

Environmental Audit Committee

Oral evidence: Net zero aviation and shipping, HC 520

Wednesday 30 March 2022

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[Watch the meeting](#)

Members present: Jerome Mayhew (Chair); Duncan Baker; James Gray; Ian Levy; Caroline Lucas; Cherilyn Mackrory; Valerie Vaz.

In the absence of the Chair, Jerome Mayhew was called to the Chair.

Questions 254 to 336

Witnesses

I: Helena Bennett, Senior Policy Adviser, Green Alliance; Andy Cornell, Representative at Renewable Transport Fuel Association, and CEO, Advanced Biofuel Solutions Ltd; Dr Neville Hargreaves, Vice President, Waste to Fuels, Velocys; and Paddy Lowe, Founder and CEO, Zero Petroleum.

II: Jonathon Counsell, Group Head of Sustainability, International Airlines Group; Jonathan Hinkles, Chief Executive, Loganair; Hemant Mistry, Director of Energy Transition, International Air Transport Association; and David Morgan, Director of Flight Operations, easyJet.

Written evidence from witnesses:

[Green Alliance](#)

[Velocys](#)

[International Consolidated Airlines Group \(IAG\)](#)

[International Air Transport Association](#)

Examination of witnesses

Witnesses: Helena Bennett, Andy Cornell, Dr Neville Hargreaves and Paddy Lowe.

Chair: Welcome to the fourth evidence session of the Environmental Audit Committee examining net zero aviation and shipping. We have two panels today. The first panel is starting now and we will start a second one at about 3.20 pm. Both panels will be considering the issues surrounding aviation and sustainable aviation fuel.

We are very glad to be joined by the witnesses in the first panel: Helena Bennett, Andy Cornell, Dr Neville Hargreaves and Paddy Lowe. Each of you in turn please introduce yourself and say a little bit about yourself, starting with Dr Hargreaves.

Dr Hargreaves: Good afternoon. I work for Velocys, which is a technology company that has technology for making synthetic fuels, in particular sustainable aviation fuel. I am leading a project, in partnership with British Airways, to build a full-scale commercial waste-to-fuel plant in north-east Lincolnshire.

Paddy Lowe: Good afternoon. I am CEO of Zero Petroleum. We are a company based in the UK seeking to commercialise synthetic fuels of the industrial format. These are fuels made from atmospheric carbon dioxide rather than from any pre-existing feedstock.

Helena Bennett: Good afternoon, everyone. Thanks for having me here. I am a senior policy adviser at Green Alliance, which is an independent think-tank and NGO based in Westminster. I work in our climate policy team and we are currently undertaking a three-year programme on transport decarbonisation, part of the remit of which is to look at aviation decarbonisation. We are currently wrapping up a report on power-to-liquid fuels and its feasibility for scaling in the UK.

Andy Cornell: Hello, everybody. I am Chief Executive of Advanced Biofuel Solutions Ltd. We are a company that designs, develops, owns and builds plants that convert waste and biomass into various different biofuels.

Q254 **Chair:** Thank you very much. My first question is essentially to set the scene about what is sustainable aviation fuel and the benefits that it may give us over the next 20 or 30 years. Starting with Dr Hargreaves, what are the potential benefits and disadvantages of SAFs and how can they contribute to the net zero future of aviation?

Dr Hargreaves: If we look at decarbonising aviation, at the heart of it is about the propulsion. SAF is really the only energy source that is suitable for all types of aircraft, including long haul as 73% of the world's aviation carbon emissions come from flights over 1,500 kilometres. The other technologies—such as hydrogen and electric—are not suitable for big aircraft and long distances. We have to do many things if we want to



decarbonise but the most important is to bring in sustainable aviation fuel. The big advantage is that it can be used in today's planes—no changes to planes, no changes to infrastructure; it is suitable for all aircraft and it is available now.

Q255 Chair: You call it sustainable and that can cover a multitude of sins, as we have learnt in previous evidence sessions. How sustainable is SAF? In your answer, perhaps you could look at the level of carbon emissions, greenhouse gases associated with its production and use but also in its use of landmass and the competition for agriculture.

Dr Hargreaves: It might be helpful to group carbon sources for SAF into three. The first, and the only one that is in commercial production today, is from lipids, from fats and oils. That can typically achieve up to about 80% carbon reduction compared with conventional fuels and it is the cheapest. Its big disadvantage is that there is not enough feedstock to meet all the needs of aviation. That comes back to your point about competition. Some of that feedstock is being used for biodiesel, which is an easier conversion for it. If we were to turn it into SAF we would not be using it for another purpose.

I think that we have to move on to the other two sources. The second is solid material, municipal solid waste, forestry residues, agricultural residues. This is a much bigger set of feedstock and the decarbonisation that can be achieved is anything from 60% to, in our case by coupling it with carbon sequestration, about 150%. We can get a net negative emission fuel because we are taking waste carbon that either came from the atmosphere relatively recently or, in the case of some of the waste, it would have been burnt anyway if we did not do this with it. We are turning some of it into fuel and we are sequestering some of it. That is how we can get to negative emissions. Not all plants will be negative emissions but some will be.

The World Economic Forum did a piece of work a couple of years ago looking at the potential supply. Somewhere between two-thirds and all of the worldwide demand for aviation fuel could be met by a combination of those first two types. However, it depends on assumptions about what else you might do with it, for example in the road sector.

I will come to the third one, carbon dioxide, which I am sure Paddy will talk about in a bit more detail. Using carbon dioxide as the sole carbon source and all your energy comes from electricity, you can achieve 100% carbon saving with that, but you need an awful lot of energy because the carbon dioxide does not contain any.

Q256 Chair: That is a good segue on to you, Mr Lowe. Do you want to expand on that first answer?

Paddy Lowe: Yes. Thank you, Neville. That is a terrific answer to set the scene. I will add a couple of points. The big issue with aviation is energy density. The power, the energy used by an aircraft is a function of its



weight itself. The heavier the energy store, the more power you are using to fly and most aviation is a commercial operation, so weight of energy is payload lost and, therefore, margin lost. It is a very big factor. Other than in very niche types of aircraft, we do not believe an electric aeroplane is viable for mass travel, for long distance travel, just simply on the basis of weight. Our number suggests 50 as the factor of energy density between a battery and the current liquid fuels that are used.

Even if you moved to hydrogen—which is a very dense energy form, denser by mass than the liquid jet fuel used today—you have to put it in very heavy containment. By the time you do that, it is about five times worse on weight than liquid jet fuel and terrible on volume as well. I have not calculated this but if you imagine the airliner from about row 15 will be a hydrogen tank going to the back. That is the type of scenario. Liquid jet fuels are the solution going forward for the vast majority of air travel because of the energy density.

We all seek in SAF, by different avenues, to provide the same fuel we use today but coming not from fossil carbon but from other routes, as Neville explained. In our company we concentrate on the third sector that Neville mentioned, which is full synthetics. That is to take carbon dioxide from the air, to take water from the air or from ambient, and turn that into fuel, which chemically is simply a reversal of what happens when you burn the fuel. When you burn jet fuel, or any of the petroleum fuels, you produce water and carbon dioxide and we reverse that to create the fuel again.

Q257 Chair: We will discuss this a bit further later on in the session, but the question that springs to mind for me is the loss of energy required or the amount of energy that you need to put in if it starts off with a renewable. Let's say it starts off with offshore wind. The conversion into hydrogen loses 75%, 80% of the energy to get—

Paddy Lowe: In very approximate numbers, to make a full synthetic SAF, half of the energy from the wind turbine or the solar panel or whatever is lost. I will come back to that.

Q258 Chair: Through the combined process?

Paddy Lowe: Through the combined process. About half of that half is in making hydrogen, so you lose about 25% of the energy or even 30% to make hydrogen, and the remainder is lost to convert the hydrogen and the carbon dioxide into the hydrocarbon fuel. The energy lost is an argument often levelled against synthetic fuels and that is why in certain transport sectors, particularly personal transport, cars and so on, it is absolutely not the correct answer. In sectors that are not driven purely by efficiency but are driven by functional mandates you have to do it.

Chair: In this case, volume and weight.

Paddy Lowe: We know how to make wind turbines and solar panels. We just make more of them to cover that loss.



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Q259 **Chair:** Turning to you, Mr Cornell, what role do you see for SAF in aviation, alongside other forms of zero carbon flight such as hydrogen and battery electric? It has been suggested by Mr Lowe that battery electric is only suitable for small aeroplanes travelling short distances. Do you agree with that?

Andy Cornell: Yes, I do. Broadly, our attitude towards decarbonising aviation is that, first, we recognise it is a massive challenge. It is one of the hardest sectors of the economy to decarbonise and there will be a range of solutions to it. I think it is a combination of hydrogen, electric, modal shift, more efficient airlines and SAF. Not one of those provides the overall solution but each one has its own segment of the decarbonisation story to play. As Neville explained really well, there is a sector in long-haul flight where SAF is probably the only solution. If we want to continue flying long haul we will need some kind of high density energy storage vessel for those flights and that is the role that SAF performs well.

The second point is that in timescales and the availability of the different technologies, I think that SAF has the potential to be available more quickly than electrification and hydrogen for some segments. It could be that by 2050 x% of flights will be hydrogen and x% will be electric, but in 2040 a bigger percentage of those will be SAF because the hydrogen and electric technology possibly will not be available.

Q260 **Chair:** Dr Hargreaves, what is your view about the availability and the timeframe for getting SAF on a commercial basis? It has been promised for quite a long time now and it does not seem to be here.

Dr Hargreaves: Technically we are ready and the first generation that I talked about—the conversion of fats and oils—is in production today and it is being expanded. We need to get the second and third types into the market to hit the volume that we need. It really is not a technical challenge now. It is a financing challenge.

Q261 **Chair:** Are you saying that the scalability has already been achieved? That you can produce at the kind of volumes that will be needed to make it a commercial success?

Dr Hargreaves: We need a lot of plants. A big waste plant is a small fuels plant. It takes about 10 tonnes of residual waste to make 1 tonne of fuel. That is just the way it is. It is a function of the energy density of the starting material and the finished product. We are going to need more distributed energy sources than petroleum, so we will need a lot of production, but I think it is about getting the first ones in the market and then we can start to expand rapidly. There is a big flow of capital available. We need to make it a mainstream investment, like happened to wind turbines a few years ago.

Q262 **Chair:** Ms Bennett, there has been quite a lot of pushback from people involved and advocates in this sector suggesting that SAF is letting the aviation industry get away with it, get off scot-free, and that it is a “now today” technology that will in some way prevent more fundamental



reform of the sector. Where do you sit on that? Do you see a longer-term application for SAF? The phrase du jour is “a transitional technology”, isn’t it, which we have been hearing about a lot in the Chamber today?

