HOUSE OF COMMONS

Science and Technology Committee

Oral evidence: UK Space Strategy and UK Satellite Infrastructure, HC 98

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Watch the meeting

Members present: Greg Clark (Chair); Aaron Bell; Chris Clarkson; Dehenna Davison; Katherine Fletcher; Mark Logan; Rebecca Long Bailey; Carol Monaghan; Graham Stringer; Zarah Sultana.

Questions 48 - 148

Witnesses

I: Dan Hart, CEO, Virgin Orbit; Nicholas Smith, Regional Director for UK and Europe, Lockheed Martin Space; and Alan Thompson, Head of Government Affairs, Skyrora.

II: Melissa Thorpe, Head of Spaceport Cornwall; Scott Hammond, Deputy Chief Executive Officer, SaxaVord Spaceport; and Pete Guthrie, Senior Programme Manager, Space Hub Sutherland.

Examination of witnesses

Witnesses: Dan Hart, Nicholas Smith and Alan Thompson.

Chair: The Science and Technology Committee continues its inquiry into the UK's space strategy and satellite infrastructure. This morning, we are going to be considering launch, both the facilities and the companies that might make use of those facilities. Before we start, I want to ask Members if they have any interests to declare. Chris Clarkson has indicated that he does.

Chris Clarkson: Yes, thank you, Chair. As one of the witnesses is from Virgin Orbit, I want to declare that in my previous employment I worked for the Virgin Group, and, as far as I can tell, I only tangentially had some relationship to Virgin Orbit. I thought that, for the sake of propriety, I should put it on the record.

Q48 **Chair:** Thank you very much indeed. Perhaps in the same spirit, I should say that when I was Secretary of State for Business I announced the funding for the space facilities in Sutherland and in Cornwall.

We will now proceed to introduce our first set of witnesses. I am very pleased to welcome, first, from California, where it is the middle of the night, Dan Hart, who is the chief executive of Virgin Orbit. Mr Hart was previously 30 years at Boeing, where he was most recently vice-president of Government Satellite Systems. We are very grateful for you making the commitment to either stay up this late or get up this early to appear before the Committee. Thank you very much indeed.

Dan Hart: It is a pleasure to be here. Thank you.

Q49 **Chair:** Thank you. We have in the Committee Room with us: Nick Smith, who is regional director for the UK and Europe for Lockheed Martin Space, and prior to his employment with Lockheed Martin Mr Smith served for 16 years in the Royal Air Force; and Alan Thompson, the head of Government affairs for Skyrora. Thank you both for coming in person and Mr Hart for appearing.

Perhaps I may start with Mr Hart. Why is it important for the UK space sector to have launch facilities within our territory?

Dan Hart: If we think about space flight and a space programme, certainly, a launch is a key element. The ability to access space and to do it at will is, and will become, more and more important as space infrastructure becomes built out with the development of small satellites and the operation and maintenance activities associated with supporting them. This week, we saw a satellite destroyed in orbit. There is a need for resilience and a need for collaboration across the allies so that there is no way space can ever be denied, launch obviously being such a vital part of that.

Q50 **Chair:** Do you expect in the years to come that there will be lots of

spaceports in lots of countries, and that perhaps most countries with a space industry will have one or more, or do you expect there to be a smaller number around the world that will establish themselves as the principal port?

Dan Hart: I think it will be a bit of a hybrid. We are going to definitely move from the state where there are a handful of spaceports that are now becoming very congested and very busy. It will move to probably more regional hubs at first and then maybe more in the future. It is important in a couple of ways. One is to reduce the congestion. There is a national need. I mentioned the resilience aspect. Commercial satellite builders are growing across the world. There is a natural progression of more regional focus of a full hub space programme.

Q51 **Chair:** I have a similar question to Nick Smith. Lockheed Martin is a global company. How does it see the future of launch sites? Do you expect a proliferation, or will there be a relatively select number?

Nicholas Smith: I would reflect what Dan has said already. He has characterised it very well from our perspective. We are seeing a couple of demands. We are seeing a strong demand, for prosperity reasons, to have access to space because we understand the prosperity benefits and economic benefits that can come from having a strong, vibrant space industry. A lot of nations are thinking about how they support that growing sector.

Equally, there is a recognition by many nations that our current way of life and many of the social benefits that come from space are incredibly important. How do you make sure as a sovereign nation that you can secure that access to space? Both those things are coming out.

The reality is that there are only going to be certain nations that, quite frankly, will be able to put in place the infrastructure for some time to operate those spaceports. Dan has characterised it well. We expect to see a hybrid where you will see some spaceports that are focused on security and sovereignty and thinking about making sure that a nation can provide for its citizens both economically and for the social good, but also there will be some that are very interested in the economic benefit. We will see this growing hybrid thing.

The last time I saw Dan was in Grottaglie in Italy. We bumped into each other where they are looking at their spaceport. They characterised the same thing, speaking to representatives of the Italian Government. They reflected exactly the same needs as well. It was very similar to some of the conversations that we are having in the UK.

Q52 **Chair:** Thank you very much indeed. Mr Thompson, the same question, how do you see it? Perhaps you might say a bit about Skyrora and the company. It is perhaps less familiar to viewers than the two companies we heard from—Virgin and Lockheed Martin.

Alan Thompson: Certainly. Thank you very much. It is a pleasure to be here. Skyrora is a small launch vehicle manufacturer. We are based in the UK, and we are looking to be one of the launch hopefuls for the UK to be delivering satellites into orbit.

We have had a very interesting journey to where we are today. In answer to the question, Nick also hinted at it, but I would go further and say that the demand that we see for small satellites lies with the environmental agencies, the datasets that we are utilising as a country to manage the environment and the datasets that we require to do a better job. The environmental agencies are one of the largest demand creators for that data—the need and the opportunity to manufacture those satellites to create better datasets to better manage the environment.

The biggest thing that has been missing in the value chain in the UK to be able to do that is launch. Launch is one of the sectors that has been overlooked. We have an incredibly good satellite manufacturing opportunity. I would say that because we have not had launch, satellites and the manufacturers have been limited because we have to wait for at least two years for satellites once they have been manufactured to get into orbit. Then we have to wait until the satellite starts transmitting the data, and then start manipulating it and understanding what that means and the implementation thereof.

There is a gap. The launch industry is a huge value gap in that value chain, and, by addressing that gap, from a commercial point of view we have an enormous opportunity, I believe, and an uplift of that opportunity by bridging that gap, and by representing quite literally logistic service providers for satellites to get into orbit. I think that there will be a significant uplift once we start that activity at the end of next year, both in new satellite manufacturing companies coming up with new innovative ways to capture that data and a better articulation of what that demand for launch will be.

That is one of the biggest challenges that we are currently disagreeing or agreeing among ourselves—saying how many launches we need, having a better understanding of the value chain from the demand creators, the data demand that we have, and then reflected into the number of satellites that are already being manufactured, and then reflected into the actual logistic service, which is what we are talking about today.

Chair: Thank you very much indeed. Let us go into some more detail on those. As is evident to those in the Room, we have a great deal of interest in this, lots of members of the Committee and three expert witnesses. I will ask colleagues and witnesses to keep their questions and answers short. That would help us get through all of the areas we want to discuss.

Q53 **Rebecca Long Bailey:** Alan, you mentioned that launch is the value gap in the supply chain. How do the locations of UK spaceports benefit suppliers of launch vehicles and satellites?

Alan Thompson: The simple answer to the question is the proximity and the lead time it takes from a manufacturer to deliver to the launch site to be launched. From the point of view of the activity that we are focused on, which is vertical launch, we require a vertical inclination. We are firing from the north of Scotland over the polar icecaps, so the satellites will be orbiting the Earth north to south. In the first instance, the opportunity is basically to reduce the lead times for those satellite manufacturers to have the proximity to have it in this country, to avoid export controls and the issues of getting the satellites to the US, et cetera. It is a logistics thing.

Q54 **Rebecca Long Bailey:** Thank you. The same question to Nick: how do the locations of UK spaceports benefit suppliers of launch vehicles and satellites?

Chair: Mr Hart had his hand up, but we will come to him after Mr Smith.

Nicholas Smith: There are many levels. The strange thing about space is that you are really reliant on the terrestrial element you go for. From a spaceport perspective, you need somewhere that you can launch from, as Alan characterised it. One of the reasons for vertical spaceports being where they are is more to do with their geography so that you can get access into those orbits.

On the prosperity element, it is really important for those areas that we are looking to put these spaceports in—and I am talking about all the spaceports—that all of those will benefit greatly from having those spaceports, from direct employment and direct job creation. We are seeing that already. We are seeing real interest in those areas, which are looking for some kind of replacement industry because a lot of the areas are looking for what will be the next thing. We are already starting to see some of that benefit as well.

The reality is that the economic benefit from these spaceports, which Alan alluded to, will be felt across the UK because we are going to demonstrate that the UK is absolutely the place to come to do space business. We are already starting to see companies coming to the UK, many of them into Scotland for that proximity reason. We will see more of that happening. That is where we will see the real economic benefit and the social benefit that comes from having a vibrant space economy. We will see it across the UK building out from where the spaceports are and then building out. We will see that benefit across the UK.

Dan Hart: Nick just covered a part of what I was going to say. We are a bit agnostic as an air launch system in that we can release the rocket anywhere and go north or south. Being in Cornwall—an area where there is a huge opportunity and potential with the workforce and with the geography there—typically you see with launch space hubs industries that are related, that pop up and start to grow around the area. You see that in Cape Canaveral, Vandenberg, Kourou and other places. I would

expect to see the same thing, and benefit both to the industry and the area.

Q55 **Rebecca Long Bailey:** Thank you. There have been a few mentions of vertical and horizontal launch sites. Will each of you explain the advantages and disadvantages of each potential location and why you would choose one method over the other so that people at home understand the differences, please?

Alan Thompson: It is a long response to quite a short question. We are a vertical launch provider. The chosen version that we have of getting access to space, we believe, is one of the most efficient and safe. It is the example and the model that is practised in the US and quite obvious in its delivery already for US satellites.

On the spaceports themselves, a bit like what Mr Hart mentioned, Skyrora is also trying to be to a certain degree agnostic. We believe that we have a solution called the mobile launch complex, which is a spaceport in a box—quite literally in containers—and we can move this solution to virtually any location that we require. At the moment, the way it is set up is that, from a regulatory point of view, spaceports are part of the responsibilities to the liability chain—spaceports and then a range service provider—and this is the way that the regulator has chosen in the UK to deal with how we parcel up the liability in the regulatory context.

From our point of view, we are focused on the vertical spaceports. There are three of them in the north of Scotland: SaxaVord spaceport on Shetland with which we have a launch service agreement or an MOU; Sutherland, which is where our competitors, Orbex, are based; and Spaceport 1, which is the spaceport on the Outer Hebrides on the west coast of Scotland.

Why are these spaceports unique for us? It is giving us the northerly trajectory—the ability to fire over the north pole in as efficient a way as possible. In practical terms, the two spaceports that we have the closest relationship to are, first, at SaxaVord. There is unimpeded access to the north pole apart from other territorial waters—Norway, Iceland, et cetera—that we have to be aware of when we are firing. We have to undergo a slight dogleg manoeuvre to launch from the one in the Outer Hebrides.

In terms of ease of access, those are the two spaceports we are considering. As I mentioned already, our preference is for Shetland, partly because of the unimpeded access and the physical location, but there are other considerations that we are taking into account, such as the regulatory partners—we require the ability to prove to the regulator that we can do this in a safe manner. There are also on-the-ground services within the spaceport and in the range services—the area which we are going to fire into.

Those are the three spaceports that we are very much focused on. As I said, Sutherland is somewhat separate partly because we are looking to collaborate with them and progress the industry in a unified way, but because our competitors are based there we have allowed them to take the lead on that.

Chair: Before Rebecca continues, Katherine Fletcher has a question to clarify something you just said.

