



HOUSE OF LORDS

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NUCLEAR RESEARCH AND DEVELOPMENT CAPABILITIES

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Witnesses: Professor Sir John Beddington and Professor David MacKay

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Members present

Lord Krebs (Chairman)
Lord Crickhowell
Lord Cunningham of Felling
Baroness Hilton of Eggardon
Lord Jenkin of Roding
Baroness Neuberger
Lord Oxburgh
Baroness Perry of Southwark
The Earl of Selborne
Lord Wade of Chorlton
Lord Warner
Lord Willis of Knaresborough
Lord Winston

Examination of Witnesses

Professor Sir John Beddington, [Government Chief Scientific Adviser], and **Professor David MacKay**, [Chief Scientific Adviser to the Department for Energy and Climate Change].

Q68 The Chairman: Welcome to this session of our inquiry into nuclear R&D. We have two witnesses today and I will ask them to introduce themselves for the record in a moment. This is to remind all Members of the Committee and the witnesses that the proceedings are being webcast and that of course there will be a transcript of this session, which will be sent to the witnesses for correction within the next few weeks. For members of the audience, there is a declaration of relevant interests by Members of the Committee as well as the scope of the inquiry available for you. Without further ado, I would like to invite our two witnesses to introduce themselves for the record. If there are any opening comments you would like to make, please feel free to do so.

Professor Sir John Beddington: I am John Beddington. I am the Government Chief Scientific Adviser. I have no initial comments.

Professor David MacKay: I am David MacKay. I am Chief Scientific Adviser to the Department of Energy and Climate Change. I am a Director General and I lead the Science and Innovation Group in DECC. I also jointly lead the Strategy and Evidence Group with the Chief Economist and the Director of Strategy in DECC. I have no opening comments.

Q69 The Chairman: Let me kick off without further ado. I want to start by asking you both to describe the roles of both the Government Chief Scientific Adviser and the departmental Chief Scientific Adviser. What is your role in ensuring that the UK does have adequate research capabilities to deliver the current plans for nuclear new build, and to ensure that there is sufficient capability for longer term nuclear plans should they emerge? We are interested in what your roles are and what you see the current situation being. Perhaps Professor MacKay could lead off on this one.

Professor David MacKay: Chief Scientific Advisers are responsible for ensuring that the best science and engineering advice underpins Government decision-making. When it comes to nuclear research strategy, not being a nuclear expert myself, I see my role to be especially to listen carefully to the views of experts and try to ensure that their evidence and arguments are well understood in my Department and in other Departments, too. I would like to describe for you how I am currently discharging that responsibility and role.

First, DECC has a Science Advisory Group and Dame Sue Ion is on that group, so I have frequent contact with her expert advice. I also make personal contact with several other advisers and, of course, read the literature that conveys expert views on nuclear research strategy.

Secondly, I am co-chair of the Energy Research Partnership. The Energy Research Partnership recently wrote a technology report on nuclear fission and it is now developing a UK nuclear fission technology roadmap in collaboration with the EPSRC, the ETI, the NDA

and the NNL. I am going to make sure that all the messages of that roadmap and report are well understood in DECC.

Third, I sit on the UK Research Council's Energy Programme Advisory Committee, which comments on national research spending priorities in general.

Fourth, the activities of the Science and Innovation Group that I lead in DECC include Technology Innovation Needs Assessments, or TINAs, which we carry out in collaboration with other members of the Low Carbon Innovation Group. The Low Carbon Innovation Group includes the Carbon Trust, the TSB and the ETI, for example. A TINA reviews the potential for innovation support to increase the value of a low carbon technology to society. We have TINAs in many areas such as offshore wind, building energy efficiency and so forth. TINAs are detailed and systematic assessments that attempt to quantify the value for money of alternative interventions so as to guide the decisions of the members of the Low Carbon Innovation Group. We have recently started the TINA for nuclear power, and this work will help to steer the future activities of DECC in this area and hopefully those of our low carbon innovation partners. Our TINA work on nuclear is going to build on the position paper written in March 2011, *UK Nuclear Horizons*, by the NNL, on the Energy Research Partnership work that I mentioned earlier, and on the TSB's 2009 *Review of the UK's Nuclear Research and Development Capability*, by Sherry, Howarth, Kearns and Waterman. In contrast to that TSB review, which looked at potential benefits on a five to 10-year timescale, TINAs look much further into the future as well. We very much emphasise long-term benefits of innovation support.

Fifthly, the Science and Innovation Group in DECC has a small budget with which it can fund research. I recently commissioned a small desk study to better understand the long-term comparative advantages of thorium-fuelled reactors, which is technology that questions are often asked about. So DECC does directly fund small amounts of desk research in nuclear.

Q70 The Chairman: Thank you. Does Sir John Beddington wish to add a particular perspective from the role of Government Chief Scientific Adviser?

Professor Sir John Beddington: Yes. As you have seen, David is the person as DECC Chief Scientific Adviser who leads in the nuclear area. I have overall responsibility that essentially the best science and engineering advice underpins Government policy and we have just started doing a review of science and engineering in DECC. To an extent, I think that that is part of my role. But I do have to be thinking in terms of, I suppose, this structure. At the moment I have responsibility for ensuring the research capability is adequate to meet long-term policy demands. Obviously, those responsibilities are distributed across DECC, BIS arguably, and the research councils. I think that that is an area that I probably need to do some more work in.