Helena Bennett: This has been said already, but it is really uncertain when zero emission aircraft will be able to come in. Every different source you look into will tell you a different timeline for zero emission aircraft. At the moment, projections from the CCC and from DfT are showing that emissions from the aviation sector will continue to grow until the mid-2030s at a time when the rest of the economy is expected to reduce its emissions by 78%. SAF will be able to help start to bring those emissions down by the mid-2030s. I agree with what my colleagues on the panel have said: that scaling up sooner will deliver benefits a lot faster.

In the case of power-to-liquid fuel, e-kerosene, synthetic fuel, whichever one you want to call it, the industries that are required for feedstock that have already been mentioned—green hydrogen and direct air capture, if we want to make it a completely circular zero carbon process—can be used for other industries even if SAF did not have application in 20, 30, 40 years’ time, so it is not a waste to invest in those industries.

I think colleagues on the panel can talk more about the scalability of other SAFs. However, I want to point out that Andrew said at the start of his first comment that we cannot see SAF as a silver solution to decarbonisation. I think that there is a risk that we continue talking about sustainable aviation fuels as something that will let us continue to expand airports and the number of terminal passengers we have.

Even with the most sustainable form of SAF, the power-to-liquid, two-thirds of aviation’s warming effects come from the non-CO₂ impact produced at the turbine when flying. There are slightly reduced impacts of these when using the e-kerosene part of it for fuel but they are still significant. We need to make sure we are talking about wider emissions and not just carbon and there is a risk that we will ignore those non-CO₂ effects that still have large warming impacts on the atmosphere.

Q263 **Ian Levy:** Thank you all for attending today and giving your time to the Committee. I will direct my first question to Andy. How developed are the production pathways for renewable low carbon fuels? Would you give the Committee an overview of the different fuels and feedstocks that are used, please?

Andy Cornell: I think Neville covered the different pathways and feedstocks quite comprehensively in his first answer. Broadly, there is oil feedstocks, for which there is an established technology for hydrogenating them and creating a drop-in aviation fuel. There are technologies focused around the gasification or thermal conversion of biomass and then Fischer-Tropsch to create a fuel. Then there are the air capture power-to-gas technologies that Mr Lowe was talking about.



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I will add a fourth pathway. There is also a set of technologies based around taking waste gases from current industrial processes, particularly carbon monoxide, which you get from some sort of steel production processes, and converting those into SAF as well. It forms a bridge between two of the other pathways. All of those are different scales of technology development.

I will slightly differ from what Neville was commenting on and say that the lipids oil pathway is technology available already and being deployed now. Each of the other pathways has an amount of technology risk in it, which I think is part of what is preventing them coming to market now. There is a combination of technology risk plus lack of commercial models for those pathways, which is important to understand and maybe we can talk a bit more about that later.

Q264 **Ian Levy:** That is lovely, thank you. I will direct my next question to Helena to expand a little bit on the testing side of things. Has there been sufficient testing to demonstrate the ability of SAF as a means to address the emissions from flights?

Helena Bennett: This question might be better directed at one of the other panellists. It is not something that we have looked into massively. There are no large, widespread commercial uses of power-to-liquid yet because it has not been scaled up to any significant degree that we can do proper testing with rigorous methods. From that fuel source, I would say no, and there might be someone else on the panel who can answer for other types of SAF, waste-based and biofuels.

Dr Hargreaves: I am happy to come in on that. One of the things about making fuels through synthesis is that when it gets to be a fuel it forgets what happened to those atoms before. Whether your fuel is using our pathway, the Fisher-Tropsch pathway that Andy referred to earlier, for example—and it is not unique to this—whether the carbon came from waste or from biomass or from the atmosphere, it still ends up as the same molecules in the fuel. The materials made by that process have been tested in flight over many years, thousands and thousands of test flights. I think that we are very confident that it behaves in pretty much the same way as jet fuel.

As Helena mentioned earlier, it has certain bits missing, what are called aromatic compounds, that contribute to soot formation. Therefore, it is about a 90% reduction in particulate emissions compared with conventional jet fuel. That helps but that is not the primary reason for doing it. It is really about the carbon source.

Q265 **Ian Levy:** Lovely, thank you. I will stay with you, Dr Hargreaves, for the next question. I believe that you are developing the first SAF facility in the UK. Can you expand a little bit on what sort of feedstocks you are using?



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Dr Hargreaves: We are using municipal solid waste and commercial and industrial waste. This is residual waste that is not able to be recycled and it is very mixed, very heterogenous. We separate out, do a physical separation. We remove metals, inerts, some hard plastics, and then we put it through what is called a gasification process. That means heating it up in a controlled atmosphere, breaking it down to one carbon atom. Then we use our own proprietary synthesis process to build it up into hydrocarbons and then there is a refining step at the end. There is a series of physical and chemical processes but at the end it delivers a product that is very similar to conventional jet fuel.

Q266 **Ian Levy:** It must be quite a long, drawn-out process, is it?

Dr Hargreaves: No, it is very quick. From when the waste enters the gasifier to when it becomes finished fuel happens almost within a few minutes.

Q267 **Ian Levy:** Mr Lowe, I will ask you a final question. I believe you have been conducting trials using 100% synthetic fuel. Was that successful and how does synthetic fuel differ from biofuels?

Paddy Lowe: I think you may be referring to the flight we conducted last November, alongside the RAF, to fly a small aircraft with synthetic gasoline. This was a gasoline not a jet fuel, although our process can be translated to either. The interesting point about that flight—for which we got a Guinness record—was because it was 100% drop-in. The fuel we made went in straight to the aeroplane, 100% blend. There was no—

Q268 **Ian Levy:** There was not a mix of anything with that?

Paddy Lowe: There was no blend with other ingredients to make the fuel that was necessary for that engine. The engine was unmodified and the power and performance was identical. That was an excellent proof of concept. We are in the process now to upscale that recipe, let's call it.

On the nature of what we call synthetics or what Helena was calling power-to-liquid—it is another name for the same thing, or electro-fuel, e-fuel—these are all the same terms for fuels that are made from renewable electricity essentially using ingredients from the atmosphere. The distinguishing point, and Neville has laid out the different feedstocks, is that this particular feedstock is effectively infinite because you are using your own emissions to make the fuel. It comes from the atmosphere in a fully circular process. The process is fundamentally net zero and fossil free by its nature.

Q269 **Ian Levy:** If I could expand slightly on that, does the synthetic fuel burn at the same temperature? I am thinking of years ago when you went from leaded petrol to unleaded petrol and changes had to be done to engines. Would the new fuel increase wear on the jet engine?

Paddy Lowe: No, these fuels are in one way identical to the fossil fuels that they substitute in that they can be designed to replicate the same



properties. They are essentially the same fuel; they just don't come from fossil carbon. They come from atmospheric carbon.

On the other hand, in another way they are not the same. For instance, there is no sulphur in there. Fossil fuels contain a lot of ingredients that are undesirable but occur naturally in a barrel of crude, so we don't have sulphur. As Neville said, there are opportunities for far better combustion because synthetic fuels are synthesised already. We see promise of improved combustion, but in the medium and long term that can only be greatly improved because the fuels are fully tailored by chemistry rather than being what comes up in the barrel from underground.

Ian Levy: Thank you. That is very interesting.

Q270 **Cherilyn Mackrory:** Neville, I will come to you first. You have talked a bit about that the technology is there and it is probably financial and possibly supply issues that are left to bring this to market. How close are we to getting sustainable aviation to a commercialised state, scaled up and ready to roll? Without going into the details of what we need from Government and so on, because I think that will come later, how soon can we get this up and running to a commercial state?

Dr Hargreaves: To take our project, for example, we have done preliminary engineering, all the technologies are assembled. If we got the right signals, which as you say we will come to a bit later, we could probably reach a final investment decision late 2023, early 2024, and have it in production by 2027. It is not tomorrow but it is relatively quick.

Q271 **Cherilyn Mackrory:** I am quite new to this and I am visualising great big football stadium-sized waste plants. Is that what we are looking at, and how many of those dotted around would we need to achieve that?

Dr Hargreaves: The industry group Sustainable Aviation did quite a nice piece of work on the potential for such plants in the UK a couple of years ago and identified a natural community of about 14 plants using a variety of different feedstocks. As Paddy said, if you now expand into using atmospheric carbon dioxide as a feedstock—and don't forget the industrial gases that Andy mentioned as well—that expands a long way up from that. We can probably achieve about a third of UK's jet fuel needs from solid, liquid and gaseous feedstocks, but excluding carbon dioxide, and the rest is where the synthetic fuels will have to come in.

Q272 **Cherilyn Mackrory:** Paddy, again we will come to what Government need to do in a short while, but, as far as the industry goes, how are we able to make this a competitive industry? What needs to happen and what is happening?

Paddy Lowe: I think investment in technology. I know that is an obvious answer but the technology and capital. It is a very capital-intensive industry whichever route we take and the capital is up front. It has a similar profile to investment in the oil and gas industry that we are trying to displace. It is very expensive up front but you produce machinery that



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can deliver fuels for long time spans. The other characteristic is a lot of these plants are first of a kind. That requires a particular appetite to risk and, therefore, particular support around the initial capital.

I think that the UK has a terrific opportunity to lead the way here, not only for its own defossilisation but to develop and become a world leader in the relevant technology, which would be a huge export opportunity globally. The issue here is scale and Neville started getting into that. Ricardo produced a fantastic report in December 2020 looking at the scale issue across all of Europe. That concluded that there was enough possibility to create renewable energy for Europe's own needs within its own territory.

The other point to highlight is around aviation particularly. They postulated that between 85% and 100% of all aviation fuel would be non-fossil by 2050 and that that small discrepancy there, according to scenario, whether that would be bio or fuels from waste, they saw the vast majority being for synthetics because of the issue of feedstocks. It is the more difficult route that we are pursuing but it is the one that is the end game.

Q273 Cherilyn Mackrory: I am interested in that because with a lot of the emerging technologies I am a big believer that this would all be happening anyway. However, because we have an artificial target of net zero by 2050, we have to accelerate production and almost get to a point of commercialisation while the innovation is still happening. People in the same industry but with different technologies are working collaboratively, which we can see. At what point do you think that is going to become competitive?

Paddy Lowe: I will answer very quickly. Of course, you might say that Neville and I are competitors, but there is so much need here. We talked about solutions; we need all the solutions, but we also need all the players. I would suggest that we should invest in anything that is run by sensible people to get the job done.

Dr Hargreaves: I was going to use the analogy of the early stages of the oil industry, for example, or the car industry. It is only when you have products in the market that you can really start to drive costs down. I do not think that we are about competition at this point. I agree with Paddy, it is all about getting enough different, diverse solutions in the market that do achieve the job.

Q274 Cherilyn Mackrory: Andy, I know that you wanted to come in so I will let you come in. While you are answering, could you also draw on what technologies in feedstock we need in the UK to make sure we get a sustainable SAF industry?

Andy Cornell: Sure. The point I wanted to make during Paddy's contribution is that I think he was underselling the size of the opportunity for the UK here. We have an amazing knowledge base built up through



our experience in oil and gas and through our engineering contractors. Over the last 10 or so years, there has also been a lot of development in the core underlying technologies you need to be ready to produce SAF. We have a good history in the production of more conventional biofuels as well, so, as a country, we are well placed to grasp this opportunity.

