

Defence Committee

Oral evidence: Defence and Climate Change - HC 179

Tuesday 28 February 2023

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Members present: Mr Tobias Ellwood (Chair); Robert Courts; Dave Doogan; Mr Mark Francois; Mrs Emma Lewell-Buck; Gavin Robinson; John Spellar.

Questions 100-133

Witnesses

I: Dr Tim Clack, Co-director, Climate Change and (In)Security Project, and Major General (Rtd) Dr Andrew Sharpe, Director, The Centre for Historical Analysis and Conflict Research (CHACR).

Examination of witnesses

Witnesses: Dr Clack and Major General Sharpe.

Q100 Chair: Welcome to this Defence Committee hearing on Tuesday 28 February 2023, where we will be discussing the impact of climate change and defence security. I am really delighted to welcome Dr Timothy Clack, who is director of the Climate Change and (In)Security Project at the University of Oxford, and Major General Dr Andrew Sharpe, who is director at the Centre for Historical Analysis and Conflict Research. Welcome to you both; we very much appreciate your time this morning.

Before we go into the questions themselves, maybe I can begin with you, Dr Clack. Could you just explain a little bit about what you are doing at Oxford and the connections that you already have with the British Army?

Dr Clack: The Climate Change and (In)Security Project is a collaboration between the University of Oxford and the Centre for Historical Analysis and Conflict Research—CHACR—which is based at Royal Military Academy Sandhurst. We have been in existence for about 24 months, and we have a series of aims—they are quite straightforward, really—to explore the insecurities created by climate change and how to respond to them, to create conversations between academics, state-of-the-art research, policymakers, decision takers and security practitioners, and to frame any outputs that we do in terms of making them of value for practitioners, so we focus on priority theatres to draw out lessons, develop understandings and so on. As part of our core team—there are about 12 of us now—we have academics, people who work in the policy space and security practitioners.

In terms of project outputs, these are quite varied, but we run an annual public workshop that people can dial into from all over the world. We also do a lot of bespoke, invitation-only briefing events for various partners; we have done some of those for the MoD, the Army, the United Nations, NATO and various NGOs. We also produce a series of briefing papers on various topics, and we engage and deliver public and private lectures, as requested. Since December 2022, we have also been providing the secretariat for the new all-party parliamentary group for climate and security.

Chair: That is very helpful.

Major General Sharpe: CHACR was established about 7 years ago. It is a very small organisation, independent of the Army but working to it, if that makes sense? Without getting too Clausewitzian straight away, it helps the Army with historical analysis, the unchanging nature of war and the changing character of war thinking. I am supported by a historian and a current affairs strategic analyst, a couple of people in uniform and an out-of-uniform editor of the *British Army Review*.



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It is by design a small team, because unlike most of the think-tanks that work peripheral to defence, we decided very early on that it was unaffordable to make a think-tank full of researchers and experts, all of whom would need paying to exist. CHACR therefore has a very small core, as described, and relies on going out to expertise all over the world to get views on whatever it is that we are asked to look at.

Our remit is to look at stuff that the Army specifically asks us to. There is a two-star board of six or so two-star officers from various bits of the Army who say, "Could you please look at this or that aspect, and think in rather more depth than we have to capacity to, or bring us experts with opinions on those subjects?" We also identify things that we think need looking at. In both respects, we have been working with Dr Clack and his organisation. Both independently and through a direction of the Army, we thought that climate change was one of the aspects, among all the other things we look at, that was particularly important.

Q101 **Chair:** Thank you. That was very helpful and places into context where we will go. We are going to explore the changing character of war, given what is happening to our fragile planet. I will begin with that; Dr Clack, where in the world are we going to see soonest the impact of climate change on security and governance?

Dr Clack: To start with, it is important to state that it is a complex and multi-layered forecast. It depends a little bit on what you mean by "affected". In one sense, we do ourselves a bit of a disservice by thinking regionally. Climate change is a truly international challenge, and we cannot get away from the fact that the atmosphere is a global commons, so national borders are a little bit irrelevant in some ways. What happens in one area will then have impacts in other areas—there is a connectivity issue.

Anthropogenic climate change is clearly evident and escalating, and it is transforming national economic and socio-political environments. A range of climate scenarios have been forecast, but common to all of them is a rise in sea level; increased frequency and scale of extreme weather events, such as typhoons, monsoons and tidal surges; more droughts; more floods; the melting of ice caps and the melting of permafrost. Then there are effects in the ocean, such as acidification and deoxygenation.

The IPCC report from August 2021 offers the fullest and most up-to-date synthesis. That reported a 1.1° temperature rise since December 2015—the date of the adoption of the so-called Paris agreement—but 1.1° was a global average, so it was a bit of a fudged headline. The figures are actually 1.6° over land and 0.9° over sea. We then have to factor in the fact that the report took 18 months to pull together—a massive undertaking—so the real figures are three years beyond that. It is certainly the case that certain parts of the world are heating more quickly than others. The UN has reported that the temperature rise in the Sahel—the Sahelian part of Africa—is rising 1.5 times faster than the global average. The rate of heating in the Arctic and the Antarctic is similarly beyond the average range; it is about three times faster in those places.

Those accelerated trajectories pose direct challenges to those areas for the people who live there and to those nations, like ourselves, that have strategic interests there.

If I may, it would be useful to refer you, Chair, to the October 2021 US National Intelligence Council report that identified 11 countries of great concern based on the threat of climate change. These countries were assessed to be both vulnerable to the physical effects of climate change and to lack the capacity to do the necessary adaption and mitigation. The energy, food, water and health security of the 11 countries was assessed to be at extreme risk. The countries were India, Pakistan, North Korea, Afghanistan, Iraq, Burma, Colombia, Guatemala, Haiti, Honduras and Nicaragua. It is worth going through that list simply because those countries are also high up on most instability, corruption and economic inequality indices. They are also, in many cases, countries of strategic importance. They are countries that, in some cases, have seen recent western military intervention. Some countries have nuclear weapon capabilities. Some are theatres where insurgent and terrorist groups are present, and some of those groups have the intent and capability to attack western interests, so there are lots of reasons why the UK defence and security apparatuses should take note.

Q102 **Chair:** Just to explore the consequences of that, is it fair to say that the climate crisis we now face is the biggest global long-term strategic challenge? If you agree with that, is our current global order able to agree a solution in time before we see some significant challenges come to light?

Major General Sharpe: The trite answer is yes and no. There is no doubt that this is probably the most significant global threat to all sorts of different security issues, which we can probably explore in more detail in the second question. The second part of your question: can we get the world to agree on how to deal with it? That is troubling. I think that one can make all the good intentional statements one likes internationally or nationally, but taking the next step to implement those is problematic. Furthermore, we are dealing with nations that either make statements on which they have no intention of following through or decide not to make statements of any sort, going back to Dr Clack's opening remarks. This is a global issue—a genuinely global commons—for which the petty politics of humankind are completely irrelevant. Getting humankind to come together to deal with that is fundamentally problematic. It's a security question that we might explore later, but what on earth do you do either nationally or internationally to deal with those who choose not to take part in dealing with a global problem?

Chair: That is exactly why we are doing the study—because of the security implications of what we now agree is the largest long-term threat, but the inability of our global order to provide the necessary solutions. Thank you for that. Let us turn from the global to what is pertinent for the United Kingdom. Robert, over to you.

Q103 **Robert Courts:** Thank you, Chairman. Thanks to our witnesses for joining



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us. Can we talk about some of the UK-specific challenges—that is, what the UK has to do, particularly with a focus on the defence and security world.

Major General Sharpe: Help me. In what respect? Do you mean domestically?

