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; Rebecca Long Bailey; Dehenna Davison; Carol Monaghan; Graham Stringer; Zarah Sultana.

Questions 282 -374

Witnesses

I: Josef Aschbacher, Director General, European Space Agency.

II: Dr Hiroshi Yamakawa, President, Japan Aerospace Exploration Agency; and Dr Philippe Baptiste, President, Centre National d'Études Spatiales—French National Space and Research Centre.

III: Tim Johnson, Director of Strategy and Policy, Civil Aviation Authority; and Colin Macleod, Head of UK Space Regulation, Civil Aviation Authority.

Examination of witness

Witness: Josef Aschbacher.

Q282 **Chair:** The Science and Technology Committee continues its inquiry into the UK space strategy and satellite infrastructure. We are delighted this morning to be considering evidence from witnesses from international space organisations and also from the UK regulators.

To start off, I am very pleased to welcome Dr Josef Aschbacher. He is the director general of the European Space Agency. We are very glad to have you with us this morning, Dr Aschbacher. Thank you very much indeed. Perhaps you could describe to the Committee, and to people tuning in, the mission of ESA, as it is known, and the UK's role in it.

Josef Aschbacher: Thank you, Mr Clark, and a welcome also from my side. As you see, I am joining remotely from Paris. I am very honoured to be with the Science and Technology Committee of the House of Commons. It is also a great opportunity to lay out some of the fundamentals of the co-operation that you have with the European Space Agency.

The European Space Agency, in a few words, is an intergovernmental organisation. We have 22 member states, of which the UK is a founding member. As you see from the number, the ESA member states are not identical to the EU member states, and I really would like to underline that. Of course, the UK is a very strong and important member state of ESA—not any more of the EU but certainly of ESA—with whom we are working extremely well.

The European Space Agency has several establishments across Europe. An important one is in the UK in Harwell called ECSAT where we have a focus on commercialisation of activities but also climate change and a number of other activities. All together, as ESA, we are covering all space domains such as astronauts, Earth observation, navigation, telecommunications and space science—across the board in terms of activities. We are one of the few space agencies covering the whole range of activities in the space domain. We have a budget of about €7.2 billion this year. We have a workforce of 5,500 spread over the different locations of ESA.

This is ESA, in a nutshell, but we have a number of programmes and activities in which the UK very strongly participates, and I am very happy to elaborate on those as the questions come in.

Q283 **Chair:** Thank you very much indeed. My colleagues have some questions around those areas, but there are just a couple of brief ones from me to start. The UK contribution, I think, is around 9% of the member states' contribution. Is that correct?

Josef Aschbacher: It is correct. We have two types of contributions. One is the mandatory programme, which is about 20% of our overall

budget. Within the mandatory programme, the UK has something above 14%, but, in the optional programme, which is where the member states decide on their own how much they want to contribute, the UK contribution is around 9.2%.

Q284 **Chair:** That contribution is based on participation in different programmes; the more you do, the more you contribute. It is a decision for the UK, is it not? The subscription fee is not determined by ESA; it is what the UK bids for programmes. Is that right?

Josef Aschbacher: That is exactly right. As I said, 20% is mandatory. There are some activities where the contribution is calculated based on GNP compared to other member states, but 80% of our budget from the member states is optional. Optional means that each member state decides on its own how much it wants to contribute. In some cases, we have very low contributions and in some cases we have very high contributions. That contribution of the optional programme is around 9%.

That also sends a message because according to the GNP reference, which is around 14%, the optional participation in ESA is below the GNP, and that is something that, as director general of ESA and having the UK as a very strong member state, I would hope is recognised as potential or room for improvement because I really think that the UK benefits a lot from ESA. We also benefit a lot from the UK with its unique expertise. I am very happy to interact with the UK on a regular basis, but, certainly from a budgetary point of view, I would consider that there is some room for discussion, if I may put it this way.

Q285 **Chair:** Thank you. That is very helpful. We will go into some more detail on that. Finally from me at the beginning, there are programmes that are run by ESA across Europe, but ESA also participates in global programmes. Just recently in the last few days, we have seen the deployment of the James Webb Space Telescope, which is a collaboration between NASA, ESA and the Canadian Space Agency. Describe to me what ESA's role has been in that and whether the UK was included in it.

Josef Aschbacher: Thank you. This is a very good example of where international co-operation can be highlighted. Indeed, the James Webb Space Telescope is, as you say correctly, under the lead of NASA, but an international partnership between NASA, ESA and the Canadian Space Agency. The ESA contribution is provided through contributions from its member states. We have programmes where we contribute to the James Webb Space Telescope, and we made a number of concrete contributions.

First of all, we provide science instruments. We provide the near infrared instrument—NIRSpec—in full to the James Webb Space Telescope. We provide about half of the MIRI instrument, which is another important instrument. The UK, by the way, plays a very strong role and there is a very strong contribution from the UK perspective. We also provide science teams that evaluate the science and define the mission, but also

now sit in the US in Baltimore working with US scientists on data collection and evaluation.

Importantly, the launcher is provided by Europe. It was launched, as you know, from Kourou on Christmas day on an Ariane 5 launcher. I really would like to point out that this has been a very visible but also very strong contribution from ESA. NASA has been extremely positive about this partnership but also the contribution that we made throughout the project.

The precise injection of the James Webb Space Telescope into orbit allows the operation of it to be much longer than originally planned. The original plan is for five years—the nominal lifetime based on fuel—but, because of the very precise injection by our launcher, plus the three orbital corrections that have taken place afterwards, we expect that this lifetime is probably close to 20 years. Scientists are still calculating the exact number, but it is certainly way above 10 years—somewhere between 15 and 20 years. NASA is very grateful for that because the co-operation has been phenomenal all along the way, and this is one example that really highlights that. The UK plays a very strong role in the James Webb Space Telescope in terms of instrumentation but also science.

Chair: That is very good. Thank you very much for that. I will turn to my colleagues, starting with Graham Stringer and then Rebecca Long Bailey.

Q286 **Graham Stringer:** Following up on a point about the James Webb Space Telescope, it is obviously going to help us to push back the frontiers of knowledge and look at the origins of the universe. Are there any commercial benefits from that telescope?

Josef Aschbacher: This is really a science-driven mission, as you say correctly, to discover the origins of our universe and look back further than any other telescope in humankind has ever been able to. There are two aspects that I would like to mention.

The first one is that the contributions that are given to ESA are always spent in ESA member states according to a geographical return key, which is characteristic of all our ESA programmes. If the UK pays 50 into ESA, it will get back 50 minus the management fees and the running costs of ESA. This is a guarantee. That means that the industry in the country that contributes has been given industrial contracts in order to participate.

The second part is the technology development that happens through such programmes. This is cutting-edge technology that is being developed. In this particular case, there is an instrument called the mid-infrared instrument, and the UK Astronomy Technology Centre, under the lead of Professor Gillian Wright, in particular has been active. There are certainly technology developments that help other disciplines, either in space science, Earth observation or technology development investments that benefit other disciplines.

The overall characteristic of ESA is that we help development of technology for a country or an industry in the country, and, therefore, they can position themselves better in other domains. Certainly, in the space science domain, the focus is on science, but there are also industrial benefits that come. I would say the direct translation of investments from ESA in other domains such as Earth observation, telecommunications and navigation or similar domains into economic benefit is much stronger and much more evident.

Q287 **Graham Stringer:** You have described some of the priorities and work that ESA does on an international basis. You make it sound very easy. It can't be that easy dealing with so many countries. Can you tell the Committee how you arrive at the priorities and what the process is? Could you describe the 2025 priorities? That would be helpful.

Josef Aschbacher: Thank you very much. It is a very important point. It may sound easy when we say that we work with international partners, but, as you know perfectly well, this is quite a complex set of negotiations we are going through. Certainly, our No. 1 partner is the US, and in particular NASA. We have co-operations with NASA in many domains. In space exploration, we work hand in hand with NASA, but also the other partners—Russia, Japan and Canada. On the space station, we flew an ESA astronaut of UK nationality, Tim Peake, into space a couple of years ago. We also have other co-operation of experiments in the space station. That is a good example where many partners are working.

We are building up a big programme with NASA on Mars with Mars sample return. Again, the UK is expected to play a major role. Of course, this programme is still being established. Another programme where the UK is playing a strong role with Russia is on ExoMars and the Rosalind Franklin rover. As the name indicates, it has very strong UK participation. This is implemented as an ESA project, together with Russia, and it is a Roscosmos/ESA co-operation.

Then we have other co-operations with Japan, India, Australia, South Africa and many other countries. Some people consider ESA as the space agency with most of these international partnerships. We have hundreds of co-operation agreements in place. This is hopefully of interest to the UK through its global UK agenda by using ESA as a mechanism for reinforcing and establishing some of these international partnerships.

Yes, it is not as easy as it may sound. All these negotiations are sometimes quite complex. I would not like to go into too much detail here, but there are always some problems and hiccups along the way. They are, I would say, quite challenging. The expertise of our engineers and programme managers has always managed to overcome these hurdles and as a result there has been very strong international co-operation. The James Webb Space Telescope is a fantastic example where this has been displayed very nicely very recently.

Q288 **Graham Stringer:** The Committee heard in one of our previous evidence

sessions that there was large commercial potential in clearing up space debris. How do you balance commercial projects like clearing up space debris, where you can get an income from it as well as a general benefit, with the more science-driven projects?

Josef Aschbacher: Thank you for that. Commercialisation of space, as you know perfectly well and you see almost daily in the news, is happening very rapidly and is progressing very fast. We all see regularly the launchers and activities in the US, with Elon Musk, Jeff Bezos and many others who are very active on the commercial side. Commercialisation is also a top priority of the ESA strategy called Agenda 2025 and is one of the pillars on which I would like to develop and transform space in Europe because I firmly believe that we are not doing enough in order to really make maximum benefit of all the capabilities.