The economic prospects of the 14 plants Neville was talking to are significant, but then the export opportunities that arise from developing that industry are huge as well. As a company, I get a huge number of enquiries from around the world from people who are interested in producing sustainable aviation fuel. At the moment, I kind of bat them back and say, "No, we are not ready yet" because we have not developed it yet in the UK and ready to export it. Once the technology is there, there is a massive opportunity for the UK to take that technology and sell it worldwide.

Coming on to your other question, which was quite a wide one—in fact, sorry, could you just repeat it?

Q275 Cherilyn Mackrory: It was to do with the technologies in feedstock in the UK. I think that we have touched on it already, talking about biodiesel and waste and all the rest of it. I guess it is how much and how they need to be scaled up to meet the demands of where we are heading. I think that we just need to know the scale of what we are looking at. What is coming in and what percentage of fuel will be sustainable by 2050? It is just looking at the scale of the whole market and where it is going.

Andy Cornell: There are probably two points I want to make in response to that. First, I think it is very important to consider around biomass feedstocks that there is a limited resource in there. There is only so much land and there is only so much biomass you can grow, and a lot of it is already going into the fuels industry. There is a lot of ethanol going into car and passenger vehicles. There is a lot of biodiesel currently coming into HGVs.

It is important to consider the context of the fuels we want to be using for aviation fuel in what is currently being done. As Neville has been saying—and we are very keen too—we think the focus should be on waste resources, so household waste, which is actually the UK's largest source of biomass. There is more biomass in the waste that we throw away than there is in what we grow and it is available. We should be using those to produce SAF because that is incremental. It is not taking fuels that are currently used for other things or taking biomass that could be used for food and suchlike. I think that is important.

That is really important around the lipids and oils market because a lot of those oils are currently going into biodiesel production, which is very successfully decarbonising heavy goods transport. Over time that may well reduce but there is no point pulling a load of oils out of HGVs now to move them into SAF because, overall, that is not going to result in any incremental GHG savings.



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The second point I would like to make is that because of the established industry we have for fuels, which is all supported through various incentives provided by the DfT at the moment, there is a very good system of assessing sustainability and use of feedstocks that is already in place. Again, I think the UK leads the world in understanding the evaluation of how sustainable feedstocks are and how good a particular technology pathway is used. We should make sure that we build on that in assessing the quality and the use of SAFs. It is one of the things I always bang on about: that there is work already there and a set of auditing and sustainability quality assessments in place that we should be leveraging to make sure that SAF is truly sustainable when it is introduced.

Q276 Cherilyn Mackrory: What percentage do we think we are going to get to at which aviation fuel could be supplied by SAF by 2050, do you think?

Dr Hargreaves: It depends on when we start, honestly.

Cherilyn Mackrory: Could we potentially get to 100% of—

Dr Hargreaves: I think that is technically perfectly possible.

Paddy Lowe: I was quoting the Ricardo report and it said 100%, of which between zero and 15% would be from biofuels from waste, the rest synthetic. That is its model.

Dr Hargreaves: Every year that we do not start reduces the probability of achieving that.

Q277 Cherilyn Mackrory: Helena, on that, you mentioned it not just being about fuel. I know this is probably a huge question and I want a quite short answer if you can. Do you think that the aviation sector can get to net zero? Do you think it can decarbonise completely or do you think that will never happen?

Helena Bennett: There is a difference between decarbonise completely and get to net zero, because obviously net zero relies on offsets, which in itself is a whole different conversation with its own set of issues and problems.

On net zero, with SAF in particular I think that claiming that we can get 100% SAF by 2050 is very ambitious. If we look at power to liquid—synthetic fuel, for example—it would require such a huge amount of extra renewable energy capacity because otherwise we would be taking renewable energy away from other parts of the economy that need it, such as heating our homes and electricity supply and other areas of transport. Building that extra renewable energy capacity in itself has second order implications that are negative in other ways: the amount of resource and raw materials it takes for wind turbines and solar panels, the land use it would require, obviously the economic investment, and the amount of time it would take to do all this.



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There are already limitations. Andrew has already talked about the limitations on waste and biofuels because of land mass and the amount of waste available. There are a few different conflicting sources of information about what exactly can be met by different fuels, so a different piece of research—sorry, I cannot remember who it was by—saying that only 12% of the UK's demand for SAFs can be met by waste-based fuels.

I think that we can reach net zero if there are other things alongside SAF that we are doing. I do not think SAF in itself is going to get there. Obviously, zero-emission aircraft can play a role—but probably not for a long time—potentially displacing some of those short-haul routes or domestic routes that have already been mentioned.

Without looking very carefully at the number of people flying, I do think we are going to struggle to make sure that we are decarbonising the aviation sector as quickly as possible. I know that it is not a very popular thing to say but I think that looking at demand management is going to have to play into this somewhere. At the moment, DfT is looking at projections of passenger numbers 75% higher than today by 2050, which is an incredibly massive increase in 30 years.

Yes, SAF can deliver some decarbonisation. Zero-emission flights can deliver some decarbonisation. Improvements in efficiency can improve some decarbonisation. Even all those things together scaled up really quickly with lots of investment, there is still a question mark over whether or not it would enable us to reach net zero by 2050.

Q278 Chair: There is just one small follow-up point there. There seems to be quite a big difference in opinion between what you are suggesting, which is a very high percentage uptake of SAF, and the recommendations of the Committee on Climate Change, which continues to recommend a 10% uptake of SAF by 2050. It does not project a higher uptake because it recognises the range of competing potential uses for biofuels and the inherent pressures on supply. Do you think it is just wrong?

Dr Hargreaves: I do not recognise that figure of 10% by 2050. I will have to look back at that.

Chair: We use the CCC for a lot of direction.

Dr Hargreaves: I thought it was more than that. Andy, do you remember that?

Helena Bennett: I can come in. The CCC's baseline scenario is 25% SAF by 2050 and 8% of that is synthetic fuel. That is its baseline scenario, so there could be other numbers in different scenarios that they have.

Chair: Okay, I understand.

Dr Hargreaves: That makes more sense. The truth is we really don't know. As an industry, our view is that we need to arm ourselves with the



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tools to decarbonise, and then finding out how much we can do really is speculation until we start doing it.

Chair: Thank you very much.

Q279 **James Gray:** This is all quite encouraging. We hope that the report we produce will be influential with the Government and with industry and elsewhere. Therefore, can we move on a little bit to discuss the things that we ought to be calling for from the Government to encourage this general move in the right direction?

The first question is: are the Government doing enough to encourage or to facilitate production facilities for SAF?

Dr Hargreaves: If you are looking at me, Chair, can I just say no?

James Gray: Or Paddy?

Paddy Lowe: I think we are both going to say no.

Q280 **James Gray:** What more could they be doing? That might be a better way of putting it, then.

Dr Hargreaves: As you would imagine, we have had quite a few conversations with the DfT and in recent years the focus has been around contracts for difference. The reason we suggest that is because there are two major barriers to investment. One is the fact that it is first of a kind technology and the other is that the market is of an unknown price. We are asking investors to come and have faith that we are going to deliver not only the volume but also the price when we make this product.

It is hard to imagine getting the hundreds of millions, if not billions, of investment into projects of this nature without some clarity on price. The CFD mechanism worked really well in the electricity industry. We believe the Government have sufficient experience to apply it in this industry.

Q281 **James Gray:** That is a point you made very clearly in your written evidence. That the CFD route is essential. I should just chuck in that, 30 years ago, I was one of the people who designed the CFD for the electricity industry. That was a bit of a thing. Anyway, I am a big fan. Why contracts for difference rather than futures and options, which are a perfectly agreeable alternative method for price fixing? Perhaps you are content with both?

Dr Hargreaves: Your question is: why cut off other options?

Q282 **James Gray:** Why contracts for difference rather than futures and options? You could usually have a futures contract over the counter or, indeed, traded options.

Dr Hargreaves: In the end, it is about the Government being prepared to create a stable price for the producer so that the producer can go to their bank and their investors and have an economic model that works. We are suggesting CFD because it has worked recently and effectively



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and it is a tool with which the Government are familiar. We have not seen anything that works better.

Q283 **James Gray:** Leaving CFD to one side, coming back to the question of establishing SAF production facilities in the UK, what more could the Government be doing, leaving aside the pricing mechanism?

Dr Hargreaves: I mentioned the other area of risk, which is about first of a kind plants. This is where something like the UK Infrastructure Bank could step in to make it a bit easier for capital to come in by issuing loan guarantees or coming alongside to bear some of the risk of a first of a kind plant. That is probably the other key aspect. There are some other things as well, but if they tackle both of those things that would be a pretty good hit.

Paddy Lowe: Yes, I would agree with both those points, particularly the latter. The real hurdle at the moment is first of a kind capital. I think that Neville and I both face that within our respective companies. The other thing we see is—

Q284 **James Gray:** First of a kind capital; what is that?

Paddy Lowe: We have to build plants that have not been built before.

James Gray: I see, okay.

Paddy Lowe: That is a particular challenge for investors. We also see big sums of money spent on other solutions, whether that is support for electrification of cars, support for development of new types of aircraft, huge sums going into that, when for us the obvious in that particular mode of transport is the fuel. Aircraft have been developed over the last century and they have a particular burden around safety as well as economics.

The jet engine is not the work of the devil; it is a masterpiece of engineering invented in the UK. There are massive challenges to bring in totally new technologies around aircraft and the really low-hanging fruit here is to make the right fuel for the aircraft we already use, which are incredible pieces of engineering.

James Gray: It is readily achievable, whereas redesign of the engine is not?

Paddy Lowe: Yes, we know how to do it and the level of government support feels imbalanced relative to the search for other technologies for aviation and the support those are getting.

Q285 **James Gray:** This is perhaps one for Helena. Am I right in guessing you do think that the Government ought to introduce a mandate for SAF, making it compulsory, and, if so, what effect will that have on the industry? It would be quite a tough thing to achieve, wouldn't it?



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Helena Bennett: Absolutely. I think there should be a SAF mandate. Something we are also calling for, and I know others are calling for, alongside that simultaneously is a submandate on e-kerosene—sorry, synthetic fuel, power to liquids, lots of names—at the same time, setting a level for SAF up to 2050 and within that setting a level for synthetic fuel as well.

In terms of the impact, obviously it sets a direction that industry, fuel buyers and fuel suppliers will then understand is going to be the future, but I do think there is a big challenge. You can draw a bit of a parallel to the recent zero emission vehicles mandate that the Government confirmed was going to be introduced at the end of last year. The difference there is electric vehicles, electric cars and vans, are already well permeated in the market. They have reasonably high sales rates compared to what they did a few years ago. The technology is already there. It is developed. It is on our roads. People are buying them. The same is not true with SAFs yet, especially with synthetic fuel. We do not have it commercially scaled and deployed within the UK. Capital cost is obviously a big barrier that has already been talked about by other panellists and more funding is going to be required for that.