Q104 **Robert Courts:** We have talked about the implications for the world—the global implications for security—but what would be the implications for the UK were we not to take action?

Major General Sharpe: There is a series of regional implications for us. I think you need to look out to look in, if that makes sense. It is linked to that first question—water supply globally. Water supply is a strategically very interesting problem. Water supply globally is going to affect all of us. The High North is an interesting area for the UK specifically, but perhaps not in the ways you might think. Fish stocks migrating north are going to be interesting for us. Our fishing industry is an extremely important part of us strategically. If those things that we traditionally eat from the sea find their way further north into an area of the world that is likely to become increasingly disputatious, that is going to be significant for us.

Let me go back to what Dr Clack said about areas of drought, north Africa, and migration. That is going to be significant for us; we are seeing it daily on our television screens. It is going to be increasingly something that we need to think about. Our relationship with all those nations in the world that rely on oil and gas as their primary source of GDP—of export—is going to be extremely significant because their strategic dynamic is going to change. Middle East it goes without saying. Saudi Arabia—46% or so of its GDP is based on oil. China, India, Russia—these are all countries with a significant amount of their strategic economic basis depending on the export of gas and oil. If that becomes something that the world eschews and that the world moves on from, their strategic international behaviour is going to be very different, so maintaining our understanding of that, and in defence, foreign affairs and security terms getting ahead of it and thinking through our relationships with them, is going to be really important. The end of oil and gas as key economic levers is a key destabiliser, and we need to think very hard about that.

Q105 **Robert Courts:** What about some of the resilience preparedness steps that we might need to take ourselves? I am thinking about things where if we were to do nothing, climate change would be something that has a significant impact on the country or something—we probably would expect that in any event.

Are there steps we need to take in terms of our own infrastructure? I am thinking about things like if the current ambient temperature is one that works for our strategic infrastructure, we would need to start investing in things such as air conditioning units to keep things at the right temperature. It is that sort of thing.

Major General Sharpe: Broadly domestically or in defence?

Robert Courts: In defence specifically.



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Major General Sharpe: There is a whole bunch of those sorts of things, in terms of mitigation, which you would do domestically with your house; they apply equally, but on a much grander scale, to defence—insulation, smart buildings, wind farms and solar farms. The defence estate—

Q106 **Robert Courts:** It is the estate. There are also things like the temperatures at which munitions may need to be stored or the optimum operating temperature for aircraft. It is those sorts of things.

Major General Sharpe: All of the above applies. Salinisation of the oceans affecting submarine operations—what does that mean for the strategic nuclear deterrent? Electrification of vehicles—there is a whole series of emissions things that can be done. I am struggling to get exactly where you are going with the question to give you a satisfactory answer.

Q107 **Robert Courts:** The question is intended to be around if we do nothing in the UK to respond to the challenges, what impact will that have on us? I suppose it is a very broad question, because it will have an impact on our strategic activity but also what the position for defence in the UK would be. It is probably broader than one simple answer.

Major General Sharpe: Strategically, because this is happening, I think if one decides to do nothing about it, we are going to be increasingly on the back foot and in a reactive position. I think that would be a bad thing.

Secondly, there are a whole bunch of strategic implications that, if we were to ignore them, would put us at a considerable disadvantage. For example, there is the rare earth that is required in the wind industry, which is largely found in Africa and which China is, in particular, is exploring ways of bringing to itself. If we were to disengage from that, we would put ourselves at a considerable disadvantage.

There is a whole series of strategic implications for stepping back from something that is a global issue, not least of which—because we have made a series of statements, have we not, nationally?—is that we wish to be seen as leading in that respect. That is not just for all sorts of jolly good moral, sensible and pragmatic reasons, but because we think it is the right thing to do. If we were to step back from that and ignore it—and it does not matter whether you are talking nationally, on a grand scale, or in terms of defence—that would be a retrograde step.

Q108 **Robert Courts:** We would have a soft power challenge as well as a hard power challenge, in other words.

Major General Sharpe: Absolutely.

Q109 **Chair:** You mentioned the nuclear deterrents. Could you expand a bit on that and the consequence of changes in the seas that might impact on our security from that angle?

Major General Sharpe: Not much, is the answer. I am no expert, but my understanding is that the changing density and salinisation of the sea has a growing effect on submarine operations, not least on their ability to hide. I do not understand how or why, because it is an area of science that I do



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not understand, but I think that might be something you might like to explore. It could be significant.

Chair: That is why I asked the question, because I think that is something that would deeply concern not just the MoD but us as a whole, given that that is our principal form of deterrence. Dave Doogan hinted that this might have something to do with sonar capability. Maybe it is something we can explore later, but thank you for raising that. I am sure we will turn to that at another stage.

Q110 Mrs Lewell-Buck: Does the MoD's strategic approach to climate change identify the key global risks and is there any area where the approach is lacking?

Dr Clack: The UK MoD broadly is getting things right. It acknowledges that climate change is a threat multiplier. It is a shaping threat, and it can be an existential threat as well. It is certainly very clear in articulating recognition that climate change is reshaping the global security landscape, amplifying many traditional security challenges, and it is the genesis of new ones as well. Usefully, the strategic approach recognises that climate change threatens peace through environmental emergencies, inequalities, resource scarcities, mass migration, and economic and governance vulnerabilities, and that those issues are all co-dependent, as Andrew mentioned earlier. What I would note is that the UK's strategic approach could better appreciate the relationships, the interdependencies and the co-dependencies between climate change and impacts.

There is a huge literature now in climate security studies that describes compound risks, tipping points, cascade threats, chains of causality and even polycrises—a new term that I came across the other day. What this effectively means is that it is not a simple, unidirectional flow between cause and effect; rather, effects complicate and drive further negative change, with further impacts and further consequences, and the deterioration in certain areas can be—holds the potential to be—quite rapid. An obvious example there would be that Defence needs to be conscious of the fact that not only does climate change amplify the prospect of warfare and peacekeeping operations, but the military deployments in response to that are obviously going to add to the climate and environmental problems and strains in those areas.

I would also suggest that UK MoD thinks a little bit more about how this is going to play out in urban areas. Huge amounts of climate migration are taking place already, and a lot of that migration is happening internally as rural communities can no longer be fed from their own soil and move to urban centres; they are internally displaced. If we take Mali as an example, the population of 19 million is now forecast to be 27.5 million by 2030; 46% of the population is under the age of 15. Nearly 42% of the population now lives in urban centres, and the forecast is for that to continue to beyond 50% by the end of the decade. The capacity of services and infrastructure in urban centres could easily become overwhelmed. They are strained already in places such as Bamako, Gao and Timbuktu, but they could easily become overwhelmed. In Mali, we



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have already seen reports of violence against migrants in various urban centres, Gao and Mopti in particular.

Recognising the unique dimension of the kind of urban problems that will be caused through displacement and migration could be usefully further researched and thought through.

Q111 Mrs Lewell-Buck: Picking up on that example, Dr Clack, you are saying that rapid changes are happening already, and you have explained the situation in Mali. The Department's strategic document sets out a vision for 2050. Is 2050 too late?

Dr Clack: I think 2050 is realistic in terms of making things happen, getting ducks in a row and getting the appropriate buy-in. However, I think that moving faster—indeed, more urgently—would definitely be advisable.

The question about solutions was asked a little bit earlier. I think that one of the dimensions that is often missed when we talk about defence and security is that if an adversary was attacking our cities with floods, fires and bio-weapons, threatening to take away our drinking water and destroy our food security, our agriculture and our food supply, causing untold economic harm, the response would be war, wouldn't it? It would be total and immediate war, and it would be something of the highest priority.