Q56 **Katherine Fletcher:** Thank you. My dad is an Alan, and you are a classic, proper Alan engineer. I have no shame in saying that you might be a level of detail below what I can follow. If you are doing a vertical take-off, how do you do a dogleg on that? Could you do the idiot Katherine's guide to vertical take-off? Horizontal take-off seems to imply to me it is not going up, which is not space. Would you mind helping me out?

Alan Thompson: Certainly. We have on the engines the ability to guide the vehicle. The dogleg is a slight manoeuvre to be able to get into space.

Katherine Fletcher: A vertical take-off is a rocket with a satellite on the edge of it that goes up—

Alan Thompson: Yes.

Q57 **Katherine Fletcher:** —and maybe wiggles a bit. What is a horizontal one?

Alan Thompson: Horizontal take-off is with an aircraft.

Katherine Fletcher: Right.

Alan Thompson: I am sure our colleague, Mr Hart, will say more about that.

Katherine Fletcher: Drop a payload off. Thank you very much.

Q58 **Rebecca Long Bailey:** Mr Hart, the same question to you. It follows in quite nicely.

Dan Hart: Certainly. I will first explain the system. We have a 747 airplane that used to fly from Heathrow to the US and has been modified to carry a rocket. A 70-feet rocket goes under its left wing. We take off from the airport. We climb to 35,000 feet and fly out to sea. Then we launch from the rocket. We drop it and the rocket then is autonomous and flies up to space with satellites in its fairing. We can position the airplane wherever it needs to be to get the right inclination—the right orbit—for those satellites.

There are three benefits to air launch. One is the economics of using the might of a 747 to get to 35,000 feet and the better part of Mach 1 in speed and most of the way through the atmosphere. It allows you to make a simpler rocket, so there is an economic benefit there.

Flexibility is the second. I just described part of it. We can drop the rocket off and go to any orbit that we need to, so it has benefit in orbits there. It also has benefits in resilience in that we can fly out and be unwarned. We can do a launch for military reasons and pop a satellite up without quite as much rigmarole as you need when you are stationed on the ground.

The other is environmental. Most ground-launch rockets are built and launched in wildlife areas because they need to be away from populated areas. The tradition is that if you go to old footage of Cape Canaveral you will see the birds flying up when the rocket flies. In the old days, it was a great vision of technology and nature. Today, we understand it as being damaging to nature in that there is a huge amount of smoke and soot and enormous acoustic energy that gets released when a rocket blasts off. We reuse a runway. We reuse a 747. We fly out away from populated areas and land, and then we let the rocket do its work when it is in the middle of nowhere. Those are three benefits and why we have pursued the technology.

Nicholas Smith: I will give a slightly agnostic view because we, as Lockheed Martin, are the closest to a customer that is going to be giving evidence today.

The reality is, as both Alan and Dan have said, there are pros and cons to each system. We are, for the Pathfinder launch out of Shetland and SaxaVord, partnered with ABL Space Systems, which is using a vertical launch system, but we, quite frankly, will go with any launch system that works for what we are trying to do. There are a number of advantages and disadvantages to each.

Dan has given a really good synopsis of some of the advantages of horizontal, but there are some limitations as well. For example, you need to design from the outset to understand the different forces that are going to be endured by the spacecraft through some of those things. You need to make sure that you design from the outset.

Sometimes, you will make a decision based on cost and which is the best option for you and which is your best orbital regime, but the reality is that what we have in the UK, because we are looking to do both horizontal and vertical, is that we are giving the most choice to the customer. That is the important point. There are going to be different customers and different satellite providers who will have slightly different needs, and the great thing is the UK can be one of those places where it can look to either a horizontal system or a vertical system depending on what its demands are. That is what we should be really excited about.

Q59 **Rebecca Long Bailey:** That is great. Finally, what challenges have you faced specifically when forming collaborations with spaceport management and satellite companies to develop launch the industry? Is there anything you would like to see the UK Government change or do to support further?

Nicholas Smith: It is a great question. Launch is a tough business. When you look through the history of launch, you can look through a number of companies that did not quite make it or a number of launch sites that did not quite make it. It is not straightforward. It is unfair to say the challenges you face are purely because of one thing or the other.

One thing we have found in developing the spaceport here in the UK is that we have had great support. There has been huge interest from all Departments, from all the different devolved Governments and from Westminster, who have been trying to support this. They see the benefit in it. We have been really fortunate there.

We have found within the spaceports a really strong community that is supportive of each other and trying to get some success here.

I do not think I could say that I have seen any specific challenges in our collaborations. I have found collaborations to be very easy. You would imagine that we are competitive in some ways. We will be, but the reality is that everyone recognises that, once you start launching as a nation, that is good for all of us, and we are all supportive of each other to try to get there.

On the greatest support that we are looking for longer term, one thing, as we think about the future of our space sector, that it is really important to understand—and Alan characterised it really well when he talked about logistics service providers—is that spaceports and launch service providers are infrastructure in the same way as airports or railways are, and they are a means to an end. They are a means to getting systems into space that will then drive some kind of benefit.

In order to attract customers to the UK and demonstrate that the UK is the right place to do this from, we need to generate confidence. We need to generate confidence globally that people want to come to the UK, they recognise that the UK is supportive of what they are trying to do and that things like the regulations and different levels of licensing will be conducive to that level of inward investment.

I am not aware—maybe Dan or Alan could correct me—of any spaceport anywhere in the world that does not have some level of direct or indirect ongoing Government support, either as a role as an anchor customer or maybe even more directly by providing things like range services or support to the spaceport itself, because, coming to the point about these being infrastructure, there is a recognition that it is important to support these systems for the long term so that they can be globally competitive. The reality is that we will be competing with spaceports that have quite substantial direct Government support. That is one thing I would look for.

Q60 **Rebecca Long Bailey:** Thank you, that is really helpful. Dan, the same question to you.

Dan Hart: Nick brings up some really good points there. Let me start by saying it has been a very good experience working with Cornwall Council and the spaceport at Newquay as well as working with the UK Space Agency and seeing the evolution of the space agency. It is gaining velocity, if I can go back into the business, in that it is now much more project oriented than I saw it being a couple of years ago—there are people who are used to getting things done and driving forward, and there are great conversations and great collaboration, as well as with the RAF. An RAF pilot, in fact, has been seconded to us and flew in our last mission where we put up satellites. We will be flying in just a handful of weeks on another mission. It has been a very good collaboration.

I totally agree with Nick on the regulatory framework. We are in the middle of getting our first licence. We are working well with the CAA. How that transpires will inform us on how easy it is to do a launch. There will probably be resources needed on the regulatory side as we, the three of us, ramp up our operations and get towards launch.

Finally, as Nick pointed out, it will not be that we just all of a sudden build some equipment and we have a burgeoning spaceport. Spaceports have always been a combination of commercial, civil and national security space in a Government and private framework that feed off each other and build. There will be needs.

One thing that I would recommend is that there be a lot of thought about how spaceports can drive STEM. Satellites being built at universities flying out of the UK is a great way to do that. Scientific satellites for environmental monitoring have already been mentioned, and, of course, military satellites. There will be a need to support the spaceports so that the market shifts and fully makes use of them.

Q61 **Graham Stringer:** Previous witnesses said that the spaceports planned for the United Kingdom would wash our face, would be commercially effective and make a profit. I understood you to say that there is no spaceport in the world that makes a profit—they all require subsidy. Is that your understanding of the proposals for this country?

Nicholas Smith: It depends on how you define where that boundary is. The reality is that these will be commercial spaceports with commercial launch operators, and that will be the way they will operate. We have to recognise the fact that they are going to have to compete globally. When you look at the global marketplace, they will be competing with companies that have some level of support. That can be through anchor customers. It could be through, as Dan alluded to, other broader Government initiatives.

There will be a demand—we are aware of it—for Government to launch satellites. One thing that we as a community here would say is if you want to launch a satellite do it from the UK. Do not go elsewhere if that is where you want to go. It is that kind of commitment that will help us to underpin the commercial framework that will be in place.

It depends on your definition. The reality is—and we have to be open about it—that it will be very hard to compete if there is not some level of support. One thing that we would all ask for is that level of anchor customer. Can the UK Government put in place strong national programmes that will provide a certain amount of anchor customer for these spaceports and these launch providers? It is not just spaceports; it is the whole of the sector. I would make the same call for the whole of the sector.

Q62 **Rebecca Long Bailey:** I put the same question to Alan. What collaborations have you formed across the UK launch industry? What problems have you faced? What do you want Government to do about it in policy and support?

Chair: I will ask witnesses to be brief because we have five colleagues who are keen to ask questions.

Alan Thompson: Thank you. The one thing that I would ask for, and have been asking for, particularly from Government, is the buy-in to the fact that we want to launch as a country. The previous question reflected the fact that the Government, a number of years ago, made up their mind that they wanted to do it but were not sure whether they wanted to do it. One thing that we have been lacking over the last four years, at least for the existence of Skyrora, is that absolute polarity, that clear, concise answer to the question, "If we are going to do it, what do Government need to do, how do they need to support the spaceports and how much?"

If that is clearly defined, there will be a clear engagement from private sources of finance to come in to help support it. Part of the problem that we have experienced as a company is that ambiguity at the level of Government and, to a certain degree, the fact that, to answer the question about collaboration, without collaboration we would not be here today. We need to work with the spaceports and we need to understand our integrated solution to be able to deal with that ambiguity that we have encountered at Government level.

That is why in 2012 the Federal Aviation Authority gave a copy of its regulations to HMG, and it has taken until now to get those regulations recreated. I believe that what we finally got in UK society with the CAA is a good basis for world-leading regulation for space flight based on our experience in health and safety, but it has taken a lot of time. Time is the one thing that we do not have, and we need Government to polarise, to be clear what that case is, why we are behind it, why we are backing it and how it needs to work.

Q63 **Katherine Fletcher:** Thank you, Chair. Gents, thanks very much for your time. It is fascinating. How far are we from getting this happening? I hear the questions that you are putting in. Dan, it sounds like you said it is already happening in trial.

Dan Hart: We are targeting to do our first launch out of Newquay in the middle of next year. We have proven our system. This year was an enormous year for us in that we flew into space twice. We have another mission coming up. We have a rocket that is designated to be the first rocket out of Cornwall that is in flow in the factory. We are working the licence. We have identified payloads, and we will announce that in the coming weeks. We are driving forward.

Q64 **Katherine Fletcher:** I will return, if that is okay. Alan, where are you in your journey to getting airborne?

Alan Thompson: We have a suborbital vehicle. As with Dan, we wanted to demonstrate that we could do it before finally doing it in the orbital vehicle. Suborbital means we are not going to deliver satellites into orbit, but we are demonstrating the capability.

We have a suborbital vehicle that has been ready to launch since May of last year, but because of the absence of regulations and the set-up we have not been able to secure permission to do that. This vehicle is currently in Iceland because we hoped that the Icelandic would be able to provide us with a non-objection to make that happen, but because of the weather, unfortunately, we are unable to make that happen until spring of next year. That will demonstrate our capability of space flight. By the end of next year, we have a prototype of our orbital go-to-market vehicle that will be ready to launch in quarter 4 of 2022.

Q65 **Katherine Fletcher:** Right. This is not Buck Rogers distance away for either of you, is it? I might ask a follow-up about the practicalities, if that is all right. I have just enjoyed two weeks in Glasgow with approximately 40,000 people. It strikes me that that is quite a payload to get into the air. I assume that it is a fossil-fuel-related payload that gets in there. Could you give us any idea of scale? Alan, I will come to you first and then to Dan. Do you have an idea of how many flights or how many carbon units it takes to put a satellite in? Do you have any plans to offset this?

Alan Thompson: I am sorry I do not have the number of absolute CO_2 emissions. We are utilising hydrogen peroxide. We are taking a British technology that was demonstrated 50 years ago and hydrogen peroxide, which is the oxidiser we are using, with a kerosene-based fuel as our propulsion system. We are using six parts of hydrogen peroxide to one part of kerosene, which means that, compared to liquid oxygen and the other propulsion systems that are used in the US, we are using less hydrocarbon. Therefore, per launch, we anticipate that we will be delivering up to 45% less CO_2 emissions.