You mentioned space debris. That is one of the emerging domains where a lot of commercial interest and opportunities exist. There is a situation where we are building up a huge number of satellites in orbit. We have between 3,500 to 4,000 active satellites in orbit. We also have several thousands of inactive satellites in orbit. That means that they are at the end of their lifetime, and that needs to be managed. Debris is an issue because some of these mostly inactive—sometimes also active—satellites collide. Sometimes explosions take place because the fuel tank still has some fuel, and exposure to the sun may cause an explosion, or, anti-satellite tests, as we have seen with Russia recently, create debris and cause problems. So, yes, this is a huge problem and needs to be solved.

Debris removal is one thing but there are also other elements that are more regulatory in nature. Establishing a space traffic management system is also necessary. There are different elements: technically, debris removal, in-orbit servicing and management of traffic in space from a technical point of view, but also from the regulatory point of view who is allowed, and under what conditions, to put spacecraft in orbit and the management at the end of their lives.

Q289 **Graham Stringer:** I was fortunate, as a member of a predecessor Committee of this Committee, to visit ESA in Rome some time ago. It was a very interesting visit. You have been very diplomatic about all the difficulties there are in international relations. I picked up on that visit that the relationship with the European Union—and you were careful to say your membership is different from the EU's membership—was not as easy as it may be, if I can put it crudely. You were worried about the bureaucracy of the EU trying to take over. What is the relationship now between the EU and ESA?

Josef Aschbacher: It is an important point, and I know exactly what you are hinting at. Maybe it is fair to say that my election as director general for ESA—and I started my job on 1 March last year, as you know—has been partially based on the good, strong co-operation I have built up over 20 years with the European Commission. As you may know, I was in charge of the Copernicus programme before I became the GM. I

am still in charge, but at a different level. This programme has been built up over two decades with the European Commission. It is fair to say that it needs both the European Commission and ESA to have this programme in place. The UK—and I am sure you are very familiar with the situation—is a very active member in Copernicus, and I have always, in my previous function as director of Earth observation and in my function today as director general of ESA, insisted that the UK will be allowed and given opportunities to strongly participate.

As you know, the UK participates very strongly in the ESA programme because this programme is co-funded between the ESA member states and the European Union. So the UK is already a very strong participant of the ESA programme, but also on the UK side we have an issue today in that the UK has declared its intent to participate in the EU programme. I am very grateful for the UK's clear and strong statements in this regard, but it has not yet materialised, and this is still an open issue. Certainly, I am very keen. This is a situation that is not yet fully resolved. As you know, these negotiations are taking place between Brussels and the UK Government.

On my side, I am certainly proposing architectures and an implementation mechanism for Copernicus that allow the UK to stay on board, and even if we do not have a decision today I hope that we can, through postponement of this decision into the future, make sure that the door is kept open for the UK. This is a top priority for me, because I want the UK expertise through the ESA mechanism, but also through the Brussels mechanism. This is an issue yet to be resolved. You might be informed that we have critical meetings coming up in January—in a couple of days actually. Our proposal certainly is to have all the options that make full UK participation both in ESA and in Brussels possible.

Graham Stringer: Thank you very much.

Q290 **Chair:** Given your closeness to it, what are the obstacles preventing the finalisation of the agreement to participate in Copernicus?

Josef Aschbacher: What are the obstacles? On the ESA side, as you probably know, we have negotiated the FFPA, the Financial Framework Partnership Agreement, with the Commission last year. I signed the agreement in June last year, but there was a debt of €750 million remaining or open pending signature between the UK and ratification—I do not know exactly the correct legal term—between the UK Government and Brussels, the European Commission, on its participation on the EU side of the programme. That has not happened yet. This is fully between the European Commission and the UK. ESA is not party to this part of negotiations.

Certainly, we as programme implementers are making sure from a technical engineering implementation point of view that the UK can stay on board even if the signature does not happen today. The deadline passed on 30 November, but we would like to keep the options open for

the UK to participate at a later stage. This is really between Brussels and the UK, and ESA is not a direct party to the negotiations of the UK participation in Brussels.

Q291 **Chair:** In the meantime, until that is solved one way or the other, is it the case that UK institutions and companies cannot participate in tenders and suchlike?

Josef Aschbacher: They can participate in the ESA-funded programme. Roughly, the funding split between ESA and EU funding is one third and two thirds—two thirds European Union and one third ESA member states. Certainly, on the ESA part, the UK is fully participating, and there are contracts being put in place every day, but not for the EU part because the EU funding is missing and we are waiting for the green light. Yes, it is participating on the ESA side but not on the UK side.

Q292 **Chair:** Are the projects that are ESA funded and EU funded separable?

Josef Aschbacher: Yes, they are. Overall, the system is one coherent system, but we have created an architecture to separate the funding streams.

Chair: I see. Thank you.

Q293 **Rebecca Long Bailey:** Thank you, Dr Aschbacher for speaking to us today. It is very much appreciated. Going back to some of your comments on commercialisation, what more do you think the sector should be doing to leverage further private investment at this time?

Josef Aschbacher: I really like this question. Thank you very much for that. This is one of my priorities that I am pushing very hard in ESA through Agenda 2025. If you have seen the document, you will see that commercialisation identifies a number of actions that we need to really act upon. As a starting point, the investment through, for example, venture capital funding in space in Europe as compared to the US is a factor of 15 lower in Europe as compared to the US. We are very far behind, if I may say it in very open words, in terms of the potential. I am so convinced that there is a huge potential, and I know it because I have seen many examples where Europe on one side has the talent and the expertise.

For me, the commercialisation, if I can elaborate for one minute on this, needs three ingredients. No. 1 is talent. That means people with brilliant ideas who have the drive to move things forward. No. 2 is access to money, so funding. No. 3 is speed. This is a very important element as well—that we are quick and make decisions.

On No. 1, talent, we have no shortage. It is the opposite; we have a lot of brilliant people in the UK and in other ESA member states with very good ideas, very good initiatives and also the energy to make it happen.

What we lack is access to funding, at least not in the same way as it is done through Silicon Valley, for example, where venture capital funds are much more forthcoming and easier to access than in Europe. That is something I am working on with funding entities. Also in the UK, by the way, we are working quite closely with one of these funds. I really want to increase this on one side to ensure that the funding entities get access to ESA expertise so that we can help them identify good, prospective companies, and on the other side to make sure that we marry the young start-ups or people with ideas with the funding entities to bridge this element, but also on a technical side to help these people with good ideas to mature the ideas. In some cases, when a constellation is built up, we offer to help them—*[Inaudible]*—in mini-satellites or whatever they do, but also to test them in our test chambers in ESTEC, for example, and to help them technically engineering-wise to refine the project to make it more competitive.

The third one is time. We need to speed up processes. We are too slow, I am sorry to say. I am speeding up processes in ESA certainly so that we can interact much faster with this community. This is really something I am pushing very hard from an ESA perspective. I look to the UK and have been inspired by the very commercial attitude you have, and I really would rely on you as a driver and a pioneer also within ESA to help me, and help us as ESA, to bring this to fruition.

On the other side, I can certainly assure you of my full support in the commercialisation process. We are doing a lot on this. I have created a new directorate for commercialisation that is just starting to work. We have a long list of recommendations. I can go into detail if you want, but it is beyond the scope of this meeting. Just to reassure you, it is a top priority for me, and I would like to work very closely—even closer than we do today—with the UK, especially on this segment. As you know, and as I know, the UK is quite unique within ESA member states.

Chair: Thank you, Dr Aschbacher. We have lots more questions for you and limited time. If you would not mind perhaps speeding up the answers, we will cover all the ground.

Q294 **Rebecca Long Bailey:** That was a really comprehensive answer. Thank you very much.

Moving on to the launch sites specifically, can you tell us a little bit about what launch sites the ESA uses for its missions? As the UK develops its own launch sites, would the ESA use those once they are established in the future?

Josef Aschbacher: I will be shorter in the interests of time. Today, we are using launch sites in Kourou, French Guiana, which is the European spaceport from which we launch a large portion of our satellites. We also work closely with Russia to launch from Baikonur, where some of the missions are done. There are a number of launch sites being built up in Europe, and the UK is perfectly aware of the initiatives. Once they are

ready to offer launchers, ESA spacecraft can be launched there. It will be a competitive process, of course, but, certainly, that is an option. We have a lot of medium and smaller satellites in the pipeline. We are launching five of them this year. There will be plenty of opportunities coming up and certainly this will be an important opportunity for us.

Rebecca Long Bailey: Thank you. That is very helpful.

Q295 **Chair:** To follow up one of the points that Rebecca raised about commercialisation, the Committee has received evidence from Lockheed Martin. It has said that UK companies, including SMEs, often struggle to access ESA programmes, and it has recommended to the Committee that the UK should have, as it describes it, a better balance between national programmes and ESA. You are relatively new to the post. Is the difficulty for firms accessing programmes something that you would recognise? What would you say to that advice that has been given to the Committee?

Josef Aschbacher: I am not familiar with the particular advice that was given, but, in terms of access to ESA contracts, the UK has full access to all the ESA contracts because all our procurements—there are some very small exceptions, but they are tiny in terms of money—are done through open competition. Open competition means that all the companies in ESA member states, including from the UK, can bid and can access ESA funding for this programme.

The UK is very active. It has a very vibrant economy and it is very competitive. I cannot say that the UK has any restrictions in access. It is the opposite; the UK has exactly the same rights as any other member state in accessing it because we always have open competition.

Q296 **Chair:** I think the implication was not so much the UK being excluded from that but that the processes were rather cumbersome, smaller businesses felt that they were difficult to navigate, and, therefore, a more national approach might have fewer of those constraints around them. What would your reaction be to that suggestion?

Josef Aschbacher: Understood. The processes maybe appear cumbersome, especially for smaller companies, and I would subscribe to that. That is also the reason why I am changing these processes. Part of the new commercialisation directorate that I introduced will be to streamline processes and make it easier, especially for smaller companies, to access ESA funding. I fully take this on board. I know this recommendation from other sources in other countries. This is one of the reasons why I have installed this commercialisation department. The task of this commercialisation directorate is really to streamline and simplify access for smaller and medium-sized enterprises to access ESA contracts.

