 2050.

Q72 Chair: Can I follow that up with a question of my own? With novel designs, are you confident that you do not need to go through a prototyping process that previous designs, I believe, always had?

Simon Bowen: Let me give a view. These are not novel designs. The designs we have for the SMRs are not novel designs. They are generation III technologies—light water reactor and boiling water reactor technologies—which are essentially different in scale, but they are very well-proven technologies. Are we concerned that those technologies would work? No, we are not, because they will work.



The thing that needs to be proven is the capability to build at scale and at pace. It is the demonstration of things like modularisation, how you genuinely do that and how you do it so that, in the first instance, the first of a kind is as predictable as it can be. But, from the first of a kind, you have really learned. From all the work that we have done, and all the option studies that we have done, the cost of first of a kind to what is called nth of a kind—probably fourth or fifth—is a cost reduction of around 40%. Much of that will come from your ability not to change the design but to do a lot of the modularisation work.

Q73 **Chair:** You do not need a prototype?

Simon Bowen: No, absolutely not. Apologies, I was not clear. You do not need a prototype to do that. What you are demonstrating is the ability to build at scale and drive costs down. On some of the more novel designs—you might consider this on a number of the AMRs—maybe prototyping is appropriate, but only some of them.

Q74 **Dr Offord:** It was two years ago that we introduced the Nuclear Energy (Financing) Act—the reason I remember is that I had covid, so I wasn't here. That introduced the regulated asset base, which, as we have determined through evidence to this Committee, many stakeholders welcome. It is pleasing to see that we have done something that has not only been welcomed but has also been very useful. Does GBN have a role in implementing the funding of that model?

Simon Bowen: Yes, we will in time. Of course, the funding models that will be applied to the SMRs are yet to be determined, because those will be set in policy. The current view is that those should be based on the RAB model because the RAB model appears to be as applicable to a plant the size of Sizewell as it does to the SMRs.

In parallel, we must look at other financing models because, with SMRs and the time it takes to build them, we should be able to learn much quicker and therefore de-risk much quicker, and therefore be able to attract private financing on maybe the second or third of a kind, and earlier. At that point, the RAB model may or may not be required. Whether we require CfDs will remain to be seen, but I think the RAB model provides a very good opportunity for us to do at least the first few. In parallel, we need to look at different financing models to see whether that is the right long-term model. In my opinion, it works for the short term.

Q75 **Dr Offord:** You touched on private investment. Is it your role to incentivise that?

Simon Bowen: I am hesitant about the word "incentivise". We must look to encourage companies as much as we can to bring private sector finance with them. Part of the next stage of the evaluation will be, what quantity of private sector finance can you bring in? What are the conditions attached to it?



In time, it will be more of a responsibility to try to move ourselves from what the international models would say are very public finance driven in the early stages—at the point where build times and costs are unproven—to a much more private financing model as they become more proven. It is our responsibility to move us along that continuum as quickly as possible.

Q76 Dr Offord: Would you say that GBN has a role beyond its remit for supporting the nuclear industry beyond its deployment? That would be things like exports, specialised equipment, fuels and that kind of thing.

Simon Bowen: I think it does. Again, it sits in the responsibility. We will have an accountability for the delivery of the programme, as you rightly point to, but the preparation of the supply chain will be absolutely core to us delivering at pace. Of course, with having one eye on export, we would absolutely see that as a growth opportunity. Is it a primary objective? Well, no, it is not. Our primary objective is about energy security and delivering net zero through nuclear, but it will be a by-product.

Q77 Dr Offord: When you compare SMR vendors, do you have a value-for-money assessment?

Simon Bowen: That will be a crucial part of what we do next. We have just done a high-level supplier qualification process. Through the invitation to submit an initial tender, the six-to-four process and then the four to however many we go with, that value-for-money lens will be a critical lens that we will apply all the way through.

We will have stage gates through the development all the way through to financial investment decision to ensure that what is being delivered by the vendors and the development companies represents value for money for the consumer and the taxpayer.

Q78 Dr Offord: Would that information be publicly accessible?

Simon Bowen: Yes, I guess it would be. Everything that we do is open to public scrutiny.

Q79 Dr Offord: On a final area, we have received evidence that using the RAB model to finance SMRs may introduce an overlap between Ofgem and the ONR. The evidence highlighted the importance of aligning the economic regulatory schedule and safety and environmental regulatory procedures—that would be the ONR and the Environment Agency. What role would the ONR play in co-ordinating regulation with Ofgem?

Donald Urquhart: My understanding is that Ofgem will be the economic regulator. But they will need advice and input, particularly around progress, value for money and some of the decisions being made around design modification, which always happens to some extent as you move towards building a plant.



By coincidence, our chairman has just become the chairman of Ofgem. Having spoken to him over the last few days, it is evident that he recognises the need to maintain a relationship with the ONR and other agencies. We will offer advice as we are asked to do so. We can certainly give our view and our opinion, but Ofgem will be the regulator in that case.

- Q80 **Chair:** Are there any legislative or regulatory barriers to enabling SMRs to be developed? We have just had the Energy Bill. Presumably, that meets the requirements of the Government and your requirements, but was anything missed out of the Energy Bill that we should be asking the Government to rectify?

Donald Urquhart: We have done a review of the regulations that apply here regarding nuclear safety and conventional safeguards, and they are agnostic to the technology involved. In other words, we are satisfied they will work equally for SMRs, advanced nuclear technologies and gigawatt-scale reactors. That is the advantage of having an objective goal-setting regulatory regime, rather than a prescriptive one, as you will find in some other countries. We have the flexibility to regulate proportionately, based on risk, and I am happy that the regulatory framework we are operating under is fit for purpose for all those technologies.

Simon Bowen: The short answer is that I think we have enough to be able to deliver the SMR element of these. We have enough policy space to do that. We do have to make decisions about gigawatts, so we must decide whether we are or are not committed to further gigawatt reactors.

- Q81 **Chair:** Beyond Sizewell C?

Simon Bowen: Beyond Sizewell, absolutely. That is important because there are certain sites that are very suitable for gigawatt and, therefore, do we or don't we want to use them? Also, what is the scale of the ambition? The "up to" 24 GW does not give the industry enough focus to call it a programme. Where you have a very clear aiming point, and the industry can see that we are serious about a programme—not a series of projects—we get the certainty that will allow the industry to invest. In broad terms, I think we are okay.

The final point I would make is that, in terms of this whole thing about pace, we must look at the way we do the totality of the work around planning and the DCO process. We need to work in that area to deliver our ambitions under climate change and energy security.

- Q82 **Chair:** My final question is regarding pace. If you have reached the final investment decision in 2029, when would the first SMR realistically come on stream?

Simon Bowen: Our current view—and it is shared by the vendors—is by 2035. There is the potential to accelerate that, because it could well be that, depending on the technologies we choose, they are developing those technologies in other territories and, therefore, we have the



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potential to learn early and accelerate some of the builds. Indeed, if you talk to all the vendors, they believe they can do it quicker than that. Conservatively, we think 2035 is a good planning assumption.

Chair: That concludes our session. Thank you very much, Simon Bowen and Donald Urquhart, for joining us today.