Q71 The Chairman: Before asking Baroness Perry to come in, if I could come back to Professor MacKay. You have described very fully your role in looking into this area. You will be aware of some of the evidence we have received from academic experts, as well as those who are involved in the nuclear industry, comments that basically we are not investing in nuclear research and development to anything like the level to refresh and maintain the current level of competence. That is a view from one group of witnesses who have submitted written evidence: a lot of our nuclear capability, infrastructure and capacity has already been run down and lost, no clear national direction and an arrogant belief that the future global leadership can be based entirely on historic capabilities. In other words, an extremely alarming picture has been presented to us. Is this something that you recognise and, if you do recognise it, what are you doing about it?

Professor David MacKay: Yes, I am familiar with these views of the expert community and there does seem to be a strong agreement among them. I think there are strong merits to their arguments and what I am doing about it includes the activities I described earlier. My team are leading the Technology Innovations Needs Assessment, which will try to quantify the value for money to make a strong case for research and development support. The Energy Research Partnership work, jointly with the other organisations, to create a roadmap will I hope again make clearer the arguments in favour of a stronger and more centralised strategic approach to nuclear R&D.

The Chairman: A number of Members of the Committee wish to come in, so I will go to Baroness Perry, Lord Oxburgh and Lord Winston.

Q72 Baroness Perry of Southwark: In the formulation of nuclear policy, Governments are hugely influenced, and understandably so, by public attitudes and public worries about anything with the word “nuclear” in it. What social science advice are you getting in DECC to help you think through the issues that are concerned with public attitudes?

Professor David MacKay: We get social science advice through several routes. One is via CoRWM, the Committee on Radioactive Waste Management, which includes social science expertise. The Science Advisory Group of DECC also has social scientists on it, so we certainly reflect on social science issues. DECC has recently recruited several civil servants who are social scientists, so we have had a significant increase in the internal skills in-house in DECC. That growing team of social scientists are themselves creating academic contacts as well. They are building up a network of academic advisers to support them in social science evidence.

Q73 Baroness Perry of Southwark: Are they backed up with any research?

Professor David MacKay: Are they backed up?

Baroness Perry of Southwark: Yes. Are you commissioning any research into public attitudes?

Professor David MacKay: Yes. I cannot quantify in terms of how much money we spend on such research, but certainly we engage in public consultations and we carry out studies. On the whole general area of energy road-mapping, for example, we have been doing studies in collaboration with Ipsos MORI to see what happens when a community of ordinary people are engaged with the 2050 pathways calculator, which helps people understand how lifestyle choices and technology choices determine our energy demand and what the options are for where we get our energy from. That research is intended to help us better understand, and to quantify, how much people change their minds on a range of technologies when they are introduced to quantitative evidence.

Q74 The Chairman: Before turning to Lord Oxburgh, I did not give Sir John Beddington a chance to respond to my question, which was: the overwhelming view that we are receiving from the professional and academic community is that basically the UK's strategy for nuclear R&D is not fit for purpose. You commented that you are trying to change the opinion in DECC by looking at value for money, and so on, but I wondered if, Sir John, you have any comments to make on that.

Professor Sir John Beddington: Yes. The first thing to say, I had the chance to read some of the transcripts recently and I have read the report of the ERP group and so on. I think the thing is that—albeit, I think that there is effective networking and co-ordinating arrangements that David has outlined within DECC—it probably is timely to review something at an overarching level to see whether our current R&D measures are adequate, to look at decisions and investments we are taken in a proper way. This is happening in part

in terms of the R&D but I think we need to be thinking about that. We also need to be thinking because the actual landscape in nuclear is extraordinarily diverse. There is a wide range of bodies involved in R&D, both as commissioners, providers or users. I feel uncomfortable that the overall landscape and the co-ordination of that landscape into a coherent roadmap for developing our energy needs, needs to be put in the context of what R&D has to be done. I think we need that exploration and, to an extent, I think arguments about whether the UK should invest in Generation IV or not cannot be properly evaluated until we have an overall strategy and an overall roadmap of where we actually want to be in the nuclear area, which of course links in very closely to work that David and his colleagues have been doing on how we meet our obligations for emissions reductions by 2050. I do think that the complexity of the landscape and of some of the ways in which we actually are needing to address these needs for emissions reduction, probably need a substantial new look. I think that if we compare ourselves, there is a lot of good work being done from the National Nuclear Laboratory. I think the Nuclear Decommissioning Authority are doing some excellent work. The research councils have increased their spend substantially on nuclear fission, but I do not feel comfortable that this is all joined up in an overall policy to take it forward and actually meet our R&D needs.

Q75 Lord Oxburgh: The kind of research and development that is needed to support a future nuclear programme is exacting; it is difficult; it needs first-class people, whether one is talking about civil engineering, whether one is talking about nuclear physics, whether one is talking about material science. It also tends to be expensive. We have heard that the UK has in recent years withdrawn from several important international programmes, which certainly would have the effect of broadening our experience, broadening our access to work done by others. I find this extraordinary and I wonder if you could both comment on that.

The corollary of that is: whose responsibility do you think it is to ensure that the country maintains its nuclear options open? That is not a question of whether we have another nuclear build or go for any particular generation, but whose responsibility is it to see that those options stay open? It is not just a matter of having reports; it is a matter of controlling the resources to ensure that they stay open.

