



Science and Technology Committee

Corrected oral evidence: The role of batteries and fuel cells in achieving net zero

Tuesday 8 June 2021

10 am

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Members present: Lord Patel (The Chair); Baroness Blackwood of North Oxford; Viscount Hanworth; Lord Holmes of Richmond; Lord Kakkar; Lord Krebs; Baroness Manningham-Buller; Lord Mitchell; Baroness Rock; Lord Sarfraz; Baroness Sheehan; Baroness Walmsley; Baroness Warwick of Undercliffe; Lord Winston.

Evidence Session No. 14

Virtual Proceeding

Questions 151 - 164

Witnesses

Dr Bob Moran, Deputy Director, Head of Environment Strategy, Department for Transport (DfT); Damitha Adikaari, Director of Science and Innovation for Climate and Energy, Department of Business, Energy and industrial strategy (BEIS); Hannah Boardman, Director of Advanced Manufacturing, Department of Business, Energy and industrial strategy (BEIS).

USE OF THE TRANSCRIPT

This is a corrected transcript of evidence taken in public and webcast on www.parliamentlive.tv.

Examination of witnesses

Dr Bob Moran, Damitha Adikaari and Hannah Boardman.

The Chair: Good morning to you all and thank you, particularly all the witnesses, for joining our evidence session today. We are very grateful to you for making time to join us. The main purpose is to explore with you not the policy issues, which we will ask the Ministers later on, but the implementation of policies in your roles with BEIS and the Department for Transport, which you might be able to help us with. When you first speak, please introduce yourself and your position in the department. You are most welcome, Bob Moran, Damitha Adikaari and Hannah Boardman. Thank you very much for joining us.

Q151 **Lord Winston:** Good morning. I will start with Bob Moran. Can you tell us what initiatives are in place to attract further investment in the supply chains and manufacturing for batteries, and the development of infrastructure for charging? Is the investment progressing fast enough, given, for example, that we will have to meet a target by 2030, in eight and a half years' time, and the number of cars that will still need to be changed over to electricity in that time?

Dr Bob Moran: Good morning, everybody. I am a deputy director in the Department for Transport and I head up our environment strategy team, which is a cross-cutting team that looks after government policy and the implementation of it for the natural environment, air quality, noise pollution, climate change and decarbonisation.

I think my colleagues from BEIS will be better placed to go into detail about how the supply chain is emerging, but I will pick up on the infrastructure aspect of this. We have a huge transition ahead of us. We are nudging towards about 500,000 cars on our roads now with plugs on, but the fleet is enormous; it is around 35 million, so a big transition will need to happen in a very short time.

The infrastructure is good for the size of the fleet now, but clearly there is a long way to go as we move through and transition the fleet to plugs. I think the private sector is very well placed now to invest and take charge of the charging infrastructure. Over the last decade the Government have put in support to incentivise the early market and some of those companies are now coming in to take a leading role in the transition, as we move through now and the market for vehicles matures somewhat. The private sector investment is there and is ready to move in over the next decade, putting in the infrastructure that we need to support the fleet as it transitions.

Lord Winston: You are not envisaging any government initiatives.

Dr Bob Moran: There is support at the moment. It is a case of targeting the areas where the private sector may not be ready to invest. If you talk to organisations such as the National Grid, motorway service areas as well as local authorities and council, investment is going in for infrastructure to make sure that people undertaking long journeys can

charge rapidly at motorway services while they stop for a comfort break, with some government support, as are charge points in people's houses.

There is continued support from government in grants to help people who are buying a new electric vehicle to install a charge point so that they can charge safely, conveniently and cheaply overnight.

Work continues with local authorities for on-street charging for people who do not have access to off-street parking, for example, so that there are charge points on streets.

The fourth thing is businesses and shops in shopping centres, and we are seeing an increase in the provision of charge points at destinations such as supermarkets and shopping centres. Organisations put that in to attract people.

Lord Winston: No doubt we will come to that. Thank you very much, Dr Moran. I will ask your colleagues about the supply chain, and perhaps Damitha Adikaari could start with that issue. It is a very major part of what we need and the expense is considerable.

Hannah Boardman: I think, Lord Winston, that that is a better question for me to answer. I am a director for advanced manufacturing in BEIS. I have responsibility for the automotive sector, among a number of UK manufacturing sectors. In the existing sector and then as it transitions to a future electrified sector, I am responsible for the companies that form part of the vehicle manufacturing and the supply chain as well.

You are absolutely right about the scale of the transition here, and it is not just on the consumer side. This is a huge transformation for the vehicle manufacturers and the supply chains. We do not want to leave our manufacturing base in the UK behind as the vehicles on the roads transition. We operate a number of interventions out of BEIS, some that are well established and some that are relatively new, and all of these are focused on supporting the vehicle makers but, more importantly as we see it, supporting the transition of the supply chain and attracting new suppliers and new elements, including battery manufacturing.

