HOUSE OF COMMONS

Energy Security and Net Zero Committee

Oral evidence: The work of the Department for Energy Security and Net Zero, HC 1549

Wednesday 12 July 2023

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Watch the meeting

Members present: Angus Brendan MacNeil (Chair); Hilary Benn; Vicky Ford; Barry Gardiner; Mark Garnier; Mark Pawsey; Dr Dan Poulter; Lloyd Russell-Moyle.

Questions 1 - 94

Witnesses

I: Professor Sir Ian Chapman, CEO, UK Atomic Energy Authority; Hedvig Ljungerud, Director of Strategy, North Sea Transition Authority; Paul Methven, STEP Director, UK Atomic Energy Authority; Stuart Payne, Chief Executive, North Sea Transition Authority.

Examination of Witnesses

Witnesses: Professor Sir Ian Chapman, Hedvig Ljungerud, Paul Methven and Stuart Payne.

Q1 **Chair:** Welcome to the very first public meeting of the Energy Security and Net Zero Committee. We have a full public gallery, with, I understand, some schools in from places as far away as Chelmsford and elsewhere. We have a star-studded panel of four. I will ask the panel to introduce themselves on their own terms—name, rank and serial number—starting on my left.

Hedvig Ljungerud: I am Hedvig Ljungerud. I am the director of strategy at the North Sea Transition Authority.

Stuart Payne: Good afternoon. I am Stuart Payne. I am the chief executive of the North Sea Transition Authority.

Professor Sir Ian Chapman: Good afternoon. I am Ian Chapman, chief executive of the UK Atomic Energy Authority.

Paul Methven: Good afternoon. I am Paul Methven. I am the programme director for STEP, which, no doubt, we will get into, at the UK Atomic Energy Authority.

Q2 **Chair:** Thank you very much. I will maybe start with the North Sea Transition Authority first. What is your relationship like with the Department for Energy Security and Net Zero and its Ministers, and how often have you met?

Stuart Payne: The NSTA is an arm's length body of the Department. We were created in 2015 following the Wood review, which recommended having an independent regulator for the oil and gas sector. As a company, we are owned by the Secretary of State, who, as sole shareholder, holds the board of directors accountable for the delivery of committed targets.

Those are measured regularly through engagement with the Department, and a representative of the Secretary of State sits on our board. We report and engage regularly with the departmental team and are very public in all of our metrics that we report on.

By design, we have operational independence from Ministers. The design is that our decisions should be independent of Ministers, but, ultimately, they are our shareholder and will, for example, appoint of the chair of the board, who, in turn, selects the other members of the board, including the chief executive.

Q3 **Chair:** How does the Secretary of State influence your business plans? Have you seen much difference between BEIS and ESNZ?

Stuart Payne: From our perspective, there was very little change. If you imagine putting a cookie cutter over the BEIS entity, almost everybody we dealt with stayed in the same place. The biggest benefit for us operationally

has been that we now have one director general whose purview covers all offshore energy areas. We have wind, CCS, oil and gas, and hydrogen all under one organisational unit, which can only be a good thing in co-ordination terms.

Q4 **Chair:** This is a difficult question to ask you, given the nature of your relationship with Government, but are there any downsides?

Stuart Payne: No, genuinely the reverse. As an example, I have heard Ministers publicly say that they are now able to spend much more time on the issues that, very selfishly, I would be wanting their time on than they would have been able to in the previous Department. Genuinely, to this point, there are no downsides at all.

Q5 **Chair:** So it was a mistake to get rid of the Department of Energy back in 2016, you would say.

Stuart Payne: There are no downsides to the structure that we have today, and we are very fortunate that we get the airtime with Ministers that we need.

Q6 **Chair:** In 2016, when they got rid of the Department of Energy and put it in with BEIS, that would surely have been a retrograde step, if this is better.

Stuart Payne: You make good with the situation that you have. As a practical example, a huge part of what I suspect we will come to talk about during our evidence hangs on a thing called the North Sea transition deal, which is, essentially, a version of an industrial strategy. It is not for me to comment on, but I believe that the reason that Ministers and the Prime Minister of the day created BEIS was to be able to drive industrial strategies into sectors like energy. Without that, we may not have had the North Sea transition deal. I can genuinely see wins for us from that structure in that period, whereas, now, very selfishly, we benefit from the delivery focus and it all being one area.

Q7 **Chair:** Another interpretation could have been that they created DExEU and the Department for International Trade, and felt that they had too many Government Departments and had to get rid of the Department of Energy and put it into the Business Department. That is another interpretation.

Stuart Payne: You are entitled to that interpretation.

Q8 **Chair:** Professor Chapman, what is your working relationship like with the Department?

Professor Sir Ian Chapman: I will not repeat the governance arrangements, because, as an arm's length body, we share a lot of the same governance arrangements. Unlike you as a registered company, we are a non-departmental public body. We are not a private company, but we have more or less the same governance arrangements.

We are termed a partner organisation, and I really do see it as a partnership with the Department. It does not feel like an adversarial relationship; it feels like a supportive relationship. A bit like Stuart said, I would say that the focus on what we are doing from the machinery of government change has increased, so we have had more airtime with the Secretary of State than we did previously, which is understandable. He has more time to focus on a slightly smaller portfolio. That has been a very positive change for us as well. We get pretty regular engagement with both our Minister and with the Secretary of State.

You asked about how the Secretary of State influences our business plan. The Government have set a fusion strategy, which is, essentially, what directs our work. That has given us our targets and our high-level things that we have to meet, so we are the Government's delivery body to deliver that fusion strategy.

Q9 **Chair:** Is it better to have ESNZ instead of BEIS?

Professor Sir Ian Chapman: It is a funny thing. I can see swings and roundabouts, to be honest. Our work really does encompass strong links with business and industry, so the business bit of BEIS. We are trying to create a new source of low-carbon energy, so the energy bit of it. At this phase, we are heavily dependent on overcoming some science and technology challenges, so the science bit of it. In a sense, it was the perfect Department for us, because it covered the three things that make up the genesis of the journey we have to go on. However, what I previously said is also true, in that, by having smaller Departments, you can have more focus on key issues, so I see pros and cons to the machinery of government change.

Q10 **Mark Pawsey:** You have explained to us the relationships with the Government, but I am interested in exploring the relationship with the private sector and the ability to attract investment into your respective areas. Mr Payne, what proportion of your budget is derived from the private sector? How closely do you work with it? Have the new arrangements enabled higher levels of investment in your work?

Stuart Payne: If I may, I will take the easy bit first. The balance of our income, around 96%, comes from industry. The largest chunk of that is through an industry levy that is tabled each year. The second piece is through what we call fees and charges. There are certain moments in the lifecycle of a project where there is a fee payable; for example, when you are awarded a licence, that carries a cost. The remaining 4% or so is paid from central Government funds, which are typically aimed at work that is not relating directly to offshore oil and gas activity. Right now, the most obvious example would be the work we are doing on developing carbon capture and storage.

Q11 **Mark Pawsey:** How much does that 96% amount to in cash terms?

Stuart Payne: The total figure that we spent last year is £34.8 million. Of that, £1.9 million came from Government, £28.3 million from the levy and £4.6 million from fees and charges.

There is one other mechanism that I should also explain. The fees and charges can be hard to predict, because we may not know that we are going to run a certain activity or process, so you may bring in more money than you had intended to. We cannot make a profit, and so we have a model whereby we return money to levy payers if we have not spent it.

Q12 **Mark Pawsey:** With the money that you do spend, what do you spend it on?

Stuart Payne: In terms of the engagement with business to get investment or more broadly?

Mark Pawsey: Both.

Stuart Payne: Essentially, we focus our work on three areas, and everything that we do should fall into one of these three buckets, which are, very broadly, securing energy security options for the UK, cleaning up the emissions from the production of that energy, and accelerating the transition to net zero.

We do those three things in parallel across the organisation. We work with industry in all of them. All of them will require significant investment from the private sector and require us to use the powers that Parliament has given us to help steward companies and projects to get to the right outcome.

Q13 **Mark Pawsey:** Does the fact that you are an arm's length body make it easier to encourage the private sector to do what we want it to do?

Stuart Payne: I do not know. We were set up with some freedoms, in that we will have proportionately more people than the heritage bit of DECC or whatever it was will have had, so we have more capacity to go and do those things.

Q14 **Mark Pawsey:** And be more commercially minded?

Stuart Payne: I want to be very careful, because it is easy to sound critical of historical organisations, which I am not, but the fact that we were set up as a new body with a clear purpose has allowed us to attract a wider range of people to come and join the organisation—some for just a short period—and to contribute to the sector and the transition. It will have helped us in doing those things.

Q15 **Mark Pawsey:** Professor Chapman, can you match Mr Payne's 96% of money being derived from the private sector?

Professor Sir Ian Chapman: We are the other way round, in that we are a research, technology and innovation organisation, so we are predominantly publicly funded. Our budget is £373 million this year, of which £316 million is grant in aid from the Department.

However, we are heavily engaged with the private sector. We see part of our role as enabling the private sector to grow, not for us to do private work. We now have about 4,000 companies that we work with. On our campus, we have a cluster of more than 40 tenant companies, and that is growing. They bring with them hundreds of millions in inward investment in the country, so you get a return on investment. Indeed, there was a London Economics study a few years ago that was commissioned by the Government, which showed that, over a decade, for every £1 invested, £4 came back to the country, so we can say that our multipliers are good.