Professor Sir John Beddington: Shall I perhaps answer that to start with? This is why I believe that we do need to think a bit about the overall landscape and to be thinking about a roadmap of where we wish to be, in terms of our nuclear development. Then arguably, I think that would ultimately be the responsibility of the Secretary of State for Energy and Climate Change, but there would be others who would have a role to play; the Secretary of State for BIS, for example, is involved in that.

I think it would be unwise to answer your question in a simple way. In a sense, if I have a job of trying to ensure that we have the appropriate involvement in international organisations and international research programmes and that we have the overall capacity within various institutions within the UK, that is very difficult to do in isolation unless you have an overall coherent strategy for taking nuclear forward and to ask about the R&D needs that we are going to have; for example, what proportion, whether we go above 16 gigawatts or up to 48, which I think was part of previous discussions. I do not think we can answer those questions in isolation unless we have a detailed plan about how to take that forward. R&D issues will definitely come up, but I think we need to be thinking quite hard about that. I will be very interested to hear this Committee's recommendations along these lines.

Q76 Lord Oxburgh: Do you think such a programme, let us say that it comes into existence, would have any significance unless it was funded?

Professor Sir John Beddington: I think that this is why we need to be thinking about it. We have some excellent institutions. For example, we have the National Nuclear Lab, which has fantastic facilities. It is likely to have the ability to look at the fuel cycle, to think about the issues of plutonium disposal. It has potential abilities if the commissioning of its phase 3 happens, but its constitution arguably needs to be thought about.

Q77 Lord Willis of Knaresborough: It does not have sufficient resources.

Professor Sir John Beddington: Of course, Lord Willis. The point I am making is we need to be thinking about it. For example, at the moment the National Nuclear Laboratory passes its profits, which go through to DECC and then go to the Treasury. Therefore, one question might be to think about changing its structure so that—

Q78 Lord Willis of Knaresborough: We are always thinking about things.

Professor Sir John Beddington: I am sorry, Lord Willis, I did not catch that.

Lord Willis of Knaresborough: I said we are always thinking about things, we just never do anything.

Professor Sir John Beddington: Absolutely.

Lord Willis of Knaresborough: Sorry, Lord Chairman.

Q79 The Chairman: Professor MacKay, did you wish to add anything to the response to Lord Oxburgh?

Professor David MacKay: Yes. Generation IV participation by the UK was terminated a few years ago because money was tight. I am sure that decision will be revisited in DECC. I have listened carefully to the evidence from the experts that says this is a pressing matter and the decision should be revisited as early as possible within the next three years, so I will be raising it within DECC before the next Spending Review.

The motivations for being interested in Generation IV research that I have picked up from the experts include not only the straightforward motivations of sustainability that

Generation IV reactors could have smaller quantities of waste, less long-lived waste and might offer safer reactors, but additional motivations include the possibility that, while industrial power today largely comes from fossil fuels, in the future high temperature heat might be provided by nuclear reactors. Today's reactors, Generation III reactors, cannot deliver high temperature heat, so that is a motivation from the point of view of the energy roadmap work.

Incidentally, on energy roadmaps, I am not recommending that we should try and adopt a single pathway for our energy system. Rather, because there are so many risks and uncertainties—especially about costs, with many of the key technologies for the future including carbon capture and storage and offshore wind, and so forth—I am strongly advocating a hedging strategy where we not only identify a low cost pathway, like the one identified by the Committee on Climate Change, but we should hedge for the possible risks and uncertainties and have stronger action in all sectors than you would get from that sort of central pathway. That is a motivation for looking at technologies that are not currently part of today's policies. I think there is widespread agreement around Europe and the world that, to keep options open, energy research should always adopt a considerably wider approach than the energy policy of any particular day.

Even if UK nuclear power were to be provided by Generation II and III reactors only for the next 40 years, there is still a case for supporting Generation IV research because it is a very good way to spin out other benefits. It is a way to develop and retain experts and educators who can serve the role of advisers and inspectors and who have expertise in other countries' reactors, so that when accidents occur in other countries we can give good advice to the Foreign Office. All of those roles: educators, advisers, inspectors and teachers, are needed by a Generation III programme today, so I think there are compelling arguments for involvement in advanced research along the lines of the Generation IV programme.

Q80 The Chairman: To be clear, your view is that the UK should be involved in Generation IV research and development?

Professor David MacKay: I think there are some very good arguments and I am going to try and make sure those arguments are put as well as possible.

Q81 Lord Jenkin of Roding: Could I just follow on from that, because you were here when we had the evidence last week when part of the argument centred on the question of recruitment of really able people who are going to do what you have been, rather encouragingly, describing. A point was made that if you are doing no more than keeping a watching brief, which is what we heard from Mr Higson about that, you do not actually have a seat at the table. It will be exceedingly difficult to recruit able people if all they are going to be told is to keep a watching brief. To follow up Lord Willis' point, the Chief Scientific Adviser said we need to be thinking about it. My anxiety on all this is that there is a dichotomy within the Department at the moment. Up to 2025 it is now pretty clear there is a commitment that we are going to have the Generation III reactors that have already been promised. But there is absolutely no certainty as to whether anything is going to happen after that. Your own pathways paper takes us up to 2050 and did have the possibilities of a substantial nuclear programme. We now have the Climate Change Committee recommending that there should be more emphasis on nuclear and less on the expensive offshore wind. When are you going to be able to tell those people who sit on your committees—and you mentioned Dame Sue Ion as one of them—that there is a future for nuclear power in this country? Because they are not convinced of that; neither am I.