Framing and recognising the climate crisis as a massive security problem is therefore part of the solution, and part of that is militaries addressing their own carbon footprint and enhancing their role in climate security, but the challenge is much bigger than that. The challenge is convincing decision takers and publics about just how urgent this is as a security issue. There is the classic line about the important always playing second fiddle to the urgent, but with a situation like climate change the importance is clear, and we do ourselves a huge disservice as the UK and as global citizens if we don't maintain focus on it.

Major General Sharpe: May I add to that, because I think that your question combined with the previous ones is actually the key to this? Without rephrasing, how is defence identifying and saying that it will deal with these strategic issues? Does it align with what everybody else is saying?

First of all, unsurprisingly it aligns pretty closely with Government policy statements on the subject, all of which are pretty robust and pretty positive. In the document that they produced—the "Climate Change and Sustainability Strategic Approach", which I think was published in March 2021, co-authored by Jeremy Quin and Richard Nugee—their summary of threats to peace and stability pretty much accords with the breadth of analysis on the subject about the things that we should be concerned about.

I would draw out and add a couple of things that I think are really important. The first one is what I term upstream water holding or ownership. There are large areas of the world where the control and



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ownership of water will have a severe strategic impact. For example, the Brahmaputra, which is a major source of almost everything in terms of life, agriculture and sustenance in northern India, Bangladesh and Bhutan, finds almost all of its headwater source in China—in the Chinese-controlled Himalayas. Similarly, the source of the Indus, on which northern India and Pakistan are heavily dependent, is in China. The Nile goes through 10 or 11 different countries; the headwaters of both the Blue and the White Nile are not in Egypt, above the Aswan high dam on which the Nile depends entirely. In the Middle East, more than 60% of surface water is, if you like, international—it crosses national boundaries. Those things are all going to be extremely strategically relevant.

Specifically in Defence, take for an example the islands in the Indo-Pacific that Dr Clack talked about. Diego Garcia is seriously important to our defence and indeed to the US Navy defence effort. I think the highest point on Diego Garcia is 30 foot above sea level. That has serious defence implications for us. There's the High North. People talk about migration as a weapon, and instability as a result; they talk about rare earth minerals' availability; they talk about Taiwan and chip production, and the Chinese relationship with Taiwan. The one thing they don't talk about in there—the Chairman raised this earlier on, and I highlighted it when he raised it—is how on earth do we deal with all those people who decide that they don't wish to do something about climate change? All those things are pretty well covered in a wide range of Ministry of Defence publications. I think they do a pretty good job of horizon-scanning, looking at those and analysing the problems.

There are a couple of comments, though, that go directly to your question, if I may. One is that you could accuse that document of being aspirational, which it very definitely is. I am guessing that Defence is doing an awful lot to meet those aspirations. The document itself, as you read it, sets itself targets and headmarks, but it doesn't tell you how exactly those things are going to be carried out. There are some really good examples, such as RAF Lyneham in Wiltshire—the solar farm there is seriously impressive—that show that things are actually being implemented. But I think Defence could do better about telling us what they are actually doing, as opposed to what they are hoping to do.

The second thing is about the new head of climate change and sustainability, James Clare—a two-star civil servant, I think. This isn't a personal comment on the individual at all, because I'm sure he's absolutely brilliant, but his predecessor, General Nugee, had one job, whereas the new guy in post has three jobs in his job title: climate change and sustainability, levelling up, and the Union. I am not sure that that is clever messaging.

Q112 John Spellar: Comments were made about instability and exponential population growth in sub-Saharan Africa, and Mali was cited. It could be that that is partly exacerbated by climate change, but fundamentally investment in family planning and female empowerment might well be a significant measure to resolve that issue of population growth.



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However, that is not the key question I wanted to ask, which is about our response. The Armed Forces will need to respond, and you have just outlined how that is being done, but should we be tackling all the climate change challenges, or should the Ministry of Defence be looking at prioritisation, perhaps where there are either the quickest wins or the most significant wins. If so, what are those?

Major General Sharpe: The unhelpful answer is that you have to do both, but answering in that way agrees with you that you have to set some priorities, because if you are trying to do it all—trying to eat the whole elephant, and I think we probably have to—you are going to have to break it down and prioritise.

The first and obvious thing is that Defence can do better and has a plan to do better, I am sure—in fact, I know—on emissions. It depends on which statistic you believe, but somewhere between 30% and 50% or so of total Government-based emissions come from Defence, so reducing that in all sorts of ways should be a priority.

I am no scientist, but there are all sorts of ways to do that that we might like to explore. Great steps are being made on aircraft fuel, for example, although with what they call drop-in fuel it is much harder. Non-drop-in fuel, things like biodiverse fuel—by non-drop-in, they mean you can't just throw it into the aircraft as the aircraft is and it will work; you have to modify your aircraft. They are looking at all sorts of platform and vehicle ways of reducing emissions.

Addressing the carbon neutrality of the Defence estate is something that they can and are getting after in a big way. In the same way as we would all hope to insulate our houses and investigate putting solar panels on the roof, so Defence can on a grand scale. That of course is going to require investment now to save money later, in exactly the same way as one does on a miniature scale domestically, but I think that that is really important.

There are the more eco-friendly approaches to capability and equipment development and the electrification of the vehicle fleet. Already, I know, defence is doing its best to electrify its "white" vehicle fleet—in other words, its non-military vehicle fleet—and that is going to roll on into vehicle design. There are also smart buildings, solar power—all those things. I would put those as the highest priority, not necessarily because they are going to have the biggest strategic impact, but because they are something that we can get after pretty swiftly, show leadership in, and so on.

My one concern on the strategic document we were talking about before, which plays into exactly this question, is our aspiration technologically to be what they call a fast follower. In other words, we can do all these things and crack these priorities if we closely follow what industry is doing, because private industry, outside Government, inevitably moves at a faster pace than Governments globally do. My concern would be that if you have a procurement environment in which you might be able to fast follow people in terms of knowing what they are doing, but in terms of



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acquisition you simply can't keep up with it, you might be setting yourself a series of goals and priorities that you find very hard to meet.

So I guess my short answer is: prioritise those things that you can get after really quickly, and then deal with the larger, more strategic, more difficult things slightly slower and in more measured time. It is a big "if"—it is possibly not for this panel, but certainly for you as a Committee—but if you could get after the byzantine acquisition process that slows down Defence's ability to stay up with rapidly changing technology, that would do Defence a great service.

Dr Clack: I agree with everything Major General Sharpe has said. I would make one addition: how do you inform decisions and do the prioritisation? I think the answer there is intelligence and assessment, so developing capabilities in climate intelligence and assessment would be useful—get those aggregated, and get them mainstream. That would give planners and decision makers insight into future conditions at a granular level. We would be able to speak to issues of resource scarcity, competition and cascade risks, and to how all of that interdigitates with traditional national, economic and human security issues. It could feed into commanders' critical information requirements. Subject matter experts could be brought in to illuminate triggers, indicators and warnings about the weaponisation of things like food and water, where our vulnerabilities are, and where these are being held at risk by adversaries.

That kind of intelligence does not necessarily have to come from within the MoD; obviously, there is also the Met Office, the FCDO and so on, which could very usefully feed into those assessments. If you have that local climate forecast and analyses, that obviously will ensure better mission outcomes. If we think historically, the US trained 6,000 military officers to be weather forecasters in world war two, recognising how important that was. This is going back a bit, but if we look to history, we can see weather causing strategic military shocks—everything from the Spanish Armada to Kublai Khan's attempt to conquer Japan and the fate of Napoleon and Hitler in Russia: weathers were significant factors in those military outcomes.