Another factor that has not been discussed yet is the price parity between synthetic fuel or SAF and fossil kerosene that is currently being used. There is no tax on that fossil kerosene at all and, without any kind of financial mechanism to bring that price parity down, it is going to be really difficult for airlines to buy fuel that has a certain level of SAF blended into it while the cost is so high. Whether it is CFDs that bring the cost of SAFs and synthetic fuels down, whether it is some kind of subsidy for airlines, whether airlines end up shifting the cost on to consumers and ticket prices massively go up, something will have to shift if a SAF mandate is introduced.

Something else we are calling for alongside a submandate for synthetic fuel is a tax on kerosene. This panel is unfortunate timing because tomorrow there is going to be an announcement from the European Commission about kerosene tax plans in the EU. There are a number of countries supporting it. Spain and Belgium are definitely in support and there are probably some others that have not been announced yet. I would implore everybody interested in this to look out for that tomorrow.

A huge, key thing about the SAF mandate is it will set the direction of where we are going, but price is still a big pain point for buyers and suppliers. Without addressing that, it is going to be difficult for everybody.

Andy Cornell: There are a couple of things I just want to pick up on. Broadly, while I think everyone on this panel probably supports a SAF mandate for aviation fuel, the key issue with it is that it could just lead to the import of fuels into the UK. In securing a mandate, the fuels can be shipped in from elsewhere rather than helping to develop a UK industry



for the production of SAF. That is why we think it is important that the mandate comes hand in hand with some kind of contracts for difference or other incentive scheme that can focus on the incentivisation of UK production.

Q286 James Gray: By imported fuel you don't necessarily mean import so much as aeroplanes going elsewhere to refuel? Is that what you mean?

Andy Cornell: A mixture of both. I know in the EU they are looking at introducing rules to insist that planes take their fuels from local airports to try to restrict that export of planes refuelling elsewhere, which seems like a very sensible approach for the UK to take as well. You could also very easily fuel your plane in the UK from fuel that has been manufactured in Scandinavia or wherever and imported to the UK. That is not a pathway I think we will go down. I think we want to produce local sustainable fuels for use in our planes.

The second point I wanted to make, which I will do quickly, is it is very hard to understand the risk averseness of funders until you have sat across a table and looked at them. These projects require hundreds of millions of pounds to be raised and people are not going to provide you with that capital unless you have underwritten all of the risks. That is why it is absolutely essential for the projects that there is a long-term price guarantee around the amount of money you are going to secure for your product and that the technical risk in the projects that are first of a kind is addressed. That latter one is a major problem because it is not clear to me who is actually going to underwrite that risk for these large projects. Because they are first, bankers cannot rely on previous experience in order to price that risk appropriately.

Q287 Caroline Lucas: I want to come back to Helena to start with and press you a little bit more about the challenges linked to whether or not SAF can genuinely be sustainable. You were earlier making the quite correct distinction between decarbonisation and net zero. Do you think the process for this can be fully decarbonised, or do you think we are going to be depending on quite a bit of offsetting in order to get to net zero?

Helena Bennett: There is no doubt that we will be relying on offsetting at all. If you look at any of the DfT's or the CCC's pathways that they have projected up to 2050, they all rely on some form of offset. Like I said, there is a separate conversation about the issues and sustainability of that. In terms of SAF particularly, it has been mentioned already but the synthetic fuel is the only one that can offer circularity of carbon emissions. Other types of SAF are just displacing the carbon. They are not removing carbon from the process and then reusing it. It is just being displaced from one place to another, so it is important to note that. I already said this as well but the non-CO₂ effects are still significant, even using any types of SAF, so that needs to be considered in one way or another wherever it is. Then, of course, there are also—

Q288 Caroline Lucas: Can I just ask you what you mean? How do we consider



it? In what way can those be accounted for in the process?

Helena Bennett: One way would be to look at expanding the UK emissions trading scheme to cover non-CO₂ effects, because it currently doesn't do that. That could be one tool that then helps encompass non-CO₂ effects, for example.

Something else to flag is that we talk about the emissions from the SAF in terms of what is being burned in the jet and then what is being taken out of the atmosphere if you are looking at synthetic fuel. However, all the processing of these fuels requires energy and electricity, which to be truly decarbonised would have to come from renewable sources.

Recent studies have shown that there could be quite high embedded emissions from the process of creating green hydrogen. Whether that is through the resources required and the mining that has to happen to find raw materials for the wind turbines and the solar panels to create the green hydrogen, we need to make sure that we are doing full lifecycle assessments of the use of these SAFs in order for them to be truly sustainable. We are very early on in the process of adopting SAFs at a scalable level, so there is way more research to be done in this space.

In summary, to answer your question, at the moment I don't think so but, if we do scale this up and we do it properly, there is a chance that the whole system could be net-ish zero for carbon in particular. Yes, there is quite a lot that still needs to be looked at, I think, from that point of view.

Q289 **Caroline Lucas:** Thanks very much. That is really helpful. Coming to Andy on biomass in particular, how do you think some of the sustainability challenges associated with fuels from biomass can be addressed, in particular the issue of the extent to which feedstocks are sustainable? I was noticing the Government's recommendations in terms of the different conditions that need to be met in order for this to go ahead, and it says very clearly that feedstocks, including residues, should not be obtained from land with high biodiversity value or land with high carbon stocks. Increasingly, hopefully, we are going to be moving away from the position where we have a huge amount of waste, so how sustainable is this feedstock going to be?

Andy Cornell: The first point I would make is that what is important to recognise is that being sustainable is not a binary decision. You are not either sustainable or not. It is a scale. The important thing is to develop methodologies where you can assess the level of sustainability of a particular feedstock. Clearly, cutting down rainforest to grow palm trees to get oil to make HVO is not sustainable. It is a very bad environmental industry because it leads to huge amounts of greenhouse gas emissions, whereas on the other end of the scale I would say taking residual household waste that is not suitable for recycling and turning it into fuel is sustainable because we are always going to have—



Q290 **Caroline Lucas:** If we have all sorts of net zero waste objectives and commitments as well, if that waste is already going down because we do not want to be creating more and more waste, what does that do for the calculations you are making?

Andy Cornell: I guess what I am saying is that there will always be a residual amount of waste. Currently, the UK is producing 30 million tonnes of household waste, of which 10 million tonnes is going to incineration, 20 million tonnes is still going to landfill. That number is coming down but I do not think anyone envisages it coming down to zero by 2050. There will be an amount, 5 million or 10 million tonnes, which will be there residually that will not be. In my view, making best use of that waste is turning it into things like sustainable aviation fuel because that is better than incinerating it or putting it into landfill. I guess that is my assertion. I don't think we will ever get to zero residual waste but I do not think any country is really intending to get there.

The second point I would make, which I think is quite key, is the combination of the production of sustainable fuels with carbon capture. The UK is investing quite heavily in carbon capture clusters at the moment. It is putting the infrastructure in place to be able to capture CO₂. As Neville said right at the beginning of the session, one of the great attractions of the production of SAF is the ability to capture carbon dioxide and put it into long-term sequestration while you are producing the SAF. The effect of that is to produce negative emissions.

Through the growth of the biomass or the feedstock you are using to produce the fuel, you are capturing CO₂ from the atmosphere and then, through the production of SAF and sequestration of some of that CO₂, you are putting it into long-term storage, leading to negative emissions, which you are helping to reduce. For me, in the long term, the key part of the technology is that ability to get negative emissions to offset emissions elsewhere.

Q291 **Caroline Lucas:** How confident are you that CCS infrastructure will be sufficiently developed in order to be able to be used in the way you describe in the timeframes that you are looking at?

Andy Cornell: We are developing a plant at the moment in Cheshire, and we are working closely with BEIS in order to get a support structure in place for us to be able to sequester the CO₂ from that plant in 2025. Government are working to repurpose fossil fuels, the sequestration and building up the networks for that, partly driven by the urge to decarbonise industry, the ammonia plants and the refineries around there, but also for the infrastructure in place to have negative emissions in future.

If the Government do what they say they are doing at the moment, which every impression is that they are, I think that infrastructure will be in place from 2025 onwards.



Q292 **Caroline Lucas:** You are very optimistic. Neville, do you have any reflections on the CCS and the date of 2025?

Dr Hargreaves: We are on the other side of the country and the proposed date for the Tees is 2026 and the Humber 2027, so it is a couple of years different but, broadly speaking, I agree very much with Andy. That part is on a good path to getting done and that will hugely improve the impact of what we do from a sustainability point of view.

Q293 **Caroline Lucas:** If it does not come on board in the timeframe—because the Government’s record on CCS is not great in the sense that they have had investments that then have not gone into the test programmes that were expected in the past—what does it do to the timeframe of your investments and so forth if CCS is not on stream by the timeframe that you are describing?

Dr Hargreaves: It slightly depends on how the structure of the reward system, the contract for difference, works. Without CCS we can achieve about 70% CO₂ savings instead of 150%, so it is still a worthwhile thing and it still achieves many of the other objectives I was talking about earlier of giving ourselves the tools. Building the first waste-to-fuels plant makes the second one cheaper and more effective. If the worst comes to the worst and the first one has to operate for five or 10 years without CCS, we have still achieved a carbon saving and we have still equipped ourselves for decarbonising the industry.

Caroline Lucas: Paddy, did you want to add anything on any of that?

Paddy Lowe: It is not my area.

Chair: Thank you very much, everyone. That brings us to the conclusion of the first panel of our hearing today. I want to take the opportunity to thank again Helena Bennett, Andy Cornell, Dr Neville Hargreaves and Paddy Lowe for giving us their time and their expertise. The Committee is enormously grateful to you. Thank you very much.

Examination of witnesses

Witnesses: Jonathon Counsell, Jonathan Hinkles, Hemant Mistry and David Morgan.

Q294 **Chair:** Welcome to the second session of our inquiry into sustainable aviation. We are joined now by four witnesses—one, Jonathon Counsell, in the room. I also welcome Jonathan Hinkles, chief executive of Loganair, Hemant Mistry, director of Energy Transition of the International Air Transport Association, and David Morgan, director of Flight Operations at easyJet.

Before we get stuck into the questions, although I have given your job titles, could you introduce yourselves and give a sentence as to your expertise or the reason why you are giving evidence today? Jonathon



Counsell, if you could start.

Jonathon Counsell: Thank you, Chair, and good afternoon, everybody, and thank you for the invitation to join the Committee. It is great to be able to support the important work of this inquiry. I am group head of sustainability at the International Airlines Group, which is the owner of five airlines, including British Airways. I have been in that the role for seven years. Prior to that I was head of environment at British Airways for eight years. Very much for us climate change, unsurprisingly, is our absolute priority.

Jonathan Hinkles: Good afternoon, everybody. I am Jonathan Hinkles, chief executive of Loganair, which is the UK's largest regional airline. We are based in Glasgow. We operate 43 aircraft and that is from everywhere ranging from in and out of Heathrow to maintaining regional air services and lifeline services such as within the Orkney Islands.