Professor David MacKay: You referred to a dichotomy. There are certainly two priorities. One priority that the Department is very firmly committed to is building a new generation of nuclear and aiming for 12 gigawatts, or so, within a couple of decades. That is one priority. Another priority is to ensure that the long-term innovation needs for the energy system are being supplied out to 2050 and beyond, and that is more my responsibility. What I am doing about it is the Technology Innovation Needs Assessment, which I mentioned earlier. I expect that will be complete by the end of this year. Our work on 2050 energy pathways is going to be an ongoing piece of work. We are planning another publication of version 3 of the 2050 calculator before the end of the year. That will be accompanied by the Committee on Climate Change's pathway, by some alternative pathways and by a hedging pathway that would give you the option to reach any of those credible pathways, so all of these things should be with you before the end of this year.

The Chairman: Sir John, did you wish to—

Professor Sir John Beddington: Yes, I would like to explain a little bit what I was meaning, which Lord Willis took exception to. My role is obviously an advisory one, and I have been advising the Government on the nuclear issues now pretty much since I came into the job. One of the things that I was asked to set up during the last Government was the Nuclear Centre of Excellence, which we did. It ran in pilot mode. It was addressing many of the problems that you have been discussing today. Unfortunately, that was stopped during the CSR spending round and we have not reinstated something in its place. I think we need to be thinking about how we address these nuclear problems. I think I have indicated that there is a diversity of landscapes and issues to do with the specification of the activities of the NDA, of the NNL. All of these things need to be thought about rather importantly and quickly.

As I also indicated in my remarks, I would be very keen to hear exactly what this Committee recommends to Government about what they should be doing to address these problems. I may concur with the Committee or I may provide alternative advice, but I think that it is important to recognise that this is an issue where the UK has the potential to do extremely well. We have excellent scientists and engineers in this field and I am concerned about the potential of how we could, for example, respond to significant nuclear emergencies unless we get an appropriate throughput of excellent young scientists and engineers coming into the area. I certainly take the point that was made earlier that a watching brief is not going to be attracting large numbers of people into this field. There are limits, Lord Willis, to my powers. I can advise; I cannot allocate money.

Q82 Lord Winston: I feel that we have hammered our poor witnesses quite enough on this issue, really, but I suppose we do feel it is fairly shocking that we spend about 1% of what France and America spend on nuclear fission, and that the percentage of our total energy R&D is only 1.5%. It seems to us that, at that level, it is very difficult to protect and maintain the young people that you are talking about, Sir John, and that is one of the issues I think that we are quite concerned about. I do not think you can possibly answer more than you have done already, frankly. I think this is something that obviously we will have to bear in mind in our report.

Professor Sir John Beddington: Yes.

Q83 Lord Jenkin of Roding: Could I ask a supplementary on the points that have been made? I think it was Sir John who said that the National Nuclear Laboratory and the Nuclear Decommissioning Authority were doing very good work. We have had a lot of evidence to say that their terms of reference now need to be revisited, and we may have something to

say about that. Because it is quite clear that, particularly, the NDA simply has been set up to deal with decommissioning and waste and they are actually refusing to have anything to do with new build waste, which I find depressing. The National Nuclear Laboratory has a very splendid facility, most of which is not being used—

Professor Sir John Beddington: I agree with you.

Lord Jenkin of Roding: —because its terms of reference do not allow it to have a programme of its own.

Professor Sir John Beddington: This is why I was saying earlier, Lord Jenkin, that I do think that the role and structure of both the NDA and the NNL need to be reconsidered. I think that would come out of some appropriate inquiry into asking where we are going in the future. When I said I thought they were doing good work, I think they are doing good work within their rather narrow and, in some cases, hindering terms of reference.

Q84 Lord Cunningham of Felling: A brief question following on from what you said a few moments ago, Sir John, which I took to mean that you think there should be a much improved focus and a change of momentum in what is going on in Government about these issues. I hope I am not putting a wrong interpretation on your comments; tell me if I am. Do you believe—and I will put the same question to Professor MacKay if I may—with the current situation and the current lack of momentum or lack of drive in these areas that, unless things change, we are unlikely to meet our obligations on carbon reduction and we may risk failing to meet our obligations in terms of continuous supply in extreme circumstances?

Professor David MacKay: I do not feel we have reached that point yet. Certainly, the effort required to reach the 2050 targets in many sectors is extremely large, and the Committee on Climate Change has often spoken of the need for a step change in what our policies are

delivering. I think there is a technical question of whether our credible 2050 pathways can be achieved with Generation III reactors alone or whether Generation IV reactors would be essential or just desirable or maybe better value.

Lord Cunningham of Felling: Excuse me for interrupting you. My question was not about whether it was Generation III or Generation IV reactors. It is the lack of momentum in meeting the objectives to avoid these problems.