Q297 **Chair:** Would you say there is a problem of access for SMEs at the moment? Do you feel that there is not enough participation?

Josef Aschbacher: There is no problem of principle; it is just the paperwork that has to be gone through. A bigger company has big machinery. It is used to bidding for ESA contracts. The smaller ones usually do not know ESA, so they have to get familiar. There are forms to be filled in and so on and so forth. I would like to simplify those forms and all that is needed to apply for this post in order to make it much easier. We have already installed some of these programmes that are simplifying it a lot such as InCubed and ARTES. They are doing it, but I want it at a much larger scale across ESA.

Chair: Thank you very much. I will turn to Chris Clarkson and then Carol Monaghan.

Q298 **Chris Clarkson:** I want to pick up on some of the themes that have already been raised. You mentioned earlier that the UK benefits from being a member of ESA and ESA benefits from having the UK as a member. Could you briefly outline what you consider to be some of the key benefits of UK membership?

Josef Aschbacher: There are many. What we offer as ESA, as I mentioned before, is global co-operation with many partners. I know that the new UK strategy is quite focused on establishing international partnerships. ESA is the agency that has many agreements with basically all space agencies in the world or the ones that have significant elements to offer. The UK certainly can, through ESA, develop its co-operation and links to those members.

What is at the core of ESA is our excellence in terms of engineering, project management and science, which we have at a larger scale with the 22 member states. By being part of it, the UK fully benefits and participates through its contribution in much bigger programmes, and this is true for all member states. Also, for the UK, with your contribution, you are part of a huge programme. You mentioned the James Webb Space Telescope, but there are many other examples that I could list.

So, yes, the UK can participate in these European programmes, and can also participate globally, and of course develop its R&D skills and development skills through ESA because we are a space agency in charge or charged with developing space technologies at large. As an R&D agency, we are quite strong. I think this is commonly recognised. Therefore, the UK's participation is very beneficial.

Q299 **Chris Clarkson:** Turning to those international co-operations, and in particular thinking about Europe, would you say that the UK's exit from the European Union has impacted on any of the programmes? Specifically, I would like your thoughts on how the Galileo GNSS has been impacted by the UK's inability to participate in its development now. I would also be interested in your views on what will happen if we cannot reach an agreement on Copernicus and Horizon Europe as well.

Josef Aschbacher: These are slightly different programmes. As you know, Galileo is fully funded by the EU, and, therefore, it is essential that the UK participates on the EU side in order to benefit from programmes that ESA implements on behalf of the European Union. Copernicus, as mentioned before, is co-funded. There, the UK has two funding routes; one is through ESA and one is through Brussels. I think I have explained the situation before.

In general, your question was whether the UK suffered through Brexit in this co-operation. I would say that, in the EU programmes, the situation is becoming more complex. This is clear. It really depends on the programme. I mentioned the two flagship programmes a minute ago.

On all the other programmes where ESA is running activities, the UK is exactly at the same level as any other member state. There is no change whatsoever in all the other programmes. I should recall that the EU funding within ESA is about one quarter of the overall budget. For three quarters of our budget, the UK is in exactly the same position as all the other member states. Even within this one quarter, the Copernicus programme is an exception because it is co-funded between the EU and ESA member states.

Q300 **Chris Clarkson:** Very quickly turning back to the EU and picking up on Mr Stringer's point earlier about the relationship with the EU and the bureaucratic nature of it, as you work to normalise that relationship, how will that affect non-EU members of ESA? I am thinking of ourselves, Switzerland and Norway but also partial members like Canada. I think that is the only country that is not an EU member as well.

Josef Aschbacher: Correct. Those are exactly the four countries that are not in the EU. Canada has co-operating status, while the UK is a full member state. This is exactly the point. This is an important aspect; it is certainly something I would like to discuss with the UK delegation, Switzerland and Norway, in terms of your interests and where you see ESA most benefiting your interests from a national perspective. This is a reality that we have to address. There is, of course, obviously no magic solution.

On one side, we need to find a modus operandi with Brussels. Within the context of the ESA member states, this is a task that I was given by my member states in the ESA Council for this year to address this topic, and I will certainly be more than willing and happy to understand the UK's core interests. But I can assure you that you are one of our member states and I will defend your rights. I have always done it as DG of ESA and previously as director of Earth observation. I will continue to do so because you are my member state. It is very simple.

Chris Clarkson: Thank you very much, Dr Aschbacher.

Q301 **Carol Monaghan:** Can I ask a little bit about OneWeb? I know you have mentioned this before. Thierry Breton, who oversees the European

Commission's tech policy, has said about Eutelsat's stake in OneWeb, "We took good note of their decision to participate in a project that is in direct competition with the European initiative. I do not see how structurally an entity can have stakes in two competing projects." You have talked about the tensions between this before. Could you say a bit more about that?

Josef Aschbacher: Let me be very clear. The statement on OneWeb is not something that ESA has been involved with. We learned about this statement, as you did, in public. The Secure Connectivity initiative is led by the European Commission, by Commissioner Breton. He and the European Commission are entitled to define the programme as they think most appropriate. This is not something where ESA is defining the programme because it is under the lead of the European Commission.

On the other part, the ESA member states are discussing right now a contribution to the overall constellation—so secure connectivity. We are preparing within the framework of the ESA ministerial conference a contribution. All the elements of the contribution have yet to be defined and agreed, both on the side of the commission and with my member states. I cannot give you a definite answer to this yet because the decisions will be made in November this year. Certainly, an important aspect is the contribution of ESA member states to an eventual EU-led initiative on secure connectivity and what the conditions are. I will need to consult with my member states, including the UK, on what those conditions are.

Q302 **Carol Monaghan:** Would you consider that OneWeb constitutes a European company?

Josef Aschbacher: It depends how you define Europe.

Q303 **Carol Monaghan:** Okay, maybe an EU company then.

Josef Aschbacher: OneWeb, as you know better than me, is an international company with participants in the UK, France, India, Japan, the US, and probably some other countries. It does not have a label. I read a very interesting article not in space news but in a related article, and it raised exactly this question. What is OneWeb? Is OneWeb Indian? Is OneWeb UK? Is OneWeb French? Is OneWeb Japanese? Which flag would you put on it? The conclusion was that it is an international commercial project, and we have to see it as such. As ESA, we are very pragmatic. We always work with international partners. We have yet to see what services will be offered, but we are certainly interested in developing technology for all our partners in all our member states.

Q304 **Carol Monaghan:** You can probably understand where we are coming from with these questions. We have already seen the issues around Galileo, although the UK had put in a large stake into Galileo. We have OneWeb where the UK has invested heavily in that. What do you see happening with the UK's financial stake in OneWeb?

Josef Aschbacher: As I say, the statement you just quoted before is something that the European Commission has been making in its function as the leader of the Secure Connectivity initiative. As you also know, there are many aspects that are yet to be defined. They will be defined in the next weeks and months, I expect. We are not defining the rules and conditions of the European Commission-led Secure Connectivity initiative. This is not in our hands. However, what I would like to develop is an implementation mechanism whereby ESA contributes through technology developments that will involve all the subscribing members to this programme and where we possibly or hopefully get some implementation task on behalf of the commission to implement some of the infrastructure. As I say, it is too early to make conclusions on something that is in the midst of negotiations. It is not that I am evading an answer; I simply do not know all the elements that will be developed over the next weeks and months.

Carol Monaghan: Thank you, Dr Aschbacher.

Q305 **Chair:** Further on this point, although you have said that some of these decisions are for the commission, for the European Union, you gave a very interesting interview to the *Financial Times* in December in which you expressed worries about Elon Musk's Starlink service of low-Earth orbit constellations. You said: "You have one person owning half of the active satellites in the world. That is quite amazing. De facto, he is making the rules. The rest of the world, including Europe, is just not responding quick enough." Tell us why you are so concerned about that and what you think the European response should be.

Josef Aschbacher: You are absolutely right. That statement is making two statements. It is not against Elon Musk. I want to make that very clear. I admire what he is doing. He is doing a lot in space, and he is helping us sometimes by putting a mirror in front of our face to make us realise how fast the commercial development of space goes and what needs to be done.

My message, as you read from the quote, is that Europe needs to catch up. Europe is very far behind in many domains. I have mentioned before some of the venture capital figures. Exploration is another example. In many domains, Europe is not at the same level. In some domains, Europe is at the same level as the US, or even leading such as Copernicus and Galileo space science where Europe has top satellites and science outputs that are at the same level as the US, if not even a touch better. That is certainly a reality, but in other domains we are far behind.

This is something where I want to catch up. This is at the heart of my Agenda 2025: to put European member state investments in perspective of others in China, the US and other countries. The main core of the message is that we have to catch up in order not to lose out or not to be thrown out of the race.

Q306 **Chair:** Specifically, in terms of catching up, you mean an alternative

network. Is it a European network, or does it matter where it is from as long as it is not vested in a single entity?

Josef Aschbacher: Absolutely. I certainly want a European network. I would say a European network that is being built up, and in this case we speak of Starlink, which is broadband internet, but it also applies to other domains such as human exploration—exploring the next economic frontier, which are the moon and, eventually, Mars. Europe is investing about 6% to 7% of the US today, which is a very low figure compared to US investment. I am not saying that we should multiply by a factor of 10, but we should certainly avoid becoming an irrelevant partner because it is crucial to look at these future economic zones, which is the moon, with these eyes.

There are opportunities coming up. I mentioned the moon. Of course, you are aware of the Lunar Pathfinder, which was just signed in October last year with SSTL, where we are building up a precursor technology for navigation and telecommunication around the moon. This will become a commercial service in the future. We have a programme in the pipeline called Moonlight that will be a more operational programme of this kind. Again, I would hope the UK strongly participates. I see economic opportunities coming up in many domains.

Q307 **Chair:** I see that, but specifically on LEO, which is obviously a current issue, you have said that you would like to see a European network. Who should create that? Is it ESA or the EU?