We continue to try to help companies grow. There are three ways in which we do that. The first is helping them to win business from ITER, which, as we might talk about later, is a very large international science project in the south of France, comprising 35 member states. So far, £650 million of contracts have been led by British prime companies in that work, so there is plenty of return there. We run industry programmes where we put seed funding into industries to help them overcome some of our challenges—so bringing technology from other sectors into fusion, but also, the other way round, taking fusion technology and spilling it into other sectors.

The third way is to help private fusion companies, of which there are about 40 in the world now, and that number is growing. Together, they have leveraged about $6.2 billion of private investment. Of those companies, 15 were born in the last 12 months, so it is a very strong uptick and we are helping them to grow by using our facilities and our campus.

Q16 **Mark Pawsey:** It is great to hear about the money that you have brought into the sector. You are very substantially Government-funded, but not part of Government. Has the fact that you are an arm's length organisation made it is easier to attract that investment in?

Professor Sir Ian Chapman: I might defer to Paul. Through the course of this year, we have been setting up a subsidiary of the UK Atomic Energy Authority, which will be called UK Industrial Fusion Solutions. It will be a company limited by shares and will lead on the STEP programme. That is all about a completely different paradigm relationship with our industry partners, so maybe Paul can expand on that.

Paul Methven: Suffice to say that, on structures, the most important thing is unanimity of purpose and vision. You work with whatever structure you have. As Ian says, given our intent to take forward the next stage of development to deliver a true prototype fusion energy facility, we are going to do that by standing up a company limited by shares to be the lead client body, initially on behalf of Government, with the UKAEA as 100% shareholder, but then, in time, able to receive investment from the private sector. As we demonstrate and de-risk the technology, the opportunity for the private sector to invest in that company begins to come forward.

Q17 **Mark Pawsey:** Is that an easier process with the structure that you have set up than if you were simply a Government Department?

Paul Methven: In terms of the ability to take equity, it is. We could not do that directly as a Government Department or even as an arm's length body, but, as a company, we can, so that is one point. The second point is in terms of partnering with industry for delivery. Having a structure that is more common and understood by industrial partners is very helpful.

Q18 **Vicky Ford:** My questions are for the UKAEA and are about nuclear fusion—the dream solution. The only problem is that, for at least the last 40 years, we have been saying that we will be there in 20 years. I remember coming to Culham over a decade ago, and it was 20 years away then. Is it 20 years away? How confident are you in this date of 2040, by which the Government have set out that we will have commercial nuclear fusion?

Professor Sir Ian Chapman: I steadfastly refuse to talk about dates.

Chair: It is a rolling 20 years.

Professor Sir Ian Chapman: I would quote Lev Artsimovich, who was one of the forefathers of fusion. At a press conference in the 1970s, he was asked, "When will we have fusion?" His response to that question was, "We will have fusion when society needs it". In my view, society really is at the point of needing fusion.

The answer to "when" is, "How much are you prepared to spend and how much risk are you prepared to take?" This is an embryonic technology. We still have lots of uncertainty and technical challenges to overcome, but, if you are prepared to spend money and take risk, you will deliver more quickly.

In a sense, that is why I am so excited, frankly, about the Government having a dedicated fusion strategy, having clear metrics and goals, and saying, "We are going to target 2040". It is ambitious, and perhaps even audacious, but it is a clear target. That is a driving force for the whole community to get behind and gives us the best chance of getting there.

Q19 **Vicky Ford:** Other than the Government's strategy, what developments have happened in the past decade that make you feel more confident that we are going to get there than when I came to Culham 10 years ago?

Professor Sir Ian Chapman: There have been a whole load of technical breakthroughs. In 2021, we set the world record for fusion energy released, which was 59 megajoules. In and of itself, that is not very much. It would charge your Tesla to get from London to Birmingham, and that is about it. It lasted for only five seconds, but the important thing was that it did exactly what we predicted it would do. That has given us great confidence that we can now go away and design power plants, and that we will understand how they work.

The second big thing I will point to, which is one of our key challenges, is that this is a fuel that we have to make hotter than the sun, or it does not fuse. You have this incredibly intense heat source to deal with, and so

extracting the heat is one of the big challenges for fusion. Perverse as it might sound, we want to build a much smaller power plant, which makes it much cheaper and allows penetration to the market much more quickly. Because the boundary condition is that it still has to be hotter than the sun, if you put it into a smaller box, the chances of melting the walls of that box are a lot higher, and so we need a really clever way of extracting the heat.

When you visited about 10 years ago, we had just come up with an idea for how we were going to do that. We took seven years to build a machine to test it. We were aiming to reduce the heat density that gets to the wall by a factor of 10. In any discipline, if you can do 10 times better than your competitors, it is a major advantage.

We set out on that journey. It took about 10 years to demonstrate that and, last year, we turned it on and we did that. We demonstrated that we can reduce the heat density that gets to the walls by 10 times, and that is the key result that opens up this pathway to building a much more compact power plant, which is what STEP is—the power plant programme that Paul is in charge of.

That is the excitement for me. There are major technical breakthroughs there. We have a concerted Government strategy. There is proper investment going into our field, both public and private. We are setting up a company. We have a site, which is a current coal power station, so going from fossils to fusion. The community has never known a sense of impetus and technical breakthroughs like this, so it is a really exciting time to be in our field.

Q20 **Vicky Ford:** I know that you do not want to set dates, but have you thought about how long it would take to construct a fusion power plant?

Paul Methven: Broadly, in the infrastructure sense, it is best to look at it as comparable to a reasonably sized fission power station. Although the technology is fundamentally different, scale is comparable. If you took Hinkley Point C, you could say that, from design complete through to build, with a front-end design programme, it would be of the order of 12 or 13 years.

Given all that Ian said, we are making technological breakthroughs, and a number of them very rapidly, but it is still embryonic as a design programme. Hence 2040 is ambitious but credible as the start of operations, and then we would go through progressive demonstrations thereafter across the subsequent few years.

Q21 **Vicky Ford:** So you see 2040 as a possibility to have your first production facility feeding into the grid.

Paul Methven: No, probably not feeding into the grid in 2040. We target that as start of operations, so generating what we call the first plasma. Then we progressively build through a commissioning and demonstration programme. Probably the critical thing to do is not just to focus on that timescale but for us to enable the move from the prototypic through to the

commercial subsequently. That means that, in parallel with developing a prototype, we have to put all the enabling mechanisms in place and stimulate the supply chain, so that we do not finish the prototype in the mid-2040s and then start from zero on the commercialisation thereafter. We would do that in parallel.

Q22 **Vicky Ford:** So you could see people starting to build commercial power stations before you have your prototype finished.

Paul Methven: Absolutely, yes, and our industrial strategy is focused on precisely that.

Q23 **Vicky Ford:** How quickly would fusion then become the dominant source of electricity?

Professor Sir Ian Chapman: That is a very unknown question.

Vicky Ford: If it works.

Professor Sir Ian Chapman: You are talking about an electricity market, and society is very different. If we made some pretty gross assumptions and said that fusion penetrates into the market at the same rate that fission did before Three Mile Island, and certainly before Chernobyl, where the growth rate came down, or at the same rate that oil and gas took market share off coal—they are all big infrastructure, so it is not an unreasonable assumption—then we project that, by the end of the century, fusion could be providing 10% of global full energy demand, not just electricity. That is Europe, so it is not inconsequential.

Q24 **Vicky Ford:** But we need to get to net zero by 2050.

Professor Sir Ian Chapman: The IPCC report—which is a very good report, by the way, that was published last year—talks about rapid, deep and sustained decarbonisation. Fusion will not help with the "rapid"; it will not help with 2050. However, a load of technology that will—current generation fission, carbon capture and things like that—is not sustainable, so you need a long-term solution as well, and fusion will be a hugely important part of sustaining net zero.

Q25 **Vicky Ford:** Just for now, is it a sensible working assumption that you will build fusion plants on the sites of old coal and gas-powered power stations?

Professor Sir Ian Chapman: There is a lot of attraction to that. It is not a prerequisite. You could even build on greenfield. Frankly, you can build anywhere, but utilising infrastructure that we already have is a good thing to do. That is one of the reasons why the coal power station was chosen.

Q26 **Hilary Benn:** Professor Chapman, in answer to Vicky's first question, you talked about money and risk. First, do we take it that more money would enable you to more quickly overcome the technical challenges that you have been grappling with? Secondly, what kinds of risks are you talking about?

Professor Sir Ian Chapman: The former is almost certainly true. If you spend more, and can parallelise and look at different concepts, you will overcome technical challenges more quickly. We have seen that time and again in history. Indeed, Covid was a very recent example of that. We were prepared to spend a lot of money and, frankly, go to all vendors of potential vaccines. That helped their development pathways and they could go almost an order of magnitude more quickly than we would have expected. That is the answer on parallelisation.

What I mean by risk is not a safety risk. I am talking about a risk that you spend billions—and it will be billions—to build power plants, and that they do not work as you expect. You might say, "We are going to produce 500 megawatts electric", but you get only 250 megawatts for only two thirds of the time. So the risk is that you put quite a lot of capital into a thing that does not deliver on what you expected it to do. If you want to accelerate, you have to be prepared to take more of that risk.

Q27 **Barry Gardiner:** I am guessing that the guys sitting behind you in the gallery are about 17 or 18 years of age. You have just told them that this technology, if all things go to plan, might be presenting us with 10% of global energy by the time that they reach the age of 92 or 93. You are not dealing with the question of the timescale that we need to do this by.

Let us deal with the other long-term issue. You will recall that, back in 2005, the Nuclear Decommissioning Authority took over responsibility for the nuclear clean-up programme, and UKAEA was a major part of that. I recall that, in those days, the decommissioning costs alone took up over half of the budget of the Department of Trade and Industry.