Professor David MacKay: Yes. The 2050 targets do have cross-party support, so I think the foundation is there for strong effort. Maybe the purpose of the 2050 pathways work is to try and clarify what those targets mean, in terms of the actions and policies that are required. That is something we are working on very hard right now. We are trying to make the pathways to the 2050 targets and pathways that maintain security of supply at all times. We want to make the implications of those pathways as clear and transparent as possible. I think in the past 2050 pathways work, which has used very sophisticated models, has tended to be somewhat obscure, so people have not understood how many buildings we are talking about insulating, how many wind farms we need, how many nuclear power stations are needed; the issues of balancing supply and demand at all times. These have not been transparent, and the 2050 work is intended to make all the assumptions underlying a numerate approach completely explicit and trying to make the consequences explicit in terms of a map of the UK showing, to scale, the areas required for: offshore wind farms, the number of nuclear power stations, and so forth, for a pathway that is under the control of the user of the calculator. It does not specify policy, but it allows you to compare alternative feasible pathways. I am hoping that that work will lead to a considerable increase in momentum behind strong policies that add up.

Q85 The Chairman: Let us hope you are right. There is a track record, which we have seen from some of the witness statements, of producing reports and plans but not getting on with stuff, really doing things. So I hope that your optimism is borne out.

I think we have covered the points that Lord Winston would have asked about co-ordination, unless there is anything either of you would like to say further. I think, Sir John, you have been very clear in your statement that at the moment you believe there is insufficient co-ordination among the different bodies involved in nuclear R&D, and an insufficient clarity of oversight and direction. Is that a fair summary?

Professor Sir John Beddington: Yes, that is my view and I think that I would be very interested to hear the results of this inquiry and any recommendations to Government how to take it further.

The Chairman: Professor MacKay, would you also agree with that?

Professor David MacKay: I agree with Lord Jenkin.

Q86 The Chairman: Just within that, perhaps you could just repeat—and again I think, Sir John, you have alluded to this—what would you see as the future role of the NNL? Ideally, what would its role be? You alluded to the fact that when it makes profit, that goes back to the Treasury and does not sponsor research. Do you feel that that is part of its role or would you rather defer that to an overview summary of all the bodies' roles?

Professor Sir John Beddington: I think it probably is most sensibly deferred until one has a comprehensive review of how this works. The point that was made earlier was that NNL has an enormous investment in what are state of the art laboratories. I hope that the commissioning of one of those laboratories will go ahead quite soon. I have been recommending for some while that it should. I think that it is probably too early to redefine what that role is. It has a complex structure controlled by the shareholder executive, and so

on. I would see that any examination of the way forward should think about the NNL. It should think about the NDA. It should think about how research should be co-ordinated to meet these requirements. The way that we had originally envisaged the Nuclear Centre of Excellence, which was going to be co-hosted by NNL but would involve university partnerships—in particular, Imperial College and Manchester—was an excellent idea and could have taken this agenda forward. We now need to think about how we substitute that agenda.

The Chairman: Professor MacKay, would you like to add anything to that?

Professor David MacKay: Yes. My thoughts on the National Nuclear Laboratory, the expert view is that it should receive some grant funding to allow it to work on advanced systems and to maintain expertise in other countries' reactors, for example, and I think the arguments for that are strong.

This issue of support for the NNL to unlock its excellent potential is coupled to the issue of the NDA's remit. If the NDA's remit were expanded from just cleaning up the nuclear legacy to maintaining recycling expertise, preparing for possible future recycling challenges arising from a new nuclear fleet, then maybe they would start commissioning the NNL to do a load of work with their excellent facilities, so there is a connection there between those two questions.

Q87 The Earl of Selborne: Just following up on this point about the NNL, I think it is helpful to hear the remit of the NNL and, indeed, other organisations in the whole field of nuclear research will be revisited and quickly. Isn't the fundamental problem with the National Nuclear Laboratory at the moment that its remit is effectively to give a return to the shareholder, and what you would expect of a national laboratory is to produce

economic benefit; in other words, to ensure that it is deriving the most benefit for society and not just the shareholder?

Professor David MacKay: I agree with that argument, yes. Other countries have comparable facilities that have a national mission to support the creation of knowledge and expertise.

Q88 The Earl of Selborne: Going on then, to review other structures, the commercial exploitation of nuclear research is clearly a matter of interest. Is this the responsibility of the NNL or the Technology Strategy Board? Is it being done effectively?

Professor Sir John Beddington: I do not think I can answer that in a comprehensive way. I think there are different elements which involve the Technology Strategy Board; they involve NNL; they involve the universities; they involve some of the companies themselves who need to do R&D. This is why we need to be thinking—I am sorry, I am going to annoy Lord Willis by saying, “We need to be thinking”—we need to be doing something about addressing this problem and I think I would share that view. For example, I believe that TSB in their evidence indicated they thought the NNL terms of reference and structure should be changed. I think the issues are going to have to be examined, and it is a complex landscape at the moment. I am sorry, I am conscious that I am slightly reiterating a point I made earlier, but I do think that that complex landscape needs to be fitted into what our likely requirements are going to be for nuclear energy over the next 20, 30, 40 and 50 years.

The Chairman: Is there anything you wish to follow up, Lord Selborne, on that point?

The Earl of Selborne: No.

Q89 Lord Crickhowell: My original question has been entirely swept away by what I can only describe as really quite revolutionary change from the position that Government

Departments were putting to this Committee to what is, very encouragingly, being put by both our witnesses today. It is one of the most startling transformations that I have ever heard of in the presentations of Government policy to any Committee that I have ever served on and it is very welcome.

