



Climate Change and Sustainability Report

'If you don't deal with it today, you will not be able to deal with it tomorrow'

Lt Gen Richard Nugee CB CVO CBE

'Nobody predicted it, ... but afterwards everybody saw it was inevitable' 1834 Thomas Carlyle on the French revolution

'Let us use that unprecedented luxury of seeing this next crisis coming.' Gen Tom Middendorp

OFFICIAL

Acknowledgement

I would like to express my heartfelt appreciation and thanks to the climate change and sustainability agile team, who supported this work from the beginning with great enthusiasm and patience: Gregoire de La Bernardie, Richard Byrne, James Clare, Tom Cabot, Adam Coe, Ray Dickinson, Mark Hill, Olga Kostiw, Sonia Marshall, Gordon Muir, Stuart Laws, Julia Powell, Walter Scott, Helen Sheridan, Andy Slaney.

I would also like to extend my deepest gratitude to the two Army Advanced Development Programme teams that provided a huge effort to evidence this report between March and July 2020: Damian Flanagan, Paul Joyce, Hugo Stanford-Tuck and between September and December 2020: Gabriel Burchell, Richard Grieve and Marcus Hayakawa.

I would particularly like to thank Cindy Levy, the Defence Environment Professionals and the Defence Green Network for their encouragement, enthusiasm and support.

Defence Green Network

Delivering this report would not have been possible without the support and nurturing of Jonathan Evans and his team (PA Consulting), Tony Reeves and his team (Deloitte), Rich Roberts and the Wilton Park team and the immense volume of research conducted by the Met Office (thanks to Nick Bruce-Jones and Ed Pope), dstl (Alex Stevens) and DCDC with RAND Europe. I would also like to mention the Analysis and Insight Team in Head Office and especially Harriet Dale, Charlotte Farmer and Tom Boys.

I would like to extend my sincere thanks as well to the Group of Experts that has been alongside the development process with always fruitful and challenging help: Ian Andrews, Martin Baxter, Stephen Briggs, Paul Cornish, Robert Cunliffe, Ed Davey, Sue Garrard, Lindsay Hooper, Tony Juniper, Neil Morisetti, Mark Reynolds, and Mark Stevenson.

There are many others, too many to mention, who have helped along the way. Thank you for all your support.



Lt Gen Richard Nugee CB CVO CBE

18 Dec 20

OFFICIAL

Table of Contents

Acknowledgement	2
Executive Summary	6
Chapter One – Introduction and Approach	12
1.1 Introduction	12
1.2 Structure of Report	14
PART ONE	16
Chapter Two – The Science	16
2.1 Evidence of climate change, and projections for the 2050s	16
2.2 Climate projections for the UK	18
2.3 Global implications	18
Chapter Three – Why this is relevant to Defence	20
3.1 Introduction	20
3.2 Climate Change and Security – the strategic environment	20
3.3 Opportunities and Risks for Defence	23
3.4 Impact on Operational Effectiveness	23
3.5 Impact on personnel	26
3.6 Impact on Industry	26
3.7 Impact from Government Requirements	27
3.8 Social Impacts	27
3.9 Legal Impacts	28
3.10 Economic Impacts	28
3.11 Environmental impacts	29
3.12 Summary	29
Chapter Four – Where Are We Now?	30
4.1 Introduction	30
4.2 Statutory, Mandatory and Policy Drivers	30
4.2.1 International Agreements	30
4.2.2 National UK Legislation	31
4.2.3 Mandatory Drivers	31
4.2.4 Other Drivers	34
4.2.5 Wider Commitments	35
4.3 Sustainability	36
4.3.1 Sustainability Roles and Responsibilities.	37
4.3.2 Sustainability Governance	38
4.3.3 Resources	38
4.3.4 Sustainable Procurement	39
4.3.5 Sustainable Information, Communications and Technology (ICT)	39
4.3.6 Sustainable Infrastructure	40
4.3.7 Scrutiny of Sustainability in Projects	41
4.3.8 Overseas Bases	41

OFFICIAL

4.4	MOD GHG Emissions Baseline	41
4.4.1	Carbon Sequestration and Natural Capital Opportunities.	44
4.4.2	Current Built Estate Emissions Reduction Activity	45
4.4.3	Equipment Approach Projects.	46
4.5	Climate Change	47
4.5.1	Climate Change Roles and Responsibilities	47
4.5.2	Climate Change governance	48
4.5.3	Resilient infrastructure	49
4.6	Wider Activity	50
4.6.1	Current Innovation Activity	50
4.6.2	People and Behaviours.	50
4.6.3	Sustainable Defence Support	51
4.7	Climate Change and Sustainability Report Governance	52
PART TWO		54
Chapter Five – The Strategy: a proposition		54
5.1	Introduction	54
5.2	Strategic ambitions 2050	56
5.3	Guiding principles	57
5.4	Strategic Approach	59
5.4.1	Behaviours and Communication	59
5.4.2	Governance and Head Office	62
5.4.3	The Estate	65
5.4.3.1	The Built Estate	66
5.4.3.2	The Rural Estate	69
5.4.4	Climate, Security and International	72
5.4.5	Operational capability	75
5.4.6	Procurement and Industry	79
5.4.7	Support	81
5.4.7.1	Viable Deployable and Equipment Energy: Options	83
5.4.8	Commercial	86
5.4.9	Finance	88
5.4.10	Data	90
5.4.11	Research and Development	92
	Appendix 1 to Chapter 5 – Year 1 Recommendations	94
PART THREE		96
Chapter Six – Laying the Foundations		96
6.1	The Strategic approach	96
6.2	How are we going to deliver this?	98
6.3	Where we are now?	98
6.4	What must we do and what are the choices?	99
6.6	What we could do?	100
Annex A – IMCCS The World Climate and Security Report 2020		103
Annex B – Examples of Effective Outcomes (from DCDC research)		104
Annex C – Linkages to Defence Activity and the UN Sustainable Development Goals		105

OFFICIAL

OFFICIAL

Annex D – Greening Government Commitment Performance 2016-20	106
Annex E – The main findings of the NAO Sustainability Overview published May 20	107
Annex F – CCC Recommendations relating to MOD:	108
Annex G – External and Internal Sustainability and Environmental Meetings	110
Annex H – Silt Chart Notes and Caveats	112

This review has been conducted by Lt Gen Richard Nugee at the request of the Permanent Secretary. The views, observations and suggested strategic approach are his proposal on how this work should be taken forward, overseen and kept constantly updated. The Report and its contents therefore can only be used as a handrail and guidance by the Department, who will reply with a formal approach to the imperative to address the impact of climate change and enhance its sustainability.

OFFICIAL

Executive Summary

The UK Ministry of Defence must act now to seize the opportunity to respond to the impact of climate change on future operational effectiveness, sustainability, resilience and security at home and abroad. As a major military power, defence's leadership in building security, adapting to the climate changed world and reducing emissions should be at the forefront of the Government's ambition for the Green Industrial Revolution. It can enhance UK prosperity, build on the research and innovation of the Defence Industry and improve the lived experience of its people. At the same time, there are significant opportunities to enhance operational effectiveness (which will inevitably be progressively degraded if no action is taken), save money and build a more sustainable and biodiverse defence environment. Defence itself must take advantage of the opportunities created by rapidly developing technologies to become more resilient, self-sufficient and efficient and to build on the momentum that has already begun.

This Report recommends three strategic ambitions that can be achieved by 2050:

- Defence **acts and is recognised as a global leader** in response to the emerging geopolitical and conflict-related threats being exacerbated by climate change;
- Defence has **adapted** to be able to fight and win in ever more hostile and unforgiving physical environments;
- Defence has **reduced its emissions and increased its sustainability** activity and as a department has contributed to the UK legal commitment to reach net zero emissions by 2050.

Global Leader

The security aspects of climate change are increasingly recognised by governments, international institutions and respected commentators as an issue that must be tackled now. The report describes how UK defence can lead the international community to a better understanding of the threats, causes and consequences of conflict that are multiplied by climate change; and how there is a need for international horizon scanning of where those threats might erupt into conflict. COP26 offers a once in a generation opportunity for the defence sector across the world to embrace the importance of climate and security and the operational necessity for militaries to become more resilient and sustainable. The unique coincidence of UK chairmanship of the G7, G20 and UNSC in 2021 adds to this potential. The Report foresees a role for the UK military to build global resilience, especially in those areas most vulnerable to the nexus of weak governance and powerful climactic effects. Humanitarian Assistance and Disaster Relief operations are going to become increasingly common – defence should act both to prevent and respond to the effects of climate change.

Adaptation

Defence must accept that there will be a climate changed world in the next decades and act now to build resilience and sustainability if its ability to operate at full potential in an increasingly challenging environment, and so maintain its freedom of manoeuvre, is not to be progressively degraded. This offers significant opportunity for transformative technologies, self-sufficiency to reduce supply chain demand and vulnerability, crew-less equipment and increased use of synthetic training to increase operational advantage and effectiveness, while at the same time reducing the environmental impact of its operations. This will require a change to the requirement setting, scrutiny and design of key equipment in the future, and will require a fundamental relook at the relationship between industry and defence. The concept of 'fast follower' is strongly encouraged, linked to a powerful horizon scanning capability to identify innovation and novel technologies as they emerge. Commercial and acquisition processes must change to be able to build an agility to take advantage of the speed of technological change happening in energy, materials and the digital environments.

OFFICIAL

Reduce Emissions and Increase Sustainability

The Report is clear that defence can reach net zero of its scope 1 and 2 emissions by 2050 (although unlikely before 2050) and proposes a number of success criteria that should be adopted over the next 30 years. The key is to understand the true picture through data gathering, minimising emissions as much as possible, particularly through moving to renewable energy sources and improving the efficiency of the estate, and by designing greatly reduced emissions into the operational capability of equipment. Retrofitting existing equipment and buildings to reduce emissions, will be much more expensive than building in new sustainable opportunities from the concept and design phases of a project; and thus should be a lower priority to allow technology to help reduce cost. Even with the transformation and modernisation proposed by defence, there will be some legacy equipment in 2050 with a residual emission profile. This residue must be balanced by a rural estate that sequesters as much as it can through careful management. In so doing, the estate must improve its biodiversity and pollination potential and encourage and support the tenant farmers who look after 30% of the land to embrace more sustainable farming techniques if they have not already.

The incentives to deliver reductions in emissions are still to be worked out in detail but will adopt the concept of carbon accounting (a carbon budget) so that all parts of defence are given a carbon maximum within which they will be required to live, to be reduced over time, which will enable defence to drive its contribution to net zero.

To be more sustainable, the report strongly recommends embracing the circular economy through defence's supply chain, building on partnerships with local communities where possible, and building maximum self-sufficiency at home, in overseas bases and on deployment. It also envisages a better understanding of the whole life costs of projects, including their environmental impact, rather than focussing on just the initial capital outlay.

There is significant support for climate change and sustainability to be addressed in the wider defence community; defence industry is strongly supportive of the move to a more sustainable outcome which will be consistent with the pressure from civil society and the market to deliver non-fossil fuel solutions, and the people of defence are already showing a keen interest in the possibilities that this approach offers.