Josef Aschbacher: Ideally together, because I do believe that we need to combine our forces in space in order to do it. I am happy to work with my member states to make an ESA proposal that is an ESA member state contribution or part of it. Certainly, Commissioner Breton, as you know, last year announced this initiative, so I will give him all the credit for leadership on this. Therefore, I think he certainly is in the driver's seat in defining it. I would like to work hand in hand with the commission on building it up.

What are the details of it? What is the role of ESA member states? As I said before, this is all in development right now towards, in our case, the ministerial in November, and these conditions will have to be hammered out in the next couple of weeks and months.

Q308 **Chair:** Is there any reason why OneWeb should not be part of that given that it has at least French and UK participation, both of which are ESA member states?

Josef Aschbacher: Allow me to not answer this question because we have heard the very strong statement of the European Commission on this. I think this is very clear. If I want to be a partner in implementing a joint programme, I certainly cannot overturn this statement or guideline. I see our role as ESA more in the development of technologies that are building up Secure Connectivity or Secure Connectivity elements, and then we shall see what this future project or programme, which will be

selected through an open tender, will contain in terms of partnerships. Whether OneWeb is part of it or not, I am certainly not qualified to say.

Q309 **Chair:** Obviously, this is a very current issue, and you have said that you are not critical personally or, I assume, of the firm of Elon Musk, but you have been critical of US regulators—the Government. You have said that the US regulators are interested in developing not only the economy but also the dominance of certain economic sectors. You said this is happening very, very clearly and very strongly. You see a problem there, if not directed by Mr Musk personally, of a risk of dominance that you think is incumbent on other nations in the world to step in and resist.

Josef Aschbacher: Absolutely. It is part of the same message I gave before. Europe needs to catch up in order to avoid becoming irrelevant or dominated by others. This is something that is at the core of my message in Agenda 2025. Europe, collectively, has to invest more in space in order to play an important role. We have managed to do this successfully in Earth observation. We have a very strong Earth observation programme in Europe because member states have invested and recognised the importance of it. I would hope that the same is happening in other domains.

For me, this message should serve as a wake-up call, if I may say, to my European partners—by European I mean the ESA member states because I can only speak for those—in order to recognise the potential that is there commercially, because Elon Musk is investing in this maybe for fun because he is fascinated by space, but out of economic considerations.

Yes, there is huge potential in many domains in space, and, yes, I would like to wake up European countries in order to make sure that we are not losing out on this opportunity.

To be very frank with you, I think we have a narrow window of opportunity. I really think that we need to move a bit more strongly in Europe collectively in order to benefit from the opportunities that are out there, otherwise the same will happen as happened, for example, in information technology. In information technology 15 to 20 years ago, Europe had a similar level of expertise and skills as other countries in the world—the US, Japan, China and others. The reality today is that Europe has not managed to convert this excellence into big companies. The biggest IT companies are not in Europe, and this includes the UK. This is what I want to avoid. Today, we still have the expertise in space, but I want to avoid this expertise going down and not being converted into commercial successes. This is at the core of my message.

Q310 **Chair:** Thank you, that is very clear. Finally from me, you have talked about the economic opportunity and not missing out on that. Do you see a physical dimension to it as well? The same *FT* article reported your concerns that the rush to launch thousands of communication satellites could lead to fewer radio frequencies and orbital slots available for everyone else. Is there a physical concern you have there?

Josef Aschbacher: Yes, indeed. I have seen the statement of Elon Musk saying, "There are billions of cars on the ground so we can have billions of spacecraft in space," but you have also seen other statements saying that that is not exactly true. I do not want to enter into a discussion between Elon Musk and myself. What is true is that if you occupy the space with many spacecraft there is a dominance, in a certain sense, of orbital slots both physically and in frequencies. Yes, I think there is an international effort needed in order to regulate and to make sure that there are opportunities for major space-faring nations to divide up space and offer others opportunities.

There are official mechanisms through the UN context but also more practical ones in one-to-one relations, either with the US Government or with Elon Musk himself. By the way, we are working very well with Elon Musk and his Starlink company in order to understand where his satellites are and if there is a collision risk. If there is, we need to agree on who moves the satellite—either the Starlink company or us—to avoid a collision. We almost had a collision some years ago with Aeolus, a satellite let by the UK industry. This needs closer liaison and co-operation with Elon Musk in this case, or his company, and this is happening in a practical case. We need practical measures but also regulatory measures.

Chair: Dr Aschbacher, thank you very much indeed for your evidence. We have certainly gone over time—and we are grateful for your time—but it is because we have had a wide-ranging and fascinating discussion. We are very grateful for your evidence and look forward to keeping in touch with your work. Thank you very much indeed.

Examination of witnesses

Witnesses: Dr Yamakawa and Dr Baptiste.

Q311 **Chair:** We will now turn to our next panel of witnesses. I am delighted to welcome—I see them on our screen—Dr Hiroshi Yamakawa, who is the president of JAXA, the Japan Aerospace Exploration Agency. Welcome and thank you for giving evidence to the Committee today. Dr Philippe Baptiste is the president of France's national space and research centre, CNES. Thank you very much, both of you, for joining us today.

Perhaps I could ask Dr Yamakawa to describe briefly the remit of JAXA and how it operates.

Dr Yamakawa: Thank you, Mr Clark. JAXA is the national research and development agency independent of the Government, and at the same time defined as the core implementing agency to support the whole Japanese Government.

Japan was successful in launching rockets and put the first spacecraft into orbit about 50 years ago in 1970. Since then, JAXA has engaged in almost all aspects of the space domain covering launch vehicles, Earth observation, communication and navigation satellites, human space flight, and also space science and exploration.

JAXA is supervised by four competent Ministers: the Prime Minister; the Minister of education, science and technology; the Minister of Internal Affairs and Communications; and the Minister of Economy, Trade and Industry. The Ministry of education, science and technology is responsible for JAXA's budget. In addition, JAXA also conducts R&D based on contractual agreements with other responsible Ministries such as the Cabinet Secretariat, the Cabinet Office, Ministry of the Environment, Ministry of Defense and others.

The JAXA budget for the fiscal year 2021 from the Ministry of education, science and technology is £1.5 billion, and the contract with other Ministries is approximately £0.4 billion. The JAXA budget is half of the whole Japanese Government's space budget, which is £3.2 billion in fiscal year 2021.

JAXA formed its seven-year medium to long-term plan through its five pillars in space activities: No. 1 ensuring space security; No. 2 contributing to disaster management, national resilience and solving global issues; No. 3 creation of new knowledge through space science and exploration; No. 4 realising economic growth and innovation; and No. 5 strengthening the industrial, scientific and technological basis.

These aims are in accordance with the Basic Plan on Space Policy established by the Japanese Government's strategic headquarters for National Space Policy headed by the Prime Minister. The implementing plan of the Basic Plan on Space Policy is updated every year by the Government, and JAXA's budgetary requirement is communicated to the Government through the support of the Government from a technical point of view. That is the summary of JAXA's structure.

Q312 **Chair:** Thank you very much indeed. That is a very comprehensive summary. We will follow this up with some more detailed questions.

Perhaps Dr Baptiste could briefly give the equivalent thumbnail sketch of how CNES operates in France.

Dr Baptiste: Thank you very much for your very kind invitation. CNES was created about 60 years ago by General de Gaulle. We are currently supported by three Ministries: the Ministry of the Economy and Finance; the Ministry dedicated to research and higher education; and the Ministry of Defence.

Basically, our role is pretty diverse in the space business. Something that is pretty important, I guess, is that we propose a space policy to the French Government, which then decides and then changes it, but, basically, we are pushing for the space policy and the decisions that we make.

What do we do in practice? Basically, we are working on launchers. We were the design authority of Ariane 5. About 200 people from CNES are working jointly with ESA and ArianeGroup to set up Ariane 6, the next launcher.

We are also working on science, something that is a very important part of our activities. Roughly speaking, something like 30% to 40% of our activity is dedicated to science. It is basically exploration and also understanding basic questions such as how the universe, galaxies and solar systems were created and the exploration of other planets.

As Josef Aschbacher mentioned, like many other countries in Europe, we are working a lot on Earth observation, which is absolutely key for all climate-related issues.

The fourth thing is that we are also working on telecommunications. As you know, there are two European companies that have very strong links with France—Airbus and Thales—which are great champions in telecommunications, so of course we are doing a lot of R&D with them.

Last but not least, we are also working a lot with defence, on defence programmes, and that corresponds to something like a third of our activities.

In terms of budget and numbers of people, there are about 2,500 people working at CNES. It is not only a funding agency but also a technical centre. I would say that more than half of the people have strong technical backgrounds and strong technical capabilities. They join us as PhDs and work on space technology.

The total budget of CNES varies a little from one year to another. It is about €2.5 billion. About half of this budget is dedicated to ESA—it goes to Josef whom you saw a few minutes ago. Half of the budget is dedicated to either national activities or most often—I would say in 99% of the cases where we are talking about science and Earth observation—it is dedicated to bilateral—

Chair: I think we may have lost the connection just at the end of your summary. Until our broadcasting colleagues can re-establish the connection, I will turn to Carol Monaghan, who has some questions for Dr Yamakawa, whom we can still see.

Q313 **Carol Monaghan:** Thank you, Chair, and good morning, Dr Yamakawa and Dr Baptiste, if you can hear us. Dr Yamakawa, if I could start with you, we have heard a lot during this inquiry about how the UK is developing core capabilities in communications, Earth observation and position, timing and navigation. How are you working to access and improve these core capabilities, and what other technologies are you working on?

Dr Yamakawa: Thank you very much for your question. The Japanese Government have put great emphasis on access to space capability and international competitiveness. These are the two key words for the Japanese Government's space policy. That is why as a research and development agency JAXA is concentrating on these two objectives—access to space and competitiveness. Access to space includes launch

capability—I am talking about launch vehicles—and also the three other main functions of satellites, which are communications, a navigation satellite PNT, and Earth observation.