Hemant Mistry: Good afternoon to everybody. I am Hemant Mistry; I am the director of energy transition here at IATA. IATA, as a brief introduction, represents 290 airlines across the world, approximating to over 80% of the world's traffic. I am in this role also—and I would say this—because of the issue's primacy in our agenda and how we want to support the airline community. It is fundamentally important, even coming through the financial crisis for the airlines right now.

Prior to this, I was working for our efforts in supporting efficiency improvement in airports and technology improvement in airports, in ANSPs and also on the fuel sector. I have a background also in air traffic control.

David Morgan: Good afternoon, everybody. I am the director of flight operations for easyJet, an airline with only 330 aircraft pan-European. I look after our pilot community and all the training and the operations associated with that. A secondary role, and very exciting role, is to look at how our decarbonisation pathway might look and, in particular, what future type of technology might we be able to take advantage of in order to fully decarbonise.

Q295 **Chair:** Thank you very much, all of you. I am going to start with Mr Mistry as the representative of 80% of the world's flights. I was very impressed by that statistic. The Climate Change Committee has stated that net zero carbon aviation is highly unlikely to be feasible by 2050. We are here today to try to work out whether or not it is right on that or whether we can be more optimistic and, if we can be more optimistic, how do we go about achieving it and whether there needs to be further or additional government intervention to achieve that or to assist the industry. In your view, how achievable are airline commitments to reach net zero carbon emissions by 2050?

Hemant Mistry: I think that they are achievable but there are challenges. It will require a lot of co-ordination across the industry,



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different segments of the industry as well, not just the airlines. Also, it would require some consistent thinking across Governments as well to avoid regressive policies that might impede the right investments and so on.

Q296 Chair: Thinking about it, it might make sense for you to confirm what the objectives and the undertakings of the Sustainable Aviation Coalition are for aviation. Can you clarify what the commitments are today?

Hemant Mistry: From the airline perspective, at IATA what we recently did, last year in October, was to secure commitment across the membership for net zero by 2050. In doing that, we have done various modelling in terms of what solutions could contribute towards achieving the net zero 2050. There are various ways in which that can be achieved but we have tried to understand to what extent SAF could be available—I realise that there has been some discussion about this already—what role would new technologies play, for example with hydrogen or electric, and what would be the role of carbon capture and that aspect as well.

We have done quite some modelling to try to understand this, understand the pathways for this and to make sure that our membership is fully aware of those milestones so that we can secure the commitment towards that. Getting there requires a lot of co-ordination, as I say.

Q297 Chair: Jonathon Counsell, being involved in the airline industry, you cannot think about airlines without thinking about Covid-19 and the impact that it has had on the industry as a whole, a really profound one. I am very glad that I have not been responsible for running an airline for the last couple of years. Has there been an impact on the ability of airlines to respond to their net zero commitments as a result of Covid? How, if at all, has it impacted?

Jonathon Counsell: It is true to say Covid has been the biggest difficulty our industry has faced in its history. However, we have clear evidence—and I can give you some reference points on this—that, if anything, we have increased our commitment to sustainability.

If I just talk about the overall targets, net zero emissions by 2050, we were proud to be the first airline in the world to make that commitment back in October 2019. For us that was very much a start point. It is all about: how do we get the industry to make that commitment? The next step was to get the UK Coalition of Sustainable Aviation. It committed in early 2020. Then our global alliance, Oneworld, which represents 20% of aviation, made the commitment in September 2020, but, as Hemant said, the big prize was to get the entire airline industry to commit at its AGM last year in October 2021.

We are the only global sector that is committed to net zero emissions by 2050. Of course, commitments are one thing. What we need now is action. We very much see the 2020s as the decade of action to start reducing our emissions.



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If I can talk about some points that support that, sustainable aviation fuels and the previous panel. We agree that they are not a silver bullet but they will play a very significant role. We think that between now and 2050 40% of all our emissions reductions could be due to sustainable aviation fuels. At IAG alone we have announced six partnerships with SAF suppliers here in the UK. SAF is available now, it is not in the future.

A couple of examples. For COP26 BA ran 950 flights on sustainable aviation fuels. As I say, we have a partnership with Velocys. In addition, just this week we are taking delivery of first at-scale-produced SAF here in the UK with a company called Phillips 66. That will enable us to reduce our emissions by 100,000 tonnes of CO₂ in the next two years. So SAF is now. All of that means that we have increased our commitment through the pandemic.

Q298 **Chair:** I am going to come back. You obviously listened to the first panel. I raised that there was some dispute as to the exact percentage that the Committee on Climate Change is estimating as a sensible percentage.

Jonathon Counsell: I have the numbers if you want.

Chair: That would be useful because our briefing has a degree of ambiguity, it is fair to say.

Jonathon Counsell: Yes, it has moved. We work closely with the Committee on Climate Change. It is very respectable. Five years ago, its assessment on SAF by 2050 was 5%. Quite rightly it requires significant evidence before that it will raise that. Three years ago, that was increased to 10% and last year it was increased to 25%. That is quite important to signal that it has increasing confidence around the role that SAF can play.

Chair: However, you are saying it is 40%.

Jonathon Counsell: We are saying that the cumulative impact is 40% in 2050. I can talk about the evidence that we have used to get that. By 2050 we think that up to 60% of all fuels could be sustainable aviation fuels.

Q299 **Chair:** David Morgan, which net zero delivery solutions lie within the direct control of the airlines?

David Morgan: There is a number of different solutions that we are going to have to employ to achieve that net zero pathway. It is worth saying that for 100-odd years aviation has largely been using gasoline or kerosene in all forms of aircraft, from a two-seater aircraft to the biggest A380 500-seater aircraft we have today. Going forward, we have to think about energy in a different way and apply the right energy source for the mode of transport that we are using.

We will see battery-powered aircraft for the very, very small-scale. You could go out today and buy a two-seater battery-powered aircraft. On the



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other end of the scale, for our wide-body, long-haul aircraft, at the moment the only technology that is foreseeable is sustainable aviation fuel. However, you do have a range in between with hydrogen fuel cell, hydrogen combustion and so on.

In terms of the levers between now and the point where this technology becomes available, there are still other things that we can do in order to reduce our emissions per passenger per kilometre, things like improving our airspace system, which was largely built in the 1950s and 1960s. It needs overhauling, it is being overhauled as part of the UK's airspace modernisation strategy. There is a good 10% of efficiency to be had there.

Of course, you have fleet replacement with more modern aircraft. In easyJet our latest aircraft are some 15% more fuel efficient than their predecessors. By keeping your fleet modern, turning over your older aircraft for newer aircraft, you can drive down your emissions intensities. Operational improvements: the way you operate them with the better use of big data and so on can improve things as you move down this pathway. Then, of course, sustainable aviation fuel, which we have talked about already, is going to be a necessary and important part, particularly in these first few years as we get towards the point at which zero-emissions technology in the case of short-haul aircraft might be available.

Q300 Chair: Can I just butt in there? I am sorry for cutting you off. You talk about increased turnover of your fleet and having new aircraft. Yes, that is fine for your operational emissions, but what about the whole-life carbon of the process, the construction costs or the emissions associated with the construction costs? Jonathon Counsell, could you comment on that?

Jonathon Counsell: Absolutely. One of the big focuses for us, without getting too technical for the Committee, is what we call our Scope 3 emissions. Scope 1 are the emissions of our direct flying and Scope 3 are the emissions of the products and services that we take. We set a target last year to deliver net zero emissions for our Scope 3. Pretty much 85% of those are from our fuel suppliers and the aircraft manufacturers. We are working very closely with manufacturers and it is about them reducing the carbon emissions in the production cycle, talking to Rolls-Royce, GE, Airbus and Boeing. Thankfully they have also made commitments to net zero emissions. We are all aligned in terms of that overall effect.

Q301 Chair: On the early adoption of new technology, I am going to ask all of you, have you been early adopters? What have you gone for?

Jonathon Counsell: Our focus is sustainable aviation fuels. We see that as a technology simply because not only is it available now—we think that it is the primary opportunity during the 2020s—but ultimately it is the only viable solution for medium- and long-haul flying. That represents over 70% of our emissions. Our view is that there is no silver bullet. We



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absolutely support hybrid electric and hydrogen aircraft but our view is that they will not start to make an impact until the 2030s and they are only for short-haul aircraft. For us, the priority is sustainable aviation fuels.

As I say, we have a number of partnerships here in the UK and around the world. We are already taking delivery here in the UK. Our expectation is that in Britain—I passionately believe that we can be a global leader in the supply of sustainable aviation fuels. We have the skills, we have the sites, as you heard from Andy Cornell previously. We have the feedstocks. We have committed customers in the airlines and we also have a favourable policy environment. With those things together I think that we can lead.

Our pathway to that 60% by 2050 is three plants by mid-decade, including the Velocys plant that Neville talked about. We think that we could get to 14 plants in the next 10 years and that will get us to the 10% delivery by 2030. We welcome the Government's commitment to that last year.

Q302 **Chair:** Is that on anticipated passenger number growth or is it on current levels?

Jonathon Counsell: On the latest forecast that we have seen from Government.

Q303 **Chair:** Jonathan Hinkles, what is your response?

Jonathan Hinkles: Loganair's position, first and foremost, is we set out commitment to become carbon neutral by 2040 in the middle of the pandemic last June. I would agree with the views that have been expressed widely across this afternoon's contributors to the Committee that there will be almost a small, medium and large solution to these issues. It is not a one size fits all challenge. From our perspective as a regional operator, we expect to see extensive use of hydrogen-powered aircraft for the midrange flights, typically slightly larger aircraft, which in our world is 70 seats, flying on UK regional routes, and electrical aircraft operating on the smallest routes such as those between the Orkney Islands.

We have been taking a lot of involvement in the development of those, particularly with Ampaire on the electrical side, and we have had our pilots out flying that aircraft in the test environment very recently, and also working with ZeroAvia on the development of hydrogen. We believe that those are the two technologies that will fundamentally be available the fastest to us. The type of aircraft that we operate, our largest aircraft, 72 seats, within our fleet, ZeroAvia is expecting to have that type of aircraft certificated for passenger-carrying use with hydrogen by 2027.

There is a very clear view that that is the path through which we go. We support the development of SAF. We believe that it is essential for the wider aviation community to decarbonise. We are, however, concerned



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that a SAF mandate will divert airline spending power, which is limited at the best of times, into a one size fits all solution, when in our world it will not be a one size fits all solution. There are multiple answers to the challenge that we all face to decarbonise our operations. That will involve development of all kinds of technology.

I fully support the comments that David Morgan has made as well around aerospace modernisation. We have one-way systems in the skies above the UK. The Government last June exited the UK from the EGNOS European satellite system. Therefore, we effectively have no satnav equivalent for aeronautical navigation.