The other point that we have focused on is that we have something that we are calling Ecosene, which is taking unrecyclable plastic from landfill and the oceans and turning it into rocket propellant grade 1, which is what we believe to be a useful environmental starting point at least to try to bring down on us the concept of environmental launch.

Q66 **Katherine Fletcher:** Understood. Thank you. Dan, may I ask the same question in terms of your carbon footprint of launch?

Dan Hart: Certainly. We have done some analysis. A launch to orbit is equivalent to two to three hours of 737 aircraft flight. It is a little bit more than perhaps a flight from Heathrow to Newquay and back.

The aircraft industry is looking at sustainable air fuel—certainly for a 747— and that will not be a huge leap. We are in conversations right there. Virgin Atlantic is one of the leaders. It is in the Virgin family and is being very helpful. We are looking at the rocket as well and sustainable fuel as a potential going forward.

Q67 **Katherine Fletcher:** Understood. That is really helpful. Dan, you alluded to this in your opening remarks. We have heard much about space debris, the ability for accidental collisions. This week, somebody shot at a satellite, and it is now in approximately 1,500 tennis-ball-size pieces times N number of smaller pieces. Does that affect this industry, not only the geopolitics but the practicalities of understanding this debris that you cannot launch into?

Dan Hart: The answer is "most certainly". When you do a space launch, one thing you do is you co-ordinate with, here in the US, the Space Force or the people who track debris to make sure that your satellite is not going to collide with it. You have periods where you do not launch because you want to make sure there are no collisions, whether it is a satellite, the space station or debris. Creating a mess in space can have a huge effect on this industry. It was very sad to see what was done this week.

Q68 **Katherine Fletcher:** Nick, is this an existential threat to your nascent industry, the fact that you do not know where the bits of rubbish are in orbit?

Nicholas Smith: It is absolutely a threat, and we recognise it as an industry. There are a number of reasons we see it. Dan has characterised it there. You do not want to start reducing access to space. There are risks about the spacecraft you put up there for your customers as well. It is very important that we understand this.

The other point I would make is that such is the recognition of the importance of this that we are seeing it in things like licensing requirements, where there is a requirement on all spacecraft operators to minimise the level of debris they put up there and think about their disposal plans for their spacecraft. We are seeing that come through.

The other thing that I think is really interesting—and I would say this across where we are seeing this both in the rocket technology and the spacecraft technology—is that the space industry is a high-tech industry. You find in high-tech industries there is a real recognition of the things like the environmental impact and the sustainability of those sectors. What I am seeing in the space sector right now is a drive to sustainable,

not only in the fuels they use but in sustainability of space as well. Quite frankly, what I have seen of the sector is that this is one of the sectors that will absolutely find a way of fixing that because it is driven that way.

We are seeing a retail demand. When you see a retail demand for it, that will also drive through in the solution. I am hopeful, but, you are right, it is a concern.

Q69 **Katherine Fletcher:** Alan, are we going to bump into something?

Alan Thompson: There is that risk, but the first risk that we need to identify is being able to measure exactly that space debris, what it means, what velocity, what speed it is travelling at and what that will mean in terms of collision or contagion.

One thing that Nick mentioned and I would like to share is that industry in the UK believes that we can do space better, and by doing that better we come up with a code of conduct about how we should be more responsible, as Nick mentioned, not just with regard to the environment but the utilisation of this environment up there in space. What are we doing about space debris? How can we not only begin to come up with solutions to this problem but demonstrate that as an industry we can come together with this code of conduct and lead by example as an industry? This is something that we are working on in the context of the industry with industry associations. We believe there is a challenge. We need to understand it better.

Katherine Fletcher: Understood. Gents, I will say thanks very much and let others go.

Q70 **Dehenna Davison:** Thank you very much. That was really fascinating. We have all been following the news about the satellite and the debris quite closely this week, particularly given we knew we were speaking to you guys today, so thanks for your insights on that.

I am curious about actual launch capabilities in the UK, particularly compared to other areas. We know at the moment that the European Space Agency is looking at launching larger satellites than is going to be done in the UK. Nick, where do you think the UK should place itself in the sector?

Nicholas Smith: From a launch perspective, what we have already seen from the companies that are coming here is that it is very much going to be focused on what we consider to be the micro and small launch communities. That is going to be thinking about the smaller satellites, possibly up to 300 kg to 400 kg, predominantly operating out of the low-Earth orbit. That is very much where it is going to be. Economically, it would not make sense to go any bigger than that, quite frankly. Most of the things that our customer base and the sector can provide will provide most of the benefits. That is what I would see. I will keep my answers short for the benefit of others.

Q71 **Dehenna Davison:** Alan, would you agree with that?

Alan Thompson: Yes, I would say that as a peer group New Zealand and Rocket Lab are a very similar small launch facility. The UK would do a great job in positioning itself alongside as a competitor or a supporter for what is happening in New Zealand, partly because of the satellites that are being manufactured here, which are all mostly focused on Earth observation data and of the size of 1 kg to 2 kg.

Q72 **Dehenna Davison:** Thanks, Alan. Dan, the same question to you.

Dan Hart: Yes, I completely agree. If you look at the sector of space, micro and small satellites is the fastest growing class of satellites by far that is changing the architecture of everything that is up there. Even though you might have Government agencies putting up some larger satellites, you are going to see disaggregation of many of those as well.

Q73 **Dehenna Davison:** To follow on from Katherine's stance of breaking things down into layman's terms, what different capabilities can you get from the satellites? What can you get from a smaller satellite versus a larger satellite? How will that impact the industry here in the UK?

Nicholas Smith: The reality is that what we are seeing with technology coming through in the satellite world, quite frankly, can do pretty much everything with the smaller satellite. All that really changes is things like how often they see bits of the world or whether they are over a similar point. There are differences with things like power you can get through. A larger satellite generally has the ability to do bigger power.

From a capability perspective, at the low-Earth orbit, we are seeing communications, we are seeing Earth observation, we are seeing climate monitoring and environmental monitoring. From a capability perspective, most will come into low-Earth orbit. You go up to different orbital regimes when you have a slightly different mission set. If you want to look specifically down on one part of the world for a long period of time, you will go up much higher and have a much bigger satellite.

Q74 **Dehenna Davison:** Dan and Alan, do you have anything to add to Nick's answer, or shall I move on?

Dan Hart: I think we will have a hybrid architecture up there. There is a need for large satellites. I do not want to leave you with the impression that everything will break down to the size of a toaster oven. Even the stodgiest communication companies are moving to hybrid architectures where there are some large satellites and many small satellites. That will be the norm.

Q75 **Dehenna Davison:** Thank you. Nick, I want to come to you specifically. Originally, you were planning to launch from Sutherland.

Nicholas Smith: Yes.

Q76 **Dehenna Davison:** You have now moved to Shetland, I understand. Can

you give us an explanation of why you decided to move locations?

Nicholas Smith: As I said before, these are complex capital programmes to build a spaceport. We were working with Sutherland alongside Orbex. The reality is that to try to satisfy both our different needs there was increasing risk in trying to put all those facilities in one place. We made a decision that the best way of maximising the chance for both of us to have the opportunity to launch we would make a move. We already had a strong relationship with SaxaVord up in Shetland because we have been looking at the opportunities for ground stations up there as well, so it was a natural move for us. If we move up to Shetland, it maximises the chances of both of us to launch as early as possible and also spread the economic benefit. The chance to work with the SaxaVord spaceport team was fantastic as well. I am delighted with the move.

Q77 **Dehenna Davison:** Are there restrictions on the number of launches as well? Did that come into play too?

Nicholas Smith: No, by the time we had made the decision, the conditions for Sutherland had not been announced yet, so we did not know that. That was not an impact.

Dehenna Davison: That is great. Thank you, chaps.

Chair: Thank you very much indeed, Dehenna. I think Zarah wanted to follow up some points on that set of questions.

Q78 **Zarah Sultana:** My questions will take a different direction, but I am happy to take this opportunity while I can, given time limitations.

I have a question about the UK's strategy. The goal is to capture 10% of the global economy by 2030 and by 2022 launch a rocket from Europe and be a leading provider of commercial small satellites in Europe by 2030. We are in 2021, nearly 2022. By 2030, are we realistically going to achieve those aims?

Alan Thompson: Yes. We can be more articulate about the aims that we can achieve. The industry—in particular, the small and medium-size enterprises that are beginning to grow such as ourselves and other companies with whom I mentioned we collaborate—can do more. We can sign up to a specific financial deliverable, which is the aspiration. While a strategy was good on the one hand, it did not give quite the detail and the polarity that I mentioned slightly earlier that we require. Industry is ready to be challenged and to go for a bigger deliverable, both in economic impact, as Nick mentioned, in jobs, and, in fact, environmental impact—trying to do our bit and contributing to the achievement of net zero and other CO_2 emissions reductions. There is more that can be done here, and the industry that we are collaborating with is desperately keen to be able to be part of that.

Q79 **Zarah Sultana:** Nick, you mentioned regional collaborations, and collaborations are quite easy. The European Space Agency and the EU

have Copernicus. I am probably pronouncing it wrong. I did not do classics like our Prime Minister, but there we go. Given Brexit, the UK Government and the European Governments have to work out how this participation will work. Does that concern you?

Nicholas Smith: I represent a US company, and therefore the ESA framework and the EU framework that we have been operating for some time does not affect us in the same way as others. I will be careful because I do not want to offer an opinion that may not be shared by others in the industry.

More broadly—taking both questions you have asked and pulling them into one answer—the UK has moved away from its goal of 10% of the global market. I am not convinced that is the right thing to do. I understand why it has done it. It is partly because it felt that it probably was not achievable. I would say that there are some structural limitations from my perspective in our industrial base in the UK. We have stovepipes of excellence. I do not think we have resilience in our industrial base here. I do not think we have the right level of diversity across primes, mediums and small companies because they need to coexist, and I think more can be done to try to have an impact in trying to create that diversity.

One of the reasons why we possibly do not have that diversity is that we have grown a sector very much through the European Space Agency and EU frameworks, which has been incredibly successful. Do not get me wrong. It has been a very strong benefit for the UK, and it needs to maintain, but the UK now has to think about, through its national space strategy, how it looks to put in place a strong, ambitious and robust national space programme where it can build bilateral relationships outside of that European construct and think about relationships with the US but also Japan and other emerging nations in the space area.

Q80 **Zarah Sultana:** We have talked about how geopolitics is a huge issue as space becomes more congested and contested and the space race accelerates. In previous centuries, the nuclear question was one that threatened civilisation. Do you think that the weaponisation of space is equally as threatening, and what can we do in terms of a legal framework to avoid any similar threats?

Dan Hart: There is certainly a threat that is building there. Comparing it to the nuclear threat that I grew up with, I am not sure I would say it is the same, but it nevertheless should not be in any way underestimated in that our society lives and functions using the space infrastructure and has huge potential to improve and live better using an improved space infrastructure. Having access to that is critical.

There needs to be disincentivisation of building and operating weapons in space. Part of the answer is making it a futile act in that my colleagues on the panel and ourselves are working on systems that will allow us to put up satellites very quickly and very easily. There are people building

satellites. We just talked a little while ago about the fact that small satellites can do almost anything, and they cost a fraction of what they did. There is an opportunity for us to make space easy and therefore not a great target to go after and spend money on.

That is part of the answer. We need to work together on norms of behaviour—we stay in our own areas, we co-ordinate well, we have space infrastructure and we understand where satellites are and what they are doing just like we have with aircraft and ships.

Alan Thompson: I would support what Dan just said. More of a tangibility, more of an understanding of what access to space means for society will help us better to understand how those threats appear and how we as industry can create critical mass and agreement across industry about the norms of behaviour or responsible behaviours—what that constitutes when we are up in space.

The biggest challenge at the moment is that there is no single regulator for space. How do we as an industry, taking our responsibility beyond Government, beyond the country into space, reflect what that means, what those values are and how we want to be able to propagate those values in a positive and useful way?

Q81 **Aaron Bell:** I have a couple of quick follow-ups as we are running short of time. Nick, it is a national space strategy, and you alluded in your answer to Zarah that there is a national interest in our developing this our way. How should the UK balance the supply of its launch capabilities between UK-based businesses and overseas businesses?

Nicholas Smith: Clearly, I represent a global business with a strong heritage in the UK. The reality is that the space sector is global by design. It is inherently global. We will see a number of companies that will have subsidiaries here and operate from here. From a UK perspective, it should be encouraging that. Where you see technologies for space grow up and rise up is a global thing. I am sure Alan can talk about some of their global footprint as well. The UK should be encouraging more global companies to come to the UK, invest in the UK and operate from the UK, because the reality is that there are very few large companies that are not global by design.

I do not think it is quite as simple as saying UK versus global. The space sector is inherently global. That said, when you have global companies operating here, they will work with the indigenous supply chain, as we do, and help that indigenous supply chain get access into new markets as well. That is where you get a symbiotic benefit between the two. I would encourage both.

Q82 **Aaron Bell:** Alan, what has your experience been as a UK smaller company?

Alan Thompson: It is somewhat reflected in some of the answers I have given already. As an SME, we are a four-year-old company. We have had

to break through a bit of the perception of space that exists around Government that has been very much propagated by primes, partly because space has been a Government priority or prerogative all the way round the world.

Coming into this as a commercial opportunity, we have been trying to deliver messages to engage in the actuality and the pragmatic reality of what this means. We believe that there is a huge opportunity—economic opportunity, economic transformation and delivering on new jobs for space manufacturing to be able to support the infrastructure that Nick mentioned for us to get regular access to space.

On the point that Nick mentions about the need for collaboration, there is incredible need for collaboration across the companies and the infrastructure that exist. We need to be intimate with almost everyone in the industry so that we can make it work properly, otherwise it will not work. That is the reflection and the point I made earlier about the polarity and the need for unequivocal support.

Q83 **Aaron Bell:** Once the industry is flourishing, as you said earlier, Nick, it is intended to work commercially but with the possibility of Government being an anchor customer. Should there be priority for British businesses to have launches from British sites?

Nicholas Smith: Yes, there should be priority for making sure that the British interests are launched from the UK. From that perspective, if there was an endeavour that was either being sponsored by or delivered out of the UK, I would like to see some level of incentive to make sure that that company launches from the UK, absolutely.

Q84 **Aaron Bell:** I have one final follow-up on the environmental point. Katherine covered the emissions and carbon footprint point. Dan earlier said that horizontal take-off had a much lesser impact on the physical environment. How do those of you who are still doing vertical take-offs minimise the impact on the physical environment?

Alan Thompson: We relatively recently asked this question to colleagues in the Secure World Foundation—part of the UN COPUOS meeting, the Committee on the Peaceful Uses of Outer Space—particularly in NASA, and challenged them on the point of CO_2 emissions of launch. The response was that at the moment, although not many people have measured it, CO_2 emissions of vertical launch vehicles are negligible and still pretty small. One of the stats I remember now was probably approximately 16 launches per year for us is equivalent to a one-way flight from the UK to New York. We are trying to take responsibility on this so that we can measure it better and demonstrate how we are improving it. At the moment, this is a work in progress from our point of view.

Q85 **Aaron Bell:** Are there impacts on the immediate physical surroundings, the wildlife and that kind of thing? Have you quantified them?

Alan Thompson: Absolutely. Part of our activity in preparation for launch implies engine test activity. We are measuring the sound. We are understanding how that affects the immediate flora and fauna around about us.

We have engaged with the spaceports in their planning permission application and their environmental impact assessments and all of the materials that we are utilising. In fact, we have also engaged with the Scottish Environment Protection Agency to put forward the case so that they better understand our activities and can start measuring it in a better way and have a clear baseline, and hopefully look to improve on that going forward.

Q86 **Aaron Bell:** I will give Nick a chance to answer.

Nicholas Smith: It is a great question to ask some of the spaceport operators in the next panel, the work that SaxaVord are doing and thinking about that.

I have a couple of quick points. This is not new. This has been happening around the world for many years. What is interesting is that some of the major spaceports around the world are in fact large nature conservation areas. When you think about a launch happening, it is a very small window of time when a launch happens, and the rest of the time the area is protected. What we are seeing is those areas that are spaceports become huge nature conservations. There is a lot of data that you can call on.

Q87 **Carol Monaghan:** Alan, you have been clear about the importance of collaboration, which you mentioned in your written evidence. You also talked about the regulatory environment and said it often stifles rather than supports industry. Could you say a wee bit more about that, please?

Alan Thompson: Certainly. We as a company took an incremental approach to launch. We wanted to demonstrate what small launch would mean and start with small vehicles and move through to large vehicles.

We started our launch activity in 2018. We had our first very small launch—a glorified firework—in the summer of 2018. We then set about trying to engage with the regulator to understand how we can launch our second vehicle, which is a two-stage, 4-metre long vehicle—quite a small thing. That process took rather a long time, partly because when we started there was a lack of clarity about who was going to be the regulator. It was between the UK Space Agency and the Civil Aviation Authority. One question that we are still dealing with is what happens above 100 km—what happens above the national sovereign airspace and before you get into orbit. This is a legal quandary that is still being deliberated by the UK and other countries because not many countries have experience of managing launch and their responsibilities and their liability above the notional 100 km, the concept of where space starts.

We have a convention called the Kármán line, which is 100 km. There is no legal or juridical basis for that; it is just a convention. There is a concept that above what happens in regular airspace there is an area of liability that the Government who are launching take on themselves but they do not understand the limit of that liability or what that means in the legal context.

This is a current challenge that we are faced with, and there are also the insurance aspects of how we secure an insurance policy to make that work.

Particularly on the regulatory front, we engaged at the beginning of 2019. We finally got permission for that small vehicle earlier on this year. I think the total process was 23 months. This was an attempt by our side to try to identify what a licensed process would look like. Playing by the rules at that stage was not enforced. While this was happening, the regulator was writing the rules, and the space flight regulation, as I think you are aware, came into force in August of this year. We spent a certain amount of time informing the formation of those regulations, both through practical activity and the need to demonstrate what launch means.

Q88 **Carol Monaghan:** Do you see with these new regulations that there will be a more streamlined process in getting launch licence? Twenty-three months is what you said just now.

Alan Thompson: Yes, there is a challenge on the timeline, but we are in a much better position now. As Dan mentioned, we are also in the process of our licence application for launch for next year. There is a reasonable period of time—the regulator mentioned between 18 and nine months—to be able to process that. The challenge that we have is that we are doing this for the first time. The regulator has not done this before, and it is a new set of regulations.

The position we were trying to take was to get permission to prove our activity against those regulations before they came into force. That was part of our focus. Unfortunately, we were not allowed to do that with our suborbital vehicle, and we were hoping that that might be a demonstration against those rules. That is why we have ended up in Iceland.

We are in a much better position now. The regulator is very much aligned to the activity. We are learning the process together in a collaborative way. I am sure Virgin Orbit is doing the same—the people who have submitted for licence applications. We are confident that the CAA, the regulator, is now in a much better, fully resourced position, and they also have support from other authorities in other countries. We are quite optimistic.

Q89 **Carol Monaghan:** It would probably be quite interesting for the Committee to follow up what differences companies are experiencing with

the new regulations and definitely with the interactions with the CAA. We will need to look at that.

Can I ask you about liability limits, because one of the big sticking points was the lack of liability, and now we have a notional liability of €60 million? First, is that appropriate when we are talking about the launch of smaller satellites? Nick, I will come to you as well on this. There is also a bit of ambiguity. It says that for missions that a regulator deems higher risk it may be set at a higher level. Can I have your thoughts on that, please?

Alan Thompson: Certainly. This was one of the points that we understood was fudged. I know that you raised it in the Chamber in the course of the Space Industry Act and when that was adopted. Yes, there was confusion around this partly because cap on liability was perceived to be state aid, and in the context of the European Union there was a challenge around that and how HMG was going to achieve that.

One of the points that Nick made earlier—I am sure he will come back to it, and you alluded to it—is the fact that if we reduce the limit of liability it makes it more attractive for companies to want to come here to launch. It makes it better. Small satellites—this could be a measure that we could be looking at.

Part of the challenge is that we have not really got our fingernails dirty on the concept of liability. It is one of these things that has been passed off. As far as we are concerned, we think that €60 million is a reasonable level because it is what is operating at the moment in Europe. The French and the European Space Agency are operating at that level at the moment. We believe that there is this ambiguity. I am sure you are aware that there is also a consultation that closes on 3 December, where industry will have its opportunity to feed back to Government again on the point of insurance. Part of the challenge that we require or we really think we need as an industry is to have that written into primary legislation—the €60 million—rather than just having it present in *Hansard* for satellite companies that need to understand it.

That is one thing that we are stickling on at the moment. Yes, we want to make this an attractive as possible launch state. Part of the challenge is that we need to get into practice and understanding what it means before we can better determine the levels and how that works in terms of the bigger launches or the discretion that could be applied depending on the insurance.

Q90 **Carol Monaghan:** Thank you. Nick, do you have any comments on that?

Nicholas Smith: To build on that, and coming back to the point I made earlier, it is about confidence. We need to make a statement across the globe as a nation that we are really interested in supporting it. I think €60 million, as Alan said, is comparable to other nations. It is a good place to be. One of the challenges we have is that, because it is not explicit, people look at it and say, "If I go through a licensing

application," at some point they are going to say, "Well, yours is higher risk." At that point, your plan for launching is undermined. In trying to bring customers here as a launch operator, it is that kind of definition that you need to generate the confidence to bring people to this country.

Q91 **Carol Monaghan:** Do you think that is properly understood by Government?

Nicholas Smith: I think it has been articulated in Government. To be fair, my understanding of where Government take this is that they are doing their best to be as flexible as possible with the regulations. They see a way of spearheading a new way of doing regulations, which is commendable, but there are always challenges. I think it is understood.

Do we have enough compelling evidence to argue that? That is the other challenge. We have to go through the process and possibly come back. We have the start of the legislation now. One thing we need to be alive to as we go through this is that we need to prepare to change it. We need to prepare to respond to the things we find to go through this. That is one thing I would say. We are going to be going through this together. That is one reason why we have grants. It is to work through this together under industrial research grants, to help each other out, work this licensing regime out and then learn from it.

Q92 **Carol Monaghan:** Nick, you have mentioned that the €60 million is comparable to other countries. How does the UK's framework compare with other countries in other aspects?

Nicholas Smith: I am no expert, so I have to be careful here. We are finding that, because the UK operates under the ALARP system, that means that there is not quite the same level of definition. You work with your regulator through the process and try to find the right answer. That offers flexibility, but flexibility comes at the cost of a level of confidence and certainty, which when you are trying to build business cases and reasons to launch can sometimes be a challenge. It could mean that it will set a new standard. I think that is what they are hoping for, but we have a period to go before we understand that that is the case.

Q93 **Carol Monaghan:** Two weeks ago, we took evidence, and I was asking about the national space strategy. Most of us were delighted to see something finally committed to paper. Some of the evidence we heard stated that it was a bit woolly and was a vision, but that it lacked steps and the detail that they would have liked to see. Is that your experience? Are you happy? What else would you like to see? I am happy to ask Alan.

Nicholas Smith: It is a great vision statement, but I would suggest that without an ambitious level of funding it is not a strategy. As an industry, we are calling for a clear definition of some national programmes, funded, that will help to deliver that.

Alan Thompson: I have three points: one, who owns it; two, how much does it cost; and, three, what does it deliver in terms of financials,

environmental return, jobs, and prosperity? These are the three points that we in industry have a great ambition to be able to help fashion and to input into, but those are the three things that we are lacking, particularly in that document.

Q94 **Carol Monaghan:** Finally, are you confident that we will see a UK launch in 2022?

Alan Thompson: Absolutely.

Nicholas Smith: Yes, I am confident.

Carol Monaghan: Thank you.

Q95 **Chair:** Perhaps the same question to Mr Hart on UK launch.

Dan Hart: At this point, everything looks pretty good for a launch in the middle of 2022. It is space launch, so there are always things that can happen. We have the regulatory activity going forward. We have hardware in the factory. We have a proven system. We have boots on the ground in Cornwall. We are looking forward to getting more of that and launching in the middle of next year.

Q96 **Chair:** Thank you. Mr Hart, do you have any perspective on the comparative regulatory regimes across different countries that Carol asked about?

Dan Hart: I would say that we are seeing them converging. There were larger differences and conversations, and we are seeing more close alignment. I agree with the comments that Alan and Nick made relative to having stability and confidence, the levels being reasonable and it being a potential advantage. At this point, there are some different techniques and definitions that we are having to work through. It requires us to redo documentation and things like that, which may be fine. We are cutting our teeth on our first launch. The next one will be hopefully easier.

Chair: Thank you very much indeed. That has been a fascinating and expert briefing for us from three prospective users of UK spaceports. We are very grateful to Alan Thompson and Nick Smith for coming to see us in person, and to Dan Hart for keeping the night watch to give evidence to us from California. Thank you very much indeed for that evidence.

Examination of witnesses

Witnesses: Melissa Thorpe, Scott Hammond and Pete Guthrie.

Q97 **Chair:** We are now going to move to our next panel of witnesses. Having heard from the prospective users of spaceports, we are now going to hear from the people in the companies that are building and proposing to operate these spaceports.

I am pleased to welcome—appearing virtually, I assume, from Cornwall—

Melissa Thorpe, who is the head of Spaceport Cornwall, and, joining us in person at the table, Scott Hammond, who is the deputy chief executive of SaxaVord Spaceport, which, as we have heard, is being developed in Shetland, and Peter Guthrie, who is the senior programme manager for the Space Hub Sutherland, which is one of the other vertical launch sites in the north of Scotland. Welcome to all three of you. Thank you for joining us today.

Given that all three of you as witnesses are in the business of making operational spaceports in the UK, how do you see your position in the future? Do you expect the UK to be competition with myriad sites internationally, or do you think the UK has particular advantages that is going to give it, if not a uniqueness, a certain advantage?

Pete Guthrie: From the UK's perspective—particularly where I come from in the north of Scotland—we have a particular benefit in the orbits that we can reach. We also have a benefit that we are building our industrial base here and our supply chain base here. Where that happens, you tend to find the companies become quite sticky. It is more difficult to go elsewhere. They do not really want to.

In addition, we have the burgeoning regulatory regime coming out of the CAA and the UKSA. As a result, the companies will become used to that. It will become a better trodden path as we move forward with that.

When we look at our competitors, potentially you are looking at the Azores, Andøya in Norway—they have just received £31 million of funding for their spaceport—and you are looking at things like Esrange in Sweden. We are very much at the beginning of this sector. We are at the beginning of this new space age for the UK. I am confident that the UK has a very significant part to play in the space industry going forward.

Q98 **Chair:** Thank you. Melissa Thorpe in Cornwall.

Melissa Thorpe: Thank you so much for having me. I will add to what Peter said.

For us here in Cornwall, we are trying to realise the opportunity of starting from scratch with spaceport developments. We can build in things like more responsible launch and cleaner and greener ways of launching into space. The regulations that are coming out of the CAA help with that as well. The UK has an opportunity to launch differently and to be a global leader in that. That is an opportunity for the UK.

We have a great satellite manufacturing supply chain here in the UK to create sovereign launch, capturing that marketplace rather than all these satellites being shipped overseas to launch. That is a huge opportunity. We are still going to be entering a global marketplace for launch where some of these countries have been doing it for 50 years. It will take a few years to settle, but there is an opportunity in that.

Q99 **Chair:** Thank you. Mr Hammond, when it comes to Shetland, what are

the particular advantages of Shetland compared with other parts of the world?

Scott Hammond: That is exactly the right point. This is a global industry that we are looking at and it is a very scientific industry—it is all to do with physics, maths and geography. We will compete against spaceports that have the benefits that we have up in Shetland. The likes of Cape Canaveral and French Guiana are close to the equator. They were launching to geostationary, and they wanted to launch east because that is the way the Earth spins and there is more spin at the equator.

We are going into polar orbit, so we do not want spin. The higher your latitude, the better. Quite clearly, in Scotland, we are at a far higher latitude than we are here in Westminster, and in Shetland even more so. We are closer to Norway than we are to Edinburgh. The high latitude immediately means that we can put more payload for less fuel into space.

Where a lot of people make a mistake about spaceports is they look at the very close area. You were talking about vertical launch. It is not vertical. It starts to bend very quickly because it has to parallel the Earth's surface. If it just kept going up, it would never go into orbit. It starts to curve very quickly. Our whole launch range goes up to Greenland and almost to the Arctic. You have to think in those contexts.

When you talk about the range, it is either where the rocket achieves orbit—for us, it will be just south of Greenland—or 5,000 nautical miles from the launch point, which for us is near Hawaii. Those are the sorts of scales you have to think in. You cannot think in these very small terms. We do not think we are competing with other vertical spaceports here in the UK. We are competing with the likes of Andøya in Norway because they have the advantage of that higher latitude and those direct launch trajectories. You do not want to be launching over population centres because it is inherently more dangerous than aviation. We do our risk analysis for a brand new rocket. In the States, they use one in 10 as a failure rate. Astra, an American rocket company, is zero for five at the moment. They have yet to get anything into orbit in five attempts. They have got close. They have one going up again this month.

Firefly's first flight was a failure. I think Virgin's first flight was a failure. You have to expect that there will be a failure. Where you are located has to be about safety. That has to be the primary reason for why you are there, and then there are the economics of where you are going to. That is where we see ourselves competing—very much on a global basis against the likes of Andøya.

Q100 **Graham Stringer:** Can I ask the three of you in turn what stage of development your spaceports are at, whether you will need any upfront public subsidy, and when you expect the first launch? I will start with Melissa.

Melissa Thorpe: As you heard earlier from Dan Hart, we are quite well advanced mainly because we are using an operational civilian airport. What we are doing that is quite unique down here is that we are integrating horizontal launch into our active civilian airport. This is not about creating something from scratch. We are upgrading an existing asset to be able to launch to space. It is a 747 with a rocket under its wing. We have handled 747s quite often, most recently at the G7.

All we are needing to do is just a few upgrades around the site itself. On top of that, we are developing a satellite integration facility, and that is to take advantage of the opportunity of using Virgin and launch as a catalyst to attract more businesses to the site. That is due to be complete early next year. We have submitted our spaceport licence, so as long as that comes along we are looking for spaceport readiness around April, and, as Dan said, we are looking to launch around July next year. We are quite well advanced with that. That is with the funding we already have, and that is made up of UK Space Agency funding, local Cornwall Council and funding as well from Virgin Orbit. It is a consortium public/private amount of funding for our spaceport.

Q101 **Graham Stringer:** How much is the public funding? How much cash are you getting from the public purse?

Melissa Thorpe: UK Space Agency funding in 2019 was about £7.3 million. On top of that, we had almost £12 million of Cornwall Council funding. Some of that was moved across to rescue the airport during the pandemic. Without the airport, we do not have a spaceport. Since then, we have been able to secure about £3 million of the remaining pot of European funding that was down here. We have altogether close to £17 million of public funding to upgrade our airport to a spaceport.

Q102 **Graham Stringer:** Thank you. Can I ask Scott the same questions?

Scott Hammond: This is where I disagree with Nick from Lockheed Martin. We are completely private. We have not a penny of public money in us. We have raised all our money here in London and from high-net-worth individuals around the world. We are completely private. We do not have a penny from the public purse.

Q103 **Graham Stringer:** When you say that, are you getting any infrastructure support from the public sector in terms of roads, drains and things?

Scott Hammond: No.

Graham Stringer: That is very clear, thank you.

Scott Hammond: Absolutely nothing.

Q104 **Chair:** Is that out of choice, or that you have not been allocated any?

Scott Hammond: I know where you were before. The great danger with Government, and particularly with spaceports—this is where I agree with Nick—is that Governments tend to put money as job creation into areas

that need jobs. I absolutely get that. That does not lead to sustainable business because it means that if you have a business plan that relies on a grant it is not a business plan. We would love to have Government money. Absolutely.

Q105 **Chair:** It is not the case that you would refuse. You do not have a model that you do not want to touch.

Scott Hammond: No, absolutely. We were quite late to the party. We started in 2017 after the sector report came out, which was written for the UK Space Agency and identified SaxaVord as the best location for vertical launch in the UK. We set up then. Because we were behind that, the UK decided they had given their money to Cornwall and Sutherland, so they were not going to give any money to Shetland.

Q106 **Graham Stringer:** Launch date?

Scott Hammond: We hopefully will get planning permission some time towards the end of this year, probably about mid-December. We will then start building straightaway. We have all our plans in place. We intend to do a suborbital launch in April for ourselves as training. This alludes back to something both Alan and Nick spoke about in that this is the very first time we are doing this. We need to exercise this whole thing. The regulations thus far have not allowed us to do that. We are building our own very small rocket to exercise the whole process, and that will include the regulators, council, public bodies, marine coastguard, et cetera. We are then looking to do the pathfinder launch in September of next year.

The infrastructure is quite simple. It is a concrete pad with a shed, effectively. The complicated bit is airspace, international agreements, regulation, safety analysis, et cetera. That is the complicated bit, and that is what takes up a lot of the time. Building a concrete pad is relatively simple.

Q107 **Graham Stringer:** The same questions to Peter.

Pete Guthrie: I will explain the context a little bit because you have a good range of spaceports here in front of you today. I represent Highlands and Islands Enterprise, and we are the Scottish Government's community and economic development agency for the north and west of Scotland. We are not terribly interested in spaceports for their own sake. We are interested in spaceports because they create jobs and prosperity in places where it is otherwise difficult to do so. In that context, when we put in for the 2018 UKSA funding announced by a very wise Greg Clark at the Farnborough International Airshow in 2018, we had been working through that framework and we were trying to get planning permission. That was one of the key things we did and have done that the others have not quite yet, although no doubt will imminently do so.

The process of designing a spaceport is a complex one. As others have already said, spaceports tend to be built where there is not that many people. Where there is not that many people, nature tends to thrive. On

that basis, you have to be very careful working with the regulators, and we have a very good relationship with Scottish Natural Heritage and with the Scottish Environment Protection Agency, so much so that they did not object to our planning consent, which we gained in August last year.

In terms of timescales, you do not just get planning permission and then be able to put a spade in the ground immediately. You will always have planning conditions that you have to sanitise first. That is one thing we have been doing since last year. You have to do ongoing environmental studies, and so on.

It is quite a difficult project because the first thing you are doing is creating the prototype, but it is also the final product, so you have to spend some time to get it right. In our case, we have had planning permission. We will soon sanitise our planning conditions. We think we will put a spade in the ground early next year. That will take about a year to 18 months to get launch. Space is awash with people who are very confident in timelines, and then the timelines have a habit of slipping. Indeed, the Americans have a phrase for it—Elon time, talking about Elon Musk. They say they will launch very quickly and then do not. We are confident in our timescale. First launch is the not the most important thing. Having a sustainable business is the most important thing, and that is what we are aiming for.

Q108 **Graham Stringer:** What are the consequences of the decision by Lockheed Martin to move operations to SaxaVord spaceport? What are the consequences for Space Hub Sutherland?

Pete Guthrie: As Highlands and Islands Enterprise, we are interested in producing jobs and prosperity. We see Space Hub Sutherland as a key way of doing that. We think that will create 40 jobs locally and 400 in the wider region. We have undertaken economic analysis that highlights a very significant opportunity for Scotland and for the UK.

In terms of the move, there was not any animosity. We remained friends throughout. In some ways, it is great, because it has spread the economic opportunity to Shetland. We have an excellent relationship with our launch service provider, which is a British company called Orbex, and they are based out of Forres in Moray. We are confident that they will be launching from our spaceport. In some ways it was a win-win.

Q109 **Graham Stringer:** Thanks. Scott and Melissa, what are you doing to ensure that the satellite launch is as environmentally friendly and as sustainable as possible?

Melissa Thorpe: We are all excited about this topic because it is a hot one at the moment. We went through quite a long journey back in 2019 when we were going through the local council fundraising process, investment-raising process, to get the spaceport over the line. It was at the exact same time that the council declared the climate emergency. At the time, we were quite naive in not realising that a lot of people did not

understand the importance of satellites in space to our everyday lives here on Earth and how space can benefit us on Earth and make heavy polluting industries more efficient and provide us with the data that we need to combat climate change.

The issue comes with a bit of irony in the fact that these satellites and space technologies are brilliant but in the past the way they get to space has been quite impactful. There is a lack of transparency around the world and around spaceport sites historically in trying to find out what the impact is on the local environment and local communities because sustainability is not just about environment, it is about our communities.

For us, it was a good process to go through because it woke us up to this quite early on. We have done a lot of hard work about our launch activities in, first, providing our transparent carbon impact assessment. That is on our website—even before we have launched. It is a lot of what Virgin's impacts will be as well as our activities at the spaceport itself.

That is the starting point. We need a transparent look at what our impact will be.

We can then set about looking at not just mitigating and offsetting, which we will be doing, but using our new centre for space technologies and the facilities at the airport to attract R&D, academia and SMEs to research things like biofuels that Dan mentioned, reusability of the rocket, more sustainable ways of integrating satellites and the satellite materials themselves. We are theming our whole facility around environmental intelligence and sustainable uses of space.

Finally, as a spaceport, we are a gateway to space. We are a port. There is a responsibility going forward for spaceports to consider what we are putting into space, how we are putting it there and what it is going on to do to be part of the solution and not part of the problem.

We will be releasing our sustainability impact report in January this year, which will also include an ethical framework of how Spaceport Cornwall and Cornwall Council—as well as, hopefully, the UK Space Agency and the UK as a whole—will be moving forward with this. As I said in my opening, there is an opportunity here because no other country right now in the world is really looking hard at this. Throughout the spaceports in the UK, we are all taking this so seriously and working together to make the UK the best place to look at sustainability and launching more responsibly.

Scott Hammond: There are two aspects of sustainability. There is economic sustainability, because you do not want to build something and then have a white elephant. We have three pads. We will have three integration hangars. We will have a whole number of different clients with different capabilities. That is really important to make sure that the business is a sustainable business.

When you come on to environmental sustainability, we do not control rockets but we need to look at the impact of where we are launching from and our supply chain. Take airspace as an example. We will have an airspace change, which will mean that aircraft have to go round that area. That creates more CO_2. It is part of CAP1616, the process for that airspace change. Where we are, because it is very quiet airspace, that will have a very limited impact on that extra CO_2 caused by aircraft having to divert.

You then start to look at where we are actually building. If you have ever come up to Unst, it is granite. It has a little bit of soil and it is straight on to granite. We do not have the peat issue. We are then working with one of the local firms called Pure Energy, which is a big leader in hydrogen power. It makes hydrogen power out of green energy. Currently, it uses wind turbines and water. The by-product of that—the waste product—is oxygen. We need liquid oxygen to launch the rocket, so we are working with them to start to think about how we can create both the hydrogen power and the liquid oxygen on the island. Then that reduces the CO_2 impact of bringing stuff to the spaceport. That is where we have to work—where our wider impact is rather than the actual technology of the rocket.

Q110 **Graham Stringer:** Can you tell us about your experience of dealing with the people who manufacture satellites and the launch vehicles? I know Lockheed Martin is not a UK company, but is it possible to show preference for local manufacturers in the UK?

Scott Hammond: Our clients are not really the satellites. Although we have ground stations and we are already bringing data down from satellites in orbit, our clients are clearly the launch manufacturers, the rocket manufacturers. Because we are looking at these breadth of capabilities, we want the capability of a small launch down at 150 kg, which I think is where Orbex is, all the way up to ABL 1,200 kg to get that whole breadth of capabilities within what we are doing. I have rather lost the train of thought. What was the question?

Q111 **Graham Stringer:** I was asking for your experience with the manufacturers and whether it is possible to show preference for UK manufacturers.

Scott Hammond: We are working with Skyrora, a UK manufacturer, and ABL, an American manufacturer. In addition, we are talking with HyImpulse, a German manufacturer. They have done some engine tests already with us. There are two other German manufacturers, Rocket Factory Augsberg being one of them, which also comes to us. We are talking to C6, a Canadian launch company. We talked to Polish launch companies, French launch companies and some Israeli launch companies. There is a great deal of excitement out there in the wider industry, and they are all looking to find somewhere to launch from. That I think is the real choke point; there will be a limited number of places to launch from.

Q112 **Graham Stringer:** Thank you. Melissa, the same question.

Melissa Thorpe: We are really interested in launch operators with Virgin Orbit, but they are our anchor tenant. We want to be a multiuser spaceport, so we are in discussions with many other horizontal launch operators. We announced an MOU with Sierra Space based in the US. It is not to say that we are not working with UK-based companies. We had Skyrora do their engine testing with us a few summers ago.

For us, the missing piece of the puzzle in Cornwall at the moment is satellite manufacturing. There are clusters around the UK that do that, but that is something we want to attract down to Cornwall as well so that we have that whole end-to-end ecosystem. We are lucky that we have that industry already in the UK. With our facilities using launch as a catalyst and as a magnet to attract further companies down to our new centre for space technologies, we have announced NewOrbit already to come, and we will be announcing other ones over the next few months as well. We are hoping to put that last piece of the puzzle in place down here in Cornwall to attract a UK base of satellite manufacturers to our sites so that we are right alongside the integration facility and the launch as well. It is really important for us to create that entire ecosystem. It is something that was talked about earlier, that space hub that is developing, and it is happening a lot quicker than we were expecting it to.

Graham Stringer: Thank you.

Chair: Thank you very much indeed, Graham. Before I come to Zarah and then Carol, we have a couple of supplementaries on what we have just heard from Aaron and then Katherine.

Q113 **Aaron Bell:** Thank you, Chair, and thank you all for your time. At the risk of setting witnesses against each other, I was struck by what Scott said about the business case and if you need a grant you do not have a business case. I am not quite as purist about that. There is a case for investment in the first place. Could both Peter and Melissa set out how much investment they have had so far, what other public sector support they have had, and, crucially, whether they anticipate requiring ongoing public sector support in the future?

Pete Guthrie: We are the public sector.

Aaron Bell: Yes.

Pete Guthrie: In essence, all of it so far. We have spent about £5 million developing the spaceport at this point. We expect the overall project to cost us in excess of £17 million. About £2.5 million of that comes from the UK Government through the UK Space Agency. We are also in advanced discussions with the Nuclear Decommissioning Authority for a £5 million grant. The reason for that is that in Caithness we have the Dounreay nuclear facility, which is set to enter its interim state in the 2030s. There will be a reduction in the number of staff at that site, but it

corresponds well with an increase in staff working at Space Hub Sutherland, so it is a natural fit between us. In addition, Highlands and Islands Enterprise, which I look after, has committed just below £10 million towards the space hub.

In terms of ongoing subsidy, absolutely not. It is a project that we are confident will wash its face. Indeed, we undertook market research, which concluded in March of this year, that highlighted that the UK was very well positioned to access the growing market, and it will send almost 4,000 small satellites into orbit between now and 2031. That activity has the potential to generate spaceport revenue services of around £4.2 billion in launch revenues between now and 2031. This is very much the start of this industry, not the end of it.

Q114 **Aaron Bell:** You say, "wash its face". Is there a prospect potentially of a dividend back from ongoing operations, and, if so, where would that go? Would that stay within the highlands and islands, or would it go back to the Government?

Pete Guthrie: The way the grant is structured, it is to de-risk it a bit. No one has done this before. No one has done this for this model. As other contributors have highlighted, everywhere else in the world the Government either directly or indirectly support spaceports either by giving a pipeline of launches or they support it directly with revenue funding. We are confident. We have done work with accountancy firms like RSM and EY to look at the business plan, and we are confident that it will be sustainable. That is why we have supported it as a Government agency.

Q115 **Aaron Bell:** Thank you. Melissa, the same question to you about Cornwall.

Melissa Thorpe: We received just over £7 million from the UK Space Agency. That is more towards Virgin Orbit to bring their system over to the UK as well as create the capability here in the UK. Virgin Orbit come with something called the transportable ground operating system, which is the series of lorries that support their launches all around the world. We are going to have that based here in the UK. That has been procured to a UK company, AVS, to create that capability. It is about building that launch capability here in the UK. That is where most of the UK Space Agency grant funding went to.

On top of that, we now have about £5.6 million of council investment. That is prudential borrowing, and there is an expectation that there will be a return to that. We are expecting to be revenue generating by year 5 of operations at Spaceport Cornwall, and those revenues will go back into Cornwall Council.

It is important to keep in mind with our spaceport that we are only part of the overall business plan of the airport's activities. That £5.6 million that came from Cornwall Council went to upgrading their own asset. They

own the airport. It is not just to benefit the spaceport. A lot of the activities and infrastructure that has been put in is to benefit all the other occupiers of the airport as well. A lot of that had been used during G7.

On top of that, the additional money that we have now received from the European Union was for our satellite integration facility and our centre for space technologies. That is to benefit beyond our launch operators but other SMEs and academia and for R&D and knowledge spillover from the adjacent facilities to launch. It is to take advantage of having launch on their doorstep and access to the equipment and facilities that they probably would not be able to access alone. It is a bit of a mishmash of funding for what we are doing, and it all has different outputs, but the definite goal for us is revenue generation back into Cornwall Council.

Q116 **Aaron Bell:** And then profitability.

Melissa Thorpe: Sorry?

Q117 **Aaron Bell:** And then profitability, not just washing its face. You expect it to be profitable in the long term.

Melissa Thorpe: Exactly. It is to support the wider business of the airport.

Aaron Bell: Thank you. That is very clear. I am pleased we have a variety of approaches because that is also a good thing.

Chair: Thank you very much, Aaron. Katherine has a supplementary, and then we will go to Zarah Sultana.

Q118 **Katherine Fletcher:** Thank you. Scott and Melissa, I was very struck by your description of the parabola of a vertical take-off launch. I have just quickly googled the southern hemisphere. It is very easy to assume that a UK company is concomitant with the UK geography—on the day we have announced a trade and export programme. Could you talk to me about whether the Falklands are closer to the south pole than Shetland is to the north pole? Is that too remote? Can we be doing the same thing in a different direction? Scott, you are vertical take-off, so I will start with you first.

Scott Hammond: I do not know the exact latitude of the Falkland Islands, I have to admit. There are big advantages in the southern hemisphere because there are not land masses and therefore we do not have population centres. That is one of the big advantages for Rocket Lab in New Zealand, although its latitude is not quite as high as ours. Having never been to the Falklands and not knowing how you would get stuff there, that could be a challenge. I do not know. We certainly are looking to put in a ground station down there to talk to the satellites because the higher the latitude the more often you talk to these satellites as they go around the globe.

The issue for us is getting the data out because it does not have any fibreoptic cables. It is that sort of connectivity as well. You need a certain

amount of infrastructure on top of your location. Ultimately, if you went with a latitude taken to the extreme, you would launch from one of the poles, would you not?

Q119 **Katherine Fletcher:** I might come back to that, but I have a second quick one. Melissa, is there anything in the southern hemisphere that you are investigating from a UK company base?

Melissa Thorpe: We are interested in using existing airports because of the ability to upgrade them to be able to offer horizontal launch. I know Australia, for instance, is looking at developing its own horizontal launch down there.

Virgin Orbit operate as a mobile launch operator, so they will be going round to a network of space ports around the world to launch from to take advantage of the customer base. Rather than the satellite customers coming to them, they come to the customer base of the satellites.

It is really important to remind ourselves why we are doing this, why the UK is doing it. It is to launch satellites that are in the UK or in Europe from the UK, so they are not being shipped all over the world to launch. The aim will be to capture that here in the UK. The reason I get up every morning is that launch inspires. For us, especially down in Cornwall—and I know up in Scotland it is the same for Scott—there are huge benefits for schoolchildren and anybody to be able to come and see a launch happen on their doorstep and have access to that. You lose that by putting it somewhere very remote.

I do not even think we have scratched the surface of what this is going to do for the young people in some of the remote parts of the UK to be able to have this on their doorstep and what inspiration and aspiration can do to potentially attract more children into STEM careers.

Q120 **Katherine Fletcher:** You are almost articulating an emotional agglomeration effect. Scott, does the weather affect it, because Shetland is not known for being bikini weather all year round?

Scott Hammond: I did not get a suntan up there, if that is what you are asking. It does affect it. The very first thing we did was to get 10 years' worth of weather data. We have a weather station on the island. We got the weather data. We allowed all of our potential launch clients to look at that. It is in a spreadsheet. They can put in all their launch requirements against weather. We also shared it with NASA and Cape Canaveral. They compared it to Cape Canaveral, and our launch windows are very similar to Cape Canaveral.

Katherine Fletcher: Wonderful news.

Scott Hammond: For us, it is wind. For them, it is static in the air.

Katherine Fletcher: Cool. Thank you very much, Chair.

Q121 **Zarah Sultana:** Melissa, you mentioned the sustainability report that is due out next year. Are there plans for the spaceport to achieve net zero in its carbon emissions in the long term?

Melissa Thorpe: Yes, absolutely. When we went through the council process, the council members made it very clear that they want this to be the most sustainable space programme in the world. What that means is something that we are working on because defining what a sustainable spaceport is when it has probably never really been done before is an interesting feat, but we are committed to that. That is net zero by 2030.

Because we are an active airport and because we are not really developing too much alongside what is already happening there, we have our carbon impact assessment that we did a few years ago and at the moment—at the height of all of our launch activities—we have put a self-restriction of 12 launches a year here in Cornwall. At the height of that, we are looking at about a 0.4% to 0.1% addition to Cornwall's emissions, which is low but it is still an emission, and that is what we want to change. We want to bring that right down.

That is a more strategic question to the airport operations itself. For instance, training goes on daily at the airport. If we are interested in one launch, we are looking at balancing that alongside all the benefits that it brings. We are working towards net zero, and our sustainability impact report and action plan will outline exactly how we are going to do that.

We are engaging with our community down here. We are setting up a steering group with a group of critical friends, as I call them—all the local charities and environmental groups—to help us get to that point because we are not experts on it ourselves. We are experts in launching to space. For us, it is really important that we engage with our local stakeholders on how we are going to do this together.

Q122 **Zarah Sultana:** Peter, you mentioned challenges within the planning system to make sure the land and the environment are considered whenever establishing a spaceport. Can you see more spaceports being established as seaborne-launching vessels, as we have on the coast of Wales with Black Arrow Space Technologies?

Pete Guthrie: Possibly. If you look at Space Hub Sutherland, why is our launch partner based in Moray? The answer is: for a number of reasons. It is an aerospace town. It is quite easy to get to Space Hub Sutherland. They can do that with a small truck because the launch vehicles are not particularly big.

Sea launch comes with a number of logistical issues. The Germans are looking at it at the moment, for example, because they do not have any particularly suitable launch sites. We in the north of Scotland are very blessed that we have several launch sites that we can do that with.

On your first question, Space Hub Sutherland will be the world's greenest spaceport, which I know is a big claim, but we have the science to back

that up. There are a number of reasons for that. The launch site itself is quite small physically. It is only a little over 10 acres. We are going to maximise our number of launches at 12 launches per year. The rocket that Orbex is making for us is only 90 metres tall and it is very light. Crucially, it burns biopropane and liquid oxygen, which produces very little soot. The jettisoned sections of the Prime vehicle will also be recovered.

We are also building our spaceport on deep peat. The peat bog is not pristine by any means, which is one of the reasons that we are allowed to build it there. During construction, any peat that we dig out, we are going to be restoring the peat bog to its former glory.

It is worth saying as well that the land we are building Space Hub Sutherland on is community owned. It is owned by a group called Melness Crofters' Estate. They see themselves very much as the multigenerational, community-owned stewards of the land, and we are working with them very much to restore the peat bog that has been damaged over many generations. The chairperson, a force of nature and a force for nature, Dorothy Pritchard from Melness Crofters' Estate, presented recently at COP26 to great acclaim because they share our vision that economic and environmental benefits can go hand in hand and can be pursued simultaneously.

In addition to that, the satellites launched from Sutherland will play a vital role in Earth observation and contribute to our understanding of climate change.

When I have spoken to those other questions earlier about our relationship with customers, when I have spoken to satellite manufacturers, I have essentially said, "What do you want out of the spaceport when you come here?" They were very clear that rather than going to Kazakhstan or the US, because they have to send a whole big team over there to do that, how much better would that be to have Scottish-built satellites being launched from Scotland where they only have to just pop up the road to launch that? It is a very exciting time.

Q123 **Zarah Sultana:** You mentioned the benefits of job creation and prosperity. How closely have you been working with trade unions in Scotland, working together around jobs working conditions and so forth?

Pete Guthrie: Absolutely. One of the great things that we like about space is that it is highly paid. It is not always that easy to create highly paid employment in rural areas of the north of Scotland. Our starting point with this was to work with the Dounreay trade union, which is the local nuclear facility that is being decommissioned. They wrote a very generous letter of support to our planning application. They have been working with us very closely. We see it as a fantastic opportunity to create those sorts of high-value jobs, not just living wage but well above the living wage.

If you were to go on to Orbex's website today, you would see scores of vacancies being advertised for things like propulsion engineers, IT engineers, hydraulics and all sorts of things that are very highly paid positions. That is why we as the Scottish Government's economic development agency are very keen to support the project.

Q124 **Zarah Sultana:** While the jobs are there, are you seeing the workforce coming from local communities, and is that a challenge?

Pete Guthrie: A bit of both, I suspect. When it first starts, there are a lot of local skills that can go towards the operation of the spaceport, but some things are lacking, so they will probably be shipped in. It makes perfect economic sense, particularly when launch cadence ramps up. In the first couple of years, you will be doing a launch, maybe two launches in the second year and so on. It will ramp up to the 12. As that ramps up, it makes more and more economic sense to have the requirement to have those skills and that staff locally.

Q125 **Zarah Sultana:** Thank you. I have a question about licensing. What has your experience been with the Civil Aviation Authority since the new regulations were brought in, and how does that compare to before the new regulations were brought in?

Scott Hammond: Because we started before the regulations were established, we looked at the American regulations and built to the American regulations. I would say that is how most of our clients operate as well. That is where we all started and that is all in our thinking.

Now, we are engaging directly with the Civil Aviation Authority. I would say at the moment we are in the teething area. There are aspects that have frustrated us. I do not necessarily want to talk for Parliament, but for Parliament I believe it was a non-political thing about supporting space launch. Parliament wanted to enable space launch from this country. It was not like space launch was going on and we were a bunch of cowboys and needed to be controlled. It was all about enabling it. That is what we want to see from the regulatory authorities, that they are there to enable it to happen. I always get terrified when I hear public bodies talk about the precautionary principle—doing nothing is the best solution. We need to enable space launch.

We are engaging with the Civil Aviation Authority. It has had to stand up its team, so it is learning. We want to learn with it. What we need to do is start to look at what you guys wrote and make it work and make it commercially viable. As an example, we have to do an environmental impact assessment for the spaceport. In the regulations, you said that we can use the one we have used for planning. Great. That saves us money. However, I will take one example—the visual impact of the spaceport. For the planning, because we are building our roads that we are having to build to put in place, that was part of our visual impact assessment. We have had to pay to take that out of the chapter to give to the Civil Aviation Authority rather than it reading that chapter and ignoring the bit

about the roads. We have to produce it exactly how it wants to see it. It is things like this we need to work our way through because it was all about enabling launch. What we have had to do to change our environmental impact assessment is costing us about £50,000. It is happening. There is lots still to do. We need that engagement with them.

Q126 **Zarah Sultana:** In total, how much has it cost to get a licence with all of those costs?

Scott Hammond: We do not have one yet.

Q127 **Zarah Sultana:** But the process of getting one.

Scott Hammond: That is £50,000 just on the environmental impact. We are having to do a siting assessment and safe to clear zones, which we are paying a company over in the States for. We will have to have an airspace change. It will probably cost in the region of £250,000 to £500,000 to go through that whole process. You then have to do a security plan, which we have consultants doing for us. We put £1 million against the business plan to get a licence. I do not think it will cost quite that much, but it is a lot of money.

Q128 **Zarah Sultana:** How much time has this all taken so far?

Scott Hammond: We could not start until the regulations clearly came out. Then we had to have the CAA stood up as the regulator. The very first time we could start was August of this year. We have been working really hard. We had an idea what was coming, so we have prepared the ground. We have a team of 10 within our company and all of our various consultants working on it. We hope to get the application some time in December. We are then told by the Civil Aviation Authority that it can take between nine and 18 months to get a licence. That is clearly a threat to the whole programme. We do not think it should take that long for a spaceport because that should be a lot simpler than for a launch operator. Time is of the essence, and we really need the regulator to put its shoulders to the wheel and enable space launch.

Q129 **Zarah Sultana:** Melissa, do you have anything to add to that from your experience in Cornwall?

Melissa Thorpe: We are slightly different in that we are already an operational airport. We have a lot of the things that were in the regulations already in place, and all we are doing is enhancing those to operate a spaceport. We already work with the CAA on a daily basis. We operate 747s. For us, it has been really important that we are treated slightly differently in that a lot of our manuals are already incorporating some of the activities in place.

We have had a bit of a head start on it. We submitted our licence application a few weeks ago. We are expecting that to take under six months for us to be able to launch when we want to launch next year. We think it has cost us about £200,000 altogether. We have brought

somebody in-house and hired our operations manager to focus solely on licence. He came in in December last year. When he started doing some preliminary work, as Scott just said, we did not have the full regulations until August, so he was not really able to get his teeth into it until then. We learnt a lot from G7 and the manoeuvres that we were doing there.

Aerospace change is something we have done in the past as well. We have a bit of experience in some of the areas. A lot of it, again, is new, like Scott said. For us, it has been really important that it is not reinventing the wheel with some of these activities. We have made that very clear with our application that we are adding in additional activities that a spaceport brings. Going forward, we are not sure yet what the questions will be from the CAA if our application is what they were looking for. We are waiting to hear back about that. I know Virgin has submitted its one as well.

As we go through it, I am sure we will learn more and see what potential changes might be useful in the future as we go along. We are confident that our application is fit for purpose for safely launching and enabling launch, as Scott said, next year, but there are probably a few tweaks that will hopefully need to be made as we come out the other side of the process.

Pete Guthrie: I would agree largely with what others have said. When we initially discussed the licensing with the CAA, they came back very much with the approach of, "You need to provide the entire application and then we will look at it and consider it." They have changed that now where they are much more interested in an incremental approach, which is what you have to do if you are doing something very new and novel like this.

The fact that they have adapted to the needs of the industry is absolutely to be commended. It is safe to say that they are still learning their craft, as you would expect them to be at this point.

One of the questions for this Committee is that the CAA will be receiving licence applications from everyone around this table as well as others because all the spaceports are coming on stream at a relatively similar time. Unlike where you would have an airport and maybe another one 15 years later and another one 15 years later, they are all going to be coming at the same time. To Scott's point, how big is the CAA shoulders, and is it sufficiently resourced to be able to look at the multiple licences at the same time? If it is not, how is it going to prioritise one spaceport over another or one application over another? I absolutely welcome the CAA's approach. It is very open and very easy to work with.

Chair: This is a very helpful discussion because we will have the opportunity as a Committee to ask questions of the regulators and indeed Ministers later in the inquiry.

Q130 **Carol Monaghan:** We have Andøya, we have SaxaVord, we have

Cornwall and we have other spaceports. Do you see each as competitors, or do you see you all contributing to the space landscape within the UK?

Scott Hammond: We see our main competitors as Andøya. We do not see ourselves in direct competition with Melissa in Cornwall because that is horizontal and we are vertical.

Q131 **Carol Monaghan:** What about Sutherland?

Scott Hammond: They have Orbex as their customer, and we are not interested in Orbex. We do not see that we are in competition with them. I believe you are only going to have Orbex.

Q132 **Carol Monaghan:** Peter, would you agree with that?

Pete Guthrie: Elements of it. The economic analysis we undertook with space tech partners, which was published in March, highlighted that it was an opportunity and a market for the UK and for Scotland in particular for about 130 launches a year. If they come back and say there are going to be 15 launches, everyone is going to be fighting over those launches. This is a growth market, and one where collaboration is much more important than competition because there is more than enough market to go around. We are working with the Scottish Government on the Scottish strategy, and collaboration is a key part of that.

Q133 **Carol Monaghan:** Where does, for example, Benbecula, Campbeltown and Prestwick fit into that?

Pete Guthrie: Prestwick is similar to what we are looking to do—horizontal launch. They have been heavily supported through their region growth deal. We have done various projects with Prestwick. They are doing good work. Prestwick is a wider project than just a spaceport; it is about regeneration of the local businesses in that part of the world and creating a bit of an aerospace cluster.

We are also working with Machrihanish air base, which is community owned, and trying to support their aspirations. We have also supported the project in the Western Isles, which is going through a business planning process. We have supported Shetland, too. We have put in grants to undertake digital activities. We have put in grants to do graduate placements into Shetland Space Centre as well. We have a wide look at this.

Q134 **Carol Monaghan:** Thank you. Melissa, where do you see your competitors, or do you consider them as partners in this?

Melissa Thorpe: Throughout this journey, it has been interesting to see how most of the time the media has pitted us against one another, and "the UK space race" is the classic headline. It is not true, as Scott and Peter have said. We work together. We all sit on the spaceport alliance group together. To me, this is fundamentally about the UK proposition to the rest of the world. We need to come together to create launch. It is so competitive out there. There are 80 spaceports proposed around the

world. We need to get our act together as a country first and support each other.

It is still a small industry. We all know each other. We have to collaborate. We share experiences. It is crucially important that that continues.

I think the three of the spaceports in this community at the moment are the first movers. We have to get them moving. The other sites all will come in time, I am sure, as the technologies develop. They are all different. Everybody has a different offer.

From a Government perspective, really pushing to get these three spaceports literally off the ground in the next few years is critical. There is a slight issue at the moment with trying to spread the love throughout all the sites still and back all of them equally. It is time that we say there are some that are going to move first to be able to capture that market, and then as we support these ones other ones can come online at a later date, and it is not to say that they will not at all. They are all doing different things.

That is quite an important message to get across. We have some amazing activities happening. They are all due to launch next year. Let us really get the support behind the three of us.

Q135 **Carol Monaghan:** Thank you. I asked the last panel about the regulatory framework. Could I ask about the regulations surrounding spaceports? I would like comments from all of you. Are the regulators' requirements for obtaining a spaceport appropriate, and what developments would you like to see within the UK's regulations?

Scott Hammond: Nick alluded to it in his answers. It is this concept of ALARP that we have here in the UK, which we understand in the UK. Most of the rest of the world do not understand it, which is why most of the rest of the world look towards the FAA regulations, which give certain standards to hit. Generally, rocket scientists are pretty number-type people, so they really like that. If they hit a number, they know what it is. ALARP brings advantages. They take a bit of time to bear fruit.

Q136 **Carol Monaghan:** What is ALARP?

Scott Hammond: As low as reasonably practicable.

Carol Monaghan: Thank you.

Scott Hammond: You have to show that your safety case is safe and, more importantly, why you have not made it safer. That is different. If you just have a number to hit, as soon as you hit that number you are safe, but that is not how we operate in the UK. We still use the FAA as the basis of what we are doing for all of our siting assessments, where we put the pads, where we know the rocket is going to fly to because that whole system is completely understood by the industry. In the 45 years it

has been in operation, they have had a number of mishaps but nobody has been hurt. That shows you that they are fit for purpose.

Q137 **Carol Monaghan:** Once you have gone through the FAA requirements, do you then have to overlay the UK requirement?

Scott Hammond: Particularly for us with ABL being an American company. It has to get an FAA licence. It cannot just launch with a CAA licence. Part of its licence has to show that the spaceport adheres to its licence and particularly the range. Yes, we have to show that we adhere to the FAA and then we use it to show the CAA why we are doing things.

Q138 **Carol Monaghan:** Is this sensible, or is it overly bureaucratic?

Scott Hammond: There is going to be bureaucracy everywhere. Safety has to be the No. 1 priority. You cannot get away from having pretty detailed regulations. In general, the industry would like certainty, as Nick spoke about—those numbers—because it is easy to understand and it is easy to put into a business model, et cetera. I would not say it is over-bureaucratic because safety has to be the No. 1 priority of everything we do. No, I would not say so.

Q139 **Carol Monaghan:** Thank you. Peter, do you have anything to add to that?

Pete Guthrie: From our perspective, unlike my other two colleagues here, we do not have to consider the FAA regulations. The reason for that is that we are using a British-built rocket on a British site. Where you are launching American-built rockets, you have to consider both regimes, which undoubtedly will be more complicated.

This all stems from a document—if you have not read it, you should—called "Spaceports: keeping people safe", which came from the Health and Safety Laboratory. That looked at the fact that the FAA had a particular set of regulations and requirements, usually for very large rockets like Saturn V and that sort of thing, but they also benefit from the fact that they have an extremely large land mass with very few people in it. In some cases, the UK is not like that. We already have well-established regulations and risk regimes from the likes of the nuclear industry here in the UK, which is what—

Q140 **Carol Monaghan:** But we do not have the experience in space launch.

Pete Guthrie: Exactly.

Q141 **Carol Monaghan:** Have you done any work with the FAA regulations just to say this is a sensible set of regulations that have been useful over 40 or 50 years, so should we be having a look at what they are suggesting?

Pete Guthrie: We have looked at them, and we have also undertaken special risk assessments on the site. You are right: it is new. One of the issues is that the first time you do something it is inherently going to be more hazardous than the fifth time you have done it, especially if you

have shown that you can successfully launch five times. Safety is absolutely key, and that has always been our approach. Working with the community landowner, it has always been our approach that it is absolutely No. 1. Is it overly bureaucratic? It is bureaucratic, but it is bureaucratic for a good reason because some poor civil servant has to go and say to a Minister, "Please sign off on this."

Q142 **Carol Monaghan:** Are there any further developments you would like to see in the UK space regulations?

Pete Guthrie: It will evolve. We are at the start of this process, and the CAA has shown itself to be open and adaptable to adapting the process as industry needs. We are very much at the start of it. When you are at the start of anything that is hazardous, you are going to err on the side of risk aversion. As we go through that, we show the safety of the sites, we show the reliability of the launch vehicles—it will naturally adapt.

Q143 **Carol Monaghan:** Thank you. Melissa, do you have anything to add to that?

Melissa Thorpe: To back up what Scott and Peter are saying, it is bureaucratic but it is for a reason, and I think there is some opportunity in there. Remember that there is not just one licence that we have to get for this. There is a spaceport licence, operator licence, range licence and a licence for the payloads themselves, for the satellites that the UK Space Agency are running. We are, as far as I am aware, the only place in the world that will be licensing the payloads themselves. That is four different licences potentially for a launch. That comes with levels of bureaucracy. If it is for the right reasons, we understand.

The CAA has been incredibly supportive with us. We have worked with it on this. I know for a fact that the Department for Transport, CAA and UKSA have spent a lot of time with the FAA over many years working with them and learning from them. It is not that we have just gone and created our own thing without speaking to the FAA. I also know the FAA is very keen to be a guide in the future and, like Peter said, probably to help us evolve as it has been doing it for so long.

We will be having to work with the FAA because of Virgin Orbit, and we see that as a positive in a way because it gives an added layer to the safety of our first launch here at Cornwall. It is a great starting point. It will continue to evolve as long as we are all still able to communicate what is and what is not working to each other.

Q144 **Carol Monaghan:** Melissa, do you feel confident enough that you can feed into that evolution of regulations?

Melissa Thorpe: Yes, definitely. We have already been asked even though we have not been through the whole process yet—starting to think about the future and what we would do and what would work better. There is a lot of engagement, and the process has been a very pleasant surprise for us down here.

Carol Monaghan: Thank you. Melissa, you said in your earlier comments that it was going to be great to have youngsters seeing spaceports and the excitement around launch and the ambition that will be generated as a result. Probably many of us politicians are feeling the same way, so we are looking forward to seeing launches next year. Thanks very much all of you for your evidence.

Q145 **Chair:** Thank you very much indeed, Carol.

You have given evidence saying that the more the merrier—the more launch sites we have, the more our reputation as a place to launch satellites as well as build them will be enhanced. There was a legal challenge to the planning permission in Sutherland. SaxaVord was not part of that, Mr Hammond. That was not a competitive thing.

Scott Hammond: No, the landowner around Sutherland, Anders Povlsen, is an investor into Shetland.

Q146 **Chair:** But it was on his own behalf.

Scott Hammond: Yes, on his own behalf. Nothing to do with us.

Q147 **Chair:** I see. Thank you. Finally, in terms of the logistics, Shetland has an even more northerly location in polar orbit. That is an advantage. But it requires transportation by sea, presumably, of satellites to be launched there. How much of a constraint is that, and do you have plans—

Scott Hammond: Have you ever been to Shetland?

Chair: I have not.

Scott Hammond: Okay. We would love you to come up. We extend an invite right this minute.

Chair: Well, I would love to come.

Scott Hammond: Shetland has been supporting oil and gas for the last 40 to 50 years. It has a large industrial base in light manufacturing. We get two container ferries a day coming out of Aberdeen. One also brings people. There were, pre-Covid, 27 flights a day into the airport. People travel from all around the world to work in the oil industry in Shetland.

It is a misnomer, and a lot of people make the assumption that there is a limited supply chain up there. When we bring up the customers—and, in fact, when we brought up Lockheed Martin—the engineers are so excited when they see all the light engineering firms that are already in situ that can help them. When HyImpulse were doing their engine test, we got the phone call on the Saturday and they said, "There is a problem with the regulator," and I am afraid we thought, "The bloody regulator, what on earth do they have to do with it?" Actually, what they meant was a valve. It was not the public regulator at that point. One of their valves was not working and they needed to go back to Germany to get it, so they rang Germany and Germany said, "We will get back to you." We said to them, "Go to the firm Ocean Kinetics, which is in Lerwick," and Ocean Kinetics

built them 12 valves in three hours. It did its engine test before it got the answer from Germany saying, "It is going to take us another five days to get it there." The support and the supply chain that exists in Shetland, I would suggest, is second to none.

Q148 **Chair:** That is very good to hear. We have influence over some types of regulators but not others. To confirm what you are saying, in terms of the logistics operations, you do not need any investment in new port facilities or anything like that. You are making use of the existing, very well-developed ports.

Scott Hammond: Absolutely. When Skyrora came to visit, we showed them Lerwick port. Lerwick port takes 1 million tonnes of cargo a year. As we were driving around the port, we saw hydrogen peroxide coming off because it already goes to the island. It is used in fish farming, which I did not know until I got into this business. We have all those licences already.

Chair: Very good. On the assumption that the suggestion extends to the whole Committee to come and inspect it—

Scott Hammond: Absolutely. We would love the whole Committee to come.

Chair: This is a very interesting subject. We have been treated to some great expertise today in both panels. I am very grateful for your time in giving evidence to us today.