I do have to ask the question how it was the Government got itself into a position of presenting a set of papers to us originally, which we all found absolutely extraordinary in the light of the evidence that we were receiving already, and it is welcome that we are hearing that there has to be an urgent re-examination. I was going to ask how urgent, and I was even encouraged by Professor MacKay's thoughts that we might be getting a series of important conclusions by the end of the year. But I do not think we can entirely expect that the whole of Government policy is going to be decided by the recommendations of this Committee.

So my question, I think a question we have all been confronted with: in the light of the very dramatic change of evidence—encouragingly—how do we get, quickly and effectively now, from what was an indefensible position to one that we can all proceed with? How do you see this being carried forward effectively within Government so that we can get some progress?

Professor David MacKay: I think the main vehicle for carrying forward the work of the Technology Innovation Needs Assessment, which I mentioned earlier, will be the Low Carbon Innovation Group. That consists of the TSB, which looks at the early technology readiness levels and the relatively short-term needs of industry. The TSB, the Carbon Trust, the ETI, the research councils, BIS and DECC are currently members of that group, and we meet at official level frequently and at senior level somewhat less frequently. I intend to make this area one of the top priorities for discussion at senior level at the Low Carbon Innovation Group, once the Technology Innovation Needs Assessment is complete.

The Chairman: When did you say that would be complete?

Professor David MacKay: Hopefully, by the end of this year.

Q90 Lord Oxburgh: Would you both agree that, in this particular area, but thinking more widely about a series of excellent scientific reports that we have had on research in a variety of areas, research capabilities and so on, one of the reasons they have not come to anything—and this is the point that Lord Willis has been making—is that all too frequently they lie across departmental barriers and no one owns that report and is responsible for its implementation. My question is whether either of you see any prospect of changing it? Would you, Professor Beddington, for example, be willing to write to the Prime Minister and say, “This capability is deteriorating or is going to be inadequate to support our efforts for the future unless there is proper interdepartmental action”, which probably means a designated budget contributed by those Departments, which is earmarked for that project?

Professor Sir John Beddington: I think writing to the Prime Minister is something I will consider, Lord Oxburgh. It is not a device for getting change in Government that I use very often. In terms of trying to get some movement, I do think that the report of this Committee will be helpful. You have been taking very wide amounts of evidence. I certainly accept your analysis that there needs to be a buy-in from more than a single Department. I think that there are a number of areas where one can think about how you could improve that. Although it is quite clear that DECC is the Department that has the main focus, obviously BIS has potential, and Defra and indeed, the FCO, if we are thinking about issues of non-proliferation, all of which were part of the plans for this Nuclear Centre of Excellence. So I think we need to be thinking about how we can take this forward in a sensible way.

What seems to me to be clear is that the status quo is going to present significant problems and that if we do not do this, what are the consequences? I should imagine your report will

lay out such consequences fairly clearly, and I will read them with interest and perhaps be in a position to endorse those consequences. It does seem to me quite clear, for example, that in the context of chairing the SAGE to deal with the Japanese disaster in Fukushima, I was calling on people who were very senior in their organisations, who had worked in the nuclear industry for a very substantial time. Professor Grimes was your adviser; he was probably the youngest. I have real concerns, if some sort of problem like Fukushima occurred in Europe or some analogous problem in the future in the UK, whether we would have people with the experience of the industry to do it. Again, I would endorse the issues—the points that were made earlier—that we have to be thinking about a viable future for young people wanting to take up studying and working in the nuclear field. In terms of achieving that in a context of complex and significant Government cutbacks, I think I have to try to work out how to advise them, work out a way through. Writing to the Prime Minister may be an option but one I certainly cannot guarantee to take up.

Q91 Lord Cunningham of Felling: Historically, we had a situation when we were building nuclear power stations, which is very different to the circumstances which prevail today. You had a Central Electricity Generating Board, which was a champion of civil nuclear power; you had a powerful United Kingdom Atomic Energy Authority; you had powerful leadership in the British nuclear fission. None of those exist anymore. Who is going to be the person, or which is going to be the organisation, which champions this new development of civil nuclear power and ensures that it is driven forward?

Professor Sir John Beddington: Ultimately, it is a Government decision. Ultimately, Government is going to decide what it wants to do with the nuclear industry and, to the extent that Professor MacKay and I are just advisers, that would be a decision taken by Government. If Government takes the decision to move down that direction, then

Government would be championing it and putting the resources in. I cannot speak for Government, I am only an adviser.

Lord Cunningham of Felling: You have a voice but you cannot speak.

Professor Sir John Beddington: I think I can. I can provide my advice.

Q92 Lord Cunningham of Felling: Thank you. Can I just go on to the question, which I was going to ask, about funding for geological disposal of high level radioactive waste. The question of fuel reprocessing, which we have not touched on yet in this morning's discussions. We have had NIREX; we have had CoRWM. I think the latest estimate is we may have some geological facility in 2040. Is that right, or are we just going to go on accumulating more and more high active nuclear waste and prevaricate about finding a final solution for it?

Professor David MacKay: If I can take your question to be: are research requirements being adequately dealt with, and is geological disposal on track from the research and development point of view? DECC has oversight of the NDA's work and as Chief Scientific Adviser I scrutinise their R&D spend annually. I remain open to evidence from experts who think that things are not on track, but my impression is that the work programme for geological disposal is healthy. There is a spend of roughly £5 million a year on research in that area at the moment and the NDA published a research strategy for geological disposal in March 2009. As the programme moves into surface investigations, the amount of funding required will increase. I understand that this is in hand; that the increase has been budgeted for by the NDA. So on geological disposal, I feel quite comfortable, but my door is always open to hear any concerns that I should be aware of.