We have three core interventions that I will flag to you. The first is the Faraday battery challenge, which is just over £300 million. It has been running for a number of years and it is there to do three things. The first is fundamental research in new battery technology, the second is applying that, and the third is manufacturing new batteries, new technologies at scale. The UK Battery Industrialisation Centre in the Midlands was recently finished and will open shortly. That is a fantastic facility to take the fundamental research, which has been running for a number of years and in which we are absolutely world-leading, and to get companies and battery manufacturers and vehicle manufacturers in there to try out these new technologies.

The second key thing, which is focused on the vehicle manufacturers and the supply chain, is the Advanced Propulsion Centre, which has been running since 2013. It is a joint government and industry venture of £1 billion. It is entirely focused on electrified and zero emission technologies, including fuel-cell technologies, and supporting the transition. A huge

number of projects have been running out of that for eight years, with another two years to go on that initiative, and there is a huge amount being done in the supply chain.

The most recent intervention that I want to draw to your attention is something called the automotive transformation fund, which we announced about two years ago. It is £500 million at the moment and is entirely focused on securing battery manufacturing in the UK and transitioning the supply chain. We have some excellent conversations happening with battery manufacturers, but we also have very good conversations happening throughout the supply chain on really critical elements, including things like cathode active materials and lots of parts that we are having to attract to the UK for the first time at scale.

Lord Winston: Thank you very much indeed.

Q152 **The Chair:** Dr Moran, very quickly, you said that private investors were ready to invest, which is contrary to the evidence we have heard. Can you give us an example of how much private investment has gone into any of this technology development so far?

Dr Bob Moran: The best example I can think of is charge points. For the last 12 to 18 months, more charge points have been installed by private companies than those that have been installed with government support, particularly rapid chargers, chargers that are provided in car parks, at shopping centres and that kind of stuff. Those are all being provided by companies that are not relying on government support. That is the best illustration I can give.

The Chair: How much private sector investment is going for instance into gigafactories for batteries?

Dr Bob Moran: Our colleagues in BEIS are best placed to answer that.

The Chair: Alright. We will move on at this stage.

Q153 **Baroness Warwick of Undercliffe:** I will move on to hydrogen strategy. The UK has an ambition to develop a hydrogen economy, not just in transport but including aspects of industry and heating. Evidence suggests that there is a disconnect between this ambition and the limited support for the development of fuel cells and electrolyzers and for the expansion of manufacturing, especially when compared to batteries.

Can you tell me about the degree of co-ordination between the hydrogen strategy, which I believe we now expect in July, and government support for the development and manufacture of fuel cells and electrolyzers? I will go to Dr Moran first and then to Damitha Adikaari and then to Hannah Boardman.

Dr Bob Moran: I am sorry. I do not want to feel like I am passing the buck, but I think Damitha is probably best placed to kick off on this. I would love to add in some transport applications and bits and pieces.

Damitha Adikaari: I am the director responsible for climate science and energy innovation at BEIS. I will first answer the question on the hydrogen strategy and the wider uses of hydrogen.

As you mentioned, we are quickly working on an overall strategy, which will be published as soon as possible. In that, we are looking at hydrogen as an alternative energy vector with zero emissions at the point of use across a wide range of applications. That covers potentially heat in all aspects, mainly in industry but perhaps in buildings and transport, as well as in some of the other areas where there has been less focus up to now—for example, longer-duration energy storage.

The strategy will look at all those aspects and at the supply side, as well as the requirement to create incentives, policies and the market pull, to ensure that the demand is also there when the supply side picks up in producing sufficient quantities of clean hydrogen. I say “clean” with emphasis, because there is debate about the right approach to clean hydrogen. Green hydrogen can be produced using renewable electricity and electrolyzers, and, of course, with carbon capture and storage we could use fossil fuel-based inputs to produce so-called blue hydrogen. At the moment, the government strategy is to be technology-agnostic here. There is a twin-track approach in supporting funding for hydrogen supply, and the net zero hydrogen fund initiative recently announced through the 10-point plan is supposed to address that aspect.

On the fuel cells-related question, our efforts so far have been fundamentally on research, development and demonstration. We have been focusing quite a bit. We have not been targeting fuel cells specifically, but the department’s and the wider UKRI’s effort on providing support for innovation has created avenues for fuel-cell manufacturers and researchers to exploit the opportunities that we have provided and to drive up the innovation chain—the so-called technology readiness levels scale—where some are quite low into higher commercialisation levels, perhaps into readiness level stage 8.

I will give some examples from the innovation competitions that I have been responsible for. One is the £30 million hydrogen supply competition, which is ongoing and is supporting electrolyzers producing green hydrogen and demonstration projects. We have also supported ITM Power’s Gigastack project, and another flagship project, called the Dolphyn project, is looking to exploit offshore wind to generate green hydrogen.

On fuel cells, from a demand perspective there has been significant support throughout. If you go back a decade or so, significant investment has been made, fundamentally through a number of initiatives. The Hydrogen and Fuel Cells SUPERGEN, supported by the Engineering and Physical Sciences Research Council, is the flagship, but other initiatives, which are not closed for fuel-cell researchers and innovators, have had some successes. The committee heard from Ceres Power some time back in your deliberations. That is one of the companies that was spun out from Imperial College and benefited from the Hydrogen and Fuel Cells SUPERGEN.

However, I also want to highlight that even though we have made support available for the fuel-cell industry and innovators in the form of funding and opportunities, the uptake has been low, and that is driven by the market conditions, as I see it. To give you a statistic, one flagship project that I am responsible for is a competition called the energy entrepreneurs fund. Since 2013, we have invested £72 million over 152 projects over seven rounds. We have had only four successful fuel-cell projects through the seven competitions we have run.

Baroness Warwick of Undercliffe: Thank you very much indeed. I will just ask Hannah Boardman to touch, from her perspective in the manufacturing area, on whether the strategy will expand the industry to gain greater economic benefit from the UK's expertise in these areas.

Hannah Boardman: The application into the automotive sector of fuel-cell technology is at a much earlier stage than batteries, but we have some really exciting projects that we have brought forward already. Damitha mentioned Ceres, which is one of the key projects which the APC has funded over the last few years. We have had eight projects that looking specifically at fuel cells and fuel-cell application into automotive towards the end of the technology readiness level scale. We are looking at commercialisation of these technologies and, so far over those eight projects, the APC has looked at more than £80 million—

The Chair: Do you think that the lack of technologies to invest in when it comes to fuel cells is related to our lack of investment in science research? Yes or no?

Hannah Boardman: From my perspective, no. From my perspective, the lack of concerted interest in fuel-cell technology development in the UK, as applied through the sectors I am responsible for, is entirely driven by the market in Europe and the fact that batteries have expanded as the technology of choice for European automotive manufacturers and suppliers.

The Chair: Okay, thank you very much. Can I most respectfully ask the witnesses to be brief in their answers, please, because otherwise we will run out of time? You are the penultimate witness evidence session, so we have heard all about the science and its applications. What we are after is the policy implementation.

Q154 **Baroness Walmsley:** I want to turn to static applications. We have heard that the main focus on batteries is for transport and that insufficient policy attention is being paid to other applications for batteries or indeed applications of fuel cells.

Can you tell us what scale of deployment is envisaged for batteries and fuel cells in non-transport applications such as buildings or the grids? To support these deployments, what co-ordination is there between the heat and buildings strategy, the hydrogen strategy and the regulations governing deployment of the electricity grids? By the way, when will we get to see those strategies? Perhaps we could start with Ms Boardman.

Hannah Boardman: I am afraid I would be talking entirely about applications for transport. I think Damitha is best placed to respond to you.

Damitha Adikaari: Thank you, Baroness Walmsley. Static applications, if you look at batteries and fuel cells, are at two different stages. Globally, static applications of fuel cells seem to be catching up and creating a market, especially in Japan and Korea. In the UK, batteries have made quite a lot of progress in static applications. If we look at the latest capacity market auction, 250 megawatts of battery installations were in the capacity market four years ahead last year, and that is quite significant from a very low base. Currently we have about a gigawatt of battery static applications from a large-scale perspective, and we expect there is a pipeline of about 8 gigawatts.

Of course the future is uncertain, but the projections vary widely. I think you have heard witnesses mention estimates of 20 gigawatts to 40 gigawatts, depending on what assumptions you make and what modelling you are using. It is quite clear that batteries will play an important role, which is why initially in 2017, in our smart systems and flexibility plan, we identified a number of market barriers for battery deployment for static applications. We are planning on an update of that plan. We have made quite a lot of progress in reducing the barriers, which is why quite a number of installations have come forward. Planning consent has been pursued for large-scale installations of batteries; for example, there are 350 megawatt-size battery installations currently. It is a good, healthy pipeline.

There are also opportunities from a technology innovation perspective. We are looking to electrify our light vehicles fleet, and we are doing quite a bit of investment on innovation on vehicle-to-grid applications. That is to say that, even though they are not static per se, they could perform some static roles in supporting the grid. There is quite a bit of innovation activity to be done, which we are investing in.

Baroness Walmsley: Could I probe you, please, on the speed of scale-up? One gigawatt is very little, 4 gigawatts we are virtually there, 8 gigawatts is planned, but that is not going to be enough, is it?

Damitha Adikaari: I agree with you on the current projections. We need a lot more, but I also look back to 2016 when we had virtually no firm applications of this. Over the last five years, the system operators have produced new services, there have been new initiatives to create market incentives and revenue streams, and the Government are working with the industry on removing the barriers, one step at a time of course, to ensure that the market picks up. It is also supported by the concerted action that we have seen over the last 10 years whereby the current dominant technology has reduced costs by almost 90%.

Also, there are new technologies coming through. For static applications, we do not necessarily need to rely on lithium-ion batteries in future. There are other technologies that could be used, and those will take a little bit of time, even though there is innovation: for example, the Oxford demonstration, and the Prospering from the Energy Revolution challenge,

which is now installing a 5 megawatt-hour flow battery—the first of its size in the world. We are working with the industry to build a liquid air energy storage facility in Manchester, which is also the first of its kind in the world.

We expect that all these technologies will drive the cost down further, and we will ensure that sufficient market incentives are in place and will continue to remove any barriers that we foresee so that we can achieve those ambitions.

Baroness Walmsley: Thank you. I think we can move on, Lord Chair, but perhaps I can probe Dr Moran later about the charging infrastructure, if there is time.

The Chair: I will remember that.

Q155 **Baroness Sheehan:** I will move on to the research and innovation landscape. If it is appropriate, I will start with Hannah Boardman. What assessment has been made of the effectiveness of recent investments in battery research and innovation in the quality of proposals and the impact?

Hannah Boardman: The application that I am best placed to talk about is the Faraday battery challenge, which I talked about previously. It is over £300 million and looking at research, application and then scaled manufacturing. Faraday is one of our industrial strategy challenge fund programmes, and as a challenge it has eight markets that it looks at for every project and assesses them again against the scale of the technology and the opportunities for innovation and recycling. A huge amount goes into the assessment of what the challenge is up to at the project-by-project level.

On its internal governance, it is also managed by interests in central government sitting on its board, and I do think that the way we are assessing the opportunities which those programmes come forward with is appropriate and is generating a huge amount of value.

The biggest thing that will come out of the Faraday battery challenge is the UK Battery Industrialisation Centre, which is about to launch in earnest, and from that we really will see how we take that early-stage technology development in the UK, how we bring its application forward and how we look at manufacturing at scale. That will be where these new technologies that Damitha talked about will be brought all the way to the point of commercialisation, which ultimately is where we prove the worth of the innovation that we have been investing in. From my perspective, it looks really exciting, and I think will bring forward an awful lot of commercialisation.

Baroness Sheehan: Thank you. You mentioned that the APC comes to a natural end in about two years' time. What does the future hold for the APC?

Hannah Boardman: As a huge fan of everything it is trying to do, I sincerely hope that we are able to secure future funding for the APC. It has changed a lot over the last eight years. It started off doing an awful

lot of work with internal combustion engines and getting cleaner and greener and more effective technologies. That has moved on phenomenally now, and we are doing a huge amount of investment through that company for electrification of vehicles and battery application and components for those vehicles. As I mentioned, the APC has funded a number of fuel-cell technology projects so far, but I suggest that we will see greater investment, greater interest and greater need for government support in the way we have looked at other technologies through APC in the past. It is my hope that we can keep that excellent institution going and developing and looking at new technologies as the market changes.

Baroness Sheehan: Thank you. I will move on to Damitha Adikaari. Is there a risk in pushing to meet the 2030 deadline and then missing opportunities to adopt better alternatives? I will let you define what those better alternatives might be.

Damitha Adikaari: There is a risk that we could lock in technologies, given the tight timelines of achieving the tight targets that we have set. At the same time, that allows us to pursue harder the technologies that would have taken much longer if we did not have the targets. I look at it positively: that it creates more opportunities to drive some of the technologies faster towards commercialisation.

Baroness Sheehan: What do you think could be better alternatives?

Damitha Adikaari: If we look at just batteries, different chemistries for different applications are being pursued and they have different benefits: some are heavier but cheaper and good for stationary, some are lighter and therefore have high energy density and are good for transport applications.

The technologies that are perhaps a bit earlier in the race will not catch up in a conventional sense if we did not have the urgency. Currently, there is significant interest in the industry. For example, the latest competition that we launched on long-duration energy storage includes different types of storage. We had 180 expressions of interest, whereas in the previous rounds when we had 80% targets, before our net zero target, got half that interest from the industry. The industry is gearing up, which gives us greater opportunities. There is a portfolio of technologies for energy storage, not just electrochemical batteries, which is the focus here.

Baroness Sheehan: Would it be fair to summarise what you have just said and say that BEIS's focus on future technologies is about the improvement of existing battery storage, and fuel cells and hydrogen are very much a secondary consideration?

Damitha Adikaari: No. We are supporting new discoveries, which we need to continue to do, but because the timelines are tight we need to work on discovered technologies and drive them faster towards commercialisation. That needs public support, and we are providing that. That means there is a need for other support for innovators and

businesses that are coming into this field because of the opportunity which the targets provide.

In that sense, we are providing support and policy interventions for the whole chain and not just one area, thinking that that would be the only solution that is required because of the timing pressures.

The Chair: Thank you very much. Ms Boardman, did I hear you say—please correct me if I am wrong—that a bigger investment in APC and fuel cells will be required for us to become a leader in the field?

Hannah Boardman: I think if you were to invest further in the Advanced Propulsion Centre, you would allow it to continue to reflect what the market is asking of it at the moment. Some of what is being asked is government support through the APC for fuel-cell-technology programmes. However, the percentage of fuel-cell tech programmes that are coming forward in the UK is much, much lower than battery technology, so it reflects the industry.

The Chair: That is helpful.

Baroness Sheehan: I have a quick question to follow up on what Ms Boardman has said about interest not coming forward. Is that a reflection of what the website of the Research Council's website says, which is that fuel-cell technology is not currently a high priority for government or industry? That sounds to me like a very demotivating statement to our electrochemists.

Hannah Boardman: I agree with you. In terms of what is happening for zero-emission technology in automotive in Europe, batteries are very firmly in the lead. That is not just because of government intervention. It is different in Asia. We have an ongoing dialogue with a number of companies, particularly Toyota, about their ambitions for technology in the UK, and there is a strong fuel-cell element to what they are looking at. Toyota is obviously not the only company we are talking to.

The dominant technology for European application in road transport at the moment, for the vehicles that are being electrified, is batteries. However, we need to be open in the future to see what additionally comes forward and to recognise that the batteries we create at the moment will not power the extremely large power density that is required for something like the big Jaguar Land Rovers, for example, or for larger commercial vehicles. So we need to continue to be open minded as to what comes in the future and what industry and businesses will be asking of us.

The Chair: Thank you very much. You have mentioned a couple of times the industrial battery centre, which is about to open. By the way, it is fascinating. I took a virtual tour of it 10 days ago. It is an R&D facility to attract companies to invest in it. Do you agree that you will require continuous government funding to keep it a leader in the field?

Hannah Boardman: We have to see. The idea is that now, having made that significant investment and brought something to the end of the chain from the very early fundamental research all the way up to

commercialisation, the UK Battery Industrialisation Centre will effectively be able to pay for itself with vehicle manufacturers and battery manufacturers coming together.

We have some exciting projects going in there. We will have to see. If it does not quite work as a model, we will have to look again and see what we think is the right answer. At the moment, I am confident in the business model that we have for the centre.

The Chair: Thank you very much.

Q156 **Lord Sarfraz:** This is probably another question for BEIS. We have seen what has happened in the semiconductor industry with supply shortages. How do we make sure that we have the raw materials we need to support our battery ambitions in this country?

Hannah Boardman: The semiconductor issue is obviously dramatically impacting the sector that I look after, and it is a really unpredictable issue. It has bubbled up over the last 12 months because of changes to consumer behaviour through Covid as well as the general impact that Covid has had on paths of supply across the globe.

We are not in a position right now to have a semiconductor industry running in the UK, nor do I necessarily think that is the right thing to do. However, I fully recognise that as we do something as dramatic as transitioning the whole of our automotive sector from internal combustion to electrification and try to attract the supply chain to the UK, we really need to focus on making sure that we have security of supply of the raw materials that currently go into that supply chain and will go into that supply chain in the future.

As Damitha said, we might be in a position in the medium term where our need for lithium, and for lithium ion in batteries, is less than it is right now. That would be encouraging, because obviously it would give us less of a dependency question there. However, there are lots of critical raw materials that we need to have security of supply for. There is a lot of work at the moment—predominately between my department, the Department of International Trade and the very centre of government—on looking at raw material supply for application into the industries I work with and how we secure that and, alongside that, how we innovate so that we do not have the dependence on some of the critical materials that we have right now.

Lord Sarfraz: What tools do we have to secure supply? It is not like we have a sovereign wealth fund that can invest in mining assets and so on. How do we do it practically?

Hannah Boardman: There are two things. One is that we remove our dependence by innovating past it. If you look at some of the future technologies for batteries, you potentially have far less dependence on critical materials that are not as easy to come by in Britain or in Europe itself.

Secondly, you look at your existing supply chains and how you work together with countries in a similar position to you to ensure as much of the supply as possible into the future.

Thirdly, we look at alternative ways of finding the raw materials that we need. We have a lot of conversations about whether there are other opportunities within the UK or within Europe to find other raw materials, or whether we are looking at the possibility of technological applications like deep-sea mining, which might give us a different approach to finding the supply and then ensuring it.

There is no single answer. There are a few different ways of looking at it.

Q157 **Lord Sarfraz:** Thank you. How important will recycling be? Ideally, what percentage of a battery can be manufactured with recycled material? Could it be 80% or 100%? Does that mean that we should be focusing on recycling? We have heard in previous sessions that gigafactories can make changes and change with new chemistries. Can recycling also change with new chemistries?

Damitha Adikaari: As Hannah outlined, there are currently a number of initiatives looking at the supply chain and reinforcing the requirements, as well as looking recently at domestic supply chains.

I am sure you have heard about Cornish lithium and some of the research and development work that we are funding, working with the Faraday battery challenge. Lithium extraction from brine, for example, is not commercial at the moment, but we think there is potential for the UK to do a lot of technologies on that front. So there is investment going into that.

The Faraday battery challenge is also looking at recyclability, which is one of the important aspects that it is working on. It has set an ambitious target of 90% to 95% of recyclability, which of course is an ambition. At the moment it is very low; I am sure you have heard from other witnesses that perhaps 10% is a good thing at the moment. The UK does not have facilities at the moment for recycling.

The expectation is that, in the medium term, recycling technology will pick up and therefore that the cost associated with it will come down and we will recycle more and more. Currently in Belgium, where most of our exports are being recycled, extraction is about 50% or less. It is not a very efficient process, so a significant amount of innovation needs to happen. Of course, this is a very fast-moving field. We have not had a lot of end-of-life products, and it is picking up at the moment.

The other thing that we should not forget is reusability, especially of electric-vehicles batteries. A number of projects that we have funded looked at sorting and then refitting those used batteries, which could be 70% efficient at the end of life of a mobility application and can be used for stationary applications. Quite a number of companies are innovating on this and bidding into some of the competitions that we run. There are promising signs of a good opportunity to reuse, not just recycle.

The Chair: Thank you very much.

Q158 **Baroness Rock:** Moving on from innovation, I want to talk a little bit about skills and training. We have heard from previous witnesses that the move to batteries and fuel cells will require a set of different skills, including in supply chains, manufacture, maintenance, recycling and, importantly, in safety.

I wonder if the witnesses could talk a bit about the timetable on deliverables for ensuring that the necessary skills will be in place by 2030, and comment on the fact that we had skills initiatives in the former industrial strategy and the automotive sector deal and whether those have been preserved.

Hannah Boardman: We have a two-pronged skills challenge here. The first is obviously to get the right skills to support an electrified industry and an electric supply chain with everything that you just talked about. The second thing is to take what we have right now—an internal combustion engine-focused industry—and translate as much of those people, those jobs, that employment and those suppliers into an electrified future that is obviously very different; an internal combustion engine and all its component parts looks very different to a battery-powered vehicle. There is therefore a two-pronged challenge there.

There is a lot of effort going into bringing the right suppliers to the UK, because in the electrified future there will be a lot of new companies that come and take part in our UK automotive sector. You talked about the work done under the industrial strategy and the automotive sector deal. The conversations with the existing industry and its trade association, the Society of Motor Manufacturers and Traders, about the future skills requirements of the industries are deep and complicated, for the reasons I have set out already.

We keep that dialogue going and we still have that initiative running. We mainly run it through the Automotive Council, which is the governing body of all conversations between government and the automotive industry. There is a strong focus there right now on skills, on the new future and on the transformation from internal combustion engines.

Baroness Rock: Thank you. Dr Moran, I imagine you might have something to add on this.

Dr Bob Moran: Not too much actually. We work very, very closely with BEIS on skills in the automotive sector and transport applications. That is where the heart of the early moves to create the new skills is.

I could mention one initiative that we have, which is the hydrogen transport hub in Tees Valley. That is an initiative where we are not just supporting hydrogen fuel-cell vehicles or transport applications on to the roads and the waterways but looking into the local university and colleges and creating the technical skills in the workforce of the future to support a different way of powering our transport. That is one example which Minister Maclean, who you will talk to shortly, kicked off last year to bring together everything that is needed to ensure that this whole transition from energy—not just transport, but energy—happens properly. On

things like that we work very closely with BEIS, the Green Jobs Taskforce and things like that.

Baroness Rock: Would you say that we will have the skills in place by the 2030 deadline?

Dr Bob Moran: The best place to look for that is the Prime Minister's 10-point plan for a green industrial revolution. It is not just talking about a decarbonised outcome for transport, for example. It is very focused on creating jobs and ensuring that the workforce of the future has the right skills and the pipeline is there now to make sure everyone is equipped for the change we have to see and the change we will see.

Baroness Rock: Thank you, Dr Moran. Mr Adikaari, do you have anything to add on the skills and training side?

Damitha Adikaari: The only thing—[*Connection lost.*]

Baroness Rock: Mr Adikaari, we might have lost you. Perhaps we could come back to Mr Adikaari on that later.

Q159 **Lord Mitchell:** Good morning, everybody. In a post-Brexit world, we know that we have to work harder to get investors coming into our country. In this particular area, what are we doing to provide long-term stability so that these investors come into our country? What are we doing to try to compete with other countries in low-carbon technology? I will put that to Ms Boardman, yet again.

Hannah Boardman: Yes, of course.

Lord Mitchell: We are beating up on you, I am sorry.

Hannah Boardman: It is fine. I enjoy talking about all this. It excites me a great deal, so I am very happy to answer lots of questions.

Everyone in Europe has a big challenge in attracting this sort of investment from Asia, securing automotive manufacturing sectors in the UK and across Europe, and giving manufacturing a good future in an electrified environment, which is very different to what we have focused on for many, many years now. It is a big challenge for us.

The UK has a unique offer in that we have been putting a huge amount of effort and focus on fundamental research into battery technology for a number of years. We are a go-to place for those who are looking at innovation in battery technology. We have a huge number of companies that look at our universities and the consortia that spin up from those universities, and think that there is a great deal of excellent work happening in the UK. It is a good place to go to for those sorts of skills. The sorts of skills that spin up those technologies we are typically bringing forward into companies that then look at the application of batteries. We have an ecosystem that grows from fundamental research into application and is now growing into manufacturing.

The Faraday battery challenge and all the work that has happened there is extremely attractive to a lot of people who are looking at Europe and saying, "Where do we want to set up our battery industry?"

The automotive transformation fund, which is the money that I talked about previously to transform the supply chain and to attract battery manufacturing to the UK, is not just looking at the end of the battery supply chain. You have seen a lot of what we call gigafactories popping up all over Europe over the last decade. That is very much the end of the chain. That is where you pull everything together, create the final battery and put it into a vehicle. We need to do that in the UK, but we do not want to stop there. We want to go much deeper and much further back into the supply chain so that we have something that is secure, meets our future trade arrangement requirements to originate content in the UK, and is much more comprehensive when it comes to attracting everybody who sits in that supply chain. That is the unique offer which the UK has, and that is generating a huge amount of interest.

Two other key things are going in our favour with investment. One is the mix of our energy. When I talk to battery manufacturers interested in the UK, one of the things we always focus on is just how green the energy mix for the UK is right now, because you want to be putting green energy into doing things like charging these batteries before you put them into vehicles.

Secondly, there is what we are doing in our domestic policy for the transformation of the sector. We have said, exactly as you have mentioned a couple of times today, that we want to ban all new internal combustion engines by 2030. We want to do that with the transformation of our manufacturing sector. That is an exciting proposition and there are a number of key companies. You mentioned Britishvolt. That is a company that is talking to us, because it is extremely interested in the Government's overall ambition and what that will mean for manufacturing and the totality of the supply chain.

We have a lot more to do. It is difficult to attract these investments, because a lot is already shored up in Asia. However, we do have some unique components in what we offer and we have a lot of really exciting conversations ongoing at the moment.

Lord Mitchell: Thank you. Mr Adikaari, can we try you again, please?

Damitha Adikaari: I apologise for the previous hiccup, Lord Mitchell, but I did not hear the first part of your question.

Lord Mitchell: We wanted to know what the UK is doing to provide longer-term stability for investors and to try to compete with other countries in low-carbon technology.

Damitha Adikaari: I can address that from an innovation perspective, fundamentally because this question is about technologies and driving the technologies very quickly to commercialisation.

We are focusing widely on using targeted interventions on batteries, and on other technologies as well, and then, depending on where they are in their technology readiness, giving different options, opportunities, interventions so that private investment can come through. I mentioned one example earlier: the liquid air energy storage project in Manchester, which we are developing and are almost ready to build. That has

significant foreign investment. It is the first of its kind; at 50 megawatts, it is a significant size. That is fundamentally because of the different types of interventions that we have provided to the industry, which have been attractive to global multinationals and players. There are a number of examples like that. In Cheshire, for example, we are building the UK's largest carbon capture, storage and utilisation plant.

Batteries and fuel cells are much smaller in terms of investment size, but we are seeing significant interest and private investment coming through.

Q160 **Lord Mitchell:** I have a supplementary question. What is the rationale for ending the UK's industrial strategy after only four years? Has the move to the plan for growth had the desired effects? Ms Boardman, we have to ask you that again, I am sorry.

The Chair: A brief answer, please, but it is a good question.

Hannah Boardman: It is a very good question. Obviously some of that is a political decision, which I am not in a position to comment on.

The Chair: Full stop. Will that do?

Hannah Boardman: All I was going to say is that from my perspective the industrial strategy, and particularly the automotive sector deal, was a very successful organising framework for government and industry to come together to talk about what they need to achieve, what is happening in the UK and what government support is required. We still have that organising framework through the mechanisms that were set up and that flourished under the industrial strategy, such as the Automotive Council.

The Chair: Dare I say it, Ms Boardman, you are a good civil servant. It is clear from the language what "industrial strategy" means. Does the language "build back better" convey the same meaning?

Hannah Boardman: It is very action orientated, which I think can be helpful. An industrial strategy is something that permeates globally. What has been helpful is that we had an industrial strategy for a number of years that allowed us to have conversations, particularly with—

The Chair: I am afraid we have to leave it there. The next question is from Lord Holmes.

Q161 **Lord Holmes of Richmond:** Ms Boardman, just to pursue that point, at a high level, what has been lost in moving from the industrial strategy to plan for growth? What was in that which is not in plan for growth? What, if anything, have we gained through moving from the industrial strategy to the plan for growth? Thank you.

Hannah Boardman: Thank you. What we have gained from the plan for growth is more direct focus on immediate action. The industrial strategy had an awful lot of very important high-level statements about what we are looking to achieve, but less direct action and immediate action.

I will look at things coming out of, and around, the plan for growth. Damitha talked about the 10-point plan. The 10-point plan announced the

decision to transform UK roads and the sale of petrol and diesel and ultimately all non-zero-emission cars. The plan for growth is how we will achieve that and how we will support the industry to transition. From my perspective, the plan for growth is more of a call to action than the industrial strategy previously was, which is extremely helpful for doing the things we have talked about already to push the industry to transform faster.

The main thing that we lose from not having the language of a UK industrial strategy is that there are countries and companies around the world that we talk to, particularly in Asia, where the concept of an industrial strategy—think about Japan—is a very positive thing and something that they can directly relate to. It is a little trickier to have them relate directly to the concept of a plan for growth as such. But, with the way we have these dialogues going and the way we can explain things, that is not a problem. It just does not translate quite as well as an industrial strategy.

The Chair: We got the answer.

Q162 **Baroness Rock:** Mr Adikaari, I am so sorry, we lost you briefly for a second there but thank you for coming back. I was asking about skills and training. I wondered if you had anything to add, particularly on the timetable for 2030.

Damitha Adikaari: What I wanted to contribute was that the skills question is also a retraining question. It is easy to focus on the supply side when it comes to net zero. When it comes to the demand side, different levels of skill will be required and the sectors will have to transform into doing different things or different ways of working. The targets are ambitious. Six hundred thousand heat pumps a year is a very tough target which the Government have set for themselves. That will require a lot of effort in terms of standardisation, training and repurposing of the existing workforce.

I also want to emphasise that when it comes to net zero, even if we look at the batteries and fuel cells aspect of it, we need a wide range of skills, and quite a bit of that is transferrable. It is a big transformation, but it is deliverable.

Baroness Rock: That is extremely helpful, Mr Adikaari, thank you very much.

Q163 **Baroness Walmsley:** This question is for Dr Moran. If we are going to roll out EV cars as far as we want to, we will have to influence final-purchaser decisions. The charging infrastructure is a major barrier to that. I have to say, as an EV user myself and as somebody who has talked to a lot of other EV users, that I did not recognise the rosy picture you painted.

My first quick question is: how much surveying have you done of the opinions and lived experiences of EV drivers? Secondly, there are not enough rapid chargers, a lot of them are broken, they are all run by

different companies, they all have different operating systems, very often they do not work and there is a need for co-ordination. Is the department getting all these operating companies together and putting pressure on them about the quality of the service they are providing to the end user? Two quick questions there.

The Chair: You will have to be quick, otherwise I will have to cut you off.

Baroness Walmsley: Perhaps you could write to us.

The Chair: No, please answer it.

Dr Bob Moran: I can be very quick. Certainly in terms of lived experience, our Secretary of State for Transport is an avid electric-vehicle driver, as is Minister Maclean, who I believe you are talking to shortly. They share their experiences with us.

We are at the very early stages. We do accept and acknowledge the point around maintenance of charge points. A lot of the charge points were installed 10 years ago and their maintenance contracts have run out. However, we have the biggest and one of the best EV-charging infrastructures certainly in Europe, if not in the world. You are never more than 25 miles away from a rapid charge point now if you are driving an electric vehicle. Yes, access and the consumer experience could be better, but it is something we are putting time and effort into.

Baroness Walmsley: What about getting the companies together to co-ordinate?

Dr Moran: Yes, we do that. Yes, our Office for Zero Emission Vehicles may co-ordinate this policy across all the government departments that have an interest on behalf of Ministers, and they have a regular dialogue with all the committees.

Baroness Walmsley: Perhaps I will write to you.

Q164 **The Chair:** I have a very quick question. From all three of you we heard how world-leading, world-beating, and so on, we are. We are leading in everything in all kinds of ways. You talked just now about charging points, Dr Moran. We are leading the world. What are we not leading in?

Hannah Boardman: We are not leading in fuel-cell technology development.

Dr Moran: I stand by my comments. In terms of net zero and the context of technology and transition for that, we are—

The Chair: What are we not leading in?

Dr Moran: It is fair to say that fuel cells are not as advanced in the UK as they might be.

Damitha Adikaari: I would say that we are not leading on materials reprocessing, but we are leading on science and the technologies on those aspects.

The Chair: Thank you very much all three of you. I am sorry that we have been more challenging than we normally are, but it is because you

were such good witnesses. Thank you very much indeed, all three of you. We much appreciate your coming today to give us evidence. Good luck with your work, and thank you.