



# UK Engagement with Space Committee

## Uncorrected oral evidence

Monday 24 March 2025

3.45 pm

Watch the meeting

Members present: Baroness Ashton of Upholland (The Chair); Baroness Bonham-Carter of Yarnbury; Lord Clement-Jones; Baroness Donaghy; Lord Lansley; Baroness Mobarik; Lord St John of Bletso; Viscount Stansgate; Baroness Stowell of Beeston.

Evidence Session No. 6

Heard in Public

Questions 57 – 67

### Witnesses

I: Joshua Western, Co-founder and CEO, Space Forge Ltd; Dr Rory Holmes, UK Managing Director, ClearSpace; Dr Katie King, CEO and Co-founder, BioOrbit Ltd.

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## Examination of witnesses

Joshua Western, Dr Rory Holmes and Dr Katie King.

Q57 **The Chair:** Welcome. I am delighted that everybody is here for this public session of the inquiry into the UK's engagement with space. I am delighted that we have three people who have volunteered to come and give us evidence based on questions that we will be putting to them. I welcome Dr Rory Holmes, the UK managing director of ClearSpace UK; Dr Katie King, the CEO of BioOrbit; and Mr Joshua Western, the co-founder and CEO of Space Forge. We are absolutely delighted to have you with us.

The way that we run these sessions is we have just about an hour. Individual members of the committee will ask a question or two. Please do not all feel you have to answer every question, and if you do, be as succinct as you can for the benefit of time because there is a lot we would love to cover, if we can.

It is possible that there will be a Division at some point. If there is, I will suspend this part of the proceedings. If you can bear with us while people rush off to vote and come back, we hope to be able to carry on without too much disruption. It is the inevitability of Parliament that there is parliamentary business going on around us in which we have to participate.

At the beginning of your first answer, it would be really helpful, if you would like, to say a little about your company and organisation. People have read the biographies, but it is always good to hear just a 30-second snapshot of what you would like to say to us. Let me begin with a broad question for all three of you. In your view, how big are the opportunities in the in-space economy in the coming years? Whoever would like to start, please do.

**Joshua Western:** Everybody is looking at me so I will go first. Thank you so much for having me. I am the CEO and co-founder of Space Forge. Space Forge is both a materials company and a space company, which means we produce advanced compound semiconductor crystals. They are the inorganic materials that make up computer chips. As a company, right now, that is done here on earth. Later this year, we will start to do it in space. The combination of microgravity and the purity of space vacuum allows us to create semiconductors up to five orders of magnitude higher in purity compared to the ground. Back here on earth, that means we can effectively reduce energy consumption by up to 75% in almost all major infrastructure. Effectively, anywhere where there is a chip deployed, we can probably help.

Because of that very reason, when I think about the growing in-space manufacturing economy I think about both the growth in the space market itself and the overall global semiconductor industry. Currently, we are looking at annual growth within the overall space economy of up to



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about 1 trillion for all space activity by around 2035. The compound semiconductor economy as a market has already existed for a number of years. It is growing at a significant clip: about 10% year-on-year, so much so that right now Space Forge has a £2 billion immediately accessible market which fits within about a £30 billion overall addressable market, but the rate at which that is growing means that by around 2030 we will be looking at a £70 billion to £90 billion market. That is activity in the semiconductor industry which Space Forge can directly access by being a UK company able to support Europe, our allies, and further abroad in the southern hemisphere, not including markets where we would not be able to export this technology because of either its dual-use nature or those countries having their own entities. So, we are looking at really staggering sums growing at significant pace.

**The Chair:** I will ask each one of you the same question: how many jobs do you think that would create? I am getting into the basics of economic growth.

**Joshua Western:** For Space Forge alone, more than 1,000. We are already the UK's largest privately owned space company. In many ways, that is a fantastic accolade. In other ways, we are about 70 people in an industrial estate in Wales. There is a huge gap between the private market and the public market when it comes to space and advanced manufacturing in the UK. That said, four years ago, we were two people in a garage on the outskirts of Bristol, so we have grown significantly since that point. Across the team of 75, we represent 24 different countries. We have recruited from rest of world talent as well as creating a homegrown pipeline here in the UK with Early Careers and an apprenticeship programme which is all done, as I say, in Wales. We became Wales's biggest space company when we hit about 20 people.

**Dr Katie King:** Thank you very much for having me. I am co-founder and CEO of BioOrbit. We are building a pharmaceuticals factory in space. Similarly to Space Forge, we are using the superior crystallisation process that takes place in space but applying it to the crystallisation of pharmaceutical drugs. In real terms that means, through crystallising antibody drugs, we can turn it from something that needs to be injected in the vein into a really concentrated dose that you can self-inject at home, so patients do not need to go to hospital to receive treatment anymore. They can stay at home and GPs can administer it, or they can self-administer, so it really decreases the burden on the healthcare system. But to get the quality needed to enable that, we need a microgravity environment to get that quality of antibody crystal.