Reprocessing is a different matter. Reprocessing is happening today at Sellafield but there are currently no plans for reprocessing to continue once their contracts are completed. The

expert view does seem to be that the levels of research in reprocessing are not adequate for the full spectrum of possible futures that the nuclear industry might see. Of course, Britain has great expertise in this area, so it would be sad to see that expertise wither.

There is not zero research; there is some research in reprocessing. The NDA is funding the NNL to participate in an R&D project called “Actinide recycling by separation and transmutation”, and that is in association with EURATOM and FP7. The NDA is also investigating reprocessing techniques for some of the exotic fuels that are part of the existing waste legacy, and the EPSRC is currently financing the MBase research consortium. That is a consortium involving Manchester, Imperial, Lancaster, Reading, the NNL and Idaho, with funding of £1.3 million over a number of years. So something is happening, but the expert view does seem to be that there should be more if we want to keep options—advanced reactors and Generation IV, and so forth—open.

What should we do about that? The expert recommendations include that the NDA’s remit should be revisited, as we have been discussing, and the expert view is strongly behind some sort of involvement in advanced research, such as Generation IV. The Technology Innovation Needs Assessment is going to look at that question and try and articulate the case for the option of, for example, rejoining the Generation IV international consortium, which would then give a natural pathway to increasing reprocessing or such.

Q93 Lord Cunningham of Felling: We have been for decades a world leader in reprocessing technology and knowhow. One of the principal benefits of that—not the only one—was that British Nuclear Fuels was the highest Yen earner in the British economy. Are we just going to give all that up?

Professor David MacKay: The current position is that there are no plans for reprocessing beyond the current contracts. The work I have described will look at the potential value for money from maintaining reprocessing activities.

Q94 Lord Jenkin of Roding: We have been given advance notice by Ministers—notably by Lord Marland, the DECC Minister in this House—that the Government is considering very carefully the question of additional reprocessing and the possible establishment of a MOX plant. Then when we saw the papers produced by DECC on the plutonium legacy, it was made fairly clear that that is likely to be the most economic way of dealing with the plutonium, as opposed to any other waste. Certainly, one does not want simply to bury it because that could create further difficulties. So it would seem to me that we are halfway there. It is not a blank canvass.

Professor David MacKay: Absolutely. When it comes to having a MOX plant so as to turn the plutonium legacy into useful fuel for Generation III reactors, I think the Government position on that is, “We are consulting on that, and that is the lead option for how to manage the plutonium legacy”. So everything I was just saying about reprocessing was referring to our plans for the future arising from future reactors, where the current default position is that reprocessing will not happen, and the consequences of that would be an increased waste legacy, in terms of volume of waste, and an increased requirement for nuclear fuel, because if we do not reprocess we are not using fuel so efficiently. So there are clear arguments, in addition to handling the plutonium waste wisely or not treating it as waste, there is also the argument for reprocessing and that is an ongoing discussion.

Q95 Lord Jenkin of Roding: Are these not inevitably bound up together? Could you have a MOX plant without a commitment to continue reprocessing?

Professor David MacKay: I think you could, because we have such a large volume of plutonium that a MOX plant could run its entire life just taking the plutonium that we have already separated at THORP, without us needing an additional reprocessing facility to keep the MOX plant happy. We have 100 tonnes of plutonium, and I believe that would keep a MOX plant very busy for 50 years or so.

Q96 Lord Jenkin of Roding: But that would not necessarily be your preferred option?

Professor David MacKay: No. I think there is a strong case for reprocessing as well. It is expensive to make facilities like THORP. So it is not a clear cut case but I think—especially if the rest of the world goes for nuclear in a big way, and if we do not want to have very large geological disposal facilities—that gives an impetus for saying, “Yes, reprocessing should remain a research priority and a possible—

Q97 Lord Cunningham of Felling: I am not sure whether it is still so, but it used to be the case that providing the fuel cycle for a nuclear reactor—that is making the fuel, bringing it back and recycling, remaking fuel—was greater value than building a nuclear power station, in terms of the outputs for the economy. Is that still the case, in your calculations? If you have the numbers, I would like you to submit them to the Committee.

Professor David MacKay: I think if everything goes well, then that could still hold. I think a reason why people are more cautious about going for reprocessing and MOX plants is the actual track record of what has sometimes happened with accidents and problems at THORP and with a MOX plant that was built at Sellafield that has—

Lord Cunningham of Felling: Never fulfilled its potential.

Professor David MacKay: Yes. I think if the numbers were done on the basis of that reality that might be an argument for saying, “Let us just use once through reactors and not have all

that additional complexity". We do not have to repeat the errors of the past. I think it is possible to make MOX plants that work. I think it is possible to make excellent reprocessing facilities, and THORP has worked very well for most of its life. As you said, it has generated a lot of income as well.

Q98 Baroness Hilton of Eggardon: I have a question, first of all, about the Low Carbon Innovation Group. Is the Treasury represented in the group?

Professor David MacKay: No, the Treasury is not part of the group. Of course, we have many contacts with Treasury by other means at DECC.

Q99 Baroness Hilton of Eggardon: They are not open to education by being part of the group?