The flipside of that, potentially, would be climate counter-intelligence, and Major General Sharpe has already mentioned that lots of countries have climate treaty obligations linked to things like reducing emissions, technology transfer and that kind of thing. It would be really useful to be able to verify reporting in relation to those, addressing greenwashing, false reporting and that kind of thing. It would keep other nations honest, incentivise parties to keep their commitments, and expose disinformation. If that information was released publicly in some fashion, public exposure could lead to other forms of pressure, such as consumer pressure, citizen pressure and that kind of thing, so I think climate intelligence and climate counter-intelligence are areas that could be usefully resourced. They could have significant impact.

Q113 **Dave Doogan:** Major General, I wonder if could push back on your characterisation of the Ministry of Defence as making great strides in this



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priority. I am not sure I see the evidence of that. Government is a big emitter, and defence is 50% of Government emissions. Inherently, therefore, that is significant low-hanging fruit. If you are that big an emitter, you must have some easy targets—not to be too military about it—to get after, and I am not sure what they are in the Ministry of Defence.

I am not sure what easy, quick wins the Ministry of Defence has. I spend a lot of time on defence establishments, and I do not recall seeing many electric vehicles. I know that the MoD made a great show of completing one entire flight envelope with sustainable aviation fuel. That is great in proving the technology, but every day defence continues to burn tonnes and tonnes of fossil fuels in its doubtless important operations.

It is also instructive to look at the language of the Ministry of Defence. In its paper entitled, "Climate Change and Sustainability Strategic Approach", the language tells it all: the goal for 2026 to 2035 will be "to reduce emissions significantly using existing and emerging technology" to cut carbon output; and in the long term, from 2036 to 2050, the MoD will use "novel technologies" to reduce emissions further. That is not really a plan, is it? That is just a narrative, and a narrative that underpins a wholesale lack of any form of achievement whatever in reducing emissions.

Major General Sharpe: I think I agree with everything you just said, Mr Doogan, up to the very last few words. If I came across as saying, "Hurrah, defence is doing brilliantly", forgive me; that is not what I meant at all. I hope—in fact, I am sure—that what I said was that what struck me about that document was that it is very aspirational. It laid out a plan of wonderful things that we were going to do, not least of which—I cannot remember exactly where in the document—that we intend to be a world leader in this respect.

Dave Doogan: Again, that is narrative.

Major General Sharpe: Correct. So, great vision but, forgive me, there is an old Japanese proverb that vision without action is just a daydream, but action without vision is always a nightmare. I think you could accuse that document of being vision without action, couldn't you? Yes. There are some pointers in the right direction, which is what I was seeking to give, rather than patting defence on the back for a fait accompli.

There are moves in the right direction that are impressive. The solar farm at RAF Lyneham is an impressive piece of people sitting down and going "Right. There is a big piece of flat ground that points south, which we can invest in and deal with." I have to say that it seems to me that in terms of infrastructure basing, the Royal Air Force seems to be ahead of the other two—perhaps because it is easier so to be in that respect.

The electrification of the white vehicle fleet has just started. A number of cars and vans in that fleet are beginning to be moved over. With all these things, we need to invest—because we need to get rid of stuff, if we are trying to sell diesel vans, nobody wants to buy them, while we are



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replacing them with electric vehicles, which everyone wants to buy, so there is a balance of investment.

Q114 **Dave Doogan:** Are you concerned, as I am? That is all good, and sometimes you have to do things that do not have a massive impact, because they are part of a broader envelope that together make the effect that you are looking for happen. My concern, however, is that a couple of thousand electric transit vans will not put much of a dent in a fleet of A400s burning tonnes of kerosene a day.

Major General Sharpe: Absolutely.

Dave Doogan: My assessment would be that it lacks ambition in an operational sense, rather than in an aspirational sense—it lacks actual operational ambition—and there is no track record of significant improvement to date.

Major General Sharpe: I would disagree that it lacks ambition; I think it is extremely ambitious—not necessarily in a positive sense, because only by matching ambition with the ability to act are you going to get after it. The problem is the prioritisation of where a stretched defence budget, for all sorts of reasons, puts its money. There is a queue of people all saying that they can reasonably aspire to be a priority in how defence spends its money. The document to which you have referred sets out an aspiration to be the strategic high priority. I am sure there is a queue of other people writing similar documents and saying that they need to be the strategic high priority.

I also refer back to my comments on and answer to the previous question. Unless, collectively, defence gets after the length of its procurement chain, from a good idea to having stuff, not just in this respect but in lots of other respects, we are always going to be lagging between our defence statements of intent and vision and our defence's ability to get after those and turn them into reality.

Chair: You touched on earlier the importance of the High North. The Arctic circle is warming twice as fast as the rest of the world. Perhaps we will now turn to that.

Q115 **Robert Courts:** Looking at things from an operational perspective, as the Chairman has touched on, and the geographic perspective, the obvious area to pick is of course the High North, an area that is warming, which will mean it is navigable for larger periods of time. Resources are going to be opened up that were not opened up before. The ice that is there will behave more unpredictably, as we have seen. Should we focus specifically on some of these more challenging areas? NATO's flank up in the High North and the Arctic circle is the obvious example of that, although there will be others. Or should we maintain a broader, more flexible range of operations?

Major General Sharpe: Despite what I said earlier about the importance of the High North, I am a sceptic in two ways. Don't get me wrong—this is a really important region that will have serious strategic effects. Both the



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US and China have already made a number of public statements—this is going to lead to the opening up of a new internationally available waterway that we can all use—and Russia has made a very clear statement that this is Russian territorial waters that it will regulate. If that is not a recipe for a strategic confrontation, Lord knows what is. So, yes, it is important.

Chair: I wonder where they got that idea from.

Major General Sharpe: Our fish stocks are moving north, etc. So, absolutely, this is an important region. But my scepticism finds two sources. One is that, without being too simplistic, we are an island nation based on global trade and always have been, and we will continue to be an island nation based on global trade. Sure, this will be a new route—a contentious route—of global trade and resource, but that does not mean it will be the only one. If it is one that de facto brings people into confrontation, for us to put not all of our eggs but a disproportionate number in that basket when we are an island nation based on global trade would not be a savvy thing to do.

My second source of scepticism comes from the fact that I wonder why we think that the UK will suddenly become the experts in this that will make a difference to NATO. Iceland and Norway are pretty good at this and they are in NATO. Sweden's pretty good at this and they aspire to be in NATO any moment now. Finland's really good at this and they aspire to be in NATO. These new members will want to demonstrate to NATO what they can offer as value add immediately. If we are going to suggest that we should put our eggs in that basket, first, I think it is flawed, and secondly, I think that a lot of other people will have an alternative view.

So my answer is—sadly, because it sounds like we want to have all cakes and eat them—that for all those reasons that we have been exploring this morning, if you want to stay relevant, front-footed, engaged and all of those good words, you have to be more global in your aspiration. NATO is a good start point. You have got to accept that we have to engage with Russia, China and India, and that the Indo-Pacific is important. Africa, particularly north Africa, is going to be important to us. Europe does not go away, because there it is. I am afraid my feeling is, “High North, is that important? Sure. Is that where should be putting our emphasis at the expense of everywhere else?” Unwise, would be my view.

Q116 **Robert Courts:** Presumably, the inherent instability and unpredictability of climate change emphasises that answer. Because you simply do not know what the impacts may be on other places around the world, and how people may react to them.

Major General Sharpe: Exactly so.

Dr Clack: I would add to that. Obviously, Andrew makes the point that there is significant strategic friction already in that part of the world, with the North sea route opening up. China, quite fascinatingly, has started to make reference publicly to the polar silk road, and also to designate and

self-style itself as a near-Arctic state, which is of course geographically false.