On a lot of our routes that means that we are now back to using old-style radio beacons and the rate of flights going out being unable to land in islands like Barra and Tiree in the Scottish islands and coming back to Glasgow without having landed there because of the loss of this satnav capability. We have gone backwards before we can go forwards, following that. Airspace modernisation and navigation aids, particularly the UK's commitment to satellite-based navigation, is an important intermediate step until those technologies become available.

Q304 **Chair:** David Morgan, what is easyJet up to? Have you been adopting new technologies or not?

David Morgan: Yes. Since the year 2000 we have reduced our aviation emissions, our carbon emissions, by one-third just by using better modern aircraft, operational improvements in the way that we operate the aircraft and so on, continuous-descend approaches, single-engine taxis. There is a range of dozens of different initiatives that have been employed and they will need to continue.

In terms of the radical new technology that we are going to need, in our case we also believe that hydrogen is a very credible fuel for a short-haul airline like easyJet. This has been shown by the recent report from the ATI, that has finished a one-year study of this. In terms of that, we are partnering already with a number of organisations on the development of those aircraft.

Airbus, the biggest aircraft manufacturer in the world, has already pledged that in 2035 it will be producing a commercially viable zero-emissions aircraft running on hydrogen. We are working with it. We are working with a number of other companies—Cranfield Aerospace Solutions, GKN Aerospace and so on—all who are working at pace in order to deliver this new technology.

Chair: Thank you very much. I am now going to hand over to Duncan Baker MP to take on the questioning.

Q305 **Duncan Baker:** Thank you. The technology that is involved in this is particularly interesting. Some of the questions that I had have been answered by the Chair, so we will flit around a little bit. Can I start with



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Jonathon Counsell? Your airline group is the first one to commit to net zero, which is quite an accolade in its own right. You have committed to 19 million tonnes of SAF between now and 2040 in your roadmap. Is that the main way that you are looking to decarbonise across the group? There must be a variety of different ways to do that.

Jonathon Counsell: It is probably the single biggest element but we believe that we need everything to decarbonise the hard-to-abate sector. We need all technologies. In our latest roadmap, so high-level numbers, 10% of our reduction will depend on operational efficiencies, as David and Jonathan talked about. Airspace modernisation, absolutely. There is a 10% opportunity there by just moving to better practice of air traffic control.

Beyond that, new aircraft and engine technology, including hybrid electric and hydrogen. We think that that could deliver us a 30% emissions reductions. SAF, though, is 40%, so it is the biggest single. We have seen tremendous momentum in SAF. I have been working on sustainable aviation fuel for 15 years. It was a lonely place then. There is now almost complete convergence across the industry that this has a big role to play. We have seen that with the policy moves in the US, in Europe and here in the UK. Now it is just a matter of when not if. We are very confident. Beyond that our focus is in-sector emissions reductions. In combination we can get our in-sector reductions down to 80% but we will rely on what we call out-of-sector or market-based measures of about 20% over that period.

We talked about carbon offsetting. We absolutely believe that as a transitional mechanism we will depend on offsetting but through our global scheme that was agreed at ICAO, the carbon offsetting and reduction scheme for international aviation. We are clear that we will only use the highest quality of offset, as set by CORSIA. It serves a very robust governance structure with very strict eligibility criteria, so much so that in the first process to qualify credits, nothing qualified because it did not meet the standard, and we support that. We see that CORSIA has a huge role to play to drive up the global quality of carbon offsets, because the aviation industry in the transition will be the largest customer.

As I say, it is transitional. Ultimately we want to get out of offsets and we want to rely on carbon-removal technology—greenhouse gas removal and carbon capture. We are excited about the number of developments that we have seen, particularly here in the UK. We welcome the Government's ambition for 10 million tonnes by 2030 and support of up to £1 billion and the four carbon cluster projects. We think that the UK is going to potentially be a world leader here. We would like to transition out of offsets into carbon-removal technology by 2035.

Q306 **Duncan Baker:** Can I press you a little bit? Should we not be honest and say that, at the end of the day, we will always have limitations with aviation because we do not have the technology, and I do not know if we ever will, to be able to fly long haul with battery cells and hydrogen? We



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do not have the technology clearly at the moment. IAG flies long haul and biofuels will therefore come into their element with that particular question. Do we ever think that we will get to a situation where you can fly long haul on battery-operated or hydrogen fuel-cell planes?

Jonathon Counsell: I totally agree. I fully support electric, battery and hydrogen for short haul. We are talking up to a 150-seat aircraft with a 1,500-kilometre range, but beyond that it is sustainable aviation fuels. That is why for medium and long haul we think that that is the answer.

We talked about the different pathways. To start with we will be looking at the waste-based pathways that were talked about on the early panel, but ultimately it is the power-to-liquids route. Of course, one of the challenges there is that it is very energy intensive but, again, there are some exciting developments there—the Rolls-Royce initiative that has been set up on small modular reactors. Essentially you need lots of low-carbon electricity but we think that there are great moves taking place where we can see a pathway. Typically, we talk about 2035 before you get the first at-scale power to liquid. We think that that could be even soon.

Q307 **Duncan Baker:** David Morgan, can I come on to you? EasyJet is predominantly short-haul flights and hydrogen is therefore something that would be suitable for your business. You have said that you have joined the UN's race to net zero and you have said that hydrogen will enter your fleet very soon. Are you very optimistic about that in the future?

David Morgan: Yes, I am getting more optimistic by the week. The level of attention on hydrogen and tackling this problem right around the world is very, very encouraging. The latest ATI report that has just come out even surprised us with its level of optimism. This is a report done following 12 months of intensive study by scientists, engineers and industry experts. Their concept aircraft include up to a 280-seater travelling 5,700 nautical miles on hydrogen, so we are even pushing beyond the short-haul range here.

The laws of physics do not have to change in order for this to happen, but we do need obviously the development. The aviation industry is quite rightly one of the safest industries in the world. Any future hydrogen aircraft will need to be as safe if not safer than the aircraft that we fly today, so it naturally has to go through a very rigorous process during this development but we are confident that it will get there.

The one area that we will all need to keep an eye on is the infrastructure needed to be able to supply these aircraft with a sufficient amount of green hydrogen needed to be able to operate these fleets. That is a whole different challenge again but one that we are starting to address in terms of collaboration with other hard-to-abate sectors that will also use hydrogen. We welcomed the publication last year of the UK hydrogen strategy and we think that there perhaps needs to be more ambition in



that direction still. Nevertheless, we are encouraged by the direction in which hydrogen is moving in that regard.

Q308 Duncan Baker: A decade is not a long period of time and we do not have any commercial planes flying with hydrogen fuel cells in them yet. Are we really confident that in a decade we will have that technology and easyJet will be putting planes up in the sky that are flying on hydrogen, realistically? The cost alone must be enormous to replace your fleet with hydrogen planes.

David Morgan: Yes, this is not a replacement that is going to happen overnight. We believe that in the long term the cost of running hydrogen aircraft will be economically very attractive compared to the alternatives. However, we are talking about a transition here. We have had a hydrogen flight by ZeroAvia already on a small aircraft with a hydrogen fuel cell, and we are going to see a lot more of those.

Jonathan will be starting to use them as one of the frontrunners for his fleet. We are going to have to wait a little bit longer in easyJet for the size of aircraft that we need for those short-haul ranges. However, like I say, we are confident that the technology and the will to get there is very much alive and we just need to encourage that, continue to invest and make sure that we are pushing forward with the hydrogen economy generally to be able to support this.

Q309 Duncan Baker: Let's give Jonathan Hinkles a chance to answer that. As the largest carrier with Loganair, you have entered the green skies initiative. What chance is there that we are going to see electric aircraft in your fleet and hydrogen as well?

Jonathan Hinkles: I share David's view that I am getting more optimistic by the week in terms of the progress that is being made. I have never seen progress at a rate like this in the time that I have been in the industry. While I think that the challenges in relation to the power-to-weight ratios of batteries will confine electrical flying to very short-haul operations, such as those in trial services in Scotland initially, we see a good prospect for the hydrogen power and we see that potentially within a decade. I do not think that that is a flight of fancy. Similarly, the one-off costs to modify an existing aircraft to be able to work on the basis of hydrogen are quite substantial but the running costs reduce substantially once you are able to transition to hydrogen of that aircraft.

Another important factor for us as a business—which at the end of the day I make no apologies for saying that we have to be—is that the volatility of that price will not be subject to the ups and downs as we are seeing due to terrible events going on in the world at the moment, which is the same volatility that you see through oil prices today. It will provide a more stable economic base for our industry and for that reason alone it has to be welcome.

Q310 Duncan Baker: We are all terribly optimistic, which is very good. No



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wonder Paddy Lowe got out of Formula One. There would not be an industry there much longer if we are going to move to all this electrification of everything.

Jonathon Counsell, the optimism is one thing. How do we measure these net zero targets? Are they independently audited? When we say that we are going to get to this rate and that by 2030 or by 2040 we will have somewhat in our different businesses achieved net zero, who is looking at that and agreeing that those KPIs are being met and are they independently checked?

Jonathon Counsell: No, indeed. The other point that has been made to us is that 2050 is quite a long time away and you need to start a lot earlier. We have a series of metrics, the first of which is our carbon efficiency target to 2025. We use the industry standard, which is grams of CO₂ per passenger-kilometre. Our target is 80, but more important is a 10% improvement on what we are achieving today. Essentially that will be driven by replacing our fleet with more efficient aircraft. Long-haul aircraft are up to 40% more efficient than the aircraft they replacement. You have the Boeing 787 Dreamliner and the Airbus A350.

Beyond that, we have a 2030 target. We have the 10% SAF commitment. That 1 million tonnes of SAF by 2030. Some say that that does not sound like a lot. It is 1,000 times more than we are producing today and the first 10% is more difficult than the second 90%. These are high-risk plants and financing those first plants is challenging, but once you get to 10% you are well on your way to proving the business case.

Q311 **Duncan Baker:** Who is going to check that? Who is going to say that you have done it?

Jonathon Counsell: All our target are audited. We publicly state them. We have them in our annual reported accounts and they are all independently audited.

A couple of other checkpoints in terms of our net emissions. While carbon efficiency is important, essentially it is about tonnes of carbon dioxide. We have a net emissions reduction target of 20% by 2030. One view is that aviation emissions are growing out of control. We are absolutely clear that during the 2020s our emissions are going down. We have publicly declared those and they will be independently assessed.

Aligned to that, for instance, BA was the first airline to raise capital last year where the cost of that capital is linked to our climate change performance. The financial performance of our business is now locked in to our climate change performance. This year the performance award of all of our managers will also be linked to our climate change performance, so we are really embedding it as a core issue within our business.

Q312 **Duncan Baker:** I want to bring Hemant Mistry into the last question and give you a chance to comment on this section as well. How reliant are net



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zero targets on carbon offsetting and carbon capture measures as opposed to carbon reduction measures.