When it comes to the size of the market and the opportunities, it is really important in the space economy to think about phase 1, which is the infrastructure that comes in to enable these things to take place and then phase 2, which is value-added services. BioOrbit is very much in phase 2—value-added services—but we could not do what we are doing if it



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were not for phase 1 infrastructure re-entry vehicles such as Space Forge is developing. These two have to come in parallel.

We are using space for a non-space sector for biotech. We are a biotech company that utilises space, which is a different way of looking at it. In terms of opportunities, the market we are going into is the antibody market, which is projected to be worth \$1 trillion by 2034. Each contract that we get will be in the billions—per contract—so it is really about co-developing those drugs alongside pharma companies. There is a lot of money there; we are talking about a multi-billion-dollar market that is immediately accessible.

**Dr Rory Holmes:** Thank you very much for inviting us here. I am the UK managing director of a company called ClearSpace, which is an in-orbit services company. Until recently, when you launched a satellite into space, you had no way of interacting with it physically again. If it broke, you could not repair it. If it ran out of fuel, you could not refuel it, and if it became obsolete, you could not upgrade it; but that is changing. The technology now allows us to go and physically interact with objects in orbit again.

There is a whole range of types of services you can provide to other satellites in orbit, such as repair, refuelling, inspection, and upgrade, as well as addressing some challenges we face at the moment around space debris and removing objects. In terms of the size of the market, UKspace published a report in 2023 highlighting a £2.3 billion opportunity for the UK alone in this new and emerging market. These are new markets for us all; there is no incumbent there that we need to disrupt. These emerging markets really are wide open—and, hopefully, for us in the UK to capture.

Q58 **Viscount Stansgate:** My question was to Katie and Joshua, and I would like to congratulate you on having, in effect, answered the question before I managed to ask it. It was going to be for you to explain why in-space manufacturing is better than terrestrial—you have already touched on that—and what the likely shape of the market is going to be over the years ahead. You have said something about that, too. If there is anything else you would like to add for the record, it would be very helpful to know. You touched on the fact that it is going to be concentrating on antibodies and that the environment in space is purer than that on earth and not subject to gravity, but if there is any more you would like to add, we would be very pleased to hear it.

**Dr Katie King:** It is good to think about the sectors that we are addressing. We are using space for non-space; typically, we get classed as space companies but we are very different in terms of our customer set. We have semiconductors and pharmaceuticals. It is very important to think about the in-space economy and the opportunities of the different sectors that we are addressing. We are a biotech company that uses space, and it is about how these different sectors can benefit from utilising a space environment. For us, it is manufacturing and how the



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environment itself changes these fundamental processes that then gives you a better product down here on earth.

**Viscount Stansgate:** Is there no damage to the product between the time it is manufactured in space and getting it down to earth safely?

**Dr Katie King:** There is no damage, but it is something that we are testing. Protein crystals have been tested time and time again on the ISS, and when the crystals have returned to earth, which is something we are doing. We will need to do tests for each re-entry vehicle, just in case there is a different impact that that particular vehicle experiences, but theoretically it is a no. We have our first test of that in three months.

**Viscount Stansgate:** Can you give us some idea how much space you need to do this in space? What size of satellite, in effect, are you going to be doing this in-space manufacturing on?

**Dr Katie King:** We are building for two pieces of infrastructure: the re-entry vehicles, like the ones that Space Forge is building, and for commercial space stations. They both have pros and cons for the scale that we are producing. Re-entry vehicles give us that high iteration, and we can produce tens and hundreds of kilos with that. But when we hit the multi-tonne, as we want to, we will need a whole space module that could give us a tonne of crystals per year, which is a very sizeable chunk of the pharmaceutical market.

**The Chair:** Lord St John is joining us remotely. Would you like to put your question?

Q59 **Lord St John of Bletso:** Yes, please. I have a question for Rory Holmes. Rory, I am interested in the whole area of active debris removal. How serious is the threat of space debris? The regulations are not particularly clear. What are the incentives for firms or states to procure your services, and who is responsible for paying for the removal of space debris? Would it be the state, insurance companies or the private sector? It seems unfair that the public should have to pick up the tab.

**Dr Rory Holmes:** The challenge of space debris is one that we need to take seriously. I am pleased that we are covering this topic here. Over the last 50 years, we have just abandoned objects in orbit when they reach the end of life. We launch them, they do something, and when they come to the end of life, we leave them: both rocket bodies and satellites. These objects career around and they can collide and make more pieces of space debris, which can then go on to cause further collisions and problems. With the volume of satellites that we are launching drastically increasing, there is a real risk that if we do not address this problem, we could leave space unusable in certain orbits for future generations. We need to take this very seriously now.