Talking about launch capability, we have two kinds of launch vehicles. One is the H-IIA rocket, which is a liquid-propellant launch vehicle; and the other is Epsilon, which is a solid-propellant launch vehicle. Last December, just one month ago, Mitsubishi Heavy Industries specifically launched the UK's Inmarsat satellite from the Japanese launch site, Tanegashima Space Center. That kind of access to space capabilities is very important for Japanese space policy.

Talking about Earth observation, we have operated optical sensors, optical telescopes, Earth observation satellites and also radar satellites—specifically, synthetic aperture radar, SAR, satellites—for more than 25 years, which contribute to not only disaster monitoring, or disaster response, but also to climate change issues.

Talking about navigation satellites, JAXA developed the first Japanese navigation satellite called QZSS, Quazi-Zenith Satellite System, and launched it 11 years ago. We have transferred that system to the Japanese Government, specifically speaking the Cabinet Office. The Cabinet Office is currently operating the Japanese navigation satellite system. By the way, the Japanese navigation satellite system is not global; it is a regional navigation satellite system.

Talking about communications satellites, two years ago we launched an optical data relay satellite, which is very important in terms of international competitiveness, communication capacity and the spacecraft mass system. These are the main functions of satellites that we are developing and operating.

Q314 **Carol Monaghan:** Obviously, Japan is a little further down the line than the UK in terms of launching. Could you say a little about how you worked with the Japanese Government to develop your space strategy?

Dr Yamakawa: Basically, the space policy is established by the Government, and we provide mainly technical input to the Government to assess the space policy. That is the basic strategy. The important point is that we are always developing new technologies to make a more vibrant space strategy. That kind of communication with the Government is always happening.

Q315 **Carol Monaghan:** You feel it is something that can develop and mature over time.

Dr Yamakawa: Yes, I think so. I did not mention space debris removal. For example, we are right now developing a space debris removal satellite that will launch this year. We also would like to make it a commercial activity in the near future. That kind of technology development is heavily related to the space policy. I am talking about

international competitiveness not only in terms of Government capability but also industrial capability.

Q316 **Carol Monaghan:** Thank you. Turning to Dr Baptiste, I am not sure if you heard the question, so I will repeat it for you. In terms of improving or accessing core capabilities of communications, Earth observation and PNT services, what sort of work has your agency been doing in order to push this forward?

Dr Baptiste: Sorry, I think I had communication problems, so I am not sure you heard my answer to the first question.

As far as the second question is concerned, what we are doing today in France is that we are mostly working on this topic inside the European community with our European Space Agency. As I mentioned before, about half of our effort goes through ESA and the other half is either national programmes or bilateral programmes that are run jointly with another partner—typically Japan, India, or NASA, or partners like this.

If I understand your question, to develop these new capabilities around Earth observation and communication, we try to invest in research and technology in advance. We have R&D programmes that we are building jointly with our industry to prepare the next breakthrough, or what we believe will be the next breakthrough, and to be able to have a national and a European industry that is at the top level in terms of technology.

Q317 **Carol Monaghan:** Do you see yourself looking at what ESA is doing and you fit in around it? France is a major contribution to ESA's budget. Do you see yourself just leaning on that contribution to draw down on ESA research, or do you see French programmes independent of the ESA programmes, or are they all interlinked?

Dr Baptiste: That is a very good question. It varies a lot depending on the kinds of applications we are talking about. Typically, if we are talking about defence and security applications, most of the time what we are doing is not related to what we are doing with ESA. On the other side, if we are talking about Earth observation, there are very strong interlinks. Most of our efforts go through ESA, and we are doing some equipment that fits into ESA missions. At the same time, we have a couple of programmes that are independent of ESA, but, in this case, we always try to be complementary.

I must admit that we also try to use good opportunities. Typically, we have many programmes in science with NASA because they are great partners, and, typically, we have a long-standing relationship on several topics—sorry, the English term escapes me—

Carol Monaghan: Thankfully, you are not trying my French.

Dr Baptiste: —to measure the depth and level of oceans. We are very good at that. We have been working a lot with them over the years, and

we are still doing this in a bilateral framework, but of course we try to make this consistent with the overall effort that we do inside ESA.

So, basically, there is no simple answer to this question. It depends a lot on the topic we are talking about.

Q318 **Carol Monaghan:** Can I ask a final very quick question of you then? When you are developing space strategy in France, from what you are saying, the defence capability is separate from the ESA priority. Would your strategy have both those elements within it, or is it driven more by ESA goals, or, I suppose, by French independent goals?

Dr Baptiste: The current ESA strategy is an input when we are building the French strategy. Of course, we take this into account. On top of that, we try, as all other member states do, to have an influence on the strategy of ESA. It is not only an incoming element to build our own strategy, but it should also be a bit of an outcome of what we are planning inside. This is a complex exercise.

Carol Monaghan: Thank you. Merci.

Chair: Thank you very much indeed, Carol. In the interests of time, I think we are going to have to speed up a bit in the questions and answers. I am going to go to Zarah Sultana and then Rebecca Long Bailey.

Q319 **Zarah Sultana:** Dr Yamakawa, how much do the Japanese Government spend on space activities, and how much does your agency receive from that budget?

Dr Yamakawa: The whole Government budget for space is £3.2 billion for this year. Of that, JAXA's budget is about £1.5 billion. JAXA's budget is about half of the whole Government budget for space.

Q320 **Zarah Sultana:** Do you work with the Japanese Government to create this budget?

Dr Yamakawa: JAXA supports the Government in terms of the technology base. We will always talk to the Japanese Government about near-future missions and programmes, and through that process we communicate our budgetary requirements to the Government.

Q321 **Zarah Sultana:** Dr Yamakawa, you mentioned that you have an annual budget of £3.5 billion. How is that split in terms of funding for civilian and defence space programmes? Is it a 50:50 split or more than that, or different from that?

Dr Yamakawa: I do not have the exact number, but the biggest budget goes to JAXA and JAXA's budget is mainly for civil space activity. The other major budget goes to the Cabinet Secretariat—the Cabinet Office—and the Ministry of Defence. Those Ministries use those budgets not only for civil but national security.

Q322 **Zarah Sultana:** Dr Baptiste, how much is the French Government's annual budget on space activity and of that how much does your agency receive?

Dr Baptiste: I do not have a very precise answer, but most of the budget for space goes through CNES, but not all of it. I would say that a ratio of 75% to 80% would go through CNES.

Q323 **Zarah Sultana:** Do you work quite closely with the French Government in deciding or working towards that budget?

Dr Baptiste: Yes, very closely.

Q324 **Zarah Sultana:** Dr Yamakawa, does your agency have access to launch sites in Japan?

Dr Yamakawa: We have our own launch sites. We have two launch sites in the southern part of Japan and have been operating those for about 60 years.

Q325 **Zarah Sultana:** Are they publicly or privately funded?

Dr Yamakawa: They are publicly funded.

Q326 **Zarah Sultana:** Dr Baptiste, is it the same for you in France?

Dr Baptiste: For France, the launch site is the European launch site in Kourou in French Guiana. There was a deal in 1975 involving all Governments to make this launch site the European launch site for all heavy launches. It is completely open to ESA activities, but, to try to sum it up, it is basically run by CNES and the French Government. At the launch site we have many facilities that are owned by private actors: ArianeGroup, ADEO and so on. Many industrial actors are there.

Q327 **Zarah Sultana:** Who is responsible for the regulation of the launch sites?

Dr Baptiste: CNES; we are responsible for it.

Q328 **Zarah Sultana:** Dr Yamakawa, in terms of your agency and launch sites in Japan, who is responsible for the regulation of those?

Dr Yamakawa: We are responsible for the operation of the launch site, but the Cabinet Office is responsible for providing the launch permit.

Q329 **Zarah Sultana:** When it comes to your agency's activities, do you find yourself collaborating with industry on projects, and what benefits do you find that that brings to the work you are doing?

Dr Yamakawa: One of the aims of JAXA is to strengthen the international competitiveness of the Japanese space industry. Of course, we collaborate with the Japanese space industry. I would like to note one collaboration with space start-ups or venture companies in Japan. We collaborate with those SMEs by providing both financial and human resources from both sides. JAXA and small companies provide their financial and human resources to develop new kinds of technologies for

their businesses and create new businesses with the possibility of providing positive feedback for JAXA's future missions. We are doing that kind of collaboration with SMEs in Japan.

Q330 **Zarah Sultana:** Dr Baptiste?

Dr Baptiste: Collaboration is really key for us. This is part of the DNA of CNES. Over the 60 years we have been running we have always tried to push technology and create business with the technologies that we develop inside CNES.

If I take two examples, this is typically the case for the launcher business that was started in CNES and then became European and was transferred to ArianeGroup. This is also the case, if I take another example, for the SPOT programme for the Earth optical observation programme. It was created inside CNES and after it became the Pléiades programme, which is now completely run by industry. We believe this is a very strong model. You build the technology and when it matures you push it out to industry. You need to have strong interaction with industry as early as possible. Now everything is changing because of the new space that is coming because of start-ups.

Zarah Sultana: Thank you.

Q331 **Rebecca Long Bailey:** Is your space industry currently suffering from a skills shortage, and, if so, what action would you like to see to address it?

Dr Yamakawa: I beg your pardon. Could you repeat your question please?

Q332 **Rebecca Long Bailey:** Is your space industry currently suffering from a skills shortage and what action would you like to see to address such a shortage?

Dr Yamakawa: If I understand correctly, yes, we are suffering from a skills shortage. We would like to enlarge the size of the whole space industry because the space industry itself is very important to the Japanese economy. At the same time, the space industry supports the Japanese Government's space activity. Both are very important in terms of growth of near-future space activities. We are trying to scale up the size of the Japanese space industry.

Q333 **Rebecca Long Bailey:** Dr Baptiste, I put the same question to you.

Dr Baptiste: I give a slightly different answer. Roughly speaking, the answer would be no because the space industry, space business and working for the space agency is something people love. We have a lot of applications. We do not really suffer from a shortage. Of course there are some specific profiles where it can be difficult, even in the space business, to find a good data scientist, especially due to the fact that we do not have exactly the same attractiveness in terms of salaries as other industries, but, roughly speaking, the answer is no. It is very attractive.