The friction was readily apparent even before the Russian invasion of Ukraine. The Russians were heavily investing in their defence structure, and had infrastructure in the Arctic, particularly in the Murmansk province. They were making a lot of performance and posturing through the presence of missile cruisers, nuclear submarines, MiG-31 flights over the north pole and into US and Scandinavian airspace. NATO has dispatched B-1 Lancer bombers to Norway, and restarted cold war training programmes, such as the annual Arctic Warrior exercises.

Of course, the war in Ukraine has done nothing to cool tensions, quite the reverse. Another impact of Russia's Ukraine war has been the western pause in Arctic Council diplomacy. Finland and Sweden, which were previously non-aligned Arctic Council members, are now seeking to join NATO. That means that the Arctic Council, whose mandate is essentially designed to avoid military escalation and security issues, will soon be made up of seven NATO members plus Russia.

It is an area of significant strategic concern. That makes specialist equipment necessary. It is why those countries that have strategic interests there are already building new icebreakers, or are at least reinforcing the hulls of existing naval vessels.

On the one hand, because of the geopolitical situation, it is perhaps unrealistic to suggest anything other than NATO's flank will continue to be the primary concern of UK armed forces, certainly in the short term, maybe even in the mid term. There is a military saying that holds a lot of truth: you don't get to pick the war, it picks you. Because of that, there is a need to maintain global reach and global war-fighting and other capabilities.

The upshot, agreeing with General Andrew, is that the UK needs to exceed the breadth and depth of its current capabilities, because of climate change and the complexities it brings in. It is a challenge of augmentation and addition, rather than reallocation. We need to build a broad and flexible capacity, because it is very difficult to predict future tipping points and potential changes, and those changes could happen very quickly.

Q117 Chair: Thank you. For clarity, I think I am correct in saying that Russia is not currently participating; it is suspended from the Arctic Council. Is that correct?

Dr Clack: That is correct.

Q118 John Spellar: This is initially a question for you, General. Can the armed forces derive operational benefits from adapting to tackling climate change? In that context, what thoughts do you have on the environmental and operational benefits that micro-nuclear reactors could provide for deployed forces, and what is your assessment of the risks?



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Major General Sharpe: Thank you, Mr Spellar. If I may, I am going to address the first part of that question and then demur on the second and pass to Tim, because Dr Clack knows rather more of the sub-question than I do. I know you have a particular interest in that area and probably know more about it than I do.

To address the first part of your question, I think the answer is yes, absolutely. Let me give an example of particular interest to me. I am, although perhaps amateur, becoming increasingly professional as a Napoleonic historian, and this piece of ancient history is actually very relevant to where we see ourselves now in terms of a shift. Part of the Napoleonic design for warfare was to be able to do operational manoeuvre—grand-scale campaign manoeuvre—in a different way from his opponents, including ourselves. By living off the land instead of living off a slow-moving ox-pulled supply train, he could form these corps that could move independently and concentrate for effect. In a very different but very similar-sounding way, if you read most of the futures concepts that Defence is writing, from “Future Soldier” in the Army Futures directorate to the DCDC publications, they are talking about less dense battlefields, a change in logistic reliance, open spaces, less frontage and so on.

Without deciding whether that is right—I think it probably broadly is—there are some very exciting areas where, if we get ahead of the technology and procure it rapidly, we can derive some serious operational benefit. Specifically, for example, if we got the right mixture, in land war, of the electrification of our fighting fleet of vehicles, battery life, small-scale solar power, and micro-reactors—the next part of the conversation—that would give us a real logistic freedom. The biggest tie for those fighting fleets is their ability to be supplied with food, ammunition and fuel. If you were able to deal with the fuel issue by making the vehicles effectively self-sustaining, that would give you both a tactical and, more importantly, in that Napoleonic sense, an operational flexibility in the way you prosecute land war. I think that would give us a significant advantage and allow us to reshape our Army in all sorts of ways.

I am sure that there are other examples that would apply to the same imaginative capability development for air and maritime, not the least of which, as a second concrete example, is uncrewed equipment in all its shapes and forms. Uncrewed equipment can do all sorts of things that crewed equipment can do, but it does it in a much more sustainable way, not least because it is likely to be much smaller and more compact. So I think the answer is yes. I am sure the answer is yes. I am sure that if I and think-tanks like mine have identified all those, Defence probably has too. On where we are in seizing that opportunity, and how able we are to do that and stay up as a fast follower, at the risk of sounding like I am saddling up a hobbyhorse or banging a broken drum, I am afraid that unless we can stay up in that procurement race such that the opportunities are available to us, instead of just visible to us, we will not crack the problem.

John Spellar: Thank you. Tim?

Dr Clack: I would agree. I would also add that, on the electrification of the green fleet, there are clear operational advantages to the military technologies. Things like reduced thermal and noise signatures are important, as are improved platform performance and reduced logistical drag, in terms of fuel resupply. Obviously, there are transition costs, but it is useful to think in terms of whole-life costs, because there are savings over the lifecycle of those vehicles.

DSDL has run a hybrid electric drive technology demonstrator programme. It converted three in-service vehicles to hybrid drive—the MAN SV truck, the Foxhound and the Jackal. It demonstrated through that that engine-generated electrical power has massive emission reductions. Nitrogen oxide was down by 20%, carbon dioxide was down by 23% and carbon monoxide was down by 50%. There were some other interesting advantages that came into play. There was improved mobility due to the improved high/low-speed torque. There was increased survivability, of course, from silent running using batteries, and actually there was potential for increased levels of power, including greater duration, in terms of silent watch.

There are also other potential things. This was explained to me by an engineer. The use of an electric hub motor removes the design constraints of a mechanical prop shaft, which basically offers all kinds of freedoms to the suspension design. That means you can have a wider wheelbase. The suspension system can offer enhanced off-road mobility, and importantly it can also provide additional stand-off against IED and mine blasts. There are all kinds of interesting opportunities that can be exploited on the engineering side, which will offer operational advantage.

Q119 **John Spellar:** And modular nuclear?

Dr Clack: On modular nuclear, I will caveat my answer by saying that I am not a specialist on nuclear reactors. It is important to make that point. I am conscious of some of the pros and cons of that technology. The potential is clearly there to meet energy demands through small modular reactors, which I think are up to 300 MW, and micro-reactors, which are up to 10 MW. They are small and transportable—you can fit them on a C-17 aircraft—which is good news if you need to deploy to remote localities and need reliable power for forward operating bases and so on.

There is also the self-sufficiency, in terms of meeting power demands, and the rapid installation. Apparently, they can be generating power within a few weeks, which is much better than a solar farm solution, which takes much longer to assemble and produce power. My understanding is that the technologies can self-adjust, which means you don't need to deploy large numbers of specialist operators; there are in-built passive safety systems to prevent overheating.

That is the good news side. There is certainly potential there to provide the right levels of power for forward operating bases. Also, you are putting



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fewer people in harm's way, of course, if you are removing the need for all those—constant—resupply convoys for fuel and so on.

The primary issue that speaks against the deployment of the technologies in certain contexts is that they could be attacked. As we saw in Afghanistan and Iraq, and Mali and Somalia recently, FOBs are attacked with indirect fire. They are also attacked by person and vehicle-borne IEDs. In the most extreme situation, an overrun threat is also present; al-Shabaab have run over KDF camps in Somalia in recent years. If they are attacked or if there is a reactor accident, troops at the base and local communities, local civilians, risk exposure and contamination.

The obvious protective measures that could be put in place are things like assembly of HESCO barriers, or burial. That could undermine the safety and performance of the reactors, because airflow is required to prevent overheating. Of course, climate change is a relevant factor there if the military are being asked to conduct operations in increasingly hot environments.