ClearSpace is an in-orbit services company, so we are targeting a wide range of services. One of the important services is debris removal. In terms of who remains liable for these objects, the pieces of debris



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ultimately remain the liability of the launching state—the state that signed off on the launch—which will be the UK in some instances and other countries in others. We should not look at debris removal in isolation, though; it is just one type of in-orbit service. If you have robotics capabilities and sensing capabilities that allow you to remove objects from orbit, it means you can do other things as well: you can extend the life of satellites, refuel satellites, and provide security and defence applications. So, when we look at how these services are commercially viable, we should not just look at it in isolation; we should consider the wider package of services that these core capabilities companies such as ClearSpace are developing.

**Lord St John of Bletso:** My supplementary is more in terms of space fiction, but we hear a lot about potential asteroids coming to earth. To what degree can gravity tractors divert potentially threatening asteroids?

**Dr Rory Holmes:** That is a very good question, but I am probably not the expert to address you on that. I might have to pass it on, I am afraid.

**The Chair:** We have talked a bit about the opportunities; we now need to look at the barriers so, Baroness Mobarik, would you like to start us on that?

Q60 **Baroness Mobarik:** It has been really inspiring to hear from you all; this is such exciting work. What are the key barriers to growth that your businesses face?

**Joshua Western:** They are very different for each of us. Broadly speaking, the challenges fall into three categories: access to finance, regulation and an indication from Government of support—effectively, long-term support being available for the sorts of industries that we are working in. Nothing happens in space quickly: it takes a long time to get things going. What I would add to that is that capital is abundant. There are trillions available in private capital all around the world. At Space Forge, we have done a fairly good job in being able to access some of that. We have investors from the UK, lots of investment from America, and interestingly, our largest single investor is from Germany, which is an interesting position to occupy. We have been successful in leveraging British Business Bank financing, as well as other UK government-backed abilities to address that finance.

However, we are now entering the scale-up phase, and the quantum of funding that is available for scale-up companies doing as hard as a technology as we are in space is difficult to find in the UK, both from a private financing perspective and in creating the strategic programmes that are effectively cross-government and can enable our capabilities more broadly. As Rory touched on with regards to ClearSpace, space technology naturally touches on defence as well as civil applications and scientific endeavours, and the Department for Transport is involved in the regulation. We need that cross-government support to be able to support





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long-term, high-duration programmes with the significance of funding that allows us to enable that.

The way in which I look at it is that the UK has been, historically, fantastic at inventing technologies. My favourite example is the Merlin engine for the Spitfire. However, that was successfully commercialised in America once Ford picked up the manufacturing and scale-manufactured it for, I think, the Spitfire Mk II. We are in danger of repeating history for each UK homegrown deep tech scale-up, if we find it easier to commercialise abroad compared to the UK. Currently, that is not the case for Space Forge, but I am continually inundated with offers from Europe, the Middle East and America to shift our HQ to their country. For me personally, there is a special green colour that you only find in the UK, I like seeing it when I fly back into Heathrow. I do not want to leave, but I need that quantum of financing and, more importantly, the duration of financing to be able to stay and grow here.

**Dr Katie King:** At BioOrbit, we are very much in the start-up phase, so not quite at the scale-up phase yet. As Josh said, finance, regulation and government support are the three key areas. When it comes to finance in the start-up area, there are three main sources: grants, private capital and commercial partners. Grants can de-risk the private capital coming in. However, an area where government can really help is to facilitate the conversations with the commercial partners. If the big players such as pharmaceutical companies are already in contact with Government, it is hard for a start-up to have those conversations. Through facilitating those channels of conversation and partnerships, those in private capital will come in because they want to be sure that there is a commercial customer at the end of it. So, if there is aid in making those conversations and partnerships happen, private capital will follow. It does not have to be that more grant money is needed; it is just about different ways of enabling access to private capital coming in to de-risk it.

**Dr Rory Holmes:** To add to that, ClearSpace and all of us have been really lucky to get support from Government through various mechanisms: contracts and grants are really crucial for the R&D development work we do. We are seeing a change now in the focus that the Government are putting on specific areas in the space industry. We all understand that there is a limited amount of money available. Perhaps in the past we sprinkled little bits of money on lots of different places, whereas now we all realise that we need to focus and pick which areas we think the UK can do well in and make sure sufficient funding is focused on those.

On a slightly separate point, we are lucky that we are supported on a large programme by the UK Space Agency. I understand that there are certain procurement challenges in government, but when we work on these large programmes, we build large teams. When these programmes are phased and there starts to be gaps between phases, for example, if a three-month gap between the end of one phase and the start of the next



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becomes a six-month or a nine-month gap, then that can have a significant impact on a small company like ours and our cash flow. We would benefit from focusing the money and, when it is allocated, making sure it is continuous in its application.

**Baroness Mobarik:** You have really shed a light on the space finance landscape that exists in the UK, which was going to be my next question, but you have answered that. Would you like to add anything on whether there are any other barriers?

**Joshua Western:** I would like to echo what we are saying around this table; it is not necessarily the quantum of finance that is available. Broadly speaking, that is roughly at the right level but it certainly requires a more focused application. However, what we should really be targeting is the mechanics in which that funding is delivered. Grants are widely available for the deep tech industry and hardware developments, but they really need to be contracts. Contracts allow me to leverage private finance to a much greater extent compared to grants. Roughly speaking, each grant per pound is worth about 50p to an investor. As a contract, it is worth about 10p.

I hope that would not be too much of a challenge to achieve. Ultimately, it would bring greater stability to the companies. It would also bring greater oversight from Government of what those companies are working on because it would allow them to do things such as milestone payments and actually recognise that the company is delivering what it said it would. So, it would create a better operation overall while also creating a much riper environment for deep tech investment from private markets, demonstrating that the UK Government have supported them in a new means and similar to the way that our compatriots in France, Germany, Spain and America are.

Q61 **Baroness Bonham-Carter of Yarnbury:** I come from a creative industries background, and what you say reflects so much of what happens in that area too: the incredible start-ups, but not the scale-ups. Josh—if I can call you that—the fact that you started in your garage in Wales and are determined not to be gobbled up by someone from America is commendable, but it is difficult, is it not?

I wanted to ask you all about skills. Again, that shortage is reflected in the creative industries. I had not heard this word before until I read my homework, but apparently, we have skills density: as I understood that, we have very highly educated people but not enough people doing it at a different level. Is that about a lack of careers advice? I am going to wrap this all up because I think you all need to answer this. Is it our education system or our complication with visas? I point out that out of the six people coming to talk to us today, Dr King, you are the only woman. So, there you are. There are lots of questions in there.

**Dr Rory Holmes:** The question of skills is one that is discussed frequently in the space industry in the various forms we are in. The





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impact it had on ClearSpace was that it drove us to put our base in London. We are lucky that we have attracted a number of people from outside the UK: the EU in particular and even wider afield. In fact, if you look at the team behind me who have built the robotic arm, none of them are UK nationals to start with.

**Baroness Bonham-Carter of Yarnbury:** Sorry to interrupt, but is that still possible?

**Dr Rory Holmes:** We have been lucky to have been able to secure the visas we need, and by basing ourselves in London we have been able to attract people into the UK. It is probably worth pointing out that more than 50% of our staff are non-UK nationals.

**Joshua Western:** Broadly, I do not recognise that skills challenge that we apparently have in the space sector. For lack of a better term, space is cool. It is difficult to make a space job not sound interesting. On average, we get about 50 applicants per post. We recently advertised for a position and had over 100 applications in four days. This is at all levels. For our CFO position, we had over 100 applicants; for a manufacturing technician, we had 150. We have some benefits in that you can easily access things like surfing beaches from our office in Cardiff, which makes it easier—I would not like to try surfing on the Thames. We have a highly diverse and international team as well. We represent 24 different countries across our team of 75. We have recruited from, I believe, every inhabited continent that there is. We have Australians, people from Japan and South America, and we have a North American team and office. It is on us to be more creative in this industry to attract the right sort of talent.

As we noted in the introductions, I do not have a PhD. My background is in politics. The way I got into this industry was that Tim Peake was selected for his tour of the ISS in the year I was graduating. It was the first time I found out the UK even had a space industry. I wrote to the CEO of a space company and asked for a job, and he graciously gave me an interview. Effectively, we have a PR problem. We do not talk enough about the fantastic roles that you can come in and do, whether you are technical or non-technical, whatever your job is in the industry. We have made sure to do that at Space Forge. Our head of facilities used to run Aston Martin manufacturing lines. Our head of electronics used to build synthesisers for 1980s bands. We have recruited from pretty much every engineering facet that is available in the UK in order to build our team. The main difference between engineering for the space industry and any other sector is basically the funny suit that you have to wear to go and do it. Once you have overcome that burden, it is actually quite simple to hire.

**Baroness Bonham-Carter of Yarnbury:** I do not want to interrupt before Dr King, but you said that your workforce is very international. That is great, but one of my questions was whether there is enough careers advice fed into our schools about what I agree is a very exciting



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career?

**Joshua Western:** To be honest, probably not. I went to school in rural Somerset, so there were lots of jobs that I did not know were a thing until I went to college. Then I went to university and then entered the big wide world of work. I have gone back to the school that I went to. My mother happens to be a teacher, and I have supported her school. Space Forge has done a lot with local schools around us in Wales. One of the things that the UK Space Agency has really excelled at, certainly capitalising on the likes of Tim Peake's mission, has been getting the word out there that the space industry is accessible.

**Baroness Bonham-Carter of Yarnbury:** That is excellent.

**Dr Katie King:** To counter Josh, I would say I have had problems with skills and hiring. I would like to make a few points here. One is in terms of the education piece and preparing children for the future. The space industry that they enter in 10 or 20 years' time is going to be very different to now. I am a scientist, and I did not realise the benefits of microgravity until after I completed my master's degree during my PhD and I thought "Wow". If the seed had been planted in my head when I was younger, who knows what would have happened. It could be some simple things talking about the future of the space industry—not astronauts but the space industry, and the use cases of space—to children.

As the infrastructure changes, there is more opportunity for the applications of space and growing out different industries. Planting those seeds—what microgravity can be used for across all industries, for example—is a nice thing to speak about with children. Bearing in mind how the infrastructure is changing, we have re-entry vehicles; we will have commercial space stations. In the machinery that will bring about those applications, we need payload engineers but with a science mind. We are very much bridging space engineering and whatever the subject matter is—perhaps a life science expert. That is where I am struggling. I am getting some space engineers, but they are not diverse. I have been paying a lot of attention to my team's diversity and am struggling to have that as it should be, in my eyes. We need space engineers, but we also need to drag in life scientists to the space industry. It is not dragging, it is an exciting thing to do, but it about bringing them into an unfamiliar sector, so I am having some problems.

**Baroness Bonham-Carter of Yarnbury:** And diversity is about male/female as much as anything.

**Dr Katie King:** Yes.

**Baroness Stowell of Beeston:** I have a couple of things before I ask my question. First, it is great to have you and thanks for being here. On the point that Mr Western made about contracts, can I just clarify, were you talking about government contracts?



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**Joshua Western:** Yes. Explicitly, I am talking about where there are grant mechanisms available and changing them to contract mechanisms instead.

Q62 **Baroness Stowell of Beeston:** I just wanted to make sure I had understood. I will direct this question to you, Mr Western, but if others want to add, then that is fine. In the context of scaling up, one of the things we are interested to know is whether the space sector experiences the same phenomenon we see in the tech sector, which is that in order to scale firms find themselves either having to relocate—you have already touched on the encouragement that you have had to move—or being acquired by another player. Is that quite common now in the space sector as a route to scale?

**Joshua Western:** Broadly speaking, yes. There are lots of historical examples of companies that have invented something here, or people who have done a PhD and invented something, then moved abroad to scale that significantly. There is a gap in that homegrown companies and foreign companies that are encouraged to move here and invest are broadly treated the same. Because of that, there is a widening gap in why you would try to grow something here if you might have an easier time abroad and then bring it back into the UK via an investment mechanism. We are starting to see the right environment emerge from across government to support homegrown space scale-ups. That comes in part because cross-government has entered a new phase of coherence, and the UK Space Agency has really hit its stride with what it needs to do to support the companies. But to echo some points made earlier regarding the gap between funding cycles for programmes, three-year comprehensive spending reviews versus one-year cycles, invention and innovation do not happen in a financial year. It takes time; that is critical.

**Baroness Stowell of Beeston:** Dr King, for a business such as yours, which is a non-space business looking for partnerships with the larger pharmaceutical companies and what have you, are you already under pressure to be taken over by a pharma business? Are those pharma businesses usually overseas, for example, in America? Are we likely to see BioOrbit swallowed up by some big American pharma?

**Dr Katie King:** It is a good question. Space is not fully on the road map for pharma companies currently, because the opportunities are only just coming. That is where these partnerships are great because they do not need to build up the whole skillset within their company yet. We will see what happens; there is a chance that it could happen in the future. We have not had that yet. We are still quite early and have to develop out. One of the key things when I have had these conversations with pharma is a scepticism over the scalability. This is where the infrastructure comes in. It is there in the road map of the general space industry infrastructure, and the scale is possible, but there is a slight scepticism. Once that has been demonstrated over the next couple of years and they see we can use space in a scalable manner to hit these quantities, it will be a very interesting time. We might have some knocks on the door then.



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**Baroness Stowell of Beeston:** Dr Holmes, is there anything about being in the UK that would make you want to stay here?

**Dr Rory Holmes:** Absolutely. The UK is a great place to be. We have a good talent pool and the good inventions.

**Baroness Stowell of Beeston:** Is there anything we could do to make sure that we do not lose you?

**Dr Rory Holmes:** It comes to focus. We have to spend our space money from Government in specific focused areas. Government funding allows us to capitalise on crowding in private investment to grow and to scale. If we can pick which areas we want to focus on and make sure that they are properly funded, meaning that we can also bring in the private investment, that will help a lot of companies get over the scaling valley we currently see.

**The Chair:** You have all talked a lot about focus and government policies; Baroness Donaghy, do you want to pursue that?

Q63 **Baroness Donaghy:** You covered a little of this earlier on in the session, but what policies would you like to see the UK Government adopt to facilitate the growth of the space sector, and what is your experience with the UK Space Agency? Is there anything it could do more effectively to help your work?

**Dr Rory Holmes:** We are lucky that we have numerous programmes with the UK Space Agency. I have an incredibly positive view of the agency and the people we work with. It seems to have found the right balance between providing scrutiny and oversight for taxpayers' money while giving the freedom to move fast in developing technology. Under our programmes, we have moved really fast. The robotic arm you see over there is testament to that. I think incredibly highly of the way it approaches things.

On areas to improve, the UK Space Agency is just one part of the Government that is engaged in space. There is also DSIT, DBT, MoD, and UK Space Command. Having a more joined up and consistent strategy would help, particularly as a lot of our technologies now cross into dual use and the defence world. I see those conversations going on, and there is a move to join up and make sure that it is clearer for companies like ours. I commend that and hope it continues.

**Joshua Western:** The policy area we need to bring into the UK is the ability to license and regulate re-entry vehicles, which Dr King touched on as being urgently required. To be able to deliver pharmaceutical crystals and, indeed, semiconductors back home, we need the ability to re-enter them. The UK's Space Industry Act does not currently provide for the ability, effectively, to license re-entry vehicles in the UK. That work is being undertaken at some pace by the UK Space Agency and the Civil Aviation Authority. Right now, if I develop and build the platform in the UK, I take it to America for launch, and currently plan to be able to return



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to Portugal—because Portugal has existing laws that allow it to license re-entry vehicles. That then sets me up with a very interesting problem: space is currently treated like international waters. If I therefore make something in space and bring it back into the UK, am I charged import customs, duties and taxes, much like if I was docking at a port? That is something that we are having to negotiate right now, using the Freeport network to try to orchestrate how we get our semiconductors without that being too burdensome to us as a start-up.

I should probably add, as this is pertinent, that I used to work in the UK Space Agency. So, speaking as a former civil servant, it has my unending empathy for trying to operate in the continual changing of Government. Having seen it from the inside and worked with it externally as well, it is doing a fantastic job with the levers that it has available to it. I would certainly echo Dr Holmes on the ability to work cross-government to improve those levers.

Perhaps we could elevate the agency's status. I do not know what form that could take but right now, we are being outspent by a remarkable sum when compared to our nearest economies. France is spending about double nationally and with the European Space Agency compared to the UK space budget. Germany is about 50% higher; that is obviously still dwarfed by figures like those for American spending on space, as an example. The Ministry of Defence, the Department for Science, Innovation and Technology and the Department for Business and Trade have all demonstrated that space is a critical emerging economy for the UK, and we are being outspent. If we want to form a leadership position, we are going to have to increase spending.

**Dr Katie King:** I will add one point. This is really about the focus. The UK Space Agency has been brilliant and BioOrbit was really helped by being part of its accelerator programme in the early days. We had fantastic support on that. Some UK Space Agency grants are quite broad, so again, this is about focus. It is really important to be very specific about exactly what technology it wants to be invested in through the grant funding. Picking the key areas in which we want to be the winners and getting partnerships involved earlier on, before the grants even go out, will make it much easier and more streamlined for private capital to come in if partnerships are already being discussed.

In the case of pharma, it could be that we want to develop this capability and have some pharma partners already lined up; now we need to find the start-ups and the people to make it happen. It makes it much faster, and the projects can then move much more quickly. Currently, if you win a grant and you have to get co-funding, it is then on the start-up to find it through private capital, which can delay you by six or nine months before you even get started. As a start-up, you could die in that time so it is really critical to be as streamlined as possible, particularly for the early stages of a company.

Q64 **Lord Lansley:** Thank you very much for your very interesting remarks. I



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want to turn to the international partnerships that the UK has in space activities. You have all had some experience, presumably through the UK Space Agency in some cases, but maybe beyond. How do you feel we might best use our international partnerships or use them better in the future?

**Dr Rory Holmes:** I might answer this differently to the way you are expecting, if I may. I firmly believe that we can do much more as a country. We need a lot more ambition on what we can achieve nationally. There is always a time and a place for collaborating with the European Space Agency, for example, particularly on the very big, expensive science missions. But we are entering this new world of space where things are cheaper, and we can get to orbit quicker. Nationally, we need to increase our ambition and make sure that here in the UK we demonstrate our technology and capitalise on these emerging markets. I would really encourage us to think big nationally here in the UK.

**Lord Lansley:** We have heard exactly that view expressed previously, but is it not all part of a portfolio of activities? I wonder if perhaps Mr Western or Dr King want to say a bit more about where international partnerships fit in when you look at our overall portfolio of activities.

**Joshua Western:** It is worth saying that Space Forge already operates in the UK and the US. We are just about to establish an office inside the European Union as well. We have partners in Japan and Australia. So, alongside spending a lot of time in terminal 5, we are growing at significant pace internationally. Most of that work is driven from our UK HQ. A core strength that we do not really talk about enough in the UK is effectively the soft power that we have in building those international partnerships. ESA is a critical one: it has allowed us to maintain operations in a critical domain with Europe while existing outside the European Union, whereas we have effectively been barred from other programmes since our decision to leave.

While we should increase our ambition nationally, though, we need the technical capacity to be able to understand those ambitions as well. One current benefit of ESA is that we pull in technical knowledge from its 22 or so member states that we do not always have in the UK. So, alongside increasing our ambition, we need to increase our competence to understand what companies are pitching. I appreciate that what I am trying to do might sound like science fiction. I need a third party to vet me and establish the credibility of what I say, alongside any other capability or technology development that is brought through.

We need to move beyond technology development, which is a term we have all used here today. The technology development has to turn into actual capability and if we have that, those are the things that we can lead on from the UK, nationally or with our international partners.

**Dr Katie King:** My experience with ESA has been great. The investment into the European Space Agency has come through to provide us with





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flight opportunities. Should we go to a more national approach then, again, we need to provide that same level of support to start-ups and get flight opportunities directly from the UK Space Agency. Touching upon both points, we need to level up, in terms of having that technical ability within the UK Space Agency to pull the levers, and get those flight opportunities direct rather than via ESA.

**Lord Lansley:** In terms of bilateral partnerships, obviously the bulk of our international partnership money goes to the European Space Agency, but are there others—you mentioned Japan and queried India—with whom it would be ideal for us to work?

**Joshua Western:** Yes, internationally. Working with ESA makes a great deal of sense. It is our closest trading partners, geographically speaking. Speaking from my perspective, Japan is a wonderful partner. It has a phenomenal semiconductor industry and excellent space capability. Our ability to work with it on an international bilateral programme allows us to open up Asia as a market for our sorts of capability.

**The Chair:** I am going to have to suspend the session.

*Sitting suspended.*

**The Chair:** Welcome back to the public session with our three witnesses. Thank you so much for staying with us. I am going to move on to an issue of regulation and invite Lord Clement-Jones to ask his questions.

Q65 **Lord Clement-Jones:** Thank you for a very interesting session so far. To Katie and Joshua on the regulation point, you have already talked about the re-entry licence aspects. I want to follow up on other aspects of regulation—for instance, safety, IP and supply chain liability—and whether you feel that there are other areas of regulation to do with manufacturing in space that were desirable, but we will come back to that.

**The Chair:** Sorry, we did not have information that there would be a longer delay. With deep apologies, the business of the House must come first. I will now suspend the session again.

*Sitting suspended.*

**The Chair:** Welcome back. I am delighted that we still have our witnesses with us and that we will, I hope, be able to finish the session with them and move on to other witnesses who have kindly agreed to be here today. We were just thinking about regulation. Lord Clement-Jones, you have sort of posed your questions, but do you want to recap as the Bell was ringing at the time?

**Lord Clement-Jones:** We have talked about re-entry regulation and so on, but I wondered if there were other aspects of the space economy that you thought we should be regulating. Some areas that I suggested might be the question of IP for the design of things manufactured in



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space, safety and supply chain liability. These all relate to, in a sense, territory that is not covered by current legislation or regulation.

**Joshua Western:** I am happy to expand on the answer I was providing earlier regarding re-entry regulation. We have an extensive relationship with the Civil Aviation Authority. It is one of 12 regulatory bodies that we keep up to speed on what we are doing. We touched on the telecoms union and Ofcom. We work with the Ministry of Defence, the Military Aviation Authority, the coastguard, Natural Resources Wales and a whole bunch of others.

One of the UK's strengths is that we can engage with all those regulators. The number of them, providing their requests are not too onerous, is not a problem because we get continual engagement. That is not the case in other countries where they would be perceived to have better regulation. I do not necessarily agree with that. As an example, Space Forge has just been awarded the licence for our next mission, ForgeStar-1. That is the first time an in-space manufacturing licence has been granted in the UK and only the second time ever that one has been awarded globally. It is a real strength that the UK has been able to demonstrate something like that.

I am very cautious in answering this question because I have been in front of a Select Committee before and was asked what I thought about regulation. Since I provided evidence to that session back in March 2023, regulation has improved. The speed and the relationships have changed. The resources available to support the regulatory engagements of the UK have all been remarkable, positive shifts. However, re-entry is one of those areas that we are yet to grapple with from a policy and regulation perspective. There are going to be others. That is why I also touched on the likes of imports, customs and duties as that is going to be a very interesting problem to solve. Right now, I am the only company that has that problem in the UK. I am not a big enough fish to worry about that problem just yet, but I am starting to keep an eye on it.

**Lord Clement-Jones:** I will come to Katie in a minute, but Joshua, is the IP or the product liability involved in something that you manufacture in space something that concerns you? Where is that all going to head? Do you need an international regime, or if you get a licence from the UK to do something, do you feel that gives you the hinterland to have protection in these other areas?

**Joshua Western:** I need an international regime if everybody internationally subscribes to it. The ultimate challenge we have right now is that not every country agrees on the way that space should be operated. Most international regimes are therefore beginning to fall down where global superpowers start to disagree with the perceived international norms of operation. When it comes to IP specifically, it is not so much about the protection of the intellectual property but actually down to physical piracy. One of the things I have to be concerned about is the literal maritime theft of our products upon landing in the water.



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Something we grapple with as a company is the perceived cargo value and the strategic imperative edge that our technology can provide us here in the UK and our allies, versus what that could do for our adversaries should they be able to access it.

**Lord Clement-Jones:** I am with you. You have a bit of a barrier to entry because you are manufacturing up in space.

**Joshua Western:** Yes.

**Lord Clement-Jones:** So, know-how and IP and things like that are not quite as important because they have to emulate what you do in space, and they cannot do that.

**Joshua Western:** Exactly. We have first-mover advantage. We refer to it as an above-shore capability: we can provide security to the geographical domains of manufacturing and our supply chains by virtue of having been producing in space such that we can then re-enter, ideally right next door to our customers. I would like that, but it will take some time to get that accurate. If I could start to land in the geographies where our customers operate, I could improve the overall capability and capacity of the supply chain by virtue of having produced it in space, if that supply chain can be secured.

**Lord Clement-Jones:** That is a fantastic idea: delivering the product right there down to earth and straight to the customer. Katie, are they the same considerations for you?

**Dr Katie King:** Yes. We are bridging the pharmaceutical sector and the space sector. The pharmaceutical industry is highly regulated, so to produce products that can be used pharmaceutically, they have to go through a whole lot of regulation, including GMP: good manufacturing practice. All our processes and hardware have to be compliant with these practices, so that our products can then be injected into humans.

There is a process for that on earth, but how auditing and approval happens off-planet has not been written yet. Some conversations are beginning to happen, but the question is how we can ensure GMP compliance off-planet compared to coming and looking at factories and how it is done here on earth. There is a question mark over how we can make this happen, but it has to happen for this industry to be realised. As we use space for non-space applications, each of these non-space sectors will have its own regulation that may then affect the use of space that we have to think about.

In terms of pharmaceutical production, those GMP requirements will also affect the space infrastructure partners we work with, because they become part of the process and, therefore, part of the drug approval process as well. So, there are hurdles that we have to get through and a lot of conversations that have to happen before the end goal. We need to facilitate those conversations between the different regulatory spaces.



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**Lord Clement-Jones:** This will depend on the partner you are choosing in terms of manufacture, so it could be the FDA, the European Medicines Agency or the MHRA, and in each case, it will differ.

**Dr Katie King:** Yes. It would be brilliant to have one that spearheads it, as it is much easier for the others to then replicate and copy whatever that regulation space is. It could be a great benefit for the UK working with the MHRA to define what that regulation looks like for production, which would then make it easier for the other bodies to follow.

**Lord Clement-Jones:** Which regulator are you going to start with, do you think?

**Dr Katie King:** That is a very good question, but there is a question before that: which pharmaceutical partner will be first? Where it is working will then influence which jurisdiction.

**Lord Clement-Jones:** You are not quite there yet.

**Dr Katie King:** Not quite.

Q66 **Baroness Stowell of Beeston:** A quick question from me, which is through the lens of competition regulation. Is there a similar situation for the space sector as a lot of start-ups experience in the tech sector, which is that to get going they end up paying what they call rents to bigger firms in order to access customers, for example, app businesses on app stores. Are you at the mercy of any of the bigger players in terms of your access to market?

**Joshua Western:** Right now, we are at the mercy of access to space. Right now, we are really able to access only one operational space launch provider. We need other launch capabilities to come online if we are to diversify away from one provider because, right now, we effectively exist within a monopoly in the launch environment. For physical space businesses, we are in a position where we are very friendly with those providers, and they are very affordable. But we have realised, both as the UK and as Europe, that that is not going to be sufficient if we really want to grow this economy.

**Baroness Stowell of Beeston:** Thank you. We can talk to the next panel about that.

Q67 **Viscount Stansgate:** Mr Western, you said a moment ago that it would be nice if there was an agreed international regime for space— incidentally, we are not doing very well on earth either. This is probably a question for you, Dr Holmes, if I may suggest it. Are the efforts being made by the UK to shape the agenda on international space sustainability, such as ESSI, the Astra Carta or indeed UN resolutions that exist in this area, likely to be effective and helpful? Do you know of any efforts being made, for example, at the UN level, to try to make them more effective? Is there any light you can shed on this important area?



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**Dr Rory Holmes:** Yes, absolutely. As you mentioned, there are a number of initiatives led from the UK—ESSI and the Astra Carta—targeted at space sustainability. Those are hugely effective and give us a position of thought leadership in the UK on the topic of space sustainability. In parallel to that, we need our technology development to show that it is not just those initiatives; we need the capability to physically remove space debris and to perform these complex missions as well. We have that thought leadership, which is great, and now we need to follow up to make sure that our technology and the promise of what we can do matches that as a leader in the world.

**Viscount Stansgate:** The person that gets the space debris issue right will have a huge influence on the international regulation that makes it possible.

**Dr Rory Holmes:** Yes.

**Viscount Stansgate:** Unless anyone wants to add anything to that, and bearing in mind you have been here for a very long time, those are all my questions.

**The Chair:** You have been incredibly generous, Dr Rory Holmes, Dr Katie King, and Joshua Western. Thank you so much for being part of this evidence session. It has been incredibly rich and useful for us, and I hope, despite the interruptions that it has been, in some part, enjoyable for you, so thank you again for your time. Of course, if there is anything you might want to add, please let us know in writing. We would be really grateful to receive it. I am now going to suspend this session while we move to our other witnesses.