Q334 **Rebecca Long Bailey:** My other question is about international collaboration. Who are your main international collaborators, and how do you benefit from these international collaborations?

Dr Baptiste: As I mentioned earlier, our primary collaborators are inside ESA, so that is very clear, but we want to keep up very strong international collaboration. As to the countries with which we want to work, given the technical level of the agencies, which is basically the main driver for us, NASA is pretty good and has a lot of very interesting programmes. NASA is one of our key partners. We have JAXA, with which we have several programmes, but we also have India and China. We still have some programmes with Russia but quite a lot less than we used to have. On top of that, in total, I think we have about 45 bilateral agreements with many countries all over the world, but the key partners are those that I have mentioned before.

Q335 **Rebecca Long Bailey:** Thank you; that is very helpful. I put the same question to Dr Yamakawa.

Dr Yamakawa: I think international collaboration is key and very important for the success of space missions. JAXA has so many international collaborations with about 70 countries, including NASA in the United States, ESA, the European Space Agency, CNES and of course UKSA. I am delighted to say that we signed a memorandum of co-operation with the United Kingdom Space Agency last year covering, for example, sustainable and safe utilisation of the orbiting environment as items of co-operation. Under that memorandum of co-operation, implementing arrangements were signed to co-operate with the UK Defence Science and Technology Laboratory, DSTL, for space debris collaboration. This kind of bilateral collaboration is the key for maximising the output of space missions.

JAXA is also collaborating in a multilateral way. For example, together with the Japanese Government we are hosting an international meeting called APRSAF, which is an abbreviation of the Asia-Pacific Regional Space Agency Forum. Every year we have the participation of 30 countries from the Asia-Pacific region. We are discussing possible future collaboration in many possible areas, so we are mixing both bilateral and multilateral collaborations.

Rebecca Long Bailey: Thank you; that is very helpful.

Q336 **Aaron Bell:** I want to ask about a specific programme: NASA's Artemis programme. Dr Yamakawa, JAXA is participating in Artemis. For what reason did you decide to participate, and what specific parts of the mission will JAXA be carrying out as part of Artemis?

Dr Yamakawa: JAXA, and before that the Government of Japan, decided to participate in the Artemis programme about two years ago, and since then JAXA is discussing with its international partners, including NASA, the European Space Agency and the Canadian Space Agency, how to proceed and maximise the output of the Artemis programme. The

Artemis programme is the next giant leap for humankind and we think it is very important for Japan to participate in that programme.

JAXA will collaborate with the USA and Europe in providing, for example, environment control and life support systems, power systems or thermal control systems. Those are the kinds of things we will provide. We will also provide a cargo transportation capability to the Gateway, which is a lunar orbiting station of the Artemis programme. Right now we are doing research and development of a manned pressurised rover that will be deployed on the surface of the moon. We are going to provide this kind of system within 10 years.

Q337 **Aaron Bell:** Do you also anticipate providing astronauts for the programme?

Dr Yamakawa: That is a very great motivation for us. We would like to send a JAXA astronaut to the surface of the moon.

Q338 **Aaron Bell:** Dr Baptiste, at this stage France has not signed the Artemis Accords and therefore is not part of the programme. The Artemis Accords are slightly separate from the programme. Those are an international agreement about the exploration of the moon, Mars and other planetary objects. Does France intend to sign the accords and does it intend to get involved in the Artemis programme?

Dr Baptiste: There are a lot of discussions right now between the US and French Government on this topic, so it is a little bit early to say. Let us say I am pretty optimistic on this. I think the question that all European countries should ask themselves is, "What is our European vision for human exploration? What is the place of Europe tomorrow on the moon and the day after tomorrow on Mars?" Of course, it is great to work with our American colleagues on the Artemis programme, but policy leaders in Europe should really think about a more autonomous and ambitious programme for the moon and Mars tomorrow. We are quite far away from that, but this topic will come up next year either during the space summit that will take place in Toulouse in February or later during the ministerial conference at ESA level. This is quite important for Europe in terms of political ambition.

Q339 **Aaron Bell:** Is it possible that Europe will almost seek to compete rather than collaborate on the manned exploration of the moon and Mars in the future?

Dr Baptiste: I am not sure that it is a matter of competition but let us start with an ambition. I am not sure that Europe today has a strong political ambition on the topic. If you look at what we did over the past 60 years, as far as France is concerned, basically we have always decided not to play with either the Russians or the US. I think that it was a very good and clever strategy. It was good in terms of budgets and investment. We invested most of our effort in technology and industries that had some important business outcomes. This was quite a good strategy. The question is whether it is still valid today. Does it still work

today or should we change it now? This is a question that every country in Europe should ask.

Q340 **Aaron Bell:** If Europe does not come to a collective position, is there something that France would consider doing on its own account as the leading EU nation in terms of your space budget?

Dr Baptiste: I am not sure I can answer that question right now.

Q341 **Aaron Bell:** Fair enough. Can I also ask you both briefly about space debris, which we have covered in previous panels? Most countries are looking to improve their space situational awareness systems. What is your country doing about this? Would you consider using your system to help other countries monitor space debris, and how do we solve the problem collectively? Who really should be responsible for the increasing amount of debris in space and international efforts to combat it?

Dr Baptiste: It is a key issue especially in the LEO space. Traffic is increasing; it is almost doubling every year. Recently, we have seen projects for constellations involving 300,000 satellites. They are great projects, but we need to regulate them at some point and we are still far away from that. We need to work on it. France is a funding partner of EUSST, which is in charge of this topic. My personal impression is that we need some kind of international regulation at some point. I am not sure we are ready to go there, but at some point we will have to consider the question. That is really my own personal view on this topic.

Q342 **Aaron Bell:** Dr Yamakawa, I believe that JAXA is monitoring space debris. Can you tell us a little bit about what you do already and what your thoughts are about international collaboration?

Dr Yamakawa: Securing safe and sustainable use of outer space is very critical and important, I think that international rule-making, in other words an international code of conduct, is vital for near-future space activities, especially in low-Earth orbit. JAXA has been operating its own satellites for more than 50 years. For our daily operations, collision avoidance with space debris is an imminent issue for us. For more than 20 years we have been using our own domestic optical and radio telescopes to observe space debris approaching our satellites and we are using those data to avoid collisions.

In addition, about eight or nine years ago the Japanese Government and JAXA concluded a memorandum of understanding with the US Department of Defense to share SSA—space situational awareness—services and information, so we are already doing international collaboration in terms of space debris issues.

Currently, the Japanese Government—more specifically, the Ministry of Defence—is developing the Japanese Government's SSA system—space situational awareness system. In this regard JAXA has been developing SSA radar and analysis systems and upgrading its optical telescopes and related technologies to contribute to the Government's SSA system.

In addition to that, we are currently developing a space debris removal satellite actively or positively to change or make better the low-Earth orbital environment.

Aaron Bell: Thank you very much; that was very helpful.

Q343 **Chair:** Dr Yamakawa, I do not know whether you heard Dr Aschbacher's concerns in the LEO field about the dominance of Starlink and his call for other jurisdictions, or collections of countries, to organise themselves to challenge that dominance. Is that a source of concern in Japan?

Dr Yamakawa: I would not say it is a concern. All I can say is that we have to tackle the increased population of space satellites and space debris in low-Earth orbit. I think humankind will launch new satellites and spacecraft in the near future. Anyway, we have to solve the problem. I am talking about avoiding collisions with space debris or, more importantly, active spacecraft—satellites. That is all I can say right now.

Q344 **Chair:** Do you think that requires some kind of international co-ordinating authority, or will technical advances be embedded into satellites to allow them to avoid collisions and suchlike?

Dr Yamakawa: We are doing our best in our daily satellite operations by data sharing with our international partners and also using our own ground systems to observe space debris. In addition to that, we need some kind of code of conduct or rule-making in low-Earth orbit to prevent collisions with space debris.

Chair: I am very grateful to both witnesses, Dr Yamakawa and Dr Baptiste, for joining us virtually. Space is an area that has long benefited from international co-operation. In our inquiry we are very keen to learn from the examples of other countries and you have helped us to do that today. Thank you very much indeed for joining us.

Examination of witnesses

Witnesses: Tim Johnson and Colin Macleod.

Q345 **Chair:** I turn to our final panel of witnesses. Being from the UK, they join us in person. I am very pleased to welcome Tim Johnson, director of strategy and policy for the Civil Aviation Authority, and Colin MacLeod, head of UK space regulation at the CAA. The CAA is charged with being the lead regulator for the space industry in the UK.

You have heard some of the previous sessions and have looked at the evidence the Committee has taken. There is something of a space race for launch, certainly in Europe, and a number of European countries and jurisdictions are advancing launch capability, for the very good reason that a lot more satellites are required to be launched. We manufacture and design them here. It would be very good to have these facilities available. Will we get to the point where we can have a launch in 2022?

Tim Johnson: Good morning and thank you for the opportunity to give evidence to the Committee this morning. First, let me say a little bit about what the CAA has been doing to support the mission. As you know, the Government have an ambitious and exciting strategy for space. Our role within that is to implement the regulatory framework set out by Parliament which puts public safety and other considerations, such as the environment, at its heart. Alongside that, that framework was designed with agility and innovation in mind as well, so the approach in that framework very much sets that out. As regulator, we will be very data and evidence-based in reaching those decisions.

It has now been five months since we were formally given the space regulation role. We were very determined to be open for business on day one and we met that objective. We have a fully resourced team of 35 people with a broad mix of capabilities, skills and experience to process the applications that we get. Since that time we have been engaging very actively with the sector. We have visited 17 space companies and have been holding multilateral and one-on-one meetings with space companies to explain the new regulatory framework and system as it relates to their applications. As of today, we have 14 applications in what we call a pre-application phase. Four applications have been formally submitted through our online portal and we are working very closely with those companies to move them through the regulatory framework.