Another issue would be transportation. Host countries and over-flight countries would need to grant permission at the time of deployment, and obviously we cannot guarantee that that would happen.

My view is that there is a role for these technologies, but given the risks, the best places to deploy them would probably be remote and more stable environments—obviously, the context would need to be thought through, but places like Diego Garcia, the Falkland Islands and Cyprus. In other localities, other theatres, the context would be the key determination. During the Afghanistan campaign, with the ISTAR and protections in place, a small modular reactor would have been viable in terms of powering, for example, Camp Bastion and Camp Leatherneck—these huge hubs. Smaller FOBs would have been too exposed, I think. But we need to think longer term. Had the US and UK left modular reactors for the Afghan security forces at the point of transition in 2014, these would now likely be in the hands of the Taliban. There are obvious risks to be kept in mind, but they are not insurmountable; obviously, a modular reactor could have been removed at the point of transition. I think it's a case of exploring each context and evaluating the risk and benefit.

Q120 Chair: To conclude this topic, the head of Rolls-Royce, the new CEO, has frozen hiring on its new modular reactor programme. We are arguably one of the more advanced countries that is able to provide a micro or modular reactor, simply because we have this technology already in Astute-class submarines, for example. There is a procurement race to provide the first micro or modular reactor. Putin is clearly weaponising energy. Do you think that the Government is not doing enough to support Rolls-Royce in providing the first modular reactor and micro reactor, General?

Major General Sharpe: That is a leading question, isn't it?

Chair: Do you agree with me? Would that be—



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Major General Sharpe: I always agree with you! Look, I'm not sure, but it strikes me that it would make huge sense, if we are leading in something, that we keep leading in it.

Q121 **Chair:** And do you think it's daft that the people in the Treasury, when we are leading on something that is a new invention, say, "You have to wait for somebody else to invent it, so that we can do a cost comparator to see whether you're getting value for money"?

Major General Sharpe: I refer you to my earlier comments on the procurement side of this.

Chair: The point has been made, and I hope the Government is listening. We have an advantage, and we should take advantage of that and leverage it. Let's move over more widely to our armed forces adapting.

Q122 **Mr Francois:** Major General, perhaps we could start with you on this one. In what ways do the armed forces need to adapt to tackle climate change successfully via their operations abroad? One of my colleagues is going to ask you shortly—this is a heads-up—about what we can do at home, but perhaps we could just start with their operations abroad. Are we going to have to adopt a different structure, training, doctrine, equipment or even culture to be more aware of the climate change implications of our operations outside the United Kingdom? Major General, perhaps you could start and then I will ask Tim afterwards.

Major General Sharpe: Thanks, Mr Francois. A bit, I think—kit, in particular, yes, and I will come back to it. The other areas are harder to put your finger on. For defence structuring of various sorts, training, doctrine, culture and so on, it is much harder to put a finger on that and say there are some obvious answers. There are some simple answers: small arms training with tracers, for example, will be increasingly problematic if you are going to set fire to your training areas every time you open up with a general-purpose machine gun.

Mr Francois: I've seen it happen.

Major General Sharpe: Haven't we both? I have spent unnecessary hours of my life wandering around remote parts of America, Canada, Kenya and various other places, stamping on burning bushes—not divine burning bushes—because somebody has been not unhelpful with a machine gun, but has been merely pointing it at a target and setting fire to things. That may well become increasingly problematic—absolutely—and it will be something that we need to think about. It is also something that could cause increasing co-operation problems with the training areas on which we increasingly rely, often in hot places—the middle east, east Africa and the plains of America and Canada. We would be increasingly unwelcome if we are regularly setting fire to things that are very hard to put out. We have all seen the effects of a dropped cigarette in Portugal, and the size of a fire that can grow from that and threaten things. I think that sort of issue is going to become increasingly important.



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On other ways of looking at structures, doctrine and culture, I am not sure. On the equipment, however, yes—absolutely. We have touched on this as we have gone through the morning, haven't we? But in equipment terms, there are all sorts of things on land, sea and air that we are definitely going to have to adapt to. I am no expert in ship design, but it seems to me that the different requirements for increasingly being able to operate in the High North—to reference our earlier conversation—are a thicker hull and a heavier ship to be able to cope in that environment. If we accept that we will need to stay globally engaged, a thicker, heavier ship at sea will not have the same ability to power itself and so on. I think that ship design, and possibly aircraft design, will have some quite significant effects on how and where we are able to operate abroad—ship design in particular.

As I say, I am not an expert, but it seems to me that there is a balance. At the moment, you can build a ship that is going to operate pretty much wherever we would like it to; in the pretty near future, I am not sure that will continue to be true. The only other thing that I would say—we might touch on it shortly anyway—is that, increasingly, we are going to have to think about the pressures that this will put on people, as opposed to platforms. If we operate more regularly in more hostile environments, we can crack that if we operate just from a platform by designing the platform correctly; if we deploy people to deal with it, particularly on land, we have to treat each person as an independent thing we have to sustain, and that starts to put a whole of bunch of different demands certainly on equipment and possibly on structures, training, doctrine and culture.

Q123 **Mr Francois:** Thank you, that is a very full answer. Tim, anything to add?

Dr Clack: In addition to people, there are working animals. A whole infrastructure is required for military working animals.

The key, immediate “So what?” is that the def stans—Defence materiel standards—will need to be revised to take account of more extreme conditions. Some are publicly available: the rotorcraft defence standard limits fuel temperatures from solar radiation to no higher than 45°, for example. In parts of the world, that is a temperature that is exceeded regularly, creating all kinds of implications for storage, transportation, the need for coolants and so on. Also, 45° is the upper limit for lots of engine design def stans, so there are implications for lots of vehicles and platforms.

The air getting warmer and less dense has all kinds of implications for rotary-wing aircraft—their endurance, the payload they can carry and the maximum altitude that they can fly at—and all that carries huge operational risk and potentially jeopardy. It could undermine airlift capabilities, evacuation and overwatch.

Going back to General Andrew's point about naval vessels, as things stand in the design of naval engines, the ocean is often a key coolant to ensure that the engine does not overheat and, with reinforcing hulls and ships getting bigger and heavier, the potential for overheating increases. Also,



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they are deployed to parts of the world where the ocean is already +40° at certain times of the year, such as the Persian Gulf. What then happens is the risk of a thermal blanket effect undermining engines completely.

Mr Francois: That is a very real problem on the Type 45 destroyer, which the MoD has a programme to put right, but unfortunately it will take five more years to do it.

Dr Clack: Yes, the MoD is conscious of that—

Mr Francois: If it helps, we are very conscious of it too, but for slightly different reasons. Anyway, crack on.

Dr Clack: I suppose there are the extremes, too. The ability to go from an Arctic environment, with lots of Arctic-type ice slush, redeploying quickly to a very hot and humid part of the world, with lots of dust and heat, will put a lot of strain on equipment, people and working animals.

I would like to make a point on culture—I am an anthropologist by trade, so culture is something that interests me. Part of this is a defence programme of behavioural change; ultimately, that is what is necessary to create the effects we want to see.

I have also been struck by the quote from the military officer and historian Basil Liddell Hart. He once noted that “The only thing harder than getting a new idea into the military mind is to get an old one out.” It is a little bit unfair, but effecting cultural change is a hard thing in any context. We are all cultural animals. If the challenge is to achieve emission reductions and ensure military personnel are conscious of the shaping effects of climate change on the threat environment, career-long education is key.