Hemant Mistry: From the modelling that we have been doing, and that is what we have used to co-ordinate across the membership, we have been looking at single-use plastics, SAF, producing 65% of the benefits. Carbon capture and any residual efforts that we need in terms of offsetting would be 13%. We would see the offsetting to take it down. We see it as a steppingstone towards new technologies, both in terms of hydrogen electricity and electric as well but also in terms of synthetic SAF, power to liquid. That is something where we need to focus more attention to accelerate net zero progress.

One thing that I wanted to mention very quickly is something that we do not often talk about. Solutions like hydrogen and solutions like SAF have an added benefit that you can produce these energy sources locally. You do not have to ship the crude or the refined jet over long distances across sea and land to get to your destination airport, so to speak. There is a great benefit there that we sometimes do not talk about, which I think that we should be looking at.

One last point while I am speaking is that we are very focused on SAF for the immediate solutions that we have, but power to liquid, alcohol to jet, these are areas that we need to look into further as well. It is about how we can reduce those minute costs. If we can find some ways in which, for example, wind or other renewables, solar energies and so on have reduced in terms of costs, we have seen the unit costs of those solutions reduce from \$1,000—excuse me for talking in dollars—per megawatt hour to less than \$100 per megawatt hour because of the support from Governments and consistent policies. That is what we need to support the acceleration for net zero.

Duncan Baker: Thank you very much.

Caroline Lucas: Maybe I could start with Jonathon Counsell and ask you about your views on emissions trading schemes and, in particular, how effective they are at reducing emissions. I am thinking from the point of view both about the fact that there has been quite a lot of criticism that the price now is not much of a disincentive, but more structurally the issues around the non-CO₂ impacts that are not captured current by ETS systems.

Jonathon Counsell: Yes, we support and we have always been a supporter of for instance the EU emissions trading scheme, but for intra-EU emissions. Our views is that regional schemes should cover regional emissions. Global emissions need to be covered through a global mechanism. That is why we support the ICAO CORSIA scheme for global emissions. The EU ETS was audited in 2020. Aviation entered the EU ETS for intra-European emissions in 2012 and it has reduced aviation's emissions by 159 million tonnes over that period so it has been a very effective instrument.



Q313 **Caroline Lucas:** Is that CO₂ or emissions totally?

Jonathon Counsell: This is 159 million tonnes of CO₂.

Q314 **Caroline Lucas:** I want to get to the heart of the fact that one of the problems of the ETS model, as I understand it, is that a tonne of CO₂ is not the same as a tonne of greenhouse gas emissions totally. When you have emissions at altitude as well, the greenhouse gas forcing of that is a factor considerably higher than simply the CO₂ impacts. I want to press you on that.

Jonathon Counsell: Indeed. Non-CO₂ emissions. We absolutely agree that there is an additional effect of aviation on non-CO₂ emissions. The biggest impact is contrails.

Q315 **Caroline Lucas:** How would you build that into your model?

Jonathon Counsell: We actively support the research. There is better understanding of the effect but there is still a lot of uncertainty around the precise effect. We do a lot of work with the lead researchers in this area, both here in the UK and in Germany, and they all agree. They talk about the aerobars. There is still a 90% aerobar, so it could be plus or minus 90% in terms of that effect. One of the complications with contrails is daytime contrails are cooling. We absolutely agree that there is an effect and we need to support the research to understand that.

Q316 **Caroline Lucas:** Most of the evidence that I have seen suggests that the effect is a negative one, if you see what I mean. There is more heating than there is cooling.

Jonathon Counsell: I think so.

Q317 **Caroline Lucas:** As you have acknowledged, it is going to take us a while yet until we have a precise figure, so why would we not use a notional figure as an interim measure?

Jonathon Counsell: Absolutely. We had this very long debate when we first set up the EU ETS. I do not know if you recall that there was the concept of a multiplier.

Caroline Lucas: I was the rapporteur in the European Parliament for aviation, so I do remember.

Jonathon Counsell: In a conservatism principle, why would you not put that in? It was the academics who said that that was a bad idea because essentially the climate change impact of contrails versus CO₂ are so different that to use the same policies instrument is—we accept that there has to be a policy instrument. We are getting closer.

There are three things that I will make a point about. One of the things that we need to understand is the potential benefits of hydrogen aircraft and there is a view that you could avoid all contrails with them. However, that needs to be understood because there is a lot of water from burning hydrogens, but to form contrails you need these nuclei. Because it is pure



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water there is a view that it will not form contrails. There is an interesting one there.

The other opportunity is sustainable aviation fuels. There has been some great work done by Boeing and Honeywell that says that SAF fuels produce fewer contrails. More research is needed to understand that. Essentially because it is a synthetic fuel, there are no impurities so you do not have the soot particles. Essentially, a contrail is ice crystals. It needs a nuclei to form that ice crystal and you do not get that SAF. Therefore, it might have another benefit but we need to understand the research of that.

The thing that excites me in terms of the near-term opportunity is that we now have much better understanding of the atmospheric conditions that create contrails, that is the level of saturation and the temperature. The forecasters have said, "We can predict where you are going to form contrails", so this could be relatively low-hanging fruit. We could therefore plan routings to avoid those atmospheric conditions. There are a few companies that we are working with and that is something that could happen in the next couple of years.

Q318 **Caroline Lucas:** I do not doubt that there are positive things on the horizon; it just worries me that we are working on a mechanism and relying a mechanism that does not fully capture the total greenhouse gas impact.

Jonathon Counsell: My sense is that we are going to get to a place—let's not forget that the policy incentive to reduce carbon dioxide also reduces non-CO₂. It is not like they are separate. If you reduce the fuel burden you do reduce the non-CO₂ as well.

Q319 **Caroline Lucas:** There are some trade-offs, though, are there not, with nitrogen in particular? However, let's not get too—

Jonathon Counsell: The key point is that, unlike CO₂, there are some early opportunities to avoid these effects. The industry is working hard to do that and I would expect that particularly on those operational procedures we would see some benefits of that relatively soon.

Q320 **Caroline Lucas:** Thank you. Could I come to Hemant Mistry? How effective do you think both CORSIA and the EU and UK ETS schemes have been at stabilising carbon emissions in the short to medium term? Do you think that they are stimulating the kind of technology improvements that will be needed to improve emissions?

Hemant Mistry: Thank you for the question. Both are trying to do the same thing. They are effective energy-transition mechanisms until we find better solutions. The benefit of CORSIA is that it is a well thought out global system. We know that the offsets are invested, as Jonathan said earlier, in the right offsetting projects and so on. There is a very strict qualification criteria for that.



For ETS it is a bit unknown as to where that money goes and whether it is reinvested back into aviation so there is a problem with that. Also, fundamentally I would encourage a rethink when we have schemes that are overlapping. What aviation needs to progress and facilitate net zero is to have complementary schemes, regional, local, international, as opposed to overlapping and conflicting schemes, because that is going to create a problem as we go forward. We are only at the beginning of these transition tools. CORSIA is now in its first phase, its laboratory phase. It will be going into the first phase now. The mandatory phase starts in 2027 and that is where we really kick in in terms of rate of benefits.

- Q321 **Caroline Lucas:** Can I put to you some of the evidence that we have already heard in the Committee at previous sessions, where, for example, it has been said that, “The CORSIA scheme will do more harm than good and is not an effective strategy to reduce aviation emissions or promote technological improvements”. The offsets are priced far too low to provide any real disincentive to flying, and the existence of the scheme provides a disincentive to the difficult and expensive work of developing lower-emissions forms of aviation. What would you say to that?

Hemant Mistry: I would disagree with that, respectfully.

- Q322 **Caroline Lucas:** They are pretty cheap, are they not? The offsets are not providing any disincentive. Maybe you do not think that there is any role for demand reduction and modal shift, but for those of us who do, the price of the emissions trading is not providing any real incentive to do that, is it?

Hemant Mistry: Yes, exactly, and I do not think that the role of the CORSIA offset programme is built for demand management in that way. It is for making sure that the airlines are able to invest money from some of the carbon emissions and to put those into the right projects so that there are benefits in terms of lifecycle so we are helping support the net zero aspect itself.

The price for carbon will obviously change over time as well. We are at the early stages, as Jonathan said. The objective here I think works very well. Primarily what is important about CORSIA—aviation is largely international, by and large. The benefit of CORSIA is that it is an international scheme. It is agreed across the globe by the countries and it is, therefore, something that can be used by an international transport sector.

- Q323 **Caroline Lucas:** Could I come to David, and Jonathan from Loganair? Sorry, my eyes are not good enough to read your surname, sorry. Do you think that the aviation industry should pay for the development of negative emissions technologies? After all, there is a nice principle of the polluter pays, and if it is the aviation industry creating the problem, should they not be the ones paying for negative emissions technologies?

Jonathan Hinkles: To a large extent we already are. If I explain my answer there, yesterday we saw an announcement from the Government



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that there was additional funding for the ATI programme of about £685 million. If you look at the income that HM Treasury is earning through the emissions trading scheme, that is several multiples of that type of investment. If you were to say that there is a recycling scheme effectively going on of funding within government, it would not be a stretch of credulity to suggest that.

The emissions trading scheme has gone from a very low level when it started four or five years ago where you were at about £4 per tonne of carbon that you were burning, to somewhere north of £80 today. Even at today's fuel prices where the global oil price is significant, the ETS accounts for around a 25% tax on aviation fuel on the routes on which it applies, which is the vast, vast majority of the services that airlines such as Loganair operate, so there is already a significant tax.

It is conditioning our behaviour as to where we fly, how many any flights we operate and the pricing of those flights, because it is a material cost of our business that has to be reflected in the economics of running it. For the revenue coming from ETS to then be partly reused to develop those new zero-emission technologies through that government funding is a virtuous circle and a way in which we are going to break through that in a way that it would be beyond the capability for any one company to be able to do that in its own right as an airline.

Q324 **Caroline Lucas:** Unless it put up the price of air travel. There is an argument that would say that air travel is artificially cheap, not least because it does not pay tax on its aviation fuel, and all sorts of other subsidies that it receives. Therefore, one way that you could pay for more of this would be to put up the price of flying. Arguably, it should be more expensive.

Jonathan Hinkles: As I have just outlined, the emissions trading scheme is effectively a tax on aviation fuel of around 25%.

Caroline Lucas: Not very much.

Jonathan Hinkles: I would strongly dispute the notion that we do not pay tax on fuel. We are paying tax. It is in a different name. It is a duty through the emissions trading scheme, but we are paying tax on that fuel.

Q325 **Caroline Lucas:** We can discuss that. I am worried about time. Could I quickly come to David and add in another question as well? When we are looking at these negative-emission technologies, one issue is should the aviation industry themselves pay for it. Another issue, and again what we have heard in a previous session, was around the sustainability of bio-energy with carbon capture and storage, the BECCS, or the DACCS, the direct air carbon capture and sequestration. There is a real concern that we heard about in terms of relying on those technologies, primarily around the viability of those removals at the scale required and land availability to be able to rely on them to a great extent.



David Morgan: If I take easyJet's net zero pathway, we are not relying on specifically negative-emissions technology as part of that decarbonisation pathway, nor indeed are we relying on offsets. We see them as complementary. We offset currently all of the carbon emitted from our flights using traditional offsetting but that is not in lieu of having an in-sector decarbonisation pathway.