Professor David MacKay: It is an interesting idea. The membership of the group is determined by having an explicit mission to fund low carbon innovation. It is true that Treasury can do a lot to support low carbon innovation by fiscal policy, and so forth, so maybe we should look into that.

Q100 Baroness Hilton of Eggardon: But my question really is about what one can learn from the organisation of research and development in other countries. Clearly, a great deal more money is spent, but are they centrally directed by Government, or do they depend on university research departments, or can we learn something from organisations elsewhere?

Professor David MacKay: I do not yet know the details of what happens in every country, but there clearly are several countries where they have a central strategically controlled nuclear research and development programme. It is perhaps worth noting that France has a

fairly well joined-up pair of civil and military nuclear activities, and this is something your Committee has not looked at much yet. I am not necessarily advocating that way of doing things, but I imagine there are benefits in terms of maintenance of nuclear skills from having those programmes joined up.

Whereas in contrast, in the UK we have nuclear weapons research and development at Aldermaston; we have R&D in nuclear power for naval propulsion, largely done at Rolls Royce; and we have civil R&D, which is what we have been discussing here up until now. Those are three separate activities. I do not know the exact numbers that are spent on those activities, but my informal inquiries indicate that the funding for the first two—the military R&D activities—are significantly larger than the third. So it might be instructive to explore how these activities could benefit from each other, and it may be good news that there is this large spend on R&D lurking, because maybe that means the skill base that we are concerned about is larger than it might have seemed.

The Chairman: Sir John, did you wish to add anything?

Professor Sir John Beddington: Yes. When we are thinking about the comparison with other countries, I think that we can see extraordinary progress in the civil area that Korea has made, for example, by focusing and having a very detailed strategy.

I think the comparison with France that I would make is not so much the linking up of the civil and defence aspects, but I think the fact that, by and large, they have a single and relatively coherent organisation that deals with civil. They do the defence side on the other side. The fact that we have this enormous diversity of entities within the UK—“enormous” is probably too strong a word when we are dealing with single figures; a large and significant number of individual entities—goes to the sort of concern I have. I am well aware that the Committee has not talked about fusion, but I know you had Professor Cowley in front of the Committee recently. One of the things that I have been trying to do was, for example,

to consider, with this diversity of organisations, whether we can think about cross-board membership as a first step to get things joined up. For example, one of the people who sits on the NNL board has been appointed to the UKAEA board. There are things that we could do in the small scale but I think we need to be thinking about it. There is a potential for significantly improving the UK profile in efficiency and promulgating your aims.

I think there are examples where there is significant R&D spend by countries that do not even have a nuclear programme, and we need to think about why that is the case and whether, in fact, we are missing a trick there.

Q101 The Chairman: In terms of the way we are viewed from others, from outside, one of the comments that was made in Dr Adrian Simper's letter was that, "The UK's position on nuclear research looks to many outsiders as anomalous", and then, "Our withdrawal from the Nuclear Energy Agency is viewed with incredulity by countries such as Greece, Portugal and Ireland, which remain committed despite having no nuclear programme". Is that a worry for us that we are seen as a bit odd and viewed with incredulity, or is that over-egging it?

Professor Sir John Beddington: I share those concerns.

The Chairman: You share those concerns?

Professor Sir John Beddington: Yes.

Q102 The Chairman: In terms of partnership, in the longer term, in terms of nuclear research, would that weaken our position as a preferred partner in research and development?

Professor Sir John Beddington: I read Dame Sue Ion's testimony to this Committee and I think the point she makes is that you have to be doing something, you need to be an

attractive partner, and not because you are there as the United Kingdom but that you are doing interesting work that is complementary to what others are doing. I think that is a natural process of science and we should expect it. We still have very significant nuclear expertise in this country and there is a potential. In 10 years' time I do not think that potential will be there.

The Chairman: Professor MacKay, would you like to add anything to that?

Professor David MacKay: I share your concerns. Money has been tight and when we look at future budgets we will revisit these decisions.

The Chairman: Are there any other questions Members of the Committee would like to put?

Q103 Lord Jenkin of Roding: We have this very interesting table at the back of the paper, which the Lord Chairman has just quoted from, which shows a very worrying figure—the research budget spent on fission. Of course we do have quite a large fusion programme and I am not arguing that we should not be doing that. Indeed, we have had evidence that that could well help work on future fission reactors, cross-benefits and that. It is a very alarming figure and it might be helpful to know whether you could agree with the figures that Dr Simper and his colleagues produced. It is one that I have put to other witnesses. I asked the DECC official who came whether he was happy about it. I got the impression he had not realised it was quite like that.

Professor Sir John Beddington: I think when you are such a significant outlier it poses questions about: why are you such a significant outlier and what should we be thinking about doing about it in aggregate? I do not know how the figures were compiled.

Lord Jenkin of Roding: It is worth following it up.

Professor Sir John Beddington: Yes. I think, for example, in answer to an earlier question I did point out how Korea has been extraordinarily successful in building up a nuclear industry virtually from scratch, and spending 40% of R&D on total energy in fission, which indicates how that can actually be achieved. I think it is an interesting table. I think that one can query about the detail, but I think that is a table that we should be thinking hard about.

The Chairman: Are there any other questions from Members of the Committee? In which case I would like to thank both of our witnesses very much indeed for a very helpful session and to reiterate that the transcript will be available and sent to you for correction. In due course you will see the outcomes of this inquiry in terms of our report. But thank you both very much indeed.