I agree with Dr Duraid Jalili, from KCL and the Defence Academy, who has thought about this. His view is basically that insight on these topics needs to go into the military education profile at career juncture points at a macro level—basic training, trade qualification courses, ACSC, HCSC, and RCDS, so all levels—but there also needs to be micro-level systemic training linked to those in specific roles where the climate change issues and effects will be much more relevant to the day job.

Leadership is also key here; it always is, because it signals intent and purpose. A useful metaphor is that, effectively, one is trying to change the course of an oil tanker. There needs to be a course direction signalled, but constant pressure needs to be applied to keep it turning. It will take time for the change of direction to come about but, in the absence of the right signals and energies, the tanker will look to correct back to its original bearing.

Q124 **Mr Francois:** I think we have got the point on that; thank you. I will stay with you, Tim. Is climate change an equal challenge for each of the three services? Perhaps I can put the question a different way: could you rank the services in order of how difficult you think it will be for them to adapt their operations to be conscious of their climate change impact? Who will have the toughest job, who will be second and who will be third, in your



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opinion?

Dr Clack: That is an excellent question.

Mr Francois: Thanks very much.

Dr Clack: There are some commonalities that bridge all the services. Obviously, the complexity of the mission set is going to increase, and we have mentioned physical health in extreme conditions, but there are unique challenges posed to the different services.

I suspect the greatest challenge is going to be for land forces, in terms of adapting to increased training in extreme weather environments, using adapted equipment and the maintenance and strains that are placed on those kinds of vehicles. The complexity of the battle space for land forces due to climate factors is probably going to be the most extreme.

For example, if you are thinking about counter-insurgency efforts, they could easily be undermined by food and water security, the weaponisation of resources and a whole host of other factors that would not play into the challenges faced by the Air Force and the Navy. That is not to say that the Air Force and Navy do not have huge adaptation challenges themselves, but I think the scale of the adjustment and breadth of the environments in which land forces will need to operate make the challenge for them particularly acute.

Q125 **Mr Francois:** So, you are saying it is the biggest challenge for the Army. General, what is your ranking?

Major General Sharpe: Unsurprisingly, Mr Francois, I would agree with Tim, for pretty much the same reason. It is probably a matter of complexity. As Tim said, that is not to denigrate the size of the problem that faces the Royal Navy and the Royal Air Force.

In very simple terms, cracking this for them is about ensuring that your base is maximised in all sorts of ways, both to reduce its emissions and to make it liveable in, and the thing in which and from which you operate. You put your human beings into a ship, for example, you get that right, so that the conditions that they live and operate in are made good for humans so to do. You set out and do your job, and you come back again to a base that is equally optimised. That is it, in over-simplistic terms.

In the land environment, it is not just the individual platforms—and there are many more of them that you have got to optimise in that way—but all the individual people. They are the ones who are going to get sent out to do all sorts of things. That water, heat endurance, heat injuries, body cooling, body insulation—all of those things—are going to become increasingly problematic for the Army.

I guess, to duck the question in terms of the strict ranking, I would say that the land environment has got the biggest problem, in terms of complexity. The other two come equal second, but that is not to denigrate the size of the problem for everybody. It is just that it is much more



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complicated when you have got so many moving parts, and every human individually deployed is something that you have got to worry about in that respect.

Mr Francois: We have unanimity of view from both of you. The Army is much in the news at the moment, and you have just added to its list of challenges. Thank you very much.

Q126 **Robert Courts:** Can I just concentrate on the challenges facing the RAF for a moment? I was interested to hear that you feel that the Army has a greater challenge, because it is usually the other way round. I suppose it depends, as you have explained, on how you define the challenge, whether it is operational or sheer size.

I want to look at the RAF in particular, which Dave Doogan touched on. Although there are some interesting challenges and experiments going on with electric aircraft in the RAF, for example, when we look at the air mobility fleet and FastJet in particular, given that hydrogen is a long way off, is four times the storage space, is four times the cost at present, doesn't that mean that we are likely to be looking at sustainable aviation fuel, and partnering very closely with industry in the near future for FastJet mobility in particular?

Major General Sharpe: Absolutely. I know that they are working on an algae and alcohol mix, which is interesting. Okay, that is working, but at the moment, to reiterate what I said earlier, as I understand it, they have got non-drop-in as opposed to drop-in fuel. The fuels they are using at the moment require you to change the machine, not just to shove the fuel into the machine and it carries on working as it did before, which has its own developmental challenges.

Q127 **Robert Courts:** Can we just be clear about we are talking about? Sustainable aviation fuel is a drop-in. The Trent engines, for example, are able to operate on drop-in once rated. That is what the Voyager did recently.

Major General Sharpe: A lot of that is through synthetic development. The most efficient drop-ins are synthetically developed. My point was not that that is not a difficult challenge; it absolutely is. All of the challenges for those platforms are large, particularly those that are manned. The challenges are reduced when you make your platforms unmanned, on land, sea and air. The challenges for all those platforms are large.

My point is not trite: once you have cracked that complicated problem for a platform, it is cracked. Once you have cracked the problem for every single individual platform that is a human, it remains complex. Therefore, the overall challenge for land is rather larger, if that makes sense.

Q128 **Robert Courts:** Yes, it does. I understand your point; I was just keen to explore that a bit more. Dr Clack, is there anything you would like to add on the Royal Air Force?

Dr Clack: I would just add two points to that. One is on the issue of interoperability. Currently, there is a single jet fuel, which allows partner



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nations opportunities for refuelling and gives greater agility. With the move to synthetic fuels, if there is going to be a number of them, that potentially denudes the potential for interoperability. That will be fixed in time when the synthetic solution emerges and is rolled out more widely, but there is a vulnerability in the short term—a transition risk—as that moves across.

The other point is that a warming planet will have impacts on the design of military planes, their load capacity and the length of runways—their ability to take off and land. That is obviously crucial operationally. Unless the planes and the infrastructure that facilitates their use are redesigned and upgraded, there is a vulnerability—the potential for a loss of capability in critical activities, such as overwatch and logistical resupply.

Q129 Robert Courts: This is linked to the question I asked a moment ago. It depends on whether we are talking about kit or the estate. The issue for the estate, of course, is perhaps more evenly split across all the services. Perhaps we can look at what can be done to tackle climate change at home. I am thinking particularly about things like better insulated homes and the use of solar panels on military buildings. It is different on flying stations and hangars, perhaps, but what more can be done there? Military homes have been much in the news recently, so we are going to look at the challenge of getting those greened too.

Major General Sharpe: I completely agree with the thrust of your question. It strikes me as being almost a no-brainer. It doesn't matter whether you are talking about service family homes, barrack blocks or whatever. We need insulation, solar power, wind generation, efficient heating, double-glazing, air source, as opposed to oil fired—you name it. It is all the things that we all address on a domestic level; multiply that by the scale of the defence estate, and surely there is an enormous amount that can be done, and a saving of money too, I am guessing.

I guess the quandary that faces the defence estate is exactly the same quandary that faces all of us: how much can we afford to spend out of our meagre bank accounts now, even with a Government grant to help put solar panels on our roofs, to make sure that, downstream, we are spending less money on all those things and being environmentally responsible?

Q130 Robert Courts: Can I just pick that up a bit? I suppose ultimately it is a question of prioritisation, isn't it? When we look at these things and ask, "Which should we be doing?", it is an impossible question to answer, because we need to look at all of them. There are technical difficulties for, for example, aviation or large ships. Given the impact that you could have through looking at the estate, should they be prioritising that? When you look at the difficulties of decarbonising some of these areas, we may be looking at things like offsets and accepting that we cannot reduce FastJet to absolute zero, for example—that may be a possibility. If that is the case, do we not need to be more ambitious around the non-kit aspect, and therefore around the estate and offsets?



Major General Sharpe: That goes back to my answer to the first, second or third question, or whatever it was—it was quite early on. Because it is stuff that we can do, because the technology is all there and because we do not have to rely on other people developing technology and then our ability to acquire it—the same old hobby-horse—something that we can surely do immediately is get after exactly those things and we can maximise the defence estate. Again, as was said earlier, if Defence is going to get close to its visionary aspiration—“We are going to be a world leader”—and is not making, at least, its estate carbon positive as opposed to carbon neutral as rapidly as possible—I mean carbon positive in a good sense as opposed to a bad sense—then it is missing a trick, isn’t it?

I am sorry; I do not hold Defence purse-strings, so I cannot comment on what has got to give to make that so, but surely that is something that we ought to be putting money into as rapidly as possible, yes.

Dr Clack: Again, I agree with all that. There has been a lot of reporting of the fact that new buildings in the UK military’s training estate are now net negative and supplied by renewable sources such as anaerobic digestors and solar farms. But that is the tip of the iceberg, in terms of the wider defence estate when we think about accommodation, barrack blocks and so on.

I think the opportunities for doing this at the home station are enormous and that is an opportunity that should be seized. That could be in terms of energy insulation and the materials that are used in buildings. That would not be inexpensive but would be reasonably easy to deliver; it is more difficult to do this at deploy station, but none the less there are clearly opportunities there.

More broadly, defence consumption is an area that needs greater focus. I do not just mean the estate itself but everything from materials to rations to clothing to fuel and so on. Most of that is purchased from the global marketplace. Obviously, one could be charged with externalising the carbon by buying things from overseas. There may well be very good reasons for purchasing things from overseas, but we could take better account of the impacts of supply chains, embodied emissions and those kinds of things. The US army is pioneering in this space with its buy clean procurement posture. It looks at the embodied carbon emissions that are linked to everything from manufacturing, transportation, installation, maintenance to disposal—that full life cycle is considered. The emissions signatures from those are calculated and looked to be mitigated.

Q131 **Chair:** Thank you. This is my final question. Turning back to the UK and the immediacy of what we need to do, we hope to include in the report a graph that shows the number of MACA—Military Aid to the Civil Authorities—requests. I think we can all agree that the number of requests from other Departments asking for armed forces support to deal with domestic challenges, such as flooding and so forth, has increased. Would you agree that this is something to be factored into the integrated review refresh? The versatility of our armed forces, not least the infantry, to step in and provide support is absolutely critical if we are going to



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mitigate the increase in requests that is likely to come about because of adverse weather effects directly to the UK, general?

Major General Sharpe: The purpose of the armed forces is to fight the nation's wars on land, sea and air, and win them. That has to remain the core purpose of all three services, absolutely. But whether you are a politician, or a member of the polity, of the voting public or, indeed, of the armed services, if there is trouble at home and somebody says, "Can you help?", and the answer is "No," that is not really acceptable, is it?

The reality is that, whenever there are MACA tasks, of whatever nature, the Army, Navy and Air Force—it is a permanent irritation to the Navy and Air Force that people in combat clothing are always described as "calling in the Army" when, of course, it's all three services and they just look as if they're soldiers—are called in to deal with those things. If everything that we've been saying this morning is right, certainly in terms of water—floods, inundation and so on—that is likely to be on the increase rather than the decrease.

There will remain an expectation that people will be available to help the nation in those crises. It will never be their core purpose, but there will always be an expectation that they will. It doesn't matter whether it is supporting strikes or supporting the climate emergency. With anything of that sort, there will be an expectation.

I guess that the key point is that numbers matter. It won't be drones, or machinery, in any sort, that deal with this. No matter what we do with our core purpose, in terms of identifying ways of doing war—ways of doing that core purpose—the demand and expectation will always be that, when you ask for it, you will have a robust, disciplined, organised, structured, cheery soul, who will turn up and do their best to help you, and that is around numbers of people.

I guess, somewhere in that awful calculation that is going on in your minds, in Parliament's minds, and the minds of, certainly, the senior Army, Navy and Air Force folk at the moment, in terms of numbers, they all hate the numbers going, because it must be about capability, but when it comes to supporting the nation at home, the more—I don't know what the right number is. I don't want to get into silly arguments about the smallest army since the Napoleonic wars or whatever—it doesn't really matter—but there will come a point, if you're not careful, where the numbers of people are such, against those deployed abroad, and with what you've got at home to deal with it, that, when you stick up your hand and say, "We need your help,"—you've just got to be careful that you're not putting yourself in a place where the answer has to be "No," because there's no one there to help.

Q132 **Chair:** That can be tied in with Mark Francois' question about the sort of culture and structure of the armed forces. You are right to point out that the core responsibility and duty of our armed forces is to keep our nation and our interests safe, and we shouldn't see Departments lean on the armed forces as their go-to backup because they have not, themselves,



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invested enough resources into being prepared for those difficult times. In the United States, for example, you would never see—or rarely ever see—the national forces stepping in. It would be the National Guard; it would be the local capability. So is there perhaps a question, with pressures on our armed forces, about better utilising our reserves to provide more localised support, bearing in mind that they are part of the local resilience plan to some degree anyway?

Major General Sharpe: It may well be. I mean, the “Do we want a national guard in that way?” argument is the same as, “Do we want a CRS, in that French way?” argument, with a gendarmerie. It’s a perennial argument in all sorts of different shapes and sizes. Actually, I don’t think you would be surprised, because I think you know, but the number of reservists who are part of all of those efforts—whether with floods, covid or whatever—is exactly what you would expect. They are absolutely in proportion to the size of the Army, Navy and Air Force. They come in the same numbers. Not least because a larger proportion of them are not deployed abroad and they have a very different motivation from the regular soldier, sailor, and airman or woman, they are very quick to put their hand up and say, “Can I help?”—to volunteer to be part of that effort at home. They are also often more readily available. So I think the reserves are a big part of it.

Chair: Okay. We will explore that further. Dave Doogan, do you want to come in quickly?

Q133 Dave Doogan: To move away from military assistance to civil authorities, but staying with armed forces’ preparedness to help address the effects of climate change in the United Kingdom, what is your understanding of the UK’s preparedness for rising sea levels, storm surges or river catchment area deluges on the nuclear military estate in Faslane, but also in Devonport and Barrow?

Chair: We are running close to our time, so concise answers, please, but it is an important subject to cover.

Major General Sharpe: I will be extremely concise: sorry, that is very specific and I cannot help you. I do not know; I am sorry.

Mr Francois: That is concise.

Dr Clack: It is a similar response from me, unfortunately. Obviously, coastal infrastructure, including Faslane and lots of the maritime, littoral-type areas, is under threat. I think studies are being conducted to better understand the threat from sea level. In terms of what kinds of mitigations could be put in place, the cost and the timelines, I do not think that is being worked through, but there is obviously a huge issue of scale. Linking to the previous MACA question, the size of the UK population living in areas at risk of flooding is going to almost double by 2050. It is currently 1.8 million—it will become 3.3 million—so the role of the military in responding to that is going to be significant. All I can say on the coastal military installations and infrastructure is that this is a risk that I am conscious people are aware of, but I do not think it is being bottomed out



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in terms of what the response will be or even should be. It certainly is an urgent thing for attention.

Chair: Thank you. I think we have done a good job here. Thank you so much for helping us to better understand this huge challenge, but also for giving us some homework to do on various other issues—not least what happens to nuclear submarines when the salt gets too high. That is something we certainly will explore and take away with us. Thank you very much indeed, Dr Timothy Clack and Major General Andrew Sharpe, for your time this morning. That brings this evidence session to a conclusion. Thank you to the staff and to the Committee.