One thing that has always been put forward about fusion is that it is much safer. You do not have those same decommissioning costs. What are the waste risks around fusion? What are you going to need in terms of storage capacity for those items? How do you see that being managed?

Professor Sir Ian Chapman: There are lots of questions there. Can I just talk about the bit about the 10% by the end of the century? As I said, there is a whole set of assumptions in there. If you made an assumption that we could deliver a plant at 30% lower cost, it would be 40% of global demand. The cost is so important in terms of penetration into the market, just to give you some hope. If we can make it cheaper, we can do a much bigger fraction of global demand.

Q28 **Barry Gardiner:** Are we going to get it more cheaply than we are currently getting from solar in the north of Africa, which is 1.2 cents per kilowatt hour? I am all in favour of pure research and development; I am not against that, but are you seriously telling me that, with all the capital costs that are going in here, and all the returns that those who lend this money are going to want to see on that capital, it is going to be cheaper in 80-odd years' time than solar, which we already know is coming in at unbelievably low costs?

Professor Sir Ian Chapman: You have to compare apples with apples. The full cost of solar includes all the redundancy that you need in the grid, the system, the transmission and the storage.

Q29 **Barry Gardiner:** You deal with that through interconnection. It is a very logical problem and you deal with it very logically. The sun does not stop shining. The sun continues to shine in other parts of the world. You just need to capture its energy there and store it through interconnection, which is what we do with nuclear at the moment. We are reliant on our electricity supply from nuclear that is powered in France, and that is through interconnection, so it is exactly the same principle.

Professor Sir Ian Chapman: Yes, I understand how interconnection works. However, there are still long transmission lines, and you are dealing with redundancy, in that you need a lot more redundancy in the system to deal with intermittency. It is just true that you do, so that price is not the whole price.

If we compare apples with apples, my view—and we do not have a working product, so I cannot substantiate this—is that we will be cost-competitive. There is no reason to say that fusion cannot be cost-competitive. I firmly believe that our approach to energy should be like our approach to diet or to managing money. You do not have just one thing. You spread your risk across a portfolio. It would be folly to say that we will do everything with solar or offshore wind. Let us do a portfolio.

Q30 **Barry Gardiner:** Let us address the question of waste, capacity and storage. What is going to be required? What have you identified? How are you managing it?

Professor Sir Ian Chapman: Our waste streams are predominantly borne by two things. First, we produce neutrons, which irradiate the structural material that you build the machine from, which is typically tungsten or steel. You will irradiate them, but they have nowhere near the long-lasting half-lives that you get with fission waste, and it is much lower activation.

Q31 **Barry Gardiner:** How long are we talking about? For some people, the difference between 100,000 years and 1,000 years does not really matter.

Professor Sir Ian Chapman: It is hundreds of years, rather than hundreds of thousands of years, which, by the way, is also true of coal and various other things. It is that type of lifetime, but there is no high-level waste. We produce intermediate-level, but not high-level waste.

The other risk and waste stream that we have is tritium, which is radioactive. It is a very heavy hydrogen. It has a short half-life of about 12 years, but the tritium gets into everything. It gets into all the structural materials and into the armour. If you can extract the tritium from that armour at end of life, you can take what would be intermediate-level down to low-level waste.

We have a huge opportunity to do this for the first time in this country. We

have been operating JET, which is the largest fusion facility in the world, for the last 40 years. We will cease operation at the end of this year. The UK is responsible for the decommissioning programme of JET, and UKAEA will be responsible for it.

We have put forward a plan, which the Department has now adopted. The approach in conventional decommissioning is to cut everything up, put it in boxes, grout them and put them into geological disposal. Rather than doing that, where we might have had 70 containers of intermediate-level waste, we are going to take out the in-vessel material, which is where the tritium gets embedded, and detritiate it.

We have now done some proof of principle at small scale of all of the materials that make up the inside of the machine, and we can extract 99.9% of the tritium from most of those materials. Our hope and our aim is that, over the next 10 years or so, as we decommission the machine, we will recapture all of that tritium, and what would have been intermediate-level waste ends up being low level or free to recycle. It shows the sustainable lifecycle of fusion, and this will be the first time that this has ever been done, so it is a really important thing for us to demonstrate.

Q32 **Barry Gardiner:** How does the tungsten and steel casing degrade? What is its lifespan?

Professor Sir Ian Chapman: Do you mean the waste or during operation?

Barry Gardiner: During operation—the container.

Professor Sir Ian Chapman: The tungsten, which is the first armour, receives a very large dose of very energetic neutrons, which no material likes, so it is not a good thing for any material. It also receives quite a lot of heat flux and then helium bombardment as well. All of those things degrade the longevity of that material—its strength, its brittleness, its creep and all of that.

We are aiming to design that first wall to withstand a few full-power years of operation, and then we would have to go through a maintenance break to replace that armour. You would open up the top, take out the armour and put in new armour, similar to what you do in a fission reactor, where you have to replace the rods.

Q33 **Barry Gardiner:** I was going to say that we have seen real problems with fission reactors, where we have had to go in for unscheduled running repairs, which have closed down the value of the baseload that they were providing.

Professor Sir Ian Chapman: That is right. That is true of all energy provision, by the way. All energy generation has some unexpected outages. We are designing so that they last for a few full-power years, and then we would have to maintain and replace some of those components.

Q34 **Barry Gardiner:** What other safety concerns are associated with replacing

the current generation capacity with fusion?

Professor Sir Ian Chapman: The irradiation material is not really a safety concern, because it is all inside a bioshield that people do not go into. People are protected from the neutrons, because you have a big steel encasement.

The primary safety concern would be a release of tritium gas. Tritium, as I said, is radioactive, and ingesting large quantities of it is not good for you. Inside the machine, at any given time, we have tens of or maybe 100 grams of tritium, which is not a lot.

Barry Gardiner: Superman did not need a lot of kryptonite either.

Professor Sir Ian Chapman: No, but it is also a very light gas. Just bear with me. It is not a lot of tritium. That is inside a vessel, which is inside another vessel—so two vessels—and then inside a cryostat, all inside a big, thick concrete building.

Of course, it is conceivable that a plane flies into that building and breaks the building, the cryostat and the two vessels, and you get a release of gas. That gas would just go straight north into the atmosphere and be dispersed very rapidly. There would be very small amounts per cubic kilometre of air and nobody would get any significant dose, because the quantities that we are talking about are so small.

One of the really attractive things about fusion is that it is the most energy-dense way of releasing energy. The amount of fuel that you need is very small. For the rest of my life—for 60 years—the raw materials that I would need for electricity from fusion would be the water in one bathtub and the lithium in two laptop batteries. That is it. It is grams of material for the rest of my life.

Q35 **Mark Garnier:** It is fascinating listening to you talking about this. Can I also say that it is brilliant that we are doing it in the UK? This is inspirational stuff. I say that because I am just about to ask you about the problems that are going to be getting in your way.

Chair: He did start positive.

Mark Garnier: I wanted to started on a high note before I take you down. There are going to be a lot of barriers coming along with this. I am certainly interested in the resource barriers, so skilled workforce, materials and all that kind of stuff, and we can come to that in a minute.

I used to be an investment banker. I have had two of the world's most unpopular jobs, in that I am a politician as well. There are an awful lot of exciting things going on, and I declare an interest here, in that I chair the advisory board of the Space Energy Initiative. It is old technology, but there are new uses of this type of stuff coming through.

You have very successfully raised an awful lot of money—£5 billion—and you have this £372 million a year, plus commercial money, coming in. I can absolutely see why people are investing in this, with the intellectual

property and all of the rest of it, but, if it seems that there are other new technologies coming through, do you see that it may be more problematic on your resources if there is an alternative way of producing strong baseload power?

The reason why you are so good is that you can just power the planet with, as you say, a bathtub of water. If something else is going to come before that, are you worried that the investment going into fusion may be diverted into space energy or something else that nobody has yet thought of?

Professor Sir Ian Chapman: There is always a risk that you get black swan things that throw everything off kilter. I do not see what they are at the moment, but that, of course, is a risk.

Mark Garnier: You are a black swan.

Professor Sir Ian Chapman: We may be one of them, but we are known. You just said there that we would provide baseload, and an important part of fusion is that it would provide baseload. My personal view on how fusion will enter the market is through the provision of primary high-grade heat.

One of our challenges is that we have too much heat. We have a source of fuel that is hotter than the centre of the sun—150 million degrees. We can run the wall very hot if we can find steels that can cope with that heat, and so you could provide high-grade heat for all the really hard-to-abate things, so cement production, glass production, ammonia production, hydrogen production and all of this stuff. It is very hard to do that in any other way than burning things.

If you do that with solar electricity, it is really inefficient, because, first of all, you have the inefficiency of generating the electricity. Turning that into hydrogen, which is a vector, not a power source in and of its own right, and then burning the hydrogen to produce heat, in order to produce cement, is a very inefficient system. There is a lot of inefficiency in that sector.

If, instead, you have this burning fusion fuel, which just produces high-grade heat to allow you to produce cement directly, that is far more efficient. That sort of opportunity for heat production and cogeneration between heat and electricity is a really important thing for fusion.

Mark Garnier: You are saying that we could put a cement factory, a steelworks, a glass factory or whatever you can think of that uses heat—a crematorium—

Chair: That is maybe a step too far.

Q36 **Mark Garnier:** It is not a huge amount of heat. That is fascinating and something that I had not really thought about.

You are not using a huge amount of natural resource in the fuel that is going into it, but there is other stuff that makes it work and protects it. As we move from security of energy supply, we are looking at security of raw material supply. Are you going to be using stunning amounts of stuff that

needs to come out of Russia or China?