In addition to processing licences, we have taken on responsibility for UK companies launching satellites. Since taking on the task on 29 July last year we have issued 74 satellite licences.

We are conscious that this is a new framework for the space industry, the CAA and the UK, so we have built in very much a learning approach as well. We have established two groups—one between the sector and regulator so we can have a regular dialogue about what is working well at a system level, and the Government through the Department for Transport, which owns the space regulations, have set up a similar group. We are meeting and engaging with the sector so that we can collectively learn as well as process applications.

Overall, we are very motivated and committed to our role, which is about putting public safety first, but making sure that the UK has an innovative and responsive regulatory framework. We are very evidence-based in what we do and we have a fully staffed team in place ready to receive and process applications in the most timely way.

Q346 **Chair:** You are set up; you have had these applications. Do you expect a launch in 2022?

Tim Johnson: We absolutely share the Government's and the industry's enthusiasm and commitment to this task. We are open for business and are processing applications. The key driver of the timetable will be the quality of the applications and the evidence presented.

Q347 **Chair:** The Government have said they want to see a satellite launch in the UK in 2022. You are the regulatory authority and have had sight of these things. Are we on track for that?

Tim Johnson: There is a lot of work to do and we are working hard in assessing the applications that we are getting, working with the operators and providing them with feedback, and we will exercise our duties in the most timely way possible.

Q348 **Chair:** It is not clear from that whether or not you expect that to happen. What is your expectation? Do you expect to launch from one of these sites this year?

Tim Johnson: We will be doing everything we can.

Q349 **Chair:** I know you will be doing everything you can but give the Committee your assessment seeing the applications that have been made. We are halfway through the first month of the year. Do you expect to license a launch during this year?

Tim Johnson: We will do everything that we can. We have everything in place.

Q350 **Chair:** I know that, but what is your assessment of whether that is likely to result in an approval?

Tim Johnson: Much of that depends on the quality of the applications.

Q351 **Chair:** You have seen them. What is your reflection on the quality of them?

Tim Johnson: There is a lot of work to do in 2022. A lot of things need to come together from many different parties. We as the regulator have a key role to play in that and we will be doing everything we can during the course of this year to—

Q352 **Chair:** The Government set an ambition, appropriately given the kind of pace and agility you mentioned, for a launch in 2022. From the tone of your unwillingness to make any assessment, were the Government mistaken? Were they whistling to keep up their spirits in this rather than it being based on a meaningful prospect?

Tim Johnson: It is absolutely right for the Government to set out some ambitions. Parliament set out the regulatory framework, and the whole system, whether that be the Government, the space sector itself and the CAA, are working very hard to achieve that end.

Q353 **Dehenna Davison:** I admit that I am a bit disappointed that we have not been able to get a clear answer from you on the question the Chair just posed about whether you do expect a launch by the end of the year. Can you give us a yes or no?

Tim Johnson: I think I have already set out where we are in the process and what we are doing. The CAA understands the importance of

timeliness in this regard and is committed to that. We are doing absolutely everything that we can to achieve that.

Q354 **Dehenna Davison:** Some of the feedback we have had in past evidence sessions is that some of the companies that have been looking to obtain licences have felt that the process is quite complicated, expensive and time-consuming. We have had more positive feedback more recently. Obviously, it took some time for you guys to get settled in and get your teeth into it, but what proactive steps are you taking to make the process as simple as possible, but also as timely as possible, because we want to make sure that the UK is incredibly competitive in this market, and if we are losing the opportunity to get some of those first launches it could be a real problem?

Tim Johnson: Perhaps Colin can set out the process.

Colin Macleod: We have set up a very open engagement policy with applicants. Maybe it is worth talking a little bit about how they apply, what we are doing and how we are adapting to that.

First, when companies want to look at launching in the UK, we have a pre-application process where we engage with them, spend some time with them and talk them through what is required of them, and what it looks and feels like for them to apply. We have set up an online portal so that organisations can go online and start the application process. Once they start that process and send us a complete package of information, including importantly the safety case, which allows us to assess the safety implications, we can then assess the application. But we also assess things like environmental impact; we assess the company, its capability and operations, and at that point we undertake some statutory consultation set up by Parliament with other regulators, such as the Office for Nuclear Regulation and the Health and Safety Executive, and then we can issue a licence.

Once we issue a licence, that does not actually mean launch because we do not want the issue of a licence to be a critical point on that journey for the applicant. Once a licence is issued, the operator still has a number of things to do before launch. That could take anything from four weeks upwards. All of these things are within the control of the applicant and the technology they use. For example, you would not undertake the emergency testing of your operation until after you had a licence issued.

In terms of what we are doing to help, we have been in place for five months. We have one spaceport and one launch operator licence, although, as Tim said, we are speaking to lots of other applicants. We have developed some new products and identified companies that are having trouble. We have developed and rolled out workshops either in groups or with specific companies that apply to help them understand what more they need to do. That has been very effective.

On your question about international competitiveness, we absolutely feel that we are at the front of international regulation on timescale. The only real comparator is the United States, which takes six months to do the formal application, but it normally works with applicants for two to five years before that point. Therefore, it is looking at two-and-a-half to five-and-a-half years to issue a licence. We expect to be doing it within around 18 months from launch, but the biggest factors in that timescale are how well the applicants can explain their safety to us. They are the experts and they know their technology, and the whole point of our approach is to enable innovative space activity to take place, so they are the biggest determinants in how quickly we can move.

Q355 **Dehenna Davison:** Just to confirm the timescale that you laid out, if I come to you today and say I operate a spaceport and want to get a licence for launch, are you telling me that the entire process from that approach to the actual launch date should be somewhere between nine and 18 months, or is that purely for the licence to be granted?

Colin Macleod: There are two different licences for spaceport and launch. For the spaceport, we are expecting it to be between six and 12 months because it is slightly more straightforward than launch. The majority of the risk is around launch. We have said for a number of years as we have developed the regulator with the rest of government that we expect those kinds of timeframes. The determining factors would be, "Have you launched your rocket before? Where are you launching it from?", because ground safety is one of the riskiest elements. If you are launching from a place where there are a lot of people, you need to have a much greater level of safety and, therefore, the insurance and mitigations you might have to put in place would be greater.

Space is cutting edge and innovative. Every application is different. Lots of American companies will take many years. Therefore, in the UK we think that nine to 18 months is a very competitive timeline for what we are trying to do compared with everyone else.

Q356 **Chair:** The Committee has taken evidence from various witnesses—I am sure you have seen some of the sessions—including from spaceport operators. The deputy chief executive of SaxaVord, which is the proposed Shetland launch site, confirmed what you said. He said they were told by the CAA "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." What would you say to that concern?

Colin Macleod: I have just mentioned that the spaceport licence should be nearer six to 12 months; the nine to 18-month period is for the launch vehicle, which is the complicated part of it. It depends on how good and high quality the application is, but also the location of the spaceport in terms of how many people are there.

Q357 **Chair:** Have you had the application from SaxaVord yet?

Colin Macleod: I do not think it is appropriate for us to talk about whether applicants have applied yet. We will be releasing information when we issue licences, but we are talking to a very large number of applicants.

Q358 **Chair:** Once you receive their application it could be as little as six months, so it could be done this year.

Colin Macleod: It is entirely dependent on what they give us in terms of their safety case and the operations that they want to undertake. There is no generic spaceport licence. Every spaceport will have a specific licence that is dependent on the risk associated with the operation and where the vehicle is being launched in terms of the air and marine environment it is overflying.

Q359 **Chair:** We heard in the previous session from international witnesses that sometimes the national space agencies are responsible for or associated with licensing. Do you feel that you have sufficient commitment to make a success of this programme? Have we made a big mistake in sending this into a kind of bureaucratic deep mine?

Tim Johnson: We are building good relationships with some of our overseas peers, particularly the Americans and the FAA, which licenses US space activity. We have put an FAA secondee into our space regulation team so we can learn from what it does. In the short term, individual states have their own licensing regimes. For example, the US space operators wanting to launch in the UK will need to have a US licence as well as a UK one. That is why we are working with the Americans. Where there are things we can learn from each other we do that. As Colin has outlined, some of the analysis and requirements to deliver a licence are mission-specific, so there will be limits to that.

I think that in the longer term there will perhaps be questions about international regulation across the wider space sector, thinking of parallels with aviation where there is a global framework that creates a baseline for international aviation activities. We are probably some way away from that and that will be a longer-term prospect, but in the short term we are working with other agencies, particularly the Americans.

Chair: There is a question that Aaron Bell was going to ask later on but it is germane to this and might provide an explanation for some of the stasis here.

Q360 **Aaron Bell:** The Chair quoted Scott Hammond. Later in the same session Pete Guthrie of Space Hub Sutherland asked direct questions that we should probably put to you now. He said, "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." You have referred to six to 12 months. He then said that, unlike where you would have an

airport and maybe another one 15 years later, these are all happening at the same time. He asked: how big are the CAA's shoulders? Is it sufficiently resourced to be able to look at multiple licences at the same time? If they are not big enough shoulders, how are they going to prioritise one spaceport over another, or one application over another?

Tim Johnson: I think there are two key parts to that answer. First, we have scaled the team to what we think the work will be.

Q361 **Chair:** You have a team of 35.

Tim Johnson: Yes, a team of 35. We have built that in a very flexible way. We have space, regulatory and policy expertise, but we have a degree of flexibility so we can reallocate and readjust the team depending on the phasing of the applications that we get.

Q362 **Chair:** What is the total staff of the CAA?

Tim Johnson: Currently, the total staff of the CAA is about 1,200 people.

Q363 **Chair:** You have 35 set up to do, as Aaron says, a mass of parallel applications. Is that enough?

Tim Johnson: Yes. We have built some additional flexibility into that model. We have the FAA secondee; we have a number of contracts with third parties who can assist us particularly with some of the technical evaluations with the European Space Agency, for example. We have built the model with flexibility for a potentially changing work flow, and if we need to increase the size of the team we will do so.