All airlines need to follow a science-based target pathway that reduces the intensity of emissions on a technical basis. We believe that it is the responsible thing to do right now, in addition to that, to invest in very credible projects around the world that are bringing benefit to society and indeed to the climate. Nevertheless, it does not detract us from the decarbonisation.

In terms of DACCS or the technical removals, is there a place for it? Yes, there may be, possibly, but as you mention it has to be scaled up significantly. It is a different conversation whether we were to rely on that for aviation. We would hope not. We would hope that with other methods we would be able to decarbonise the industry. There may be an argument to say that if we cannot get enough SAF in time is there a place for technical removals with DACCS or BECCS or whatever it is in order to fill that gap until such time as we move towards a zero-emissions technology.

Q326 **Caroline Lucas:** Thank you. Do you think all airlines should be obliged to offer offsets to customers? That is a yes or no, because the Chair is rightly hurrying me up.

David Morgan: Yes, absolutely.

Jonathan Hinkles: We already do.

Caroline Lucas: I know you do; I wondered whether everyone should.

Chair: Thank you for that very brief answer.

Q327 **Ian Levy:** I have a few questions. Could I get your opinions on Government support for net zero in aviation? Could I direct my first question to Hemant Mistry and then to Jonathan Hinkles? Should the Government spread investment in SAF, hydrogen and electrical flight equally or should we pick a winner?

Hemant Mistry: I think equally. Where we are right now, as I explained earlier, there are SAF solutions, power to liquid and so on, which would benefit from more investment on the production side. Equally, there is a lot of opportunity for electric and hydrogen going forward as well. Although there may be limitation in terms of the scope of the aircraft at the end, they would certainly provide very complementary solutions overall.

Jonathan Hinkles: The Government should be investing in all three of those methodologies for the reasons that I outlined earlier. There is a



small, medium and large solution to the challenge that we all have to decarbonise across the industry depending on the distance that you are flying. The question also becomes the scaling up of the production of SAF where the latest Euro control data is showing that 6.2% of long-haul flights are accounting for over 50% of CO₂ emissions. That is saying that if SAF is there it does require investment, but it is not a one size fits all approach and investment in SAF cannot be to the detriment of developing hydrogen and electrical solutions. As I hope you have seen earlier, that is very much the solution for regional and rural connectivity, in particular lifeline routes around the UK.

Q328 **Ian Levy:** Do you think that that investment to all three should be spread equally or should there be more investment into SAF?

Jonathan Hinkles: It may well be the case that SAF requires some more investment but that cannot be to the exclusion of the others.

Q329 **Ian Levy:** Thank you. Jonathon Counsell, what effect have the Government's policies had on the supporting the commercial uptake of net zero technology and is more needed?

Jonathon Counsell: If we think about what has happened in the last two years, the Jet Zero Council has been the priority in terms of enabling government support. We very strongly support it. Very good progress has been made, particularly in the area of SAF policy. I have to declare that I am the chair of the SAF delivery group, so I am quite close to that. We have held over 30 workshops and we have provided good information to help accelerate some of the activity.

The evidence there is that we got the mandate consultation within 12 months, which is lightning speed compared to how long it would normally take. That was great and we welcome the Government's decision around the £180 million to support early-stage develop of SAF projects and also the 10% commitment by 2030.

That said, though, as we heard from the previous panel, a mandate will not be enough. We need to de-risk the investment. I have spent a lot of my time in the last few years talking to investors and a lot of them have had difficult times with early-stage renewables. This is why our view is that you need a mandate coupled with a price stability mechanism, such as contracts for difference. If you get those two—and we have spoken to investors—they will invest in these plants in the UK.

Speed is of the urgency. We are in a race for global capital. The most attractive policies at the moment are in the United States, so it is no surprise that all the global plants are getting the global capital to build. They are winning this race. We have a great opportunity and we know that we are well advanced on the mandate. If we can get that contract for difference, both of those in legislation as soon as possible, we can establish a very strong position in terms of getting plants built.

Q330 **Ian Levy:** Do you think that the Government have done enough to draw



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in enough international support or do you think that there is more work to be done there?

Jonathon Counsell: In terms of what is happening through ICAO?

Ian Levy: Yes.

Jonathon Counsell: Yes, the UK has been instrumental. The CORSIA agreement in 2016, I cannot underestimate its significance. As I say, it is the only global mechanism to address climate change. I take the point that was made earlier. It is a low-price signal. We recognise that to get all of the 195 states of ICAO to agree to it, there were certain compromises. However, built into the CORSIA mechanism was a three-year review.

One of the things that we are calling for at the ICAO general assembly this September—it only happens every three years—is not only to agree to a long-term target of net zero emissions by 2050 but a strengthening of CORSIA. We have to strengthen our global mechanism and we need to strengthen that global price signal to incentivise development of low-carbon technology. The third thing is global ambition on sustainable aviation fuels. We fly all over the world. We do not want to just pick it up here in the UK, we want to pick it up everywhere we fly to.

The UK punches above its weight in ICAO. At COP26 we welcomed the International Aviation Climate Ambition Coalition, which I now understand has more than 50% of the world's aviation member states signed up. That is a great initiative and we would encourage them to continue to build that momentum to get the outcome that we desire at the general assembly late this year.

Ian Levy: Thank you for your answer.

Chair: For the final set of questions, we have saved the best until last.

Q331 **Cherilyn Mackrory:** I will try to be brief and we have touched on it already. I want to talk about demand management and the cost for passengers. The sixth carbon budget balanced pathway sees passenger growth limited to 25% on 2018 levels. If it was left unconstrained, the growth would be around 65% over the same period. Industry and aviation have said that growth should be left unrestricted. If that is the case, can we meet net zero targets without demand management? I am going to throw it open to whoever wants to answer first.

Jonathon Counsell: I am happy to answer that. Not surprisingly, and based on everything that we have talked about today, we believe that there are enough mitigation options for us to get to net zero emissions without requiring demand management. We believe that, if you can get a strong global approach to all of this, the impact on customer fares around the world can be less than 10%. That is what we believe is the overall cost of net zero emissions.



What we say first is that flying is a force for good. It drives huge economic value across the planet. It connects people. Here in the UK, we have over 1 million jobs in aviation and it delivers £60 billion of economic value. Globally that is 45 million jobs, \$1.6 trillion of economic benefit. Why we would deprive people from all of those economic benefits if we believe that we have the solution, and we do, to achieve net zero emissions?

Q332 Cherilyn Mackrory: Building on that, you say that it is going to be less than 10%. Do you include the fact that carbon pricing could reach as high as £300 to £500 per tonne?

Jonathon Counsell: Exactly. We have modelled all of that and that is an industry-wide global analysis, essentially, because we believe that we can get our gross emissions down so low that our dependence on out-of-sector emissions means that we can minimise that carbon-pricing effect.

Q333 Cherilyn Mackrory: Fantastic, because 15% of the UK's population generates over 70% of our international air travel and almost 100%, 96% of that, is long haul. David, if higher carbon prices mean higher ticket prices, will this lead to demand suppression? If we go back to the 1950s and air travel was a definite luxury, is that where we want to go back to? Probably not. How can we make sure that we do not get there?

David Morgan: You are absolutely right that if ticket prices go up flying becomes for the rich, wealthy people, which is how it was back in the 1950s and 1960s. It would be a tragedy for everybody if that were to take place. We know the benefits and Jonathan has explained them very well, of aviation. The contribution to our own GDP is enormous.

We do have enough levers and we are confident that we can work through this decarbonisation pathway with the levers that are available but it will require a considerable effort. We will need a regulatory framework to be developed further. One of the aims of the Jet Zero Council was to develop a co-ordinated approach to policy and regulatory framework. There is more work to be done on that particular area, but we absolutely believe that the goal should be that flying should still be affordable, inclusive, if you like, for everybody.

We have to work through this difficult transition into a greener future. We have to make sure that there is a framework in place that incentivises better behaviour, moving in that direction, and that it does not disadvantage early adopters of technology from the likes of easyJet, Loganair and so on because we have tried to do the right thing and shift—a seismic shift—into a different fuel type and so on. We would not want to be at a disadvantage of somebody who has sat back and decided to do nothing on that. Flying should be available for everybody. We believe that it can be but we are going to have to put some framework in place to make sure that that happens.

Q334 Cherilyn Mackrory: Is there an equitable option to spread the cost of



that? How are we calculating this?

David Morgan: The cost of the transition in different areas, as has been mentioned previously, there is going to be a range of different technologies needed to be able to do this with investment in SAF, hydrogen and electric and so on. In terms of the consumer ticket price, we will have to see how things move in that direction but I think that the aim should be to keep flying affordable, as we have said. Demand management seems a very poor tool in order to transition to a better future in that regard.

Chair: Thank you very much. Caroline Lucas is sneaking in, as ever, for the final word.

Q335 **Caroline Lucas:** I simply wanted to point out from an equity point of view, whether you recognise that 15% of people take 70% of the flights. The thing that is driving aviation emissions is a small number of people flying one hell of a lot of the time. If we are really serious about an equity perspective—as I hope we are—we might look at those range of subsidies, which I know you do not agree exist but many other people would say that aviation does get lots of subsidies, that would be a better place to start. End of.

Chair: Was that a question?

Caroline Lucas: Discuss!

Jonathan Hinkles: There is a very, very important point that is being overlooked in the demand management and some of the arguments that Caroline Lucas has just put forward. Three out of five domestic flights in the UK cross water. If you live in the Shetland Islands your nearest mainline railway station is in Bergen in Norway. Alternative forms of transport are not an option. For the rural communities in the UK and those, for example, in Northern Ireland, the islands around our shores, there is no viable option for the vast majority of journeys other than air.

That is why we are taking steps to decarbonise to address our impact, but demand management and saying that 15% of people take 70% of flights—yes, the average person who lives in the Shetland Islands, Orkney, the Western Isles, probably does fly significantly more than the average person who lives in Manchester.

Q336 **Caroline Lucas:** I do not think that that is what is driving it. It is the people with two or three homes in other parts of the world that is driving it, not your person in the Shetlands. However, we can discuss that.

Chair: A final word from Jonathon Counsell and then I am going to bring this to a conclusion.

Jonathon Counsell: If you have effective carbon pricing mechanisms you have natural equity, because if you fly more you pay more because



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you emit more carbon. That is the mechanism that we should look to to drive equity.

Caroline Lucas: If we had decent pricing, maybe.

Chair: On that note I am going to draw this discussion to a close. It has been fascinating. Thank you very much for all the advice and expertise that you have brought to the debate. Overwhelmingly, it was quite optimistic in its outlook. It is encouraging in an area such as this to have such a development of forecasts developing in the right direction rather than the wrong direction.

On that, I am going to thank Jonathon Counsell, Jonathan Hinkles, Hemant Mistry and David Morgan for their contributions and bring this session to a close.