Professor Sir Ian Chapman: No, not a stunning amount of stuff, because, as I said, it is very high energy density. However, there are lots of rare materials that we require. Let me just go through a few.

Tritium is our fuel. There is no natural tritium left now. It has all long since decayed. We get our tritium as a by-product from heavy water fission reactors, so CANDU reactors. There are about 30 to 40 kilos of tritium in the world today. That is it.

Q37 **Mark Garnier:** How much do you need?

Professor Sir Ian Chapman: We need 3 to 4 kilos to start a power plant. There is enough to start a few power plants, but those then have to make their own tritium, not only enough to keep fuelling themselves, but oversupply so that they can then provide for the next fusion power plant. That is a supply chain issue.

Then there is lithium. We encase the machine in lithium, which allows us to breed the tritium. The neutron comes out, passes through the lithium and produces tritium and helium, and then you recycle the tritium back into the machine to fuel it. However, there is substantial demand for electrification in various other ways, so, while we do not need lithium on the scale that, say, the electrification of vehicles does, we still need it. If it is all used up in other things, it becomes a scarce material.

The way in which we contain the machine is twofold. I talked about tungsten. The price of tungsten is going up. It is needed in defence, aerospace and various other things. We might use vanadium in some of our structural materials. Vanadium is pretty much dominated by China, Russia and South Africa. They are about the only places where vanadium is mined.

The magnets that we use to confine the fuel have various rare earth materials in them—yttrium, lanthanum, gadolinium and various things like that. They are called rare earths because you do not find them in very many places. So there are a number of materials challenges.

Q38 **Mark Garnier:** I am slightly wishing that I had spent more time paying attention to my chemistry lessons when I was 15. In order to make all this happen, you are going to need an awful lot of very clever people, from nuclear physicists all the way down to mechanical and electrical engineers. Are we producing enough out of our universities? Do we have the capacity to source them from the UK or will we have to go out to the rest of the world and find these geniuses?

Professor Sir Ian Chapman: On the training of people, we have some really good training provision, but we need to scale that further. At the moment, we have about 160 PhDs in fusion. We have about 35 university partnerships. That is really good and they are very high quality, but we will need to scale that.

We have an apprentice training centre not just for our own needs but also those of our industrial partners. I think we now have 24 industrial partners; I should check that number. We have 280 apprentice learners in school at the moment. We already have funding from the Department to scale that to be doing 1,000 a year by 2026. We will be doing plenty of apprentices and high-quality technicians who get experience in cryogenics, high voltage and high vacuum, which are all the things that you need for fusion, but have spillovers into all sorts of other sectors too. We are doing a good job on the quality of our skills provision, but we do not yet quite have the capacity that we need.

We are very good at attracting from overseas. UKAEA is not a big organisation. We have 2,500 people, but we have 70 nationalities within the workforce, so we are a real beacon for and attracter of high-quality people.

Paul Methven: We need to stimulate the same growth in skills across a range of aspects in industry. Part of the objective, by unifying our efforts together with the private sector to deliver a prototype power plan, is to stimulate the development of industry, including the skills base. That is not merely in engineering, but across a whole range of skills—the project managers, the commercial specialists, the finance specialists and the ecosystem that really is going to make this fly commercially in the long run. Industry is really up for the challenge now of joining together with the public sector through that single purpose of delivering a power plant and putting the UK in the lead. That will drive the development and generation of skills.

Chair: Some on-the-spot creative thinking there, so very impressive.

Q39 **Lloyd Russell-Moyle:** How significant is the delivery of fusion to the Government's delivery of the 2050 target? Is it pretty irrelevant to reaching the target?

Professor Sir Ian Chapman: I do not think that fusion will play a significant role, even if we could, as some of the other Committee members have asked about, be more aggressive, take more risk and invest more. If you said to EDF tomorrow, "Here is all the money for Sizewell", it will still take 10 or 15 years until that is really operating. That is just true of the energy sector, I am afraid. Everything in energy is slow; nothing happens quickly, because it is all massive infrastructure. I do not foresee that fusion will play any significant role in our 2050 targets. However, as I said before, it is really important for sustaining decarbonisation in the long term.

Q40 **Lloyd Russell-Moyle:** What kinds of provisions do we need to be making to be able to fit fusion in and not have two sets of dead technology? There is a concern that we are going to have dead technology up to the 2050 target as we have to stop doing certain things, and then you do not want to have invested in another set of technology which, by 2100, we are starting to roll out. What protections need to be put in place to enable fusion to be an opportunity?

Professor Sir Ian Chapman: As I said before, in electricity terms, I see fusion as entering into baseload, but also the co-generation and heat opportunities. At the same time, we need security in the near term. We need to keep the lights on, so we will have to be using technologies like carbon capture and generation III fission, neither of which will be able to last for centuries. They have limited utility, and so you need something that can replace them.

Lloyd Russell-Moyle: Is it just old coal power stations that you are slotting in next to, or is it a model where, as you were talking about earlier on, you have the steel plant and the cement plant—not the crematorium? The latest crematorium technology is that you dissolve the bodies in water.

Chair: That is too much information.

Q41 **Lloyd Russell-Moyle:** Co-op funerals is rolling out the first one next month.

If we build a load of infrastructure, we need to be able to slot you into that infrastructure, so how do we need to build it? What discussions are you having with the people who are doing the other bits of infrastructure to make sure that you are physically in the right locations? If you are next to the coal power stations, you might not be next to the steel or cement works that you are saying you would have to be next to.

Professor Sir Ian Chapman: We could go anywhere, as I said. We can fit within the grid and where industrial sectors are, so it does not worry me a great deal.

To your question on what we need to do within the UK, I should emphasise that, while the UK is a pioneer in fusion, one of the main reasons for the country investing in it is that fusion works everywhere. Every country would buy fusion. Every country has the natural resources for fusion. It is very low land use and works everywhere.

Lloyd Russell-Moyle: Apart from tritium, which no one has.

Professor Sir Ian Chapman: The fleet has to self-fuel. It can go everywhere, which means that this is a huge export opportunity. We have a technology that might be important for industrial purposes in the UK, but will be absolutely essential in other countries because they have very high population densities. How are Indonesia, Nigeria and other places like this with very high population density—even India, for that matter—going to generate their power? You would say that they are very good for solar; they are right on the blinking equator, but the population density is too high. It does not work, and so they need high-energy-density provision. Fusion offers that huge economic potential for the country. We have a product here that we could sell in every jurisdiction.

Q42 **Lloyd Russell-Moyle:** The primary focus is, of course, generating electricity, and you have talked about the other industrial processes. Is the generation of electricity then a secondary part?

Paul Methven: Climate change is a global problem and it is always seductive to boil it down to national numbers, but, even if we just take domestic energy, electricity consumes only about a third of the total energy in the country. If we want to achieve decarbonisation in total and on a global scale, we have to think substantially beyond electricity.

As Ian said earlier, while fusion is a very effective potential baseload electricity provider and, on the back end of it, we put steam turbines or supercritical CO_2 gas turbine adaptations to produce electricity, equally we can just produce direct high-grade heat. In fact, some of the industrial providers that we are talking to in looking at their future energy mix as supply organisations are at least as, if not more, concerned about how they decarbonise industrial processes—the other two thirds of the equation—as about electricity.

We have a multi-use and multi-country deployable energy source, which we will need some of in the UK in the 2050-plus timeframe, but, in addition to supporting domestic energy needs—energy rather than just electricity—it also principally supports the UK being a leader in decarbonisation of the globe beyond 2050.

Q43 **Lloyd Russell-Moyle:** I hear this, but the target is that we need to decarbonise steel and concrete now. We will come on to carbon storage later. As yet, it is not rolled out anywhere in Europe at mass scale. Is your view that carbon capture and storage is the solution because it dovetails in? The other pathway, where you then develop green steel through hydrogen, means that you have built whole new steel plants that you are then having to come down and tear out only 50 years later.

Paul Methven: The only way to look at this is that it is not about one solution but about time phasing.

Q44 **Lloyd Russell-Moyle:** With carbon capture, I can see the phasing working, but, with anything else, you are totally out of phase. Is that not right?

Paul Methven: I do not think that we are out of phase. We will be ready as early as we can be, subject to the input factors that Ian described. Perhaps what we are not quite looking at in this discussion is the growth in energy demand that will naturally happen globally beyond 2050. Even if we were able to achieve a net zero position domestically and globally by 2050, the sustainment of that would rely to some degree on a flatline in energy demand, and that is not going to be the case with global population growth and the requirement to ensure that emerging nations have access to energy as we have had. In short, the problem gets harder, and what we are saying is that we will be ready as early as possible, but we are a solution to a problem that keeps getting worse.

Professor Sir Ian Chapman: Just to expand on the stranded assets point, the lifetime of those assets is comparable to the lifetime of a power plant. By the time fusion comes online, if you had a furnace that was adapted to

hydrogen, that probably has a 30-year lifetime anyway, so you would be replacing it with next generation technology either way. It is not going to last for 100 years.

Q45 **Lloyd Russell-Moyle:** You are talking not about this round of adaptions but totally about the next round of adaptions, and we should almost ignore you for the purpose of the 2050 target. If that is the case, is there a danger that we plough a lot of resources and attention into you, and then forget to invest in those medium-term technologies? Is there a danger that you suck away investment and attention from the immediate challenge?

Professor Sir Ian Chapman: The scale of the problem is such that you should be investing more than we currently are in all of those technologies. It absolutely needs all of them. The one thing that I will say about fusion, which may not apply to all of the others, is that we have a genuine global leadership position, so there is an opportunity for massive economic return if you can have a product that you sell to the world.

Lloyd Russell-Moyle: Whereas we slipped the ball with the other technologies by waiting around.

Chair: We are going to take a bit of a change in direction. Dr Dan Poulter, who is going to pick up in a second, is one of the best members of the Committee and an NHS doctor. He is going to show how good he is by picking up the pace in the next round of questioning.

Dr Poulter: I may slightly disappoint you, in that I have one clarification question that I wanted to follow up, with your indulgence.

Chair: I am slightly disappointed. I make an appeal to the panel to be quicker as well.

Q46 **Dr Poulter:** You mentioned the fuel, deuterium-tritium, for fusion, and that the only real source of the tritium component is, effectively, from the process of nuclear fission. To produce enough for one fusion power plant, you would need the by-products from three to four fission plants. In 2040 or 2050, how many fission nuclear plants would we have in the UK, both the ones that may have come to the end of their life and those that will be coming onstream, for example Sizewell C, if that were to come to fruition? We are not guaranteed that yet.

Professor Sir Ian Chapman: The Government's target is to have 24 gigawatts of fission plant. If I just bring that back to tritium production, at the moment we get our tritium from heavy water fission plants. There are not very many of them. They are in South Korea, Romania and Canada. Not very many of them are operational. It is a Canadian design that did not roll out globally. There is nothing to say, by the way, that you could not put some lithium material into a conventional nuclear power station. You could put it into a pressurised water reactor, and that would help produce some tritium, and so, if we really needed to, we could backfit existing nuclear power stations to do that.

However, to reiterate the point, a fusion power plant will have to overbreed

in tritium. It we will have to produce enough tritium to serve itself, but then also to provide for the few that come next. It is not something that I worry about enormously, because we have to design for that, and our designs account for that overproduction. That technology has never been proven, but it is one of many things that we will have to demonstrate in our prototype machine in STEP that we are aiming to do.

Q47 **Dr Poulter:** At the moment, we would be reliant on importing tritium from overseas.

Professor Sir Ian Chapman: That is correct. The initial charge will be imported.

Dr Poulter: So we would not have our own secure supply of tritium. If we wanted to produce our own supply, we would have to make some changes to UK fission reactors in order to achieve that.

Professor Sir Ian Chapman: That is true.

Q48 **Dr Poulter:** Is the thinking and planning taking place at the moment to allow that to happen?

Professor Sir Ian Chapman: No, not really, because we are confident that we will be able to source the tritium. At the moment, we have a very good relationship with Canada. All the tritium that we have used to date has been bought from Canada, and that is where we are expecting to source our tritium from. To the earlier question about other rare earth metals and things like that, I am more worried about some of those supplies than I am about tritium.

Dr Poulter: Those come primarily from China and Russia.

Professor Sir Ian Chapman: China, Russia, South Africa and some other Asian countries.

Q49 **Dr Poulter:** Widening this out to some of our other witnesses, we are often told that the UK has a geographical advantage for renewable energy generation. Is that true and, if so, why?

Stuart Payne: If I may, I will start and then pass to Hedvig, because it is my favourite phrase. I genuinely think that the North Sea is the crown jewel in our energy system. We are preposterously lucky as a nation. Over the next seven years or so to 2030, we see ourselves as being able to attract around £200 billion of investment in wind, hydrogen, oil and gas.

It has the opportunity to store 78 gigatonnes of carbon, which would be broadly equivalent to all the carbon that the UK has ever emitted since the industrial revolution. It is not only a place where we can deliver energy through wind, tidal, oil and gas, and we can store emissions, but it also leans into one consistent set of skills and jobs that the UK is very good at. I accept that that sounds glib as a quote, but I really do think that it is a huge resource.

Hedvig Ljungerud: We often say that the key to unlocking a lot of this is around integration. Back in 2018, we started looking at energy integration and how we can make that possible, working very closely with the Department and many others. The opportunity is there, but there is some work needed to unlock it.

Q50 **Dr Poulter:** What is a practical or realistic timeline to phase out and move away from fossil fuels to renewables?

Hedvig Ljungerud: From our point of view, because we look at the offshore production of fossil fuels, the phasing-out has to start on the demand side. Today, about three quarters of UK energy is from oil and gas, so it is a big job to reduce the demand. It is really important, and the sooner, the better, frankly. What we do in fossil fuel terms is on the UK production side, where we argue that, as long as we need it, we will be net importers. We will remain net importers for as long as we have projections. There are advantages to having it domestically. From the energy security options point of view, if we can make it cleaner, we get jobs, fiscal and balance of payment benefits. Having said that, the sooner we transition away from it, the better. Everyone agrees on that.

Stuart Payne: The Government's targets are clear. They are to have 20 to 30 megatonnes per year of carbon stored by 2030, and 50 megatonnes by 2035. If you can abate some of the carbon you are producing, it reduces some of the negative impact.

I really would echo Professor Chapman's point that it is like a diet. You want a bit of everything, not just for redundancy but for the reality that you need to have sequential phasing. A great example is hydrogen. We have had a lot of conversations around the siting of plants versus heavy emitters like steel and concrete. We have exactly the same conversations around where carbon stores could be based.

You could have the opportunity, for example, through big hydrogen production, which could come from electrolysing water, to link to huge floating wind structures, which you do not necessarily need at night. Rather than wasting the power, you could store it as hydrogen and then use it for a variety of purposes, much like you can use with fusion.

One of the biggest opportunities for the UK is that structural thinking. Your question was really important as to whether we have dead technologies. If you step back from the technology, the way of thinking is, "Do not assume that you are the right one. Assume that something cleverer comes next. How do you make your systems capable of being clipped together?" Having that humility is really important.

We have a golden opportunity now, because we are looking at things like, "How quickly can you phase out your reliance on unabated gas? What would replace that and what would you need to make that happen? What does that mean, for example, when we look at clusters around carbon

storage?" That kind of structural thinking will be vital to then ask, "When the next sector comes along, how do we make that a quicker transition?"

Q51 **Dr Poulter:** Just to pull this down a little bit, I absolutely accept the points that you make. It is very useful context about the potential for new technology to come onstream. As we are now, with our current trajectory, how quick will the transition from fossil fuels to renewables be?

Stuart Payne: Hedvig will correct me if I am wrong. I think I am right in saying that, on the latest projections, by 2050, between 20% and 25% of our energy will come from oil and gas. You go from 76% last year, so three quarters, down to around or slightly less than one quarter by 2050. However, I would again say that that can be abated. If you have, for example, emissions coming from heavy industry that start with fossil fuels—so you have power generation from fossil fuels—but you are able to capture and store that carbon, then you may still have a dependency as the UK on it, but the impact may not be there for those reasons. Does that make sense?

Dr Poulter: It does, absolutely.

Stuart Payne: Forgive me, but, just because it is important for the record, did I get the date right, in terms of 2050 and about 25%?

Hedvig Ljungerud: I would have to double check.

Stuart Payne: If that is wrong, we will correct it.

Q52 **Dr Poulter:** Can you also clarify when you do come back to us whether you think that is realistic? That is one of the questions we would be grateful for an answer on, not just the general thought about what the trajectory is going to be, but actually, given the way we are moving and what is likely to come, whether that is realistic.

Stuart Payne: I am very happy to do that.

Q53 **Dr Poulter:** Thank you. We talked a little bit about the North Sea. That was alluded to in your questions. Can you outline the economic benefits of the North Sea in terms of the energy generation sector going forwards? Do you think it is going to be a net contributor to the economy? I am presuming you will say yes, but can you perhaps expand on that?

Stuart Payne: I will not surprise you by saying yes. These are figures from one of the trade associations, so it is not my figure, but it was publicly quoted as being about £20 billion of GVA from the oil and gas sector last year. As I mentioned earlier, the capital and operating investment going in that we can see through to 2030 is £200 billion, taken altogether, so renewables, oil and gas, and all of those pieces. There are 200,000 people who work in and around the offshore energy sector. That is a huge number of people in terms of the jobs and benefits that brings. We touched in a previous answer on the opportunity for exports.

From my perspective, a really good example of the transition is the subsea world. The subsea world was largely invented in the north-east of Scotland and the north-east of England. This is around the kind of engineering that means you do not see it. It is below the waterline, but you can tie back installations; you have remote-operated vehicles, all sorts of very clever kit and very clever people. There are around 40,000 subsea engineers in the UK today. We have about a third of the world's global market. The industry is really good at this. That industry is at the heart of the wind industry, and will be at the heart of unleashing floating wind, where you can have gigawatts per wind farm.

This will be transformational. The skills that are needed to connect clever, complex bits of machinery back to the shore are exactly the same skills that you have been using historically. You can see that sector transitioning the people and the companies from one area to the other. Personally, my belief is that that has to be the model for everything we do. I always use the same three things: the capital, so we need the investment of the energy industry, particularly the oil and gas sector; the capability, those 200,000 people who are vital; and the kit, because we aim to direct industry as much as we can to make reuse of existing pipelines, platforms and technology, such that the value becomes huge for the UK.

If you can make that work in the North Sea, you can make it work anywhere. The North Sea is a ridiculously challenging environment to work in. For the last 40 or 50 years, the world of the oil and gas sector has had people with Geordie, Scouse and Scottish accents, because our engineering talent has been around the world. I am passionate that we can do exactly the same in the transition. By proving that we can do those things here, we can get carbon storage right and make hydrogen work at scale, and we have the opportunity for those jobs to then transfer overseas, exactly as happened with the subsea sector in the late 1990s.

Q54 **Dr Poulter:** That is helpful. I was going to come on to ask you about that. Just one thing, I suppose, would be helpful to clarify. You talked about the transferability of the skills and some aspects of the infrastructure, but, in terms of the platforms and the other things, what will happen to those once we have made that transition away, to a large extent, from oil, gas and fossil fuels?

Stuart Payne: It will be on a case-by-case basis. At the moment, our priority interest is in pipelines. We believe there are £7 billion-worth of pipelines that can be reused and repurposed for things like hydrogen and CCS safely, but can then make those much more investable, because you have taken out the capital cost. I am conscious of time, so we can follow up afterwards, if you would like, on the platforms.

Q55 **Chair:** You mentioned the North Sea is a crown jewel. Norway also has this crown jewel and treats its resource very differently. It gives benefits for society. It has an oil fund. The UK privatised and gave tax breaks. At one time, in Margaret Thatcher's income, about 8% of her tax receipts were from the North Sea. They have turned it from a resource underground to

a resource overground; this resource has vanished in the UK. Does the extent of your authority go to learning those sort of things from Norway for the future, so that there is no repetition of those mistakes?

Stuart Payne: No. Fiscal matters are completely out of our remit.

Q56 **Chair:** Do you make recommendations?

Stuart Payne: It linked to an earlier question around the development of industries. What we do, in partnership with the Department, other Departments and the devolved Governments, is talk about the opportunity of renewables. For example, we all accept we did not capture some of the benefits of the first round of onshore wind. We are all determined that we must capture those benefits for floating wind, so we try to learn those lessons jointly, yes.

Q57 **Vicky Ford:** Are you suggesting that you take floating wind, make loads and loads of electricity and not take that electricity onshore, but use that electricity to make hydrogen and pump the hydrogen through the pipes that have been used to get gas? That is an idea.

Stuart Payne: It would be the secondary purpose. Primarily these things would be built for electricity generation. One of the questions is always what you do. Mr Gardiner brought up the idea of solar storage, which is often the challenge. One way of storing would be at night, when you do not have as much pull, to convert it into a storable thing like hydrogen, which you could store and then use for other purposes.

Q58 **Vicky Ford:** Then pump it through the existing pipes that are underneath the North Sea.

Stuart Payne: As long as we believe they are safe to do that, yes, that is exactly the kind of thing we would like to do.

Q59 **Hilary Benn:** You could use wave energy attached to floating offshore wind, if and as the technology develops. You would have the same connector to take the electricity.

Stuart Payne: Absolutely, and the big piece for me is that the sheer scale of floating wind dwarfs the existing understanding of wind. If the industry can get that right, it gives you a range of these options. It would be a really good problem to have, to work out what you want to do with all that energy.

Q60 **Hilary Benn:** One of your responsibilities as the NSTA is to accelerate the transition to net zero. Taking something like the Bacton project, what would you say to people who make this argument? If you are going to make hydrogen, which let me be clear I am very keen on, by continuing to burn natural gas for quite a long time, you lock yourself into that, so are you actually going to be able to make CCS work to capture 85%, 90% or more? Should we not just be focusing on green hydrogen from the start? What answer would you give to that view?

Stuart Payne: In part, the view from Government consistently is that you are going to need both for a period. Certainly I know, in countries where there is no natural source of gas—they have no blue hydrogen options; blue hydrogen is where you abate the carbon from methane—they will move straight to green hydrogen. The question for us has been what we can do to accelerate the transition. That includes accelerating a market for people who are willing to pay for hydrogen and thus fund developments including green hydrogen.

The future is clearly in green hydrogen. That is the sustainable model. How do you make sure we get there as quickly and safely as we can? One way is to allow industry to prove a market for hydrogen, while you are also proving up your carbon stores and maintaining an infrastructure, particularly in the south-east, so Bacton is a great example, where you have a huge amount of money, time and carbon sunk into platforms, pipes and the facility onshore, which you could then reuse for other purposes. I really like the Bacton concept. It is genuine transition in action, securing jobs in the UK and a clean future, which is good.

To get there more quickly, in my understanding, one of the strong pressures is the speed with which you can actually get hydrogen into the pipes. The quickest way of doing that, or a quicker way of doing that, would be to start with blue hydrogen. You are then essentially having customers for the first time paying and thus feeding the system.

Q61 **Hilary Benn:** In essence, I take your point about the need for transitional steps towards net zero. We hear an argument from those who are interested in the hydrogen industry of the future that you have to start to demonstrate there is demand for this to unlock the investment to produce more of the stuff. The Climate Change Committee has talked about decarbonising heavy industry, which we have already touched on—transport and so on. Do you think hydrogen has any role to play in home heating, given the existence of the customer gas network?

Stuart Payne: That is definitely outside my area of expertise. Having listened to the evidence from the professor to my left, I am being very careful to not get out of my depth, but we believe hydrogen has a range of opportunities. Those things need to be tested, first, in terms of the viability of how much energy you lose. Is it the most efficient use of it? Secondly, what is the market willing to pay for? Exactly to your point, one thing that I am keen that the industry gets on with is having customers for hydrogen quickly that are willing to test it and start the process, in order to bring the cash cycle in and enable investment in things like green hydrogen.

We believe that Bacton, which you mentioned, has the opportunity to provide heat directly to the south-east of England. It is such a populous area and an obvious target for doing that. What I do not know, as it is not our area of expertise and would be an issue for downstream partners, is whether, in terms of calorific value and other things, it is the most sensible use of the hydrogen. We are keen that hydrogen should have a very strong

role to play in industrial decarbonisation. We know that. That is a large part of why the cluster model has been set up the in the way it has been.

Ideally, if you get this right, particularly through green hydrogen with large-scale floating wind, you should be in a position where you are not having to choose. You should have the option to use it for both industrial and domestic, because you should have, in theory, a plentiful, frankly limitless supply of it through electrolysis and green hydrogen.

Q62 **Hilary Benn:** It would clearly make sense for wind turbines, whose owners are currently paid to turn them off when the grid cannot cope with what they would otherwise be generating, to be turning again during that off period to produce green hydrogen.

Stuart Payne: Back to Professor Chapman's diet, yes, it is a bit of everything. That is the same logic as the Bacton example, and the motivation commercially for people who will have to put private money in to make this work. In a world where people are increasingly expecting decarbonisation of energy, if you are a company that is providing natural gas—you have spent all the money; you have the kit and the people—you are very financially motivated to make that work, for example, through a blue hydrogen trial, because that sustains your business, keeps your network going and sustains, for example, that facility.

The company that will come in and provide green hydrogen from a standing start is currently not incentivised in the same way. It does not have anything at peril. There is no risk for it. You are right; there is a huge piece of work, which is not for us. It would be more for Ofgem and others in terms of how any of those models would work financially.

The point Hedvig made earlier is the most important one from our perspective. If we develop these systems in silos, we will have a good energy system. If we develop them joined up, we can have a brilliant energy system and a very clean one, very quickly, that sustains very significant numbers of jobs.

The crucial bit is making sure that they think about each other as they are developed. That includes work on where we license things. The sea is a crowded place, and energy is not the only player. There are fisheries; there is marine protection; there are all sorts of things. A lot of the work that we do and that Hedvig leads on is plugging into people at the Crown Estate, Crown Estate Scotland, Natural Resources Wales and colleagues in Northern Ireland to talk about how the energy piece through the Department stacks up in the uses of the sea, which is going to be a hugely important focus for the next few years, frankly, because that is the period in which you will be planning these things that are all a decade or 15 years out.

Q63 **Hilary Benn:** Do you think that the multiplicity of organisations we currently have, responsible for different bits of the energy system of the present and the future that you have just described, is fit to make sure the

integration that you have so eloquently talked about is going to happen, or have we some way to go?

Stuart Payne: We can always improve, both internally, ourselves included, and in the connectivity between the others. There is a truth that the system of regulation that is set up today did not envisage the world now you have discussed as a Committee. Our job is to work with the Department, the devolved Administrations and other bodies to clear regulatory pathways. Ultimately, we have to make the UK a place that is easy to invest in, because you can do the right things here safely and more easily than in other places.

This is the other piece that is really important in this conversation. With everything I have described to you, every other country that can do it is doing it. We are in a competitive process, and I suspect it will be the same in fusion. We have to make sure that we never drop our guard on safety, particularly as we are very close to the anniversary of Piper Alpha, and that this is a place that can continue to attract capital. Part of that is making it not a regulatory spaghetti to deal with.

Q64 **Chair:** You mentioned marine protection. The Scottish Government's putative, embryonic charter about highly protected marine areas, which was highly inappropriate, has been dropped. Was that a concern to your organisation at any stage—yes or no?

Stuart Payne: No. We respect that the Scottish Government have responsibility to do that stuff.

Q65 **Chair:** It might have designated an area where you want to put some infrastructure.

Stuart Payne: That is their right. Our job is to work with all those bodies, including other licensing ones like the Crown Estate and Crown Estate Scotland, to work out how we best prioritise. I would give credit here to Defra, which is leading a piece of work called MSPri—the marine spatial prioritisation initiative—that tries to bring together all the users of the sea, including marine habitat protection. How do you make this work? It is a very complicated area.

Q66 **Mark Pawsey:** Can I ask you about the other way in which the North Sea can assist us in achieving our goals? That is by using the voids that exist under the North Sea, from which we have extracted oil and gas, and storing carbon there. Can you give us a guide as to the capacity that exists there? If we were to keep our existing methods of generating CO_2 through the industries that we have here, how long would the resource last?

Stuart Payne: The resource is 78 gigatonnes, so 78 billion tonnes. That is a meaningless number, so let me try to contextualise a little. What does that mean in practice? The UK emits 350 million to 380 million tonnes a year now. That number is expected to come down. The UK target of using carbon capture and other technologies to get to net zero by 2050 envisages a carbon sequestration of 180 million tonnes. At its peak, 180 million

tonnes is the Government target of what will be going in each year, so we have hundreds of years' worth of storage. That talks to exactly the point the professor was making, in that that is not a sustainable solution. It is a temporary solution, even if it is temporary for 50-odd years.

Q67 **Mark Pawsey:** That was my point. Professor Chapman has introduced us to technologies that look 100 years hence. Therefore, is the proposal to use those voids to store? Is it just a short-term fix or is there a long-term future for that process?

Stuart Payne: It is both. What is the bridge? If you can get to a world where your energy is produced with no emissions at all, that has to be the goal for humanity, whether it is in the UK or wherever else. As Hedvig said, today 76% of our energy comes from oil and gas. Between those things, we need to have more than warm words. You need to have actual practical things you are going to do. Carbon capture and storage is a great example of one of the things that will make a difference.

We will store those things in two areas. There are former depleted reservoirs, where we got oil and gas from. That is about 10% to 15%. The rest will be going into saline aquifers, which are much larger. The downside is that we know them less well, because the industry has mapped the places it has taken the hydrocarbons from and knows them.

Q68 **Mark Pawsey:** That is only 15% of the total. Our concept of carbon capture and storage is that we simply use those voids. You are saying that is a relatively small proportion of the availability.

Hedvig Ljungerud: Stuart is absolutely right. I just want to add that, partly because only some of it has been properly explored, mapped and so forth, that 78% needs what we call appraising. It needs much more careful exploration, seismic, et cetera, to get a better sense of how much is out there. That is why we did a large-scale licensing round, to start driving that appraisal.

Q69 **Mark Pawsey:** There is much more capacity there than we need as the UK. If we develop that proposal, how saleable is that to other economies around the world to help solve their problems?

Hedvig Ljungerud: There will be capacity for import, and it is certainly part of the consideration. The EU, for example, is looking at its own targets for carbon storage, where places like Norway and the UK will be clear markets for it to look to. In the very first instance, the track 1s that are happening now, which are the Department's business, the emitters are UK-based, but looking further forward that is certainly on everybody's radar.

Q70 **Mark Pawsey:** Is the North Sea the best place in the world to do that, or are there competitor locations around the world that may be better suited to that technology than we are?

Hedvig Ljungerud: We love to say that we are the best place in the world, but I suspect there might be others who will say that they are. We have an

outstanding natural resource, so we are in a very good place. What happens between now and a few years in the future will determine how well we capitalise on that.

Q71 **Mark Pawsey:** We are importing natural gas from all points around the world. Could we find ourselves in a position where we could bring CO_2 from other parts of the world and offer them a storage opportunity?

Hedvig Ljungerud: Absolutely, yes. For the track 1s now, the emitters are domestic UK-based ones, but down the line it is certainly in the thinking.

Q72 **Mark Pawsey:** Domestically, how is the CO_2 going to get into these holes in the ground under the North Sea?

Hedvig Ljungerud: The foreign or the UK?

Mark Pawsey: Let us say from within the UK and from outside the UK.

Hedvig Ljungerud: That is where it is interesting. Stuart talked about the pipelines. In some areas, there are existing wells, some of which we might need to seal up, but some where there might be potential to use for this. Wherever we can use existing infrastructure, that will help. I am not an engineer, so I hesitate to go into detail, but as a process it is not a million miles from a lot that is already happening offshore, in terms of moving molecules along pipes with huge dependency on the geology.

Q73 **Mark Pawsey:** Is it your assessment that the infrastructure that already exists can be repurposed without very substantial investment, or is there going to be a pretty major investment in this area?

Stuart Payne: It is going to need both. A big part of what we have been doing is working with industry to make sure that we have as good a feel as we can on two main things: the pipelines and the wells. Essentially, Hedvig is right. You are going to need to move a molecule to a point and compress it, and then inject it. What you normally do is take something out at high pressure, either pressurise or de-pressurise it and move it. You are going to do the process in reverse. Without question, there will be areas in which, for example, it links to an industrial cluster where there will need to be significant infrastructure built that then plugs you into the existing networks.

Q74 **Mark Pawsey:** For years, we spoke about carbon capture and storage. We are now talking about carbon capture usage and storage. If we are going to invest in the North Sea in the way that you would like us to, we do not want to be doing that usage, do we? Is it in your interest for us to be using the CO_2?

Stuart Payne: It is in our interest to capture the CO_2. If we can then use it in a way that does not re-pollute the environment, that is great.

Q75 **Mark Pawsey:** That is in the interest of your body.

Stuart Payne: The body would not mind either way. The issue we have is making sure that we are doing everything we can to take carbon dioxide out of the air. If that is then reused in industrial process or used for something else that captures it for good, that is absolutely fine.

Q76 **Mark Pawsey:** Is there a danger that we become so good at the usage bit that, after we have invested massively in carbon capture and storage, the investment may be wasted?

Stuart Payne: I do not think so.

Hedvig Ljungerud: That would be a wonderful problem to have.

Stuart Payne: I do not know the numbers, but I read an article a couple of years ago where, for example—and this was not you—somebody brought up the concept of carbonation of drinks. With the amount of CO_2 that is used versus a single store, you would carbonate every drink on earth for 5,000 years.

Q77 **Mark Garnier:** I want to turn to how enthusiastic the oil and gas industry is in terms of transitioning. I am slightly reminded of an expression that Sheikh Yamani came up within the 1970s, which was that the stone age did not end because we ran out of rocks. What I am trying to get to the bottom of is this. We already see a number of oil and gas exploration and production companies getting involved in the green energy transition. Is this a genuine desire in order to secure themselves a future, so they have to modernise or they become dinosaurs, or is it a cynical attempt to greenwash their balance sheets in order to make them slightly less un-ESG so that they can raise some more capital?

Stuart Payne: Forgive me. The honest answer is that you would need to ask them. We obviously are not a lobby group for them.

Q78 **Mark Garnier:** What is your experience?

Stuart Payne: In any group of people in a room, there are good and bad actors. In our experience in the North Sea, people are acutely aware of two things. The first is the social licence to operate. Our chair, when he came in a few years ago, gave a speech to most of the MDs of the industry in the UK and told them that, in his view, the social licence to operate had never been thinner.

The second one is from an ESG point of view. The investor appetite to invest in people who are only part of what would be described as the problem and not part of the solution limits your sources of capital. Where we see it, it is real. The reason I say it is real is the commitment to spend, with £14 billion committed to the transition through the North Sea transition deal by 2030. That is real commitment on real money. I want to be careful, with your permission, not to name companies, but, if one imagines a very big facility in the north of Scotland that fabricates things for oil and gas and for wind at the same time, they are the same clients.

They are putting their hands in their pocket. They are putting their money where their mouth is.

Q79 **Mark Garnier:** You are sensing a very genuine desire to have a future.

Stuart Payne: There is a very genuine desire. For example, in the offshore wind industry in the UK, a number of the largest players are the companies that you would recognise from the oil and gas sector. That is just a statement of fact. There are also oil and gas companies that have said, "We are not part of that. We do not want to get involved in those things. We do not want to get involved in carbon capture and storage. Actually, we are a pure play specialist. This is what we do". We respect that. That is not unlawful, but they will have a diminishing space to operate in and a diminishing base of investors.

Q80 **Mark Garnier:** They really are a dinosaur.

Stuart Payne: They are not a dinosaur but, like all of us, they do not have a right to be here. At a certain point, investors and society may say, "Actually, we are not willing to allow that to happen". That is not for the regulator to do, but, to be really practical, there are bits you get to opt into. You do not have to take part in carbon capture and storage. We cannot force people to invest money; we cannot make that happen. In terms of emissions reduction, we are very proud of our track record of getting after emissions reduction in the production of oil and gas, and that is not optional. You do not get to not play in that space. We have seen a 50% reduction in flaring since 2018. That is not optional. There will be zero routine flaring by 2030. That is not optional.

Q81 **Vicky Ford:** Why not sooner?

Stuart Payne: The question, "Why not sooner?", is a fair one. The date we have agreed is consistent with the World Bank date in terms of when routine flaring should end. We also recognise that a lot of that routine flaring is massive engineering works, which take a significant amount of time, including some long-lead structural items. Genuinely, the important bit of venting and flaring—and I say this very cautiously—is to stop things blowing up. That is why you vent and flare. Our priority is for those systems to be robust, safe and good. However, the dates that are there, like 2030, are the absolute latest, so a minimum of delivery. We are encouraging people to do that much earlier.

My point is that, behaving properly in terms of the transition, there is one end where you are investing in the wind and other things, and another end where you are investing in CCS, but making your own business better and better. We expect everyone to play their part in doing that.

Q82 **Mark Garnier:** Can I ask you an economic question? I was up at the D&A—decommissioning and abandonment—exhibition in Aberdeen a couple of years ago. It was very interesting. I met an economist who was talking about this. This is in the context of my being a Prime Minister's trade envoy and looking to export this product to Brunei, which we successfully did,

actually. An interesting comment was made that, if you build a production platform and you have drilled a hole in the seabed, then that has a big sunk cost, which you recover by the cost of the production and all the rest of it, but you have to put aside money in order to decommission it at some point in the future. That is a good idea.

The problem is that that money is currently sitting as a positive asset on your balance sheet while you are still producing. If you run out of production, you are now having to dip into what amounts to a balance sheet reserve in order to pay for the decommissioning. Therefore, the argument goes that you want to decommission it while it is still productive, but if you decommission it while it is still producing you cut into your cash flow and profits. While I can see the reason for all this, it is slightly problematic.

Then the other issue that was raised with me was the liability that lies with a decommissioned and abandoned well. If it suddenly bursts forth with oil coming out of it in 100 years' time, the descendants of the people who were shareholders would have a liability to that. The liability continues from generation to generation, which on the face of it seems a perfectly reasonable thing to do, to encourage people to do it properly, but actually, not in funny way, you end up with a financial incentive that incentivises not decommissioning because of the balance sheet, cash flow and then liability aspects on the rules surrounding decommissioning and abandonment. Discuss.

Stuart Payne: The bill for decommissioning in the North Sea is vast. Let us start there. In 2016, it was estimated to be £59 billion, broadly half of that liable to the taxpayer. Due to the way the tax system works, you can reclaim certain receipts. One of the first things we did as a body was to work with industry to say, "The way in which you are going to do this has to improve. You have to learn from each other. You have to partner better, form alliances and work better with your supply chain to get those costs down". That cost estimate is now 25% lower; it is billions and billions of pounds lower. The first thing you do is take the headline problem and shrink it, which tackles your balance sheet problem to a degree.

The second piece of your question in terms of liability in perpetuity is a matter for the Treasury and for DESNZ in terms of an organisation called OPRED—the Offshore Petroleum Regulator for Environment and Decommissioning—which is the prime regulator for decommissioning activity. You are right; it has what is called a section 29 notice, where it can essentially reach back. The purpose of that is that, if I sell you my assets, I do not then meet the decommissioning commitments and I disappear, the Government can reach back for the people who took the financial benefit from the activity. That is a robust and sensible system.

What we have been doing this year with the changes in financial markets is a good example. A lot of the decommissioning agreements are held within joint ventures. They will have a link to headline interest rates, for example. While interest rates have been 1% or 2%, each year, that DSA,

or decommissioning security agreement, has moved through and no one has really noticed. When you throw a projected 10% interest into that, it creates a perversity, whereby you risk having such a large provision required that exactly the risk you have identified comes to be. It is not a real risk. The work would not cost that, but your model does.

We have done work with industry and the trade association to help the joint ventures say, "How do we make sure that we have a proportionate decommissioning security agreement in place?" What we cannot and would not do is open up the liability in perpetuity bit. What we can do is try to get the headline number down and then make sure the individual provisioning within that is sensible. Does that make sense?

Q83 **Mark Garnier:** Yes, it does. It is a big subject, but it sounds like you are on to it.

Stuart Payne: I believe I was actually with you at the event, so you sparked a memory. That is another great export opportunity for us. The men and women who decommission the North Sea have the opportunity to undo what their predecessors did 50 years ago in building Brunei, Oman and all these places, and to help decommission those things safely. That is another great opportunity.

Mark Garnier: We got a $300 million export win to Brunei as a result of that, you will be pleased to hear.

Q84 **Barry Gardiner:** You spoke about the thin licence to operate that oil and gas companies have been warned about. Of course, the North Sea Transition Authority is seeing declining extraction from the field, but that declining extraction was boosted, if I can say that, in February 2022 when the then Chancellor asked Kwasi Kwarteng, who was later Chancellor, when he was at BEIS, to hurry up the six licences for the new oil and gas fields there.

You talked about the reluctance or the difficulty of getting access to capital. Is that, in your view, partly the reason for the subsidies that have been offered from the taxpayer? First of all, we had the 130% subsidy, so if Cambo had gone ahead it would not have been Shell and Siccar that were paying for the development of that field; it would have been the taxpayer paying 100% and then giving them 30% on top. That old regime has gone, but with the windfall tax we now have the 91p in the pound subsidy going into any new development in the North Sea.

How do you see that as being consistent with the principle of maximum economic recovery? Surely what it points out is that it is not economic for those companies. They cannot find the capital unless they have the subsidy.

Hedvig Ljungerud: I will not go into detail on the tax system, which is not for us.

Barry Gardiner: The question is about the details of the tax system.

Hedvig Ljungerud: I would just note that you cannot have tax repayments or tax analysis without having tax. They go hand in hand. On maximising economic recovery, it is really important to note that we look at that pre-tax. That is the core of the system. That is the difference between maximising economic recovery and what companies look at. Whether it is completely subsidised or overtaxed to the point of making it non-commercial does not affect the MER evaluation. MER is judged on a pre-tax basis, which means that it is not affected in either direction by the tax system.

Q85 **Barry Gardiner:** By all means disagree with it, but my point is that the companies would find it more difficult to get the capital finance if there was not the backstop security of knowing that those subsidies were there, because of course those subsidies are specifically there targeted at new development. Those tax breaks come only from the new development.

The companies are making other profits, so you are right; there will be taxation that those companies are paying for their existing fields, but they get the tax subsidy only on the new development. That turbocharges the investment capacity of those companies.

Hedvig Ljungerud: While tax is not for us—and I want to be clear on that—we probably would not accept the description of it as subsidies. The problem at the moment in the UK offshore sector is not too much investment; it is investor confidence, predictability and certainty. We are not at the moment seeing masses of investment going into uneconomic projects. I am slightly looking over at Stuart to interrupt me if I am wrong in that, but what we have been hearing concerns about is rather that the investor confidence at the moment needs a little shoring up.

Stuart Payne: That is absolutely right.

Vicky Ford: My last questions are about the relationship between Whitehall, the Department and your bodies. I want to hear from Hedvig, because she is the person who has worked in Whitehall. She has worked in strategy and, quite fundamentally, we have not heard enough from the women in this meeting.

Chair: That is because you are efficient and brief.

Q86 **Vicky Ford:** Men, just listen. You can come in last. Does the Department seek a conversation between the different arm's length bodies, or does the Department treat each of you individually?

Hedvig Ljungerud: It is very appropriate to direct the question to me, because I look after this. It is a little bit of both, but largely our independence is to the level that we run and manage the relationship with other bodies ourselves. On occasion, the Department will say, "There is a parallel with this arm's length body; we would like you to talk to those people", but it is mostly in-house. We have pretty extensive Whitehall relationships outside of DESNZ.

Q87 **Vicky Ford:** That was the next question. Which Departments other than

DESNZ do you need to engage with? How easy is that? Do they listen to you?

Hedvig Ljungerud: We talk quite a lot to HMT and HMRC. We were actually quoted in the terms of reference for the fiscal review as one of the bodies they will work with. We talk to Defra, as Stuart mentioned, on spatial planning, where it is the lead. We on occasion, of course, have to talk to the Cabinet Office. When we do trips, we tend to liaise with the Foreign Office and make sure we are joined up.

I would say, however, that our closest relationships are with other bodies that are quite similar to us. We work a lot with Ofgem; we work a lot with the Crown Estate, Crown Estate Scotland and Marine Scotland. You mentioned regulatory spaghetti. To untangle some of that, we need to have those discussions and make it as straightforward as possible.

Q88 **Vicky Ford:** Which of those Departments you have spoken about is the one that you find clunkiest to deal with? Was that unfair?

Hedvig Ljungerud: I am going to sound slightly sycophantic, because we normally get a direct contact and then it is very straightforward.

Vicky Ford: That is good.

Hedvig Ljungerud: If you had to approach one from not knowing and go through, if you will, the information centre, it might be different. Normally, it is pretty good.

Q89 **Vicky Ford:** How confident are you about future funding and consistent policy from Whitehall?

Hedvig Ljungerud: For us, the funding is pretty set. As we discussed, there is a large chunk of industry. We will work in the political environment we have. We have a degree of independence that means, within our statutory purpose, which any Government can change, we can set our strategy and our direction, which we have done quite clearly.

Q90 **Vicky Ford:** Ian or Paul, how confident are you about future funding and future policy from Whitehall?

Professor Sir Ian Chapman: I feel reasonably confident. There is across the House support for investment in science and low-carbon technologies.

Q91 **Vicky Ford:** You find that other Departments in Whitehall are listening to you as well.

Professor Sir Ian Chapman: Yes, the join-up between the Departments is not as bad as people often say it is. It really is reasonably functional. The only one that I would add for us is science. We have a lot of interaction with the science department in addition to Hedvig's list.

Q92 **Vicky Ford:** I get the feeling that this bit of the industry—your nuclear side, your offshore side—is very male-dominated and we do not have enough women in this industry. Is that true?

Stuart Payne: In our industry, it can be difficult. If I can be blunt, that is a choice. We inherited an organisation that had 22% females. Today, my organisation has 48% or 52%, depending on which week you are in. We choose to be an inclusive place to work and you can choose to make that difference. I have a 50:50 board. I have a female-dominated leadership team. It is not because I hired women for being women, but because I hired the best people. You can absolutely choose to.

Q93 **Vicky Ford:** That is in your organisation and you see that shifting in the industry.

Stuart Payne: I see the industry making genuine strides to try to do the same thing. By the way, our industry has a challenge. The word "dinosaur" has been used for fusion, because it is a very long-term emerging thing. If we do not appeal to people across ethnic groups, genders and backgrounds, we will get half the talent.

Q94 **Vicky Ford:** Thank you for putting me right. Would you say the same, Ian?

Professor Sir Ian Chapman: Ditto, it is exactly the same.

Chair: Thank you very much. That ends the first meeting of the Energy Security and Net Zero Committee. Winning the gold star this week for brevity and efficiency was Vicky Ford at six minutes, and Mark Pawsey earned the silver medal with a seven-minute question area.

Can I thank Hedvig Ljungerud and Stuart Payne from the North Sea Transition Authority, and Professor Sir Ian Chapman, chief executive, and Paul Methven, STEP director, from the UK Atomic Energy Authority? Thank you for coming this afternoon and for a scintillating conversation. We could have listened longer. The pressure for the Chair is to keep things moving while the information keeps flowing. Thank you all.