Q364 **Aaron Bell:** The key consideration for these commercial firms is that they will be treated fairly. Will the first application be dealt with first, or will you handle all of them in parallel?

Colin Macleod: It is almost as you suggest, in that when we receive an application on the online portal we will do an initial safety screening to make sure that all the information is there. We then have an iterative process with the applicants where we ask for more information where that is required. They will then respond to us. As Tim pointed out, we have developed this space regulatory model on the basis of the forecast of the number of spaceports, which has been well known for a number of years. The staff and the call-off contracts for consultants that we put in place are matched to what that demand was.

Demand is starting to increase, as the Chair mentioned earlier, and the number of satellites are growing. We are seeing increasing demand, but within our scale of model currently we are looking to be able to achieve that. The biggest risk we have discovered so far is as we expected and is in line with our experience of other deep technical safety case sectors. Applicants tend to take longer than they think to complete the applications, and that is why we are putting in extra support, where we can, to help them through those most difficult stages.

Q365 **Aaron Bell:** In fairness, I should say that the same people praised your overall approach. I think the concern is about the capacity and equity of the process when this crunch arises. Are you both satisfied that there will not be any issues about equity or indeed capacity, and you will get them approved as quickly as possible, assuming that the applications are up to scratch?

Colin Macleod: At this point five months in, given the applications we have received and the engagement we are having with the sector, I am comfortable that we are okay for the next year, but we are keeping it under review. We are currently looking at the forecasts for 2022-23 onward. If we need more resources to help us with the volume coming in, we have the mechanisms in place to draw them in. As Tim said, we have a number of call-off contracts that are flexible where we can bring in capacity or capability, or both, to help the team deal with any new, novel situations that we were not expecting.

Q366 **Aaron Bell:** Mr Johnson, do you want to add anything?

Tim Johnson: I support what Colin has said based on what we know today. We will flex the size of our capacity and team as we see applicants coming to talk to us. The good thing is that the UK's regulatory regime is very visible. We are talking to lots of people and I think that helps us build a good understanding of the types of people who want to come to the UK. We have been positively surprised by the number of people who want to come to talk to us. These are not just UK companies but companies from the USA and a good number of launch companies from Europe. That early engagement starting well ahead of an application landing through our online portal helps us build that picture of likely timescales and volume, and then we have a chance to reflect that in our resourcing model.

Aaron Bell: The international interest is encouraging, but obviously it will potentially cause challenges for you again in terms of the need to flex.

Q367 **Carol Monaghan:** I would like to focus on the liability cap. Mr Johnson, perhaps I could begin by posing a couple of questions to you. We have received overwhelming evidence from the space industry about the difficulties in getting insurance cover without absolute certainty on the liability cap. Many other countries have a cap of €60 million. This has been going on for a number of years. Last May, the Government produced a taskforce on innovation, growth and regulatory reform. Buried among this in proposal 15.1, there was a proposal to amend the Space Industry Act 2018 to cap liability and indemnity requirements for licence applications to launch and operate satellites from the UK.

The feeling from industry is that they have been consulted time and time again and they keep saying, "We need a cap on liability in order to get insurance." Where are we with that? What is happening with that liability cap? Are we going to get any certainty on that?

Tim Johnson: I will answer that in two parts. First, what happens for satellite launches? That is a continuation of the existing regime where the requirement is for operators to have insurance of up to £60 million for launch.

Q368 **Carol Monaghan:** There is some uncertainty around what is considered high risk.

Tim Johnson: The current approach in the UK and the model of insurance requirements is about looking at the risks of each particular operational mission. Operators will be required to have insurance up to that cap, but the Government have been very clear that they will not be expecting operators to bear unlimited liability; they will expect them to have insurance in place. That is the policy that we will be applying when we come to undertake our licensing activities.

Q369 **Carol Monaghan:** This industry needs something to kick-start it. We are hearing from the answers you have already given that a launch in 2022 is not certain, so we need something to make sure that the sector is supported in the UK and that launches can actually happen. Is the CAA doing anything to push the Government to underwrite the cost of the insurance entirely for the first couple of years in order to get this industry off the ground?

Tim Johnson: Can I ask my colleague to pick up on this point?

Colin Macleod: To try to tease this out a little bit, the UK is a signatory to the United Nations convention on liability, so the UK is responsible for the element of liability of space activities undertaken by the UK.

We have a couple of different scenarios. The existing policy on the €60 million cap for satellites under the OSA—the Outer Space Act—for UK companies launching abroad remains as it was; that has always been there. For UK companies launching satellites from the UK, that will be dealt with under the Space Industry Act, and again that will have a €60 million cap, as is currently in place. It is just worth noting for the Committee that for the UK space industry consultation on those aspects of the €60 million cap closed on 7 January of this year for industry to submit comments. We will implement whatever mechanisms or policies on satellites that the Government decide to implement.

On launch, as Tim said, it is a model insurance requirement. It is a global methodology and is similar to that for other countries. The legislation and regulations set out that that is how Government wish us to assess it. I think the model insurance requirement is very good for space because it means you consider each application on its merits. Therefore, a high-risk vehicle from a high-risk spaceport with a new operator will have a higher liability cap than for a lower-risk operation and mission with a vehicle that has been used many times before.

Currently, I think that launch insurance mechanism is very reflective of the risks and is in line with policy and making sure that those with the highest risk have to carry the highest burdens.

Q370 **Carol Monaghan:** But it is not in line with policies in other countries, so we do put ourselves at a disadvantage, do we not?

Colin Macleod: All countries have very different levels. America uses a maximum probable limit calculation for launch and sets out risks according to the vehicles. In the UK our model is very similar. I am not sure that we are at a disadvantage other than perhaps in terms of value. As for risk and protection of the public, we do it in a very similar way. A lot of countries like America can have a much lower risk associated with their operations because there are many fewer people and the environment in which they operate has a much lower risk.

Q371 **Carol Monaghan:** Can I ask a question I have already asked about the Government underwriting the insurance for the first couple of years in order to get this industry off the ground? Have there been any discussions about that?

Colin Macleod: From the perspective of the CAA, we are not involved in deciding what Government policy is on this. The Government have to underwrite all the policy above a maximum amount. What I would say is that, as Tim mentioned earlier, we are having lots of conversations with lots of launch companies across Europe, America and the UK. In all of the discussions we have had with them so far this has not been an issue for them.

Q372 **Chair:** Mr Macleod, you said that the regulatory process and the time taken depends on the applicants providing the necessary safety information. Obviously, it is absolutely crucial that safety is paramount in this. As Aaron says, the CAA has a very good reputation on this. What are you doing to help applicants prepare the safety case, given that this is a novel area, rather than waiting for them to get it right, as it were?

Colin Macleod: As the independent regulator in a safety case model, we cannot write the safety case for them, but various guidance has been published, statutory and otherwise. There are about 1,000 pages of guidance that help applicants to understand what the system is. On safety cases, we have been developing workshops where we engage either with the industry as a whole or specifically with the company on its specific application and risks to try to help them understand the methodology, if they are not within the UK.

There is a very well-used approach in the UK. The Health and Safety Executive is a global leader in using the safety case approach not only to ensure public safety but to encourage a continuous improvement safety culture within high-risk industries such as space. We are also currently looking at developing additional courses that we can offer to the space sector—spaceport applicants, operators, etc.—in the overall system as well as just the safety case.

Q373 **Chair:** You have a regulatory responsibility for a mature industry. In the aviation industry things are well established, but you have taken on something that is new and emerging. These applications are the first of a kind. One might think that there will be some iteration required here. Given the relative resource that you have, are you imposing a mature system on something that requires more hand-holding?

Tim Johnson: We absolutely understand that this is a new area. I spoke earlier about some of the feedback and learning mechanisms that we have already put in place. You are right that aviation is in one sense very stable, although there have been innovations in that over many years. Across other parts of aviation we are seeing quite a lot of innovation and rapid technology development. I am thinking about drones, urban air mobility and new forms of propulsion. I think that across a range of the CAA's activities we are seeing a similar sort of agility with new operators coming into the market wanting to operate in different ways. Across the portfolio of activities we are able to learn and apply some of the practices we are learning from and apply them across the board.

Q374 **Chair:** The reason we are holding this inquiry and taking evidence from witnesses from other countries is that everyone recognises this is a big opportunity in space. One might have thought that, if you are going to do that, a regulatory side is important and so you would put a major effort and resource into it. I have to say that in an organisation of over 1,000 people is it enough to have only 35 people working on it? Was that your choice or was it imposed on you by specific funding allocated from the Department for Transport?

Colin Macleod: I would say that the model we built was cross government. The model and financing associated with it was driven by the applications, which was the other question. They were built on the basis of the forecast. We went into quite a detailed assessment of how long it would take us to do each assessment based on a lot of experience in other sectors, so it was not driven by budget but by need. We do have the flexibility to scale this model up and down.

The other point that is crucial for the space sector is that the approach taken is to be as effective as we can be for very innovative and new companies. Unlike the FAA model, which has been very successful for 50 years and is very prescriptive and limited—for example, it says you must have a certain thickness of material for a fuel tank—we do not have that. We say, "You have developed a brand-new material for your fuel tank. That is brilliant. You tell us why it is safe. You show us how it is safe." That is why we are getting lots of interest from other companies, because the approach is to deliver against the new technologies developed by the sector as effectively as possible.

As I mentioned earlier, in terms of international comparators we are quite quick. There is no shortcut to safety; it is a very high-risk activity. First launches are extremely high risk. Therefore, we put the public first, but we want to work with the industry to make sure their applications and

new technology can be delivered as quickly as they are able to deliver them.

Chair: That is absolutely clear. Obviously, safety does come first. We see the risk of accidents in launches. The reputation of UK regulation is very strong on that, and no one doubts the commitment and hard work you are putting into it. On your behalf perhaps we might have some thoughts as to whether you could do with some extra help so you do not need to work quite as hard individually. You have been very helpful in coming to guide our inquiry this morning. Thank you very much indeed for your evidence. That concludes this meeting of the Committee.