The Report's format starts with the case for change (why this is relevant to defence), reviews the current position and makes observations as to how this can be improved. The strategy follows the observations, identifying an ambition for 2050, a target to be achieved for the end of the first 5 years (Apr 26) and a set of recommendations of what needs to be achieved in the first 12 months. In addition, a putative campaign plan, based on success criteria over the next 30 years (split into 3 epochs of 2021-25, 2026-35, 2036-50) is illustrated to show what should be achieved. A plan for the first epoch, laying the foundations for embedding climate change and sustainability into the heart of defence, and some initial investment opportunities is proposed. The initial priority for investment is on the estate – to create a sustainable estate will take time and consistent effort which can be started now, as the technology is mature. At the end of the Report is a compendium of all the research that has taken place specifically in the last 10 months to inform the thinking and detail of the report.

This Report cannot anticipate the detail of the rapid change that is occurring in both the technology and understanding of the effects of climate change, sustainability and security. It should, therefore, be taken as the foundation stone to start a transformation of defence, constantly updated and revised to meet the current situation. Defence must use this opportunity to build on this foundation, to remain fit for purpose throughout the 21st century. But nothing will happen without visible, committed and sustained leadership.

If you don't deal with it today, you will not be able to deal with it tomorrow.

OFFICIAL

OFFICIAL

Glossary of Abbreviations

AADP	Army Advanced Development Programme
ACDS C&FD	Assistant Chief of Defence Staff Capability and Force Development
ADS	Aerospace, Defence, Security & Space
AHA	Agricultural Holdings Act tenancies
AI	Artificial Intelligence
ALB	Arms Length Body
AM	Air Mobility
AONB	Area of Outstanding Natural Beauty
ARAc	Annual Report & Accounts
ASEMS	Acquisition Safety and Environment Management System
BEIS	Department for Business, Energy and Industrial Strategy
BEMS	Building Energy Management System
BKS	Barracks
BIOT	British Indian Ocean Territories
BoI	Balance of Investment
BPS	Basic Payment Scheme
BREEAM	Building Research Establishment Environmental Assessment Method
CAIC	Climate Action Implementation Committee
CAP	Common Agricultural Policy
CAS	Climate Action Strategy
CCC	Committee on Climate Change
CDS	Chief of Defence Staff
CEEQUAL	Civil Engineering Environmental Quality Award
CIO	Chief Information Officer
CIRAM	Climate Impacts Risk Assessment Methodology
CNI	Critical National Infrastructure
COP26	26 th UN Climate Change Conference of the Parties
CC&S	Climate Change and Sustainability
CCSIG	Climate Change and Sustainability Implementation Group
CSA	Chief Scientific Advisor
DCDC	Defence Concept and Doctrine Centre
DCDS MSO	Deputy Chief of Defence Staff Military Strategy and Operations
DCDS MIL CAP	Deputy Chief of Defence Staff Military Capability
Def Log	Defence Logistics
DEFRA	Department for Environment, Food and Rural Affairs
DEO	Defence Estates Optimisation
DE&S	Defence Equipment and Support
DFE	Defence Fuel Enterprise
DG SEC POL	Director General Security and Policy
DI	Defence Intelligence
D Infra	Director Infra
DIO	Defence Infrastructure Organisation
DfID	Department for International Development
DOC	Dissolved Organic Carbon
DREAM	Defence Related Environmental Assessment Method
DSEC	Defence Safety and Environment Committee
DSF	Defence Supplier Forum
DST	Defence Science and Technology
dstl	Defence Science and Technology Laboratory
EA	Environment Agency
EDA	European Defence Agency
EIA	Environmental Impact Assessment
ELMS	Environmental Land Management Scheme
EO	Enabling Organisation
ES	Environmental Stewardship
ETS	Emissions Trading System
EV	Electric Vehicle
EU ETS	European Union Emission Trading System
FAM	Future Accommodation Model

OFFICIAL

OFFICIAL

FBT	Farm Business Tenancies
FCDO	Foreign, Commonwealth and Development Office
FES	Fuel Enterprise study
F-GAS	Fluorinated Greenhouse Gasses
FLC	Front Line Command
FMC	Finance and Military Capability
FMC Infra	Finance and Military Capability Infrastructure
FW	Fixed Wing
FYM	Farm Yard Manure
GBS	Government buying standards
GCS	Government Construction Strategy
GGC	Greening Government Commitments
GHG	Green House Gases
GoE	Group of Experts
GST 6	Global Strategic Trends edition 6
G7	Group of Seven
G20	Group of Twenty
ha	Hectare
HADR	Humanitarian Assistance and Disaster Relief
HLS	Higher Level Stewardship
HMG	Her Majesty's Government
HMT	Her Majesty's Treasury
HSEP	Health Safety & Environmental Protection
IA	Information Advantage
ICRC	International Committee of the Red Cross
ICT	Information, Communications and Technology
IEMA	Institute for Environmental Management and Assessment
IEESS	Infrastructure Energy Emissions Sub-Strategy
IFRS16	International Financial Reporting Standards
IMCCS	International Military Council on Climate and Security
IOpC	Integrated Operating Concept
ISR	Intelligence Surveillance and Reconnaissance
ISTAR	Intelligence, Surveillance, Target Acquisition, and Reconnaissance
JCSSG	Joint Commitments Strategic Steering Group
JFD	Joint Force Development
JIC	Joint Intelligence Committee
JROC	Joint Requirements Oversight Committee
kWh	kilowatt-hour
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
LS	Littoral Strike
MACA	Military Aid to Civil Authorities
MEP	Modern Energy Partnership
MINDP	Minister for Defence Procurement
MOD	Ministry of Defence
NAO	National Audit Office
NATO	North Atlantic Treaty Organisation
NCSC	National Cyber Security Centre
NE	Natural England
NED	Non-Executive Director
NGO	Non-Governmental Organisation
NSIG	National Strategy Implementation Group
NZ	Net zero
OCHA	Office for the Coordination of Humanitarian Affairs
OEP	Office for Environmental Protection
OGD	Other Government Department
PJHQ	Permanent Joint Headquarters
POEMS	Project Oriented Environmental Management System
R&D	Research and Development
ROM	Rough Order of Magnitude
RUSI	Royal United Services Institute

OFFICIAL

OFFICIAL

RW	Rotary Wing
S&T	Science and Technology
SAC	Special Area of Conservation
SAF	Synthetic Aviation Fuel
SDA	Submarine Delivery Agency
SDG	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SEAT	Sustainability and Environmental Appraisal Tools
SFA	Service Families Accommodation
SFP	Single Farm Payment
SJC	Standing Joint Command
SMESG	Sustainable MOD and Energy Steering Group
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
SPA	Special Protection Areas
SRC	Short Rotation Coppice
SSSI	Site of Special Scientific Interest
Strat Com	Strategic Command
tCO₂e	Tonnes of Carbon Dioxide Equivalent
TLB	Top Level Budget holder
UKCP	UK Climate Projections
ULEV	Ultra-Low Emission Vehicle
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNSC	United Nations Security Council
UN SDG	United Nations Sustainable Development Goals
VCDS	Vice Chief of Defence Staff
WBG	Wet Bulb Global temperature
25YEP	25 Year Environment Plan

OFFICIAL



Chapter One – Introduction and Approach

1.1 Introduction

Almost a decade ago, in 2011, the then government identified Climate Change as “one of the greatest threats to both UK and global security and prosperity”¹. Since then, events such as increasing numbers of extreme weather events, flooding, droughts, loss of biodiversity, migrations of people, have been the all too visible consequences of the impact of ever accelerating climate change. All are symptoms of global warming, and all have profound implications for our defence and security, our partners and direct interests, and that of the society and the citizens defence serves. They damage economic growth and wellbeing, disrupt geopolitical stability and result in increasing demands for humanitarian relief missions. At best, they place populations and societies, governments and their institutions, under extreme stress; at worst, they interweave with and multiply other sources of insecurity, leading to civil unrest and violent conflict.

A major report on the state of the global climate for 2019² concluded that each decade since 1980 has been successively warmer than the preceding decade, with the most recent (2010–19) being around 0.2°C warmer than the previous (2000–09); and that 2019 was among the three warmest years since records began in the 1800s (only 2016 and 2015 – in some datasets – were warmer). Further, for the 32nd consecutive year, 2019 saw the loss of mass from mountain glaciers across the globe. September 2020 was the hottest month on record globally.

The relevance to defence is increasingly apparent in three fundamental ways. First, the coincidence of the joint chairmanship of G7, G20, presidency of the UNSC and COP26 in 2021 offers a powerful opportunity for defence to **act and be recognised as a global leader** to reduce the emerging geopolitical and conflict related threats, in partnership with the NATO Secretary General’s push to include climate change in his new NATO 2030 strategy. This will be reinforced by a US government under President-elect Biden who has stated that he intends to make climate change a core national security priority, directing military leaders to anticipate and address security implications of climate change.

Second, in this climate changed world, defence needs to **adapt** its equipment, people, operating procedures, and infrastructure to be able to fight and win in ever more hostile and unforgiving physical environments; defence needs to be more self-sufficient and resilient. Every part of defence is affected and needs to be aware of the implications of climate change.

Third, whilst preserving defence’s primary purpose³ there is already clear extant Government direction to **reduce emissions and increase sustainability** which defence must adhere to. The UK has set a legal requirement to reach net zero emissions by 2050 (and with the speed of evolving policy, it is entirely possible that this be brought forward); defence needs to play a full role in meeting this commitment. As the Department responsible for 50% of central government emissions, it is clear that there will be very limited opportunity for exemptions to be applied, and most probably on operations only. Defence also has a duty to limit the impact that it has on the global climate; it is not yet meeting even existing targets to reduce waste and improve resilience and sustainability. Defence must develop new commercial approaches, building partnerships with industry and the supply chain, to incentivise its suppliers to identify low carbon solutions and seek out opportunities to be more sustainable, while at the same time adhering as much as possible to the UN Sustainability Development Goals (UN SDGs).

Defence needs to mobilise all of its ingenuity, planning, people, research and development expertise, supply chains and technology to harness opportunities to increase operational effectiveness, build resilience and enhance our natural capital. With this potential alliance of industry, R&D, innovation and defence people there is an opportunity for UK prosperity to be significantly enhanced. If defence fails to do this, it will be forced into a more difficult position later to comply with the law, it will be increasingly expensive to do so and has the potential to be left

¹ Para 1.1 page 5 The Carbon Plan HMG.

² Bulletin of the American Meteorological Society published 12 Aug 20.

³ ‘to protect the people of the United Kingdom, prevent conflict, and be ready to fight our enemies. Defence also has to be prepared for the present and fit for the future.’

OFFICIAL

behind by government, our allies (particularly a resurgent US in this area), the people it protects, industry and by our adversaries.

The purpose of this Report is to capture what is already happening, and to understand what defence can and must do better. It will need a change of culture and behaviour and an acceptance from the very top that there is no alternative but to embrace the opportunity to demonstrate the part that defence can play in the government's ambition for a green recovery from the economic damage to the UK economy caused by Covid-19. That depends on decisive leadership from all levels and which the defence community is well placed, and equipped, to provide across government, within the UK, and through its links to global partners and defence institutions.

There is an inevitable tension between cost – capital investment versus long term saving – and the requirement to reduce defence emissions and energy demands as much as physically possible. It is a key tenet of the report that spending on this agenda now will be much cheaper – and over a longer time frame – than spending later, the closer we get to 2050, and that we need to start to invest in a measured, defence-focussed and affordable way, while technologies become cheaper and more accessible. There are opportunities to make substantial differences now at not great cost. But it is also important to note that building in sustainability (for example through principles of circular economy, support to the environment, reducing emissions) at the beginning of projects and programmes (equipment, estate and even non equipment contracts) is much cheaper than retrofitting. To be able to do this, defence needs to change its processes, procedures and approach to contractors, which costs effort rather than finance.

Defence has to adopt a sustainable approach, but it should still maintain the principle that, if it is to fulfil its purpose, operational effectiveness and capability should not be compromised *solely* in order to deliver a sustainable solution. Instead, capability should be enhanced by seeking and adopting a sustainable approach, increasing operational effectiveness and taking every opportunity to reduce emissions. Even with this approach, it is likely that with current and emerging technologies there will be an irreducible minimum of emissions from our operational capability. With ownership, and responsibility for ~1% of the UK landmass, it will be possible to offset any irreducible minimum by achieving an estate that reaches negative emissions ahead of 2050.

Research and Development is a key part of the solution to deliver greater effectiveness and move towards greater emission reductions. However, currently there are too many options, for example on alternative fuels, for defence to invest heavily in any particular future solution, and there are far bigger R&D establishments who are investing in particular technologies. Defence should therefore limit its research to that which is specific to defence initially, and then as technology develops and clear commercially and economically viable alternatives emerge, as a fast follower defence should be quick to adopt the best available.

To adapt defence to a climate changed world and take advantage of the opportunities now and in the future is a significant and important piece of work, which will take time and iteration to get right. It will require long term investment and a clear articulation of the benefits as well as support from other government departments, both in terms of advice and funds, and partnerships with organisations that defence does not traditionally link with. It will also require strong support and direction from the Secretary of State and the top of defence in order to be effective. With the coincidence of the momentum already growing in defence and our allies, as well as the growing awareness and leadership politically and in the country, defence must be seen to act now as well as plan to act on this issue.

In short, this Report suggests that we should be a global leader in climate security; we can reach net zero by 2050 and we must adapt to the climate changed world that will exist in 2050.

A chart showing the realistic possibility of getting scope 1 and 2 emissions to net zero is below:

OFFICIAL

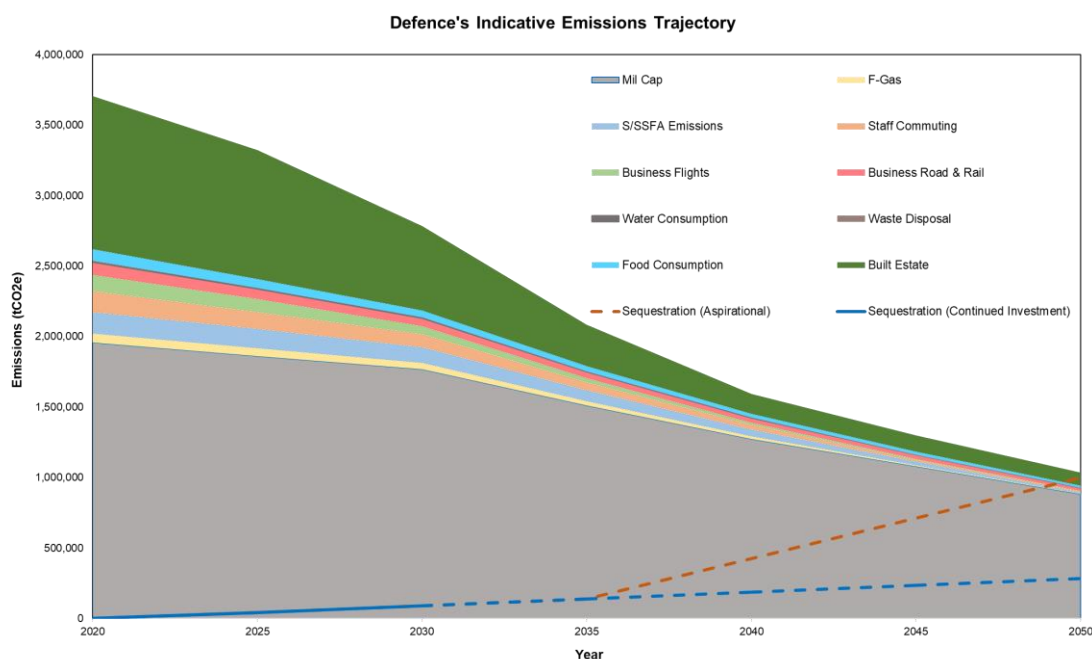


Figure 1 – Defence’s potential net zero trajectory to 2050⁴

1.2 Structure of Report

Part 1 will Review why this is relevant to defence, where defence is now, the baselines and what Government, particularly through Acts of Parliament, the recommendations of the Committee on Climate Change (CCC) and the National Audit Office (NAO) reports, and other direct commitments such as the Greening Government Commitments (GGCs), requires. There will be a brief look at international comparisons, and a list of what is already being achieved and future plans in terms of projects and programmes.

Part 2 will propose a Strategy that encompasses all element of defence, with the strategic ambitions of embedding an understanding of the impacts of sustainability and climate change on defence and acting on that understanding. It will lay out a vision for achieving net zero emissions by 2050, increased natural capital for all defence and driving our supply chain and contractors to meet the same vision, embedding a culture and behaviour of sustainability within defence and across the wider defence community.

Part 3 will lay out a Plan for the first 5 years (2021-2026). Inevitably, given the current state of technology, much of the expenditure in the early years will be on infrastructure improvement as well as understanding the baseline and its implications in more detail.

It is inevitable in such a fast-moving environment, globally, politically and technologically, that this report can only be a snapshot as of today. It must be reviewed and updated regularly and in so doing, will develop increasing coherence.

Key parts of the document are:

- The case for change specific to defence in Chapter 3 (pages 20-29)
- A proposed Strategy, split by function, in Chapter 5 (pages 54-93)
- The recommendations in Chapter 5 (a summary on pages 94-95)
- The foundation requirement and potential investment choices in Chapter 6 (pages 96-102)

The Rural Strategy and Energy Strategy are stand-alone documents linked to Chapter 5.

⁴ Silt Chart Notes and Caveats at Annex H



PART ONE

Chapter Two – The Science

2.1 Evidence of climate change, and projections for the 2050s

CO₂ Levels. Since industrialisation (c.1850-1900), the level of carbon dioxide (CO₂) in the atmosphere has increased by around 46%, taking it to its highest level for at least 800,000 years, as shown in Figure 2.

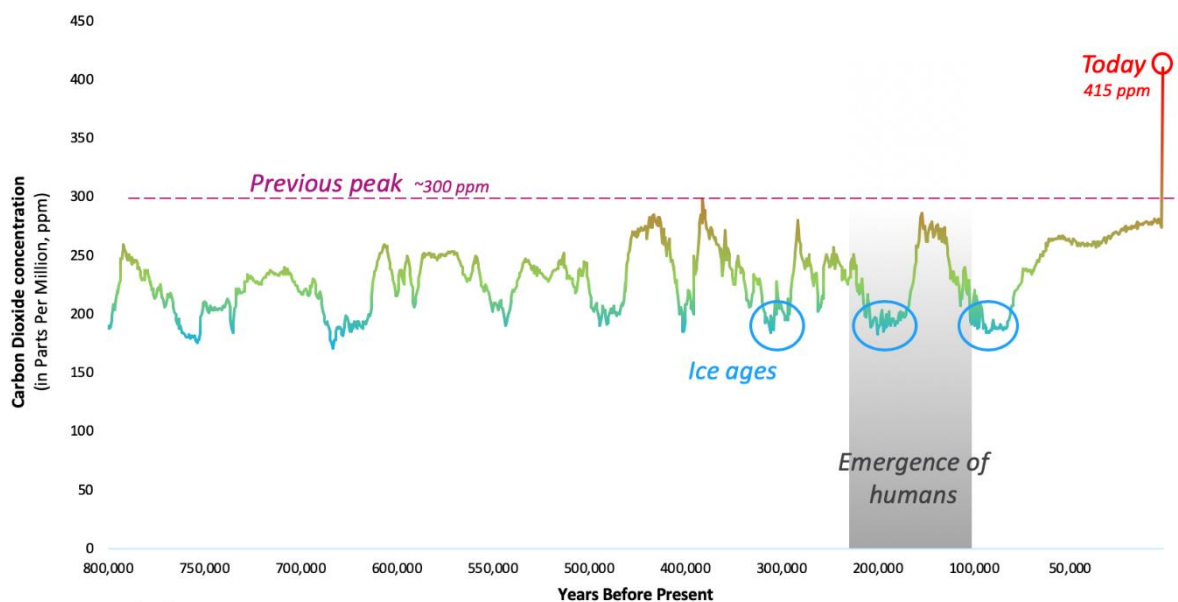


Figure 2 – Concentrations of carbon dioxide in the Earth’s atmosphere have rapidly risen to much higher levels than at any point over at least the last 800,000 years (the length of the ice core data record)⁵

Global temperature. Since the mid-1800s, the average temperature of the planet has risen by around 1°C, as shown in Figure 3. Scientists have been able to attribute most of the warming to human contributions, while natural events, such as volcanic activity, changes in solar activity, or natural sources of CO₂, have been shown to have only a small effect. Human activity and the burning of fossil fuels have increased the level of greenhouse gases in the atmosphere, enhancing the greenhouse gas effect – a heat-trapping ‘blanket’ around the Earth, warming up the planet. This has caused an imbalance in the amount of energy entering and leaving the climate system, causing temperatures to rise. Some parts of the world have seen much faster warming than the global average – land is warming faster than the ocean, while land and oceans in the polar regions are experiencing greater rates of warming than more equatorial regions - some parts of the Arctic have warmed by over 3°C.

Climate model projections for the 2050s show that global average future warming ranges from approximately 1.0 °C to 2.5°C above pre-industrial average temperatures, depending on future emissions⁶.

⁵ Figure based on EPICA Dome C ice core data (Lüthi, D., et al., 2008) provided by NOAA NCEI Paleoclimatology Program, <https://www.ncdc.noaa.gov/paleo-search/study/6091>

⁶ IPCC Fifth Assessment Report (2014) https://ar5-syr.ipcc.ch/topic_summary.php

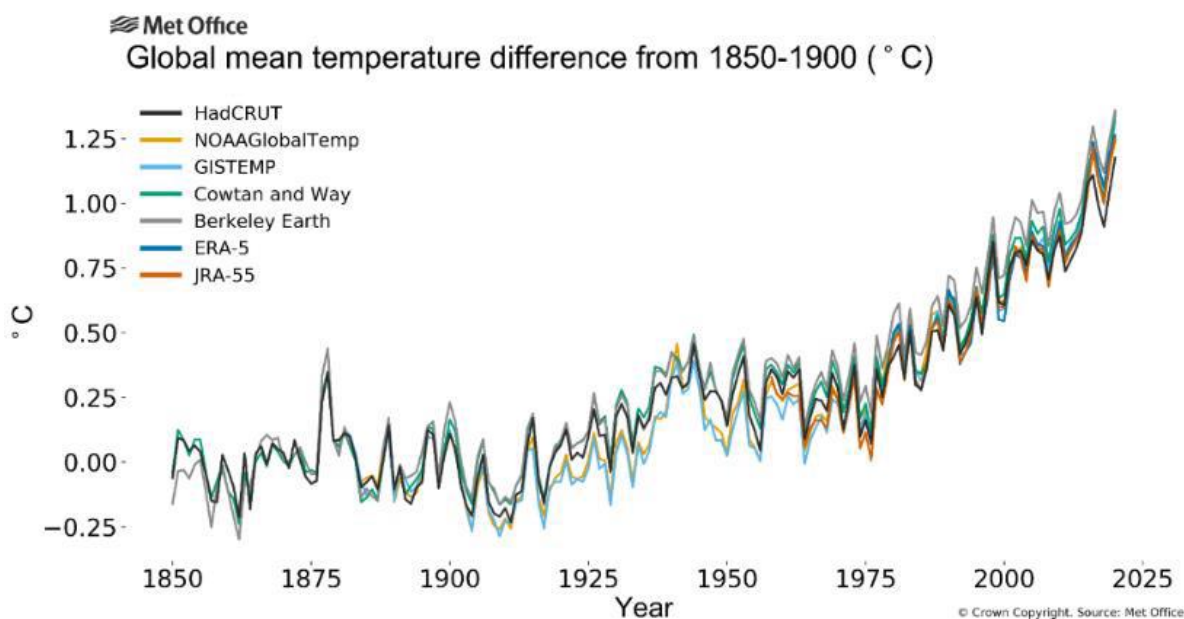


Figure 3 – Annual global mean temperatures expressed as a difference from pre-industrial conditions. Seven different datasets are shown and give good agreement on the overall evolution of global temperatures and year-to-year variability⁷.

Polar regions. Measurements show that Arctic sea ice extent in September is declining by approximately 12% per decade on average – currently equating to 87,000km² (or an area greater than Scotland) per year⁸. This suggests that the Arctic could see ice-free summers by mid-century if global greenhouse gas emissions are not reduced substantially in the near future, from the 2020s.

Sea-level rise. In addition to the melting polar regions, the oceans absorb 90% of the extra heat generated by human influence⁹. When water heats up, it expands to take up more volume, causing the sea-level to rise. Measurements show that global mean sea-level rose by around 16 cm from 1902 to 2015¹⁰, and that the rate of the rise is accelerating. Climate Projections for 2050 show that global mean sea-level is expected to be 0.1-0.3 m above levels during 1986-2005¹¹. For the middle of the century, global mean sea-level rise is relatively independent of the specific emissions scenario between now and then; however, after the mid-century, sea-level rise is markedly more rapid for higher emissions scenarios, suggesting that more than 100 million people worldwide will be exposed to sea-level rise, assuming no protection.

When ice sheets and glaciers melt, freshwater flows into the sea. As well as contributing to sea-level rise, freshwater also reduces the salinity (saltiness) of the water, which can slow or change ocean currents, such as the Gulf Stream in the North Atlantic. Changes in ocean currents affect the transport of heat around the world, thereby influencing regional patterns of temperature, rainfall, winds and humidity.

Weather extremes. Climate change is causing many extreme weather events, such as heatwaves, droughts, and floods, to become more intense and frequent. Warmer average temperatures increase the likelihood of experiencing more intense heatwaves, leading to increases in the occurrence of human heat stress. In countries that are already hot, the human heat stress limits will be exceeded more often, with potential increases in heat-related mortality, and reducing the ability to work outside. Warmer temperatures also increase the rate of water evaporation from the Earth's oceans and land surface with warmer air holding more water vapour. The combination of these phenomena means that rainfall is increasing, across the world and explains why heavy rainfall is

⁷ Available from: <https://www.metoffice.gov.uk/hadobs/monitoring/temperature.html>

⁸ IPCC Fifth Assessment Report (2014) https://ar5-syr.ipcc.ch/topic_futurechanges.php#figure_2_1

⁹ IPCC Special Report on the Ocean and Cryosphere in a changing climate (2019) <https://www.ipcc.ch/2019/09/25/srocc-press-release/>

¹⁰ <https://royalsociety.org/topics-policy/projects/climate-change-evidence-causes/question-14/>

¹¹ IPCC Fifth Assessment Report (2014) https://ar5-syr.ipcc.ch/topic_summary.php

OFFICIAL

typically becoming more intense¹². However, regions which are already dry may become drier in the future, due to higher temperatures and increased evaporation rates. The general reduction in the frequency of light rain events, and the rising in frequency of heavy rain events simultaneously increases the occurrence of droughts and floods¹³.

2.2 Climate projections for the UK

UK winters are projected to become warmer and wetter on average, although cold or dry winters will still occur sometimes. Summers are projected to become hotter and are more likely to be drier, although wetter summers are also possible. Heavy summer rainfall events will become more intense, impacting the frequency and severity of flooding. However, this is set against a background of natural climate variability which means we will still see seasons that differ from the long-term trends. Even if we do reduce greenhouse gas emissions, sea levels around the UK will keep rising beyond 2100. As such, parts of the UK will be in danger of flooding, with low lying and coastal cities at particular risk¹⁴.

2.3 Global implications

Recent evidence¹⁵ shows that, for thousands of years, humans have concentrated in a narrow subset of Earth's available climates, characterized by mean annual temperatures around 13 °C. This likely reflects a human temperature niche related to fundamental constraints based on physiology, as well as access to food and water. Depending on scenarios of population growth and warming, over the coming 50 years, 1-3 billion people are projected to be left outside the climate conditions that have served humanity well over the past 6,000 years. Much of the new area that is outside of the human temperature niche is predicted to be in the Sahara and Sahel region of Africa.

The full implications of this recent finding are unclear; however, it seems likely that there will be a significant increase in regional competition for food and water resources, followed by a rise in conflict and migration. The high temperatures in this region will also represent a considerable challenge for UK defence operations, such as humanitarian assistance and disaster response, as well as possible future military interventions.

¹² IPCC Special Report on 1.5°C (2018) <https://www.ipcc.ch/sr15/chapter/chapter-3/>

¹³ https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/climate/human-dynamics-of-climate-change/hdcc_alternative_version.compressed.pdf

¹⁴ <https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf>

¹⁵ Xu et al, 2020. Future of the human climate niche. PNAS May 26, 2020 117 (21) 11350-11355, <https://www.pnas.org/content/117/21/11350>

OFFICIAL

CLIMATE CHANGE
& ENERGY SECURITY:
A POST-CARBON
WORLD

ATLANTIC FUTURE FORUM



IHM Government

Chapter Three – Why this is relevant to Defence

3.1 Introduction

The context within which defence is operating is changing and becoming more complex. Climate change is increasingly becoming a global security issue, acknowledged by the UN and NATO, with potential threats to UK interests and responsibilities, particularly in the risks associated with global trade, increased social instability and the global transition away from fossil fuels, towards renewable energy systems. As a threat multiplier, climate change is creating unforeseen political pressures; novel weather patterns and their effects are resulting in state and regional decision making becoming more unpredictable. Social and moral debates are beginning to coalesce around acting to reduce emissions, enhance the natural environment and biodiversity and increase sustainability. As a national and international leader and opinion setter, there is a powerful moral argument for tackling climate change and its effects on the planet.

And there are strong specific defence and military arguments as well. The compound effects of climate change on human security, meteorological variation and environmental extremes will have significant impacts on security, which defence needs to be aware of. In a context of more hostile and unforgiving physical environments, defence needs to understand where future demands will come from and adapt its equipment, people, tactics, operating procedures and infrastructure to maintain its current freedom of manoeuvre to deploy throughout the world. Further, with the demand for renewable fuel systems increasing, much of industry is turning away from further development of fossil fuel-based technologies, potentially leaving defence stranded with legacy niche assets and systems which will be increasingly unaffordable to maintain or replace. To retain competitive advantage and operational effectiveness, defence needs to adapt and embrace the opportunities that will arise.

There is clear Government direction and a legal requirement to increase sustainability and reduce emissions to achieve net zero by 2050; as the department responsible for 50% of central government emissions and a significant landowner, defence will need to play its full part in meeting these goals. This offers great opportunity for novel systems and revised processes, increased use of synthetics, reduced crewing of equipment, and as renewable energy prices reduce, increased savings, whilst at the same time increasing resilience and self-sufficiency. This Government has also explicitly stated that they want the UK to have the ‘most ambitious environmental programme of any country on earth’. At the core of this approach is a public commitment to be the first generation to leave our environment in a better state than we inherited it. Nine new UK Government strategies from agriculture to peat through to energy are all due in early 2021; while the majority of these strategies will affect Defence in some way, specific focus will undoubtedly be on the national plan to meet net zero Green House Gas emissions by 2050 and on the 25 Year Environment Plan. The defence strategy should be seen as the tenth national strategy.

3.2 Climate Change and Security – the strategic environment

There is a growing body of evidence and understanding that climate change will present an increasing security risk in the future. The transition to renewable energy is particularly complex and risky¹⁶: oil and gas producer countries face potential internal instability¹⁷; security partnerships and military alliances are likely to be reconfigured¹⁸; access to rare earth elements may become increasingly contested¹⁹; new vulnerabilities will be exposed, such as interconnected digitised energy systems being susceptible to cyber-attack. Stress on oceans, food and freshwater insecurity will disrupt societies²⁰ and have social, economic, political and security effects including crop failures, wildfires, blackouts, infrastructure breakdown and infectious disease outbreaks. Sea-level rise, ocean acidification, glacial melt and pollution will change lives and where people live. Migration will increase as environmental stresses become more pronounced. There is an unfortunate overlap between countries that are the least stable and the areas most likely to feel the

¹⁶ Although there are also opportunities for rebalancing energy dependencies, thereby increasing state independence and resilience.

¹⁷ Particularly in countries where oil/gas production is a high proportion of GDP, yet there is weak governance and few financial reserves.

¹⁸ The US diminishing dependency on Saudi Arabia for example.

¹⁹ More than 50% of cobalt, used in Lithium-ion originates from the DRC.

²⁰ See for example, in Southern Iraq: <https://www.planetarysecurityinitiative.org/news/drought-ignites-tribal-conflicts-southern-iraq/>

OFFICIAL

effect of climate change. Countries most affected by this will be sub-Saharan Africa, south and east Asia, and the Middle East – many are already fragile.

An increasing world population with greater aspiration exacerbates these factors, which in turn will increase demand for all resources, including food, water, energy and rare earth materials. Their distribution will remain unequal, which may lead to economic disadvantage and increase interstate and intra-state competition and conflict. Half of the world will face water shortages by 2035. UK food and trade supply chain resilience will be a rising concern, as illustrated by Covid-19.

New threats are emerging, with concern that the environment can be used as a lever for influence or for malign persuasion, with potentially some countries intentionally exacerbating the impact of climate change to exploit the natural resources of others. Similarly, there are examples of threats to the environment being used to extort influence; we have already seen opportunities for deliberate polluting as a bargaining tactic.

A recent NATO conference²¹ stated that *'climate change is fuelling instability and conflict'*, with the Secretary General affirming that he would put forward recommendations as part of his NATO 2030 process on the future of the Alliance. This year the UNSC also held an open debate on climate change and security, stating in its opening Concept Note that *'Effects of climate change in specific situations are conducive to the potential emergence, continuation or escalation of conflict'* and observing that:

*"There is an evident need to pursue both a context-specific and an integrated approach to climate-related security risks to inform decision making, to facilitate climate-related security risk assessments and to enable appropriate responses by the Security Council."*²²

Similarly, Europe has increasingly recognised the importance of climate change and security, as exemplified by Frederica Mogherini's comment that *"When we invest in the fight against climate change, we invest in our own security"*.²³ Global Strategic Trends 06²⁴ (GST6) makes it clear that climate will increase the potential for conflict and that this will affect supply chains, with resource competition becoming increasingly frequent, potentially creating further demands on already stretched security forces:

*'The impacts of climate change will increasingly challenge extant defence and security assumptions such as basing, logistics or the environmental envelope for capability development... Defence needs to take the implications of the changing environment into consideration. The requirement to support humanitarian and disaster relief operations might be more frequent, while the local operating environment will be more complex and contested.'*²⁵

The International Military Council on Climate and Security (IMCCS)²⁶ suggest a number of key risks and opportunities, including that national, regional, and international security institutions and militaries around the world should advance robust climate resilience strategies. A summary is at Annex A.

²¹ NATO conference *NATO and Nature* 17 Sep 20.

²² High-Level Open Debate of the UN Security Council on "Climate and Security" 24 Jul 20 Concept Note

²³ High Representative for Foreign Affairs and Security Policy, High-level event on Climate, Peace and Security, 22 Jun 18

²⁴Global Strategic Trends: The Future Starts Today (6th Edition). DCDC published 2 Oct 18.

²⁵ GST 6, P.57.

²⁶ IMCCS The World Climate and Security Report 2020 published Feb 20. <https://imccs.org/report2020/>.

OFFICIAL

Climate change threatens peace

Environmental emergencies...

...create instability

- Scarce resource competition
- Mass migrations
- Health crises
- State to state competition
- Civil unrest
- Opportunities for non state actors
- Governance breakdown
- Economic destruction
- Energy geopolitics
- New areas of great power competition

Storms



Heatwaves



Sea Level rise/ flooding



Wildfires



Famine



Drought



3.3 Opportunities and Risks for Defence

There are a growing number of opportunities and risks for defence. Examples of effective outcomes are at Annex B and the three key risks are below:

- Global Leadership.** With the combination of the G7, G20 and COP26 next year, and the UK taking on presidency of the UNSC in February, there is an opportunity to show how the UK with Italy can lead the security debate about climate change, both in terms of building greater understanding of the role of defence in that environment, but also in articulating clear policy where the military might get involved. This in turn should result in a more accurate risk picture across the world on the understanding of where stress multipliers might become threat multipliers that could lead to conflict. Through engaging with NATO, the 5-eyes community and other nations, defence should shape the developing conversations on how militaries should react to climate change. One such opportunity could be with China, who have recently declared they will be carbon zero by 2060.
- Upstream Capacity Building.** Communities in conflict contribute to the effects of climate change by increasing the effect on the environment from their actions and by not prioritising trying to solve the climate crisis. Through reducing the incidence of conflict, deploying to build resilience and support the efforts of other militaries to reduce their own emissions (upstream capacity building) offers the opportunity to reduce threats, increase alliances and build skills for UK Armed Forces personnel; it should lead to better lives for the peoples of partner nations. It should address conflict drivers in advance of causes of instability such as radicalisation, promote good governance, create wealth through employment and should lead to better futures for the people of partnered nations. It can support the Government's climate change programmes while at the same time deliver security for the UK, support UK trading and extend UK influence and potentially commercial opportunities. Combining this resilience building with advice on how to tackle military emissions would be a powerful leadership role. The Army are considering an Environmental Sustainability Task Force to expand their current operations; this should be encouraged.
- Humanitarian Assistance and Disaster Relief (HADR).** An increasing number of HADR operations can be expected in the future as a result of the rise in the number and intensity of natural disasters. This is very likely to have implications for force planning and the balance of national and international Armed Forces commitments²⁷. This should increase the need for cooperation between a wide range of actors including the emergency services, other government departments (e.g. FCDO, BEIS, DfT, Defra, Home Office), NGOs and NATO and offers the opportunity for greater coordination and leadership with allies both in terms of skills and deployments. UK preparedness to deploy in response to climate-related events could become part of our strategic messaging to NATO allies and adversaries²⁸. Additional personnel with skills in engineering, diplomacy and humanitarian aid provision may be required to work in climate change-affected operating environments.

3.4 Impact on Operational Effectiveness

The following are key factors that need to be considered to maintain and improve operational effectiveness.

Self-Sufficient Operations. Becoming self-sufficient on operations, through the generation of power via sustainable and portable equipment and technologies such as solar power, allows greater resilience. Energy efficiency can serve as a force multiplier, because it increases the range and endurance of forces in the field and can reduce the number of combat forces diverted to protect energy supply lines, which are vulnerable to both asymmetric and conventional attacks and disruptions. The cost of delivering fuel, either in terms of lives and funding (with fuel to Helmand

²⁷ A Changing Climate: Exploring the Implications of Climate Change for UK Defence and Security. RAND Cox et al. Mar 20. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/930787/dcdc_report_changing_climate_gsp_RR-A487.pdf.

²⁸ Conversely, if adversaries are seen to be more active in addressing climate change issues, this may have strategic implications for the UK's ability to project global diplomatic influence.

OFFICIAL

potentially costing over 40 times more and the US reportedly spending \$500 a gallon on fuel to Afghanistan) could be substantially reduced through self-sufficiency.

Self-Sufficient Bases. Similarly, the creation of deployed operational bases that are more self-reliant will reduce the impact on the local community and further reduce supply chain vulnerabilities, thereby increasing resilience. This would also reduce the environmental impact of a deployment: it is possible, even likely, that defence will be required to deploy to areas most vulnerable to climate change related stress. Nations may limit the ability to deploy if it is recognised that by so doing, the UK would be adding further stress to the environment – defence’s licence to operate may be restricted. Similarly, it is possible that certain nations would refuse the opportunity for defence to train on or around their land if they are not environmentally friendly and sustainable. The Dutch and French are developing Smart Bases and EcoCamps as a way of addressing this issue.

Adaptation. By adapting our equipment and procedures to a climate changing environment, defence will be at a significant operational advantage over those that do not. Without adaptation, there will often be increasing levels of degradation in system performance as thresholds are approached and/or exceeded; there may be a requirement to operate equipment far below its maximum theoretical capability to avoid failures. Increased global temperatures, particularly in certain parts of the world where we would wish to deploy, will make it impossible for forces that have not adapted to operate.

The Arctic. In the next 15+ years, ice free summers in the Arctic will change the dynamics of power projection, with the potential for increased conflict around the resources there. Our ships need to be able to operate in ‘disruptive’²⁹ ice or cede operational advantage to nations that have adapted. An additional factor to be considered if defence is to operate more frequently in the Arctic is the effect of space weather; the Arctic is more susceptible to the effects of space weather than any other region of the Earth³⁰, which can interact with electronic and communications systems. Space weather events in this region can degrade the performance of Global Positioning System (GPS) capabilities required for navigation and timing, satellite communications, radio communications, radar, and the performance of Connected Autonomous Vehicles.

Surface Sea Temperature. Rising surface sea temperatures will require appropriate changes to equipment design or the acceptance of greater operational constraints in ships because sea-water heat exchange is used to remove excess heat from vessels. It is anticipated in the next 10-15 years that Gulf summer surface sea temperatures could reach 36°C frequently, and 38-40°C occasionally, pushing the limits of ship’s operating envelopes.

Littoral Strike (LS). With rising sea levels, climate change is likely to have significant effect on defence’s littoral strike capability. There is likely to be an increased need for a littoral strike capability, however, climate change will also make the operating environment more challenging. Rapidly changing coastlines, increased pollution, Hazardous Algal Blooms, coastal erosion, and a changed submerged landscape will degrade the performance of some critical capabilities such as sensors and Unmanned Underwater Vehicles. With the increasing complexity of coastal urban environments, this in turn may reduce the success of LS operations.

Sea Level. The rate of Global Mean Sea Level rise for 2006–2015 is unprecedented over the last century and was more than twice as fast as during 1902–2015. Over the period 2006–2015, contributions from melting ice sheets and glaciers were the dominant source of sea-level rise, exceeding the effect of thermal expansion of ocean water. The effect on specific defence sites have been calculated, with a significant concern over mean sea-level with astronomical tides and storm surges. At today’s sea level, an extreme event is anticipated once every 200 years but, for example for Lydd Ranges, this is projected to occur roughly every year by the end of the century. This is primarily a consequence of the projected rise in mean sea level. Further, on a global scale, sea level rise will affect potentially more than 100 million people worldwide by 2050, increasing risks of migration and acting as a threat multiplier.

²⁹ The ice between open water and hard ice for which an ice breaker is required.

³⁰ This is due to the configuration of Earth’s magnetic field, which channels charged particles of solar origin towards the Earth’s.

OFFICIAL

Intelligence, Surveillance and Reconnaissance (ISR). Many aspects of climate change could have a potential impact on ISR and sensors and these include: global temperature rise; extreme periods of cold weather; the increased incidence of extreme weather events, including hurricanes, storms, rainfall, floods, drought, and other factors such as increased pollution leading to smog. The most significant effects likely to affect radio will be extreme weather events and increased rainfall; the presence of clutter in a radar sweep can reduce the resolution of data acquired and lead to misidentification. Optical sensors are susceptible to a number of climate effects. For example, passive IR sensors are unreliable in harsh weather conditions. IR, ultrasonic and Laser are susceptible to moisture, dirt and temperature; millimetre electromagnetic waves, EHF, are degraded by atmospheric conditions such as snow, cloud, dust, smoke and fog. Climate change results in increased atmospheric turbulence and this imposes a fundamental limit to EO/IR capability, particularly at the long range required for standoff ISR. Underwater acoustic sensors are of critical importance. Melting ice is changing acoustic propagation in the world's oceans and changes in ocean chemistry and glacial melt will alter the thermohaline circulation of the ocean. This will alter the surface layer of the oceans, creating changes which will impact underwater capability.

Aviation. Higher temperatures result in reduced air density at the ground-level reducing aerodynamic lift to aircraft on take-off causing, longer take-off runs for fixed-wing aircraft, reduced payload and fuel capacities, and reduced climb rates for both fixed wing and rotary craft. Such restrictions are most significant for aircraft operating in higher altitude desert environments where the air is already relatively thin. Changes in temperature can still have significant impacts on lift at lower altitudes, particularly where aircraft are already operating close to their maximum payload weight for the length of runway. As warmer temperatures will be experienced as a result of climate change worldwide, high-altitude airfields in the Middle East and South East Asia, and in the United States are likely to be particularly at risk from reductions in lift, but restrictions may also increase at UK airfields for aircraft already operating close to maximum payload weights. Climate change that will have most significant effect on AM, ISTAR and RW lift, is the predicted increase in severe/extreme weather events, particularly the effect of increased wind speeds, increased turbulence and the increase in precipitation. A global temperature rise of between 1.5-4 °C will result in a notable effect in hot and high environments, but a limited effect on the load capacity for both FW and RW platforms during day to day operations in temperate environments.

Information Advantage (IA). Climate change has significant potential to impact IA, in particular information resilience and denial due to changes in the electromagnetic and acoustic environment. The need for an improved understanding of environmental impacts will create additional demands on information as an enabler. Information resilience will also be affected by environmental impacts (temperature, dust and moisture) on IT equipment operation and potentially the UK's ability to conduct High Altitude Persistence Surveillance operations.

Cyber. The potential for cyber-attack increases significantly as the dependence on interconnected electrical supplies becomes more prevalent, with an emphasis on vulnerable Critical National Infrastructure (CNI) that will need protecting. This could take the form of hacks, cyber espionage or disruption to the more serious attack on CNI or supply chains.

Data Systems. The use of big data, machine learning, and quantum computing are almost certain to play an increasingly important role in the future in the fight against climate change, and this will grow as they improve, and new capabilities emerge. However, the energy consumption of data systems is very significant; data centres alone accounted for approximately 1% of global energy use in 2018. MOD data centres are similarly high in energy consumption.

Fire. The frequency of dangerous fire-weather conditions ('very high' fire-danger class) in summer in the UK is projected to increase progressively throughout the 21st century, with historically extreme years like 1995 becoming the average by the 2060s. Spatially, the greatest change is projected for southern, central and eastern England, where many of defence's training areas are. For England and Wales, the percentage of summer days at or exceeding the 'very high' fire-danger class is projected to double at 2°C of global warming compared to the 1981-2010 reference period, and to multiply by five times at 4°C.

OFFICIAL

OFFICIAL

Renewable Energy. The defence estate offers significant opportunity to become more resilient through the introduction of sustainable and renewable energy production, reducing defence's dependency on the national grid or on imported fuels. Were defence able to afford the upfront capital investment in alternative energy sources such as wind, modular nuclear or solar, or other sources such as biomass or hydro, then not only would that energy be much cheaper than external provision on an annual basis, but it would also be more resilient to cyber-attack either nationally or locally on the grid. Despite a longer Return on Investment, renewable energies offer significant savings and security of supply. Modular and Micro nuclear offer particular advantages as they are similar technology as found in nuclear submarines.

3.5 Impact on personnel

Training Efficiency. Climate change will have important implications for personnel training and operating in the UK and overseas, undermining military preparedness from cancelled training and having potential longer-term consequences for individuals. These effects could harm personnel directly, through increased incidences of heat stress; have indirect consequences such as flooding which could prevent access to training facilities; and increased prevalence of diseases which may affect deployments. For the UK and the Canadian training areas, the median number of days per year where heat-illness risk management is significant (a threshold of 20°C) most likely increases by about 15 days between the baseline period (1990-2019) and the 2030s (2025-2045). At the upper end of plausible climate change projections, this increase could be considerably larger, possibly as much as 25 days. A warm year in the 2000s becomes broadly equivalent to an average year in the 2040s.

Hot Country Training. For Cyprus and Afghanistan, the occurrence of at-risk days most likely increases by around 25 days per year between the 2000s and the 2030s across a range of different Wet Bulb Globe Temperature (WBGT) thresholds between 20°C and 30°C. Thresholds that are exceeded (and therefore training lost) on less than half of the days in any typical month now become much more likely than not by the 2050s. At Akrotiri, for example, the percentage of days in a typical August in which WBGT exceeds 30°C increases from around 40% in the baseline period to nearly 100% in the 2050s.

Disease. Climate change can affect infectious disease transmission and will continue to be a frequent issue during HADR operations in extreme weather. For example, the growing spread and geographic reach of diseases transmitted by arthropod vectors (such as malaria, Zika and dengue fever) could create challenges for force survivability, increasing the need for individual medical assistance, vaccinations and personal protective equipment. Medical preparation for deployments to areas with a risk of exposure to mosquito-borne diseases could also become more costly. Higher rainfall could increase the dissemination of infectious agents in water sources, raising the risk of personnel exposure to waterborne diseases, and high temperatures could increase the growth and survival of infectious agents. As climate change increases rainfall and temperatures, these health risks to service personnel could be exacerbated in certain parts of the world. Climate change can impact air quality and is likely to lead to an increase in concentrations of surface ozone, an urban air pollutant responsible for respiratory problems which can also damage crops, leading to a reduction in crop yields and food productivity.

3.6 Impact on Industry

The significant advances likely in civilian green technology (for example the phasing out of fossil fuels for civilian vehicles leaving manufacturers less inclined to develop engines for fossil fuels) may result in defence equipment being stranded or very expensive to run and maintain. As a result, defence will become increasingly inefficient as the requirements for existing technologies will become rare outside the defence environment. In contrast, emerging technologies present an opportunity for the UK to lead in innovation and the development of military specific applications. Opportunities may also arise to exceed the capabilities of adversaries, for example through the use of 3D printing and perpetually flying aircraft powered by solar.

OFFICIAL

3.7 Impact from Government Requirements

There are a growing number of recommendations and pressures for government to act on climate change and sustainability. Most are directed to adapt to a UK of +2°C to +4°C temperature increase, to improve the UK's natural environment or to reduce emissions to net zero by 2050. The Committee on Climate Change has made it clear that defence will not be allowed exemptions and has made recommendations by department for the first time in their latest report³¹. Many of the recommendations to other government departments will also have a bearing on defence. The NAO has reported with an Environmental Sustainability Overview³² with recommendations, which was further reinforced by the Environmental Audit Committee proceedings on 30 Jun 20. The department already has obligations under the Greening Government Commitments, which have to be reported annually, and the UN Sustainable Development Goals.

In the BEIS chapter of the Integrated Review, defence has been tasked as responsible for climate and security, along with the Cabinet Office '*Amplify and accelerate domestic and international efforts to recognise climate and biodiversity as an external threat and core security concern (e.g. through NATO, UNSC, Five Eyes), including through support for cutting edge research in this area. Leads: Cabinet Office/MOD*'.

Defence engagement in support of HMG international engagement is a significant opportunity and advantage. Where possible defence engages with adversaries as a channel of communication and agent of credibility. It is also a way of securing 'terrain' and denying it to adversaries; further, leadership in adaptation and de-carbonisation will allow leadership more widely and the opportunity to sell innovative technologies to our allies.

In the run up to COP26, the UK government is planning on publishing a number of strategies that may affect defence.

The ICRC has recently published³³ revised rules and recommendations relating to the protection of the natural environment under international humanitarian law, with strict guidelines of how to operate when deployed.

3.8 Social Impacts

With climate change recognised as an increasing public concern by more than 85% of the UK population³⁴ and the majority of 18-24 year olds disagreeing with the statement that 'there is too much concern for the environment'³⁵, if defence does not act it will be seen as increasingly out of touch with the population base it protects and from which it recruits³⁶. There has been a steady increase in the number of people concerned about this issue, and defence must be seen to be responding in sympathy with this pattern of concern in the UK population.

A number of studies have suggested that the ability of commercial employers to recruit and retain their talent is becoming increasingly influenced by their policies on sustainability. While this may not be as great a concern for defence³⁷ (recruits join the Armed Forces for very different reasons) with the increase in the number of people in society who are concerned about the effects of climate change and want government to act, this will become more relevant. Additionally, the Cadet movement, which acts as a strong interface between the public and defence, and is the source of a number of recruits, is likely to be increasingly affected by defence's approach.

³¹ Reducing UK emissions Progress Report Jun 20. <https://www.theccc.org.uk/publication/reducing-uk-emissions-2020-progress-report-to-parliament/>.

³² HC318 Session 2019-2021 dated 13 May 20.

³³ Guidelines on Protection of Natural Environment in Armed Conflict. ICRC 25 Sep 20. <https://www.icrc.org/en/document/guidelines-protection-natural-environment-armed-conflict-rules-and-recommendations-relating>.

³⁴ Ipsos MORI Political Monitor Public Aug 19.

³⁵ Mediacom MTA study 2018.

³⁶ For example, a UK poll in Nov 20 to choose the theme for the 2021 Mental Health Awareness Week put Nature and the Environment top.

³⁷ Mediacom MTA study 2018. The inference from the study is that the Army policy on this topic would not prevent anyone eligible from applying to join.

OFFICIAL

Defence should be seen to be taking action to respond to those concerns. Certainly, defence will have to work with local authorities, paying attention to their policies for example when applying for planning permission; 67%³⁸ have declared a climate emergency.

With 15% of carbon emissions coming from domestic buildings in the country³⁹, the government will prioritise reducing this by retrofitting and refurbishing accommodation. This provides both opportunity in terms of funding from other government departments but also will allow for much of our accommodation to be upgraded, thereby improving the offer for service personnel and their welfare.

3.9 Legal Impacts

In an amendment to the 2008 Climate Change Act, in June 2019 the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. As the department responsible for about 50% of central government emissions, and potentially over 1% of the total UK emissions, defence is subject to those laws.

There is potentially a significant impact from the Court of Appeal decision not to allow the third runway at London Heathrow. The key take-away is that defence should be considering the net zero commitment as part of its decision-making processes when those decisions affect the environment. It is likely that, in a future case about a decision that has or may have a measurable impact on the environment, a court would find that it is reasonable to expect decision-makers to take account of the net zero commitment in making such a decision. For example, if defence was considering procuring a large number of military aircraft, it is likely that a court would expect them to take account of the net zero commitment in making the decision about which aircraft to procure. The net zero commitment would be one of many factors that are relevant to that particular decision and the court would expect a balancing exercise to be undertaken, for example carbon emissions against costs or technology required against procurement rules.

The Environment Bill is likely to include mandates on legally binding targets in resource efficiency and waste reduction, biodiversity, water and air quality. The focused disapplication offered to Defence that from parts of the Bill, would not limit the expectation or need for Defence to comply.

3.10 Economic Impacts

To meet mandated targets more of the defence budget will need to be invested in non-core activity such as 100% of the White Fleet to be EV by 2030 or to reduce our emissions footprint. The cost could be significant. Costs to remove some 60% of our emissions from the estate could be in the billions. Additionally, by moving from fossil fuels, the defence energy budget will roughly double unless the department changes its construction standards to lower new building energy consumption and invests in renewables.

Further, all developers will have to use an approach outlined in the Environment Bill that leaves biodiversity in a better state than it was before if the development results in the loss or degradation of habitats (a net biodiversity gain) and to bring forward schemes to increase ecological features. Defence will have to abide by this approach, but developers may also seek to use defence land as part of their own strategies, offering a potential commercial opportunity.

The Committee on Climate Change has recommended adjusting the UK Emissions Trading System (ETS) to include much wider carbon taxation than the current scope. Their recent Progress report comments that: *'The proposed UK ETS covers emissions from the power sector, large industrial facilities, domestic aviation and flights to Europe. In principle the scope of the scheme could be extended to include nearly all UK GHG emissions'*. If this were to occur, and defence were not given an exemption, (there is no defence exemption from the EU ETS system) there is potential for very significant taxation.

³⁸ 274/408 councils and unitary authorities

³⁹ July 2020 CAIC: Delivering net zero through Carbon Budgets 4 & 5 BEIS

3.11 Environmental impacts

Defence owns or is responsible for about ~1% of the landmass of the UK, including 30,000 ha of peat, 84,425 ha of SSSI and 123 scheduled monuments. Defence must act as custodians of these assets and demonstrate to statutory and non-statutory bodies it is active in looking after them, as further attention will be paid to the quality and state of the natural capital they represent.

3.12 Summary

Defence has significant potential to gain competitive advantage in a number of key areas from embracing climate change and sustainability if decisions are taken now to harness the opportunities that are available. The nations that recognise and prepare for this will have a significant advantage over those that do not.

The challenge will be modernising the force to account for operating in a climate changed environment and simultaneously complying with HMG's environmental regulations, with a prospect of changes being imposed on defence. The value and opportunities of modernising to a 'green compliant' armed force is an opportunity to be seized and should be incorporated within the Defence Force Design model; without doing so the climate changed environment will not be incorporated within the assumed future which will lead to poor investment choices, increased cost of later retrofit and the subsequent loss of a competitive advantage.

If defence were not to adopt an approach to sustainability and ignored the effects of climate change, there is the potential for significant disadvantage, operationally, politically, socially, economically and legally. Perhaps even more clearly, if defence does not adapt and reduce its emissions while it can, it is conceivable that, to meet the legal requirement to reach net zero by 2050, the only option in the future will be to reduce operational capability to meet the targets. This is unacceptable and would leave future generations in an impossible position.

Chapter Four – Where Are We Now?

4.1 Introduction

Defence has embedded sustainability into its policy, processes and planning for the last two decades. While most of the focus has been on its infrastructure, driven in part by a similar emphasis placed on the estate by the Greening Government Commitments (GGC), sustainability has also been incorporated into some of defence's functional policies such as Acquisition and Commercial. Although there has been significant progress made, changing ownership and priorities, at senior levels, has meant momentum has been difficult to maintain and any coordination and coherence of activity to deliver defence's existing Sustainability Strategy⁴⁰ has drifted. However, the approach to climate change and sustainability has been brought into sharp relief by the amendment in Jun 19 of the Climate Change Act which committed the UK to achieving net zero GHG Emissions by 2050. This, together with the NAO overview audit⁴¹ into defence sustainability, significantly increased interest by Government and a greater emphasis on improving defence resilience, has refocused activity.

Defence has also been cognisant of the implications of climate change on its operation, capabilities and force structures. Global Strategic Trends⁴² (GST) notes that *the 'cost of climate change to government and societies will increase and, mitigation measures will become increasingly complex and expensive to implement'*. Additionally, it notes that the increasing cost and disruption linked to climate change will have a high global impact and is relatively certain when compared to other risks. Indeed, two of the three considerations highlighted, demand for a global campaign and geo-engineering, have already been proven either through the rise of groups such as Extinction Rebellion or the need to test technology such as carbon capture. The third factor, the need to review defence's security planning assumptions has not been taken forward in any coordinated way. Capabilities are being adapted, but further activity will be required to ensure that both defence's security and capability planning assumptions acknowledge climate change as a non-conventional threat and incorporate the potential implications of sustainability and climate change on the support, generation and effect of defence capabilities.

This chapter reviews the defence situation today on sustainability and climate change, capturing pre-existing activity seeking to adapt, mitigate or enhance the resilience of defence.

4.2 Statutory, Mandatory and Policy Drivers

Defence is currently subject to a number of recommendations from national and international legislation, other government departments and Acts of Parliament. The main drivers are international agreements, national legislation and mandatory or other drivers.

4.2.1 International Agreements

UN Sustainable Development Goals (SDGs). The UN developed 17 goals to reduce poverty and inequalities while protecting the environment. Previous iterations of the Single Departmental Plan, and Defence Plan 20, have captured the SDGs as well as allocating responsibility specific to defence. MOD does not have a lead on any of the goals, but our activity does impact UK's ability to deliver. Annex C lays out how defence activity is linked to the UN SDGs.

Paris Agreement. Signed in 2016, the UN Framework Convention on Climate Change (UNFCCC) Paris Agreement sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. Each country must determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming. In UK these are linked to Carbon Budgets and associated central government GGCs, specifically directing emission reduction targets. Associated with the Paris Agreement are the UN Climate Change Conferences; the UK is to host COP26 in Nov 21 in Glasgow. This will be an unmissable opportunity to push forward UK defence leadership in this challenge. A side event dedicated to the effects of climate change on global security could be planned with militaries from different willing countries.

⁴⁰ Sustainable MOD 2015-2020 'Act and Evolve' published Sep 15

⁴¹ NAO Sustainability Overview published 13 May 20

⁴² Global Strategic Trends Sixth Edition published 2 Oct 18

4.2.2 National UK Legislation

Climate Change Act. As part of the 2008 Climate Change Act the Government set an ambitious target to reduce total GHG emissions by 80% by 2050 with legally binding carbon budgets. The Act was amended in Jun 19 to commit the UK to a legally binding target of net zero emissions by 2050. The target is set on the UK as a whole, but as the NAO noted defence, due to its size and complexity, is critical to the success of central government's greening government emission reduction commitments.

Environment Bill. The Bill which is expected to be enacted in Spring 21 sets statutory measures to embed the environmental principles and governance required to support the UK's withdrawal from the EU into UK Law. The Bill aims to drive the delivery of the Government's 25 Year Environment Plan and will:

- Enable the Government to set long-term, legally binding environmental targets;
- Require Secretary of State (Environment) to publish a policy statement on environmental principles setting out how they are to be interpreted and applied by Ministers of the Crown during the policy making process;
- Create the Office for Environmental Protection (OEP) as a new independent regulator that will hold the government to account, including through the courts if necessary. It will replace the role of the European Commission;
- Mandate biodiversity net gain for new developments;

The draft Bill currently precludes the Environmental Policy Statement from covering matters relating to the armed forces, defence and national security. The Disapplication does not preclude defence from meeting the requirements of existing legislation. The MOD are developing processes and procedures to achieve outcomes at least as good as those required by the Environmental Policy Statement. This is in line with commitments made in the Secretary of State's Policy statement on Health, Safety and Environmental Protection. Once enacted the Environment Bill will set a quinquennial reporting requirement on all public bodies, including defence, to provide updates on future enhancement activity and on projects and activities that have had an impact on enhancing biodiversity.

Observation: Defence only has a disapplication from the Environment Bill's Policy Statement. Defence will still have to maintain arrangements that produce outcomes that are, so far as reasonably practicable, at least as good as those required by legislation.

The OEP will provide scrutiny and advice on the implementation of environmental law. It will also monitor and report on public authority Environmental Improvement Plans and targets. The OEP can receive and investigate complaints on alleged serious breaches of environmental law by public authorities. It can also take legal action.

Social Value Act and Modern Slavery Act. From 1 Jan 21 it will be mandatory for applicable procurements to give a minimum 10% weighting given to Social Value criteria as part of the commercial process. The Government Procurement Policy Note 06 – Taking Account of Social Value in the Award of Central Government Contracts – has been incorporated into Commercial Officers Toolkit on KID. Similarly, the toolkit reflects the requirements of the Modern Slavery Act looking to abolish slavery in all forms from contracts and supply chains.

4.2.3 Mandatory Drivers

25 Year Environment Plan (25YEP). This sets out Government goals for improving the environment within a generation and how government will work with communities and businesses to deliver this ambition. The plan will be supported by several strategies including a: Peat strategy by Jan 21; Food strategy by Feb 21; England Tree strategy by Feb 21 and a possible agricultural strategy. Defence due to the size and scale of its natural capital assets have been invited to sit on

OFFICIAL

the 25YEP Board at DG level. The intent of the 25YEP is captured within the new suite of GGCs that have been proposed for 2021-26. MOD officials are currently responding to the draft and will continue to work closely with Defra and other non-statutory bodies; they are likely to be more far-reaching and will be legally binding.

Observation: *As Government focuses more intently on climate change, net zero and sustainability its growing ambition will be reflected in the 25 Year Environment Plan through more stretching Greening Government Commitments. These will require further investment to achieve.*

Greening Government Commitments. 2016-20 GGCs are mandated operational targets and commitments that all Central Government departments and their agencies must take to reduce their impact on the environment. Defence's GGC targets are included in the annual Defence Plan with activity disaggregated to TLBs if appropriate. The GGCs currently appear against the Infrastructure Defence Task; however, in future Defence Plans it will have its own task. Departmental Performance as at Mar 20 is below and historic performance is at Annex D:

2019-20	Whole Estate								Offices
	Emissions	Waste			Water		Paper	Domestic Flights	Water
	tCO _{2e}	Total Tonnes	% sent to landfill	% Recycled	Total m ³	Total m ³	Reams A4 Equiv.	No of Flights	m ³ / FTE
Target	-39.9%	Overall Reduced	<10%	Increase	internal target -15%	Continue to reduce water consumption from 2014/15	-50%	-30%	6m ³
Perf from baseline	-48%	-38%	7%	56%	-11%	-1%	-40%	-17%	13m ³

Figure 4 – Departmental GGC Performance

The current targets concluded in Mar 20 with mixed progress for the MOD. Replacement targets have been delayed until Mar 21. Defra has rolled over the existing targets for this FY and these have been included in DP 20. Discussions have begun with Defra and BEIS; the MOD has submitted recommendations for a suite of targets more closely aligned against departmental outputs to drive real efficiencies.

Observation: *The scale and size of defence means that if we do not meet our Greening Government Commitments then neither will central government. We are not yet meeting all of our current targets; revised targets will be even more difficult to meet.*

GGC data collection remains a key challenge both for central reporting and internally for TLB use to drive positive behaviours. As an operational department not all the GGC are a 'good fit' for defence; the main difficulties are:

- The GGCs are designed for a predominantly administrative department and to demonstrate the green credentials of the incumbent Government. In addition, the GGCs are for England while defence has a UK and overseas presence.
- The 2009/10 baselines no longer give a true reflection of MOD performance; due to data quality issues with the original data, no consistent coverage exists across GGC targets and changes to defence activities and footprint.
- Data for some overseas bases is included but local infrastructure limitations limit improvements to performance e.g. Landfill is the only waste disposal option.
- 'Waste' currently includes disposal of surplus materials and equipment. Equipment life cycles distort performance figures causing peaks and troughs.

OFFICIAL

OFFICIAL

- Carbon emissions as a result of energy consumption include the impact of national decarbonisation of the electricity grid which over the last two years has far outweighed reductions to MOD energy consumption.
- The scope of the targets makes it difficult to disaggregate the targets, as power to deliver them in totality does not sit with Commands/TLBs. For example, the water reduction target includes distribution pipe leakage, which is the responsibility of the Aquatrine service provider and internal facility usage which is influenced by Hard FM contract service levels and Command/TLB consumption.

Internal Target Setting. The NAO audit criticised MOD for the lack of targets outside of GGCs. The MOD has been developing an internal target for energy reduction on top of its previous GGC emission target which is now incorporated into DP20 as part of the Infrastructure Defence task. The target set, against a 2017/18 baseline, requires defence to reduce its energy by 10% by 2025/26. The target itself has been broken down by Command with specific targets given to TLBs based on their actual consumption of energy from their sites. The targets range from 14% for Air, 10% HOCS through to 3% for StratCom. Good progress has been made with a 2.9% reduction so far, as at Mar 20.

Observation: To generate real change across defence the Greening Government Commitments need to be translated into TLB targets and disaggregated through the defence plan with performance monitored through extant Departmental processes. As required defence should also set its own internal targets to drive the achievement of its own Climate Change and Sustainability vision.

In addition, a new target has been set for Ultra-Low Emission Vehicles (ULEV): **25% of all Government cars should be ULEV by 2022 and 100% by 2030**. Current plans will see defence operating 697 ULEVs (circa 9% of the White Fleet) with the majority of the supporting infrastructure for this first tranche in place by early 2021. The lead for meeting this target has been allocated to Support Transformation with the policy held by FMC infra.

NAO Sustainability Overview. Published in May 20, the report concluded that the Department is critical to the government's sustainability objectives, due to its size, supply chain, and the amount of land controlled. It noted that we have achieved some of the targets set through the GGCs, including on GHG emissions, but that we have made less progress in other important areas, have acknowledged weaknesses in our own governance and could do more to set our own targets. It was also acknowledged that the Department had some areas of best practice; specifically defence's sustainability guidance, for infrastructure delivery teams, was praised for going beyond that seen in other departments. The main findings from the report are at Annex E.

Observation: Defence does have areas of best practice and highly capable professionals but more needs to be done to publicise and move activity from the local to the Defence and wider-government level.

Policy Instruction 01/20 Extant Policy in Support of net zero Transition. This policy gives direction on how elements of existing MOD infrastructure policy should be applied in relation to 'net zero' and identifies areas for further development. The direction set by this Policy Instruction must be applied to the requirement setting, procurement (including scrutiny) and management of all defence funded infrastructure across the defence enterprise. It is the responsibility of all staff engaged in defence funded infrastructure and estate activities to apply and meet these MOD Policy requirements. It sets out the energy and carbon standards for new builds, major refurbishment, waste and water management.

OFFICIAL

Observation: Defence's Functional policies and strategies need to be updated to incorporate the UK's net zero Commitment and wider sustainability considerations. There is some evidence that compliance is not assured as effectively as it should be.

4.2.4 Other Drivers

Committee on Climate Change (CCC). The CCC 2020 Reducing UK Emissions Report to Parliament included its annual review of UK progress in reducing GHG emissions. It also set 4 new ongoing climate priorities for all Government departments and a series of specific recommendations for each department. The MOD has several specific recommendations to meet on emissions reduction from buildings and its car fleet, the use of alternative fuels and climate related risk and its role in climate related disaster relief. These are at Annex F.

Net zero. Legally binding carbon budgets drive the achievement of the emission reduction set out in the Climate Change Act. These carbon budgets apportion the required UK emission reduction across a 5-year period. The UK has successfully met the first two carbon budgets and is on track to meet carbon budget 3. However, carbon budget 4 (2023-2027) and 5 (2028-2032) are far more challenging, but there are potential scenarios to realise the reduction required. The carbon budget 6 proposal published Dec 20 is much more demanding as it is the first proposal that takes into account the revised target of net zero by 2050. The GGC emission targets capture the mandated reduction target for all central government targets. They are focused on bounded estate emissions rather than the full Departmental emissions footprint. For the MOD, over the 2016-20 period, the Department reduced its emissions by 48% against a 39.9% target⁴³. However, that the majority was linked to the decarbonisation of the national grid rather more than a targeted programme of interventions.

Observation: While defence has overachieved its Greening Government Commitment emission targets the majority of these savings have been due to the 'greening of the grid' rather than targeted decarbonisation activity.

The Natural Capital Committee is an independent advisory committee. It provides advice to the government on the sustainable use of natural capital. Natural capital means the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions. Natural capital is a broad term that includes many different components of the living and non-living natural environment, as well as the processes and functions that link these components and sustain life. Having possibly the largest reserves of natural capital across central government, the drive to net zero and the net biodiversity planning gains will increase the pressure on the Department. There will need to be a balance struck between military training, species preservation and changes such as increased tree planting and peatland restoration. It is essential that we have a comprehensive understanding of our natural capital and the skills and resources to deliver Government ambitions whilst protecting the military imperative.

Government Buying Standards (GBS) covers eleven goods and services sectors (Cleaning products and services, paper and paper products, Office ICT, Electrical Goods, Furniture, Park Services, Textiles, Vehicles, Water using products, Food and Catering Services and Construction projects). Some standards do not reflect best practice and are out of date; the MOD only focuses on the most significant standards. The Defence Related Environmental Assessment Methodology (DREAM) criteria for construction projects is included in GBS.

Observation: The NAO remarked that while GBS are mandated defence did not actively monitor compliance. Defence will need to consider how to monitor compliance going forward and assure policies reflect current standards and guidance.

⁴³ Against a 2009-10 baseline

Supplementary Green Book Guidance on Accounting for Climate Change was published in Jul 20. It follows the standard appraisal approach of the Green Book.

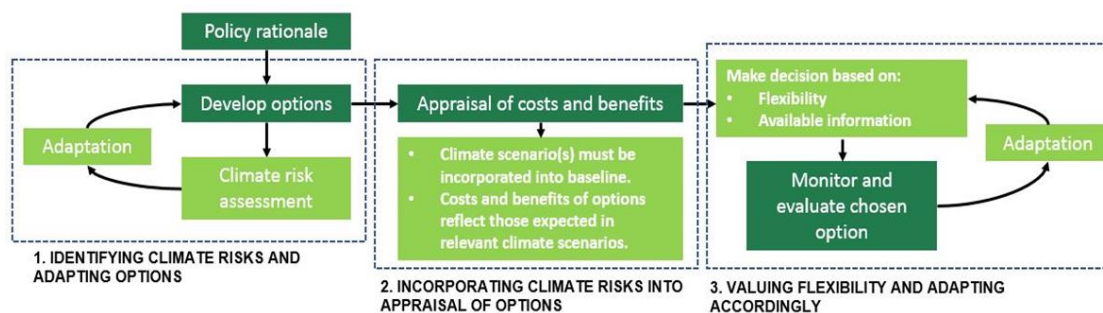


Figure 5 – Green Book guidance on accounting for climate change

The book contains useful guidance and tools. The main concern is getting the ‘demand’ for climate change built into projects from the start. Climate resilience needs to be set out as a military need and TLBs should be mandating this. The requirements of the supplement should be translated into policy to drive this forward. To date, defence (similar to most government departments) has been unable to comply with these new rules, but HMT has made clear that they must be adopted prior to the next spending review.

Observation: *By linking the revised Green Book Rules to the next Spending Review, HMT are directing significantly greater understanding of departments’ emissions than is currently being captured. The MOD will need to improve its understanding to compete with other government departments for funds.*

UK Clean Growth Strategy. In order to meet the 4th and 5th carbon budgets (covering the periods 2023-27 and 2028-32) the UK will need to accelerate decarbonisation. This strategy sets out stretching policies to achieve this and grow the economy. MOD has a role to play in delivering this strategy and the transition to clean growth through initiatives such as Modern Energy Partners sponsored by BEIS and collaborating with industry and academia. The 6th carbon budget is even more stretching and will require material change and resources to deliver.

The Integrated Review. The Department of Business, Energy and Industrial Strategy held the pen for the climate change part of the integrated review and identified defence as joint lead with the Cabinet Office to integrate climate considerations into our global risk calculus. This relates simultaneously to the physical risks of climate change, disruptive effects most likely to spark/exacerbate conflict, or irregular migration; and the transition to net zero risks for some countries.

4.2.5 Wider Commitments

Rural Estate. MOD has ownership and responsibility for ~1% of the UK landmass, primarily for training needs. There are 169 Sites of Special Scientific Interest (SSSI) across the MOD estate covering 81,266 ha and has the largest SSSI estate in England (68,851 ha)⁴⁴. This means 37% of the estate is designated as being nationally important for wildlife. The defence estate also includes land in 13 different National Parks covering 31,020 ha, land within 33 Areas of Outstanding Natural Beauty (England, Wales and Northern Ireland) covering 17,459 ha and 11 National Scenic Areas (Scotland) across a further 1,272 ha. This underscores the importance of the defence estate for wildlife and wider biodiversity.

While the condition of defence’s SSSIs are below the government target of 50% at 48% it is more than the average for other major landowners in England (39%). Recent analysis undertaken by MOD suggests at least 10% of its SSSIs are in a better condition than their current formal assessment indicates with the condition of a further 30% not known. This suggests MOD is likely to be exceeding the current target for Favourable condition (50%) in England.

⁴⁴ This is slightly larger than next biggest, which are National Trust (68, 267 ha) Forestry Commission (67,921 ha).

OFFICIAL

Heritage Environment. MOD is steward of the largest historic estate in Government ownership, being responsible for a wide range of heritage and historic assets in the UK and overseas. There are 777 Scheduled Monuments under management and 810 Listed Buildings. Protecting and improving assets classified as Heritage at Risk remains an important part of our work, and we have been working with Historic England and the devolved administrations to address this difficult issue⁴⁵. The MOD concluded the first phase of a Strategic Review into its Statutory-designated Historic Estate in May 20 and is now looking in more detail at its 57 entries on the Historic England Heritage at Risk Register, in particular to determine whether specific management activity is feasible to improve their condition. Additionally, defence is currently developing a Service Level Agreement with Historic England to improve Governance and is part of the cross-Whitehall Heritage Group, which met for the first time in Jun 20.

Observation: *The Defence's estate is a nationally important asset and it should be proactively managed and enhanced.*

4.3 Sustainability

Sustainable Development is about delivering social and economic goals while at the same time sustaining the ability of natural systems to provide natural resource and ecosystem services for the economy and society. In defence work to date has focused on two key principles which are that MOD **Acts** to make best use of our people, assets and resources and continues to **Evolve** ensuring that we remain resilient to current and future social, economic and environmental threats, by building sustainability principles into our decision making. These two principles are embedded into the current Sustainable MOD Strategy 2015-20.

In addition to the extant Sustainable MOD Strategy there are several other functional or organisational sustainability strategies which have a bearing on defence's sustainability capability:

Strategy	link with sustainability	Owner
Previous		
MOD Climate Change Strategy 2009	2009	HOCS
CURRENT STRATEGIES		
Sustainable MOD strategy 2015-2025	strong	FMC Cap Infra
Sustainable MOD strategy Waste Management 2015-2025	strong	FMC Cap Infra
Infrastructure Climate Resilience Business plan, 2015-2025	strong	FMC Cap Infra
DE&S Environmental Strategy	strong	DE&S
Science and Technology Strategy	weak	DST
SDA Technical Infrastructure Sustainability Strategy	strong	SDA
SDA Environmental Management Plan	strong	SDA
HS&EP functional strategy	medium/strong	HS&EP
UK StratCom Northwood HQ Environmental Plan 2020 Unifying Ambition 2035	strong	UK StratCom
UK StratCom Sustainability Strategy/Delivery Plan	strong	UK StratCom
Strategy for Defence Infrastructure 2020-2040 (draft)	strong	FMC Infra
Rural Strategy for Biodiversity (Intent Paper) draft	strong	PSA
A Strategy for Sustainable Digital Technology 2020- 2025	strong	ICT Digital
DIO sustainability strategy	strong	DIO

Figure 6 – Range of Current MOD Strategies linked to Sustainability

⁴⁵ Further detail for MOD can be found in the Biennial Report into the Care of the Government Historic Estate 2017–19.

OFFICIAL

Observation: *With the growing list of a number of TLB and ALBs intending to publish their own Sustainability strategies defence needs to ensure that its refreshed Defence-wide strategy provides the appropriate framework to drive defence activity while cognisant of the delegated model.*

4.3.1 Sustainability Roles and Responsibilities.

Across defence there are there are a large number of organisations/roles that have historic, extant, transitional and/or future roles linked to Sustainability (including environmental sustainability) and Environmental Protection:

Stakeholder	Responsibility
MinDP	Minister with responsibility for Sustainability
DCDS (MilCap)	Functional Owner for Infrastructure and current Task and Policy Owner of Sustainable MOD and Sustainable Estate.
FMC Dir Infra	Functional lead for Infrastructure and owner of the Strategy for Defence Infrastructure, Sustainable MOD Strategy as well as linked sustainability and infrastructure policy. Also responsible for GGC reporting, the identification and disaggregation of targets through the Defence plan and some infrastructure related environmental protection activity.
ACDS C&FD	Owens the capability planning process.
DIO	Infrastructure technical Expert and Estate Steward. DIO technical Services provide technical advice on and management of sustainability, environmental protection, heritage, ecology, forestry etc. DIO S&P provide guidance and advice and maintain the relevant JSPs on behalf of FMC Infra.
DG Defence Safety Authority (DSA)	Provides 3 rd party independent assurance activity of Defence Safety and Environment Management Systems (SEMS). The management of MOD's Derogations, Exemptions and Disapplication's (DEDs), with authority derived from the Charter issued from SofS. Historically, the DSA has also been the policy owner for the majority of environmental protection which is in the process of transitioning to D HS&EP.
DE&S	The Environmental Team, QSEP, are responsible for promulgating policy advice and guidance on Environment and Sustainable Procurement topics for DE&S. This includes providing advice and guidance to the Acquisition community through the Acquