HOUSE OF COMMONS

# Business, Energy and Industrial Strategy Committee

## Oral evidence: The Semiconductor Industry in the UK, HC 291

Tuesday 7 June 2022

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Watch the meeting

Members present: Darren Jones (Chair); Alan Brown; Ms Nusrat Ghani; Paul Howell; Mark Pawsey; Alexander Stafford.

Questions 1 - 22

### Witnesses

I: Martin McHugh, CEO, Compound Semiconductor Applications Catapult; Alastair McGibbon, Industry Expert, Compound Semiconductor Applications Catapult; Dr Andy Sellars, Strategic Development Director, Compound Semiconductor Applications Catapult.

# Examination of witnesses

Witnesses: Martin McHugh, Alastair McGibbon and Dr Andy Sellars.

Q1 **Chair:** Welcome to this morning's session of the Business, Energy and Industrial Strategy Committee for our first hearing of our new inquiry on semiconductors in the UK, looking at opportunities and vulnerabilities in the sector. In our first panel this morning, we are delighted to welcome Martin McHugh, who is the CEO of the Compound Semiconductor Applications Catapult, and his colleagues, Alastair McGibbon, who is an industry expert, and Dr Andy Sellars, who is the strategic development director. Good morning to all three of you on the screen.

Martin McHugh, this is probably the first time that a Select Committee, certainly recently, has looked at this issue. We have been getting our head around the difference between silicon chips and compound semiconductors. My understanding is that silicon chips have silicon in them—that should probably be obvious—and that compounds have silicon and some other materials. I understand that, in the UK, we are particularly strong in the compound semiconductor sector. If all of that makes sense, please can you say so and also explain what that means for the UK from its strategic position within these often complicated global supply chains?

***Martin McHugh:*** Your description of a semiconductor as a single material—mainly silicon—is correct. It is what has driven the electronic system integration for the last 30 or 40 years. It has probably been the main technology for miniaturisation and for everything that we have got used to in our electronic world.

Compound semiconductors, as the name implies, are made up of two materials. A common one would be silicon and carbide—silicon carbide. That is a particularly interesting combination of materials because it has the ability to handle far more power than conventional semiconductors, so it would be extremely useful in furthering the development of electric vehicles, for instance.

In terms of other compound semiconductors, GaN technology would be useful for taking us from 5G to 6G. The other key advantage of compound semiconductors is that they can detect and admit light, which makes them very useful for sensitive applications in future robotics and AI applications.

The UK, typically, as it is often an earlier adopter and an earlier starter in technology investment, has spent nearly £800 million in research for compound semiconductors, and has a pretty good, leading position in the world in terms of research and development. This catapult is based in the only compound semiconductor cluster in the world at the moment.

The purpose of the catapult, to answer your question about the supply chain, is really to help that transition of the research into industry—hence we are called an applications catapult—and to help companies make their

products more competitive by adopting compound semiconductors.

We are at that turning point now where it is critical that the various supply chains and the industry come together, and that we take that incredible amount of research that the UK has built over the last 15 to 20 years and make sure that that is commercialised.

Q2 **Mark Pawsey:** Just following on from that point, you told us that we have spent £800 million on research and we are in a leading position. How many people know that?

***Martin McHugh:*** That is a very good question. Within the UK, it is well understood that we are the leading researcher in terms of compound semiconductors. At the moment, we and other clusters within the UK are working on getting that message out now about this particular cluster being the only one that is in the world, but it is something that we have to work on and that the UK has to come to grips with and promote.

Q3 **Mark Pawsey:** If we have that lead, is it your assessment that Government understand that? Do decision makers in the building we are in today know that we have this leading position? All we hear about in respect of semiconductors is the problems caused by shortages.

***Martin McHugh:*** Compound semiconductors are a particular field within the broader framework of semiconductors. All of the supply chain shortages at the moment are connected with the broader semiconductor market. Compound semiconductors have not got to the point yet where they are caught up in the supply chain issue.

Q4 **Mark Pawsey:** How do we get to have a better understanding here of the valuable role of the work that you are doing and that this particular sector has? We do not know that at the moment.

***Martin McHugh:*** Part of the role of the catapult is to get those messages to the market. One good reason why we wanted to be part of this Select Committee is to get the visibility of compound semiconductors to a wider audience.

Q5 **Mark Pawsey:** Does industry more broadly understand the lead that we have in this field?

***Martin McHugh:*** The industry that is involved in compound semiconductors—

**Mark Pawsey:** No, I am talking about the people who would use the semiconductors. Do they know that we are ahead in this area?

***Martin McHugh:*** It is a mixed picture, if I am honest with you. Those who are using compound semiconductors realise that we are ahead. On the periphery, we have to extend that message—that is part of the role of the catapult—to encourage people to adopt the use of compound semiconductors in order to make their products more competitive.

Q6 **Mark Pawsey:** How can you go about doing that? How can we take

advantage of this lead that you say we have?

***Martin McHugh:*** I would like to invite Andy, our strategic development director, who is in quite a good position to answer that question.

***Dr Sellars:*** Thank you, Martin, and thank you for the opportunity to address the Committee. You are quite right. Martin has indicated that the UK has invested over £800 million in the research of compound semiconductors through universities. The role of the catapult is to translate that research into applications.

In terms of recognition, Innovate UK has recognised our leading position and established the catapult in order to drive that role. How we can help do this is to look at the large markets that we are looking to address. The net zero market of vehicle electrification and smart energy grids is one of the large markets, as are 5G and 6G communications, satellite communications and quantum technologies. By identifying these large markets, we can build the supply chains and the UK semiconductor industry to supply those supply chains, and there is a great opportunity.

Innovate UK is certainly recognising these programmes. Innovate UK, the UK's innovation agency, has funded the quantum programme very extensively, and it is these programmes that are bringing industry together to translate the work from early-stage research out to commercial applications.

Q7 **Mark Pawsey:** Is there an everyday product that we could say has a UK-based conductor in it?

***Dr Sellars:*** Yes. I can point to one very good example that my colleague Alastair has led on. We have built the entire supply chain for a power unit that goes into a McLaren electric sports car.

**Mark Pawsey:** That is not exactly an everyday product, but it is a good example none the less.

***Dr Sellars:*** It is a good example, but the catapult also works with very innovative companies to take risky products to market faster. Naturally, we tend to work with a highly innovative company that might be a smaller volume to get that product to market quickly.

On the back of that, we then won another contract with BMW. BMW is clearly a large company, but there is a natural progression here, where we tend to choose small, innovative companies, because we want to get these really risky products to market quickly. On the back of that, we can crowd in much bigger volume production of those semiconductors.

Q8 **Paul Howell:** The argument probably starts with a subject that we have all heard a lot of recently, which is about resilience. It does not matter which business sector we are talking about. It is about where we should be in the UK. We have seen reports out there that say we should not be focusing on onshoring the semiconductor industry but rather that we

should play to our current strengths.

There are two parts to the question. What do you see as our strengths and comparative advantages? Do you agree with that argument or should we be putting a more resilient structure into our UK offer? Martin, we have come to you, but feel free to put it to whichever of your colleagues is most appropriate for these answers.

***Martin McHugh:*** If it is okay with you, I would like Alastair to answer that question, please.

***Alastair McGibbon:*** Thanks, Martin, and thanks for inviting me. It is a very large, complex industry, and it is not just a case of one type of semiconductor. It is a very broad industry with lots of different capabilities. You can generally describe it as three main elements to the semiconductor industry. You have the manufacturing sites, where they make the chips, and that could be a silicon or compound semiconductor. Essentially, they are very similar processes.

You then have the electronic system. If it is an electronic system, it has a chip in it, so there is all the work around taking a chip and creating the electronics environment or solutions for different markets, which the UK is quite strong in as well.

You then have the design side. You have the manufacturing of the chips, but then you have almost a separate industry that can design the circuits that are used on the chips for the electronics. Those are the three main areas.

If you look at the UK capability in those three main areas, we have world-leading UK design capability primarily on silicon. Companies like Arm, Imagination, Dialog and EnSilica all work on these sorts of silicon design technologies, the vast majority of which are not manufactured in the UK. They are manufactured in the far east, primarily because of the capital investment for those types of silicon technologies. If you wanted to build a new fab, which is a semiconductor manufacturing site—we will mention "fab" a lot—in leading-edge silicon, you would not get much change out of about $20 billion. There is none of that in the UK. That is in the far east.

However, in the compound semiconductor and older silicon technologies, there is still a lot of silicon manufacturing in the UK, just not in leading edge. They still make a lot of money, primarily in automotive markets. There is UK capability there in older technology silicon, silicon carbide and gallium nitride compound semiconductors. There are about 25 fabs in the UK that are manufacturing these types of technologies, and they have been around for a very long time.

Once you establish something like that in manufacturing, it takes a very long time. It is very difficult to move because one of the most complex processes that man has ever created is to create a silicon chip. Once it is there, it is very sticky, so you have that in the UK for manufacturing.

In terms of post-fab, or the electronic systems integration side, there is strength in the UK, particularly in electronics, RF/microwave, sensoring and comms. Again, that is primarily in the compound semiconductor or hybrid technologies. In each of those areas, there is technology.

In terms of the issues in this industry, there was a question about the recognition within industry of the semiconductor supply chain. Quite often within the semiconductor supply chain, it is not recognised. For example, companies like Arm and Imagination, because none of the material that they use to manufacture their products is done in the UK, do not necessarily recognise the UK's manufacturing capability, and vice versa. They are quite separate.

In the future, there is the opportunity to take the UK design capability and bring that together much more closely with the UK manufacturing capability as those new technologies start to mature and reach wider markets. That is one of the opportunities.

Q9 **Paul Howell:** I get that. Just to follow the question a little bit further, what are the potential opportunities that the UK compound semiconductor industry should be looking to grasp?

***Alastair McGibbon:*** I would certainly say that, in power electronics, for example, the power chip for every new Tesla on the road is a silicon carbide power electronics chip. The UK has both manufacturing and supply chain capability in that area, and that is only going to grow. Most automotive manufacturers are looking to incorporate silicon carbide in their power electronics. It then goes into all the vehicle-to-grid charging, where it goes into the grid.

There is a new UK fab in Fife called Clas-SiC, which is a $60 million investment that manufactures silicon carbide chips and is already pretty busy and starting to grow. You have other UK manufacturing sites that have the capability to move to silicon carbide technologies. That is an area where global growth, particularly driven by automotive, is very high.

There are material supply issues at the moment, even in silicon carbide. It can take a company about a year to wait on a silicon carbide chip because, at the moment, due to the electrification agenda, volume is vastly exceeding capacity at moment. There is an opportunity in these very quickly growing but relatively new areas for the UK to acquire a leading position. You could argue that security of the supply chain in electrification is a pretty important area.

Q10 **Paul Howell:** Just coming back to what you said in terms of the structure, you are manufacturing, you have your systems and you have your design, but when it came to manufacturing, it seemed as though you were saying that the chips are going to be made in the far east.

***Alastair McGibbon:*** One type of chip—the very advanced silicon chips. If you look at microprocessors for automotive, for example, and a lot of consumer electronics, they are mostly silicon, manufactured in the far east. In the UK, you have significant manufacturing capability in non-

silicon or older silicon technologies. It is still mostly silicon in the UK, and 90% of that is for export.

Depending on the technology, the capital investment for a fab is very different. In most UK manufacturing sites, it is typically £50 million to £100 million to build and run a semiconductor fab of a reasonable scale in these sorts of technologies. If you are in the very leading-edge silicon technologies, it is exponentially higher, and the UK is not in that space.

Q11 **Paul Howell:** Sorry to interrupt you, but should it be? Are we in a situation where technology is just going to run away from us? In a past life, I worked up in what was then the Silicon Glen, and a number of the companies that were there just disappeared because they did not keep up with technology. If we need to be resilient as a country, do we not need to do something somewhere, somehow?

Just to broaden the conversation, are there some alternative things? I am a north-east MP and I know that we have people talking about using diamonds instead of silica. Is there something else that we should be taking—not just the silica agenda—in terms of where we go on semiconductors?

***Martin McHugh:*** Can I invite Andy to make a comment on that? He has written on this particular subject.

***Dr Sellars:*** It is fair to say that, whenever you build an electronic product, it always has two or three types of semiconductor in it. If I take your mobile phone, the brain is always going to be fabricated in silicon, and the facial recognition and the 5G are fabricated in compound semiconductors. The display is a third type of semiconductor. It is an organic semiconductor. Whenever you are building an electronic system, you always have two or three types of semiconductor.

Alastair is absolutely correct. When it comes to the silicon, the UK is pre-eminent in the design space. When it comes to fabricating silicon, we tend to fabricate on older design processes—typically 1990s or early 2000s design processes. For the resilience and security piece, there is certainly an opportunity where, as Alastair has said, we have about 20 to 25 fabrication facilities in UK. You are quite right that there is one in Newton Aycliffe in the north-east, several in Scotland in Greenock, and in Manchester, Oldham and Hazel Grove, et cetera.

There is an opportunity perhaps to support those fabs to move to a newer process and to secure higher functionality on the chips that they are fabricating in silicon. It is a growing market and it would certainly make the UK more resilient and secure in that space.

In the compound semiconductor space, we have a great research base and some really great companies. Alastair has alluded to Clas-SiC in Scotland, which is growing very well. There is also an opportunity here to support those companies for scale-up in particular. These are rapidly growing markets and, again, when it comes to resilience and security,

you need a couple of elements. You need the design elements, but you also need the fabrication element, so there is certainly an opportunity to support those companies in growing those particular areas.

**Paul Howell:** When you mentioned Newton Aycliffe, II-VI is in my constituency, so I have been and I am very familiar.

***Martin McHugh:*** That was the note that I made as well.

Q12 **Chair:** Martin McHugh, the resilience of UK assets has been in the media quite a bit recently, predominantly because of the National Security and Investment Act interventions on Newport Wafer Fab and the question around the listing of Arm, now that the acquisition by Nvidia has collapsed. Is there a clear message at the moment from Government to the industry about what Ministers think about intervention in this market and which assets they do and do not want to protect?

***Martin McHugh:*** I will not say that there is not a clear message. There does need to be a clear message. One of the things that the catapult has observed at the moment is that there are a number of initiatives across various Departments within Government. There are a number of industry trade bodies, such as the Society of Motor Manufacturers and Traders, lobbying the Government. We have our fellow catapult, the Royal Academy of Engineering, and other institutions commenting on and reviewing the semiconductor industry.

What that has presented is a situation for industry whereby it is unsure where to turn to within Government to voice its opinion. First of all, we welcome the elevated profile that the semiconductor and compound semiconductor industry is now getting with Government. The next stage for us would be to try to get a unified position and voice across all of Government, which would then make it easier for the industry that we represent.

Q13 **Chair:** Would it be better for the work on semiconductors to be moved from DCMS into BEIS, so that it is all in one place, or can we get to a position where all Departments are doing the same thing?

***Martin McHugh:*** It would be great if we could get to a position where all Departments are doing the same thing. As a catapult, the one thing that we have to remain clear on is our neutrality. Industry, Government, trade associations and universities trust us as that neutral convener, so we have to maintain that position of neutrality, so that people can trust us with their opinions and we can convey those opinions back up. As I said, for us it would be easier if there was a single voice from the Government, even if that was made up of two Departments.

Q14 **Chair:** On the basis of that answer, if I was to ask you your view about Newport Wafer Fab, presumably you would tell me that you would not be able to give me an opinion.

***Martin McHugh:*** On Newport Wafer Fab, we have a position of neutrality. We have to think of the UK as a whole. It was picked up with the fabs that were mentioned in Newton Aycliffe and Scotland, but we would say that our particular interest within the compound semiconductor industry across the UK is to make sure that there are targeted investments within the compound semiconductor industry, building the supply chain up across the UK, which includes Scotland, the north-east, the south-west and south Wales.

Q15 **Chair:** The Foreign Affairs Committee suggested that the Government should play a role in any listing of Arm and maintain some kind of "golden share"—I think that was the phrase they used. Would you agree that it would be beneficial to the industry if Government had that level of intervention around ownership or investment directly in companies?

***Martin McHugh:*** It is a position that we would rather not comment on at the moment. Again, it is protecting our neutrality from an industry and Government point of view.

**Chair:** I am feeling generous today, so I will not push you.

Q16 **Paul Howell:** Just going back to what we have touched on a little bit there in terms of the supply chain structure, we have talked about the different bits of the business already, but just how resilient is the UK when it comes to the supply chain? Are there gaps in it? What is the structure like? Is it fragmented all over the UK or are there clusters that are in different parts? Are there certain things in the south-west, certain things in the north-east and certain things in Scotland? Should it be encouraged to be a more collaborative structure, or is it just the way that it has evolved? What should we be looking for there? Are there any particular gaps that we should be particularly concerned about, other than what we have already covered?

***Martin McHugh:*** I will start that and then pass to Andy. There are recognised clusters within the UK. The catapult has mapped those out. We recognise a very strong RF cluster in the north-east that would benefit from targeted investment. We recognise a very strong cluster within Scotland around heavy power and satellite applications that we think would benefit from targeted investment, as well as within south Wales and the cluster where we are located, and then the clusters in and around the east of England and down in Torquay in the south-west.

We believe that those clusters could benefit from having supply chains formed around them and connecting the various supply chains to make sure that they are there to support those particular clusters as well. That is one of the roles of the catapult.

I will ask Andy and Alastair in turn to add to that as well. Andy has a particularly good map of the catapult network behind him, which just shows how wide everything is.

***Dr Sellars:*** You are right. When it comes to compound semiconductors, we do have elements across the supply chain. In design and research and fabrication, where they could do with a bit of assistance is in the scale-up, particularly to address these large markets of vehicle electrification and 5G satellite communications. Our catapult is located with IQE, a world-leading provider of compound semiconductors for facial recognition and 5G, for example, so we really are at the heart of that particular cluster.

When it comes to silicon fabrication, as we alluded to earlier, we have very good strengths in design, but there is some patchiness. High-end silicon chips are all fabbed in the far east. The UK is not unusual in this particular situation. When you look at all the major developed economies such as the US or the EU, they all buy their high-end silicon from the far east. We are not unusual in that particular situation. In compound semiconductors, we have good representation across the supply chain.

***Alastair McGibbon:*** I would say that one gap that we have not talked about is that the UK does not have what we call base wafer growth capability. All the action happens on the very top surface or epi layer of a semiconductor wafer—Andy mentioned IQE, which is world-leading at developing that epi layer—and then it goes to a fab. The epi layer is built on usually a six or eight-inch diameter wafer of different types of material. There is absolutely no UK capability in that space, so that is always a supply chain gap.

In some cases, you could argue that it would be good to have some UK sovereign capability, particularly in things like silicon carbide, which is very difficult to grow. That is a definite gap. The closest to it is our company in Livingston, Shin-Etsu. The wider global company grows silicon wafers, but in Shin-Etsu it is epi layer. That is one gap.

In terms of the clusters, historically you have ended up with fabs all over the UK, but there are clusters that you can pick out and develop. In the north-east, you have II-VI in Newton Aycliffe and a little company called INEX, which is the old Newcastle University fab that is looking to expand and grow. Both of those have two of the base technologies for future RF chips—gallium nitride and gallium arsenide.

In Scotland, there is a national focus on energy, hydrogen, high power and HGVs, and that goes well with the silicon carbide capability that is being developed. In the south-west, you have Plessey doing LED development, which fits very well with the south-west photonics cluster. You can see where there are at least centres of gravity, but there are always exceptions to the rule as well. You could certainly build supply chains around centres of gravity to grow those new supply chains.

Q17 **Paul Howell:** As a final question, you said that we could invest. What sort of support is appropriate? Is it a private sector thing? Do we need some Government intervention there? Are there some incentives? Will the market take care of itself? What do we need to do to make sure that we try to fill those gaps as time goes on?

***Alastair McGibbon:*** We have talked about targeted investment to help, but it has to be industry-led. There has to be the will from a company to establish these very complex, high-cost capabilities. That has to be there, but also incentives into research or capital investment to improve capacity, for example. A lot of those 20 to 25 companies in the UK have been there for a long time, and they make a living and they do quite well, but maybe some targeted investment to help them grow in scale or adapt to new technologies would be the sort of innovation that would help these companies.

If you are looking at high-end silicon, the only feasible way to move into the £20 billion level is to be able to attract inward investment, where you have one of the big companies like TSMC, for example, with global foundries, and the UK making the case that it would be good for it to build a site and invest in the UK. It is not something that you could start from the ground up. It is just too complex. It takes years to develop a fab in semiconductor technology. Even for the new one that I talked about in Fife, with silicon carbide, it has taken four or five years to get to where it is. It is just early production. It is very complex. You need to have industry-led investment with some help to incentivise that.

Q18 **Mark Pawsey:** We have heard that this is an industry with lots of collaboration, and we have clusters, but Alastair has just told us that there are some areas with no UK capability and that it would take a massive amount of time to develop our own capability. What potential exists for international collaboration, whereby we could work with some of these dominant players in the far east? Can we work with them to establish domestic manufacture in the UK?

***Martin McHugh:*** If it is okay with the Committee, I was going to let Andy have two minutes on that, because he has done a lot of work with international collaborations for us.

***Dr Sellars:*** It is very difficult for any one country to have complete sovereign capability in everything. The integrated review, which was published in 2020, gives us a really good framework about how we should go about collaboration. The integrated review talks about "own-access-collaborate", and "own" is where the UK has research, fabrication and supply chain capability. You can own an area and, arguably, I would say that we can own the compound semiconductor area.

The "collaborate" is where the UK has parts of the supply chain or the technology, but we still need the technology, so perhaps the "collaborate" is where we get the higher-end silicon. The "access" is where we have less of that and we need to get access.

Q19 **Mark Pawsey:** Are those discussions taking place now?

***Dr Sellars:*** To a certain degree, yes. I have been out to Taiwan and to India. The thing about these partnerships is that you want a trusted partnership. I should highlight the US, the EU, India and Taiwan as being

trusted partners, where they have complementary technology to what we have. They are also doing quite large-scale investment. Taiwan is really the home of high-end silicon fabrication. India is looking to incentivise companies to grow high-end or medium-end silicon fabrication. We can partner with these countries and are having intermediate discussions with them at the moment. The US has announced the CHIPS Act in order to become more self-reliant on high-end silicon production, and the EU is also investing heavily in this space.

Q20 **Alan Brown:** Just moving on to compound semiconductor demand, I am just wondering if somebody could explain how much of what is made in the UK is used in the UK as an end product and how much is exported. Also, how does the export value compare to the amount that needs to be imported because of the high-end stuff that comes in from the far east?

***Dr Sellars:*** IQE is a world-leading provider of compound semiconductor epi wafers. My understanding is that it exports a large proportion of what it does. I am also aware that, in 2005, Filtronic, in the north-east, exported nearly 300 million compound semiconductor devices to the US for the mobile phone industry. We do have some sizeable market exports in this area, but equally it is a global market, so we are supplying not just the UK but a global market.

***Martin McHugh:*** I was just going to say, just for some reference numbers, that the world market for compound semiconductors was around $32 billion in 2020 and is expected to grow to about $43 billion in 2025, and the UK market would be about $7 billion. What I then wanted to add is that, within the cluster here in south Wales, 95% of the output of the cluster is exported, because it is not just for electric vehicles but for mobile phones and other devices. I hope that answers your question.

Q21 **Alan Brown:** Yes. As a final question, which is probably for Alastair, how do you envisage the demand for compound semiconductors changing in the future? Is the UK capable of meeting that demand? We have already heard different things about industry and Government speaking with one voice and needing inward investment. What would be the key ask to make sure that the UK is well placed to meet that future demand?

***Alastair McGibbon:*** There are probably three elements. Compound semiconductors are still relatively new, so there is an opportunity to grow in the areas of power electronics, communications and sensing. We would see three main likely interventions there. One is selective targeting of semiconductor manufacturing investment across the various capabilities in the UK.

In the post-fab, the electronic systems side, there is existing capability. Andy talked about the project in which we have developed a supply chain that goes up through to McLaren and now BMW in power electronics. Bringing that industry together in electronic systems integration is important, because, again, there are bits of IP all the way up, post fab, where you are putting the system together. That is where we stand. In

both silicon and component semiconductor technologies, that is important.

The third area is really exploiting the great design capability that we have in the UK. As the compound semiconductor technologies become more mature, they could be more generally used by designers and solution providers in electronics, and that is where the design community can come in. As that becomes more commoditised and more accessible, the UK design capability is potentially in a good position to start to work much more closely with the UK manufacturing and post-fab supply chain than it has done previously. That is more of an industry networking and integration challenge. Those would be the three areas.

Q22 **Alan Brown:** How would that collaboration early enough in the process come about to make that much more coherent and then create these additional jobs?

***Alastair McGibbon:*** I can give some examples. Developing products and solutions, even at an innovation level, to bring the supply chain together into collaborative projects works well. We have seen that happen in power electronics and in RF.

An example would be the project called ESCAPE, which we worked with the UK industry to develop. That is a 12-partner end-to-end supply chain in silicon carbide power for automotive. It started with IQE in south Wales. The fab was in Clas-SiC in Scotland. There were several packaging companies around the UK, and then Turbo Power Systems in the north-east did a McLaren-applied solution. You then have a demonstrator of a full UK end-to-end supply chain with product. It is not creating a hermetically sealed supply chain.

What then happens is those companies can then go and work with whoever they want globally. They are showing what they can do and then you are creating that capability, and other companies can start to be partners within that. You are creating not just one supply chain, but width in the supply chain, and having two or three fabrication or design capabilities. That is what gives you strength in a cluster, not just one thing. I would say that that would be a very good way to go as you look at those new technologies: encouraging supply chain collaborations.

**Chair:** Thank you to Martin McHugh, Alastair McGibbon and Dr Andy Sellars for your contributions this morning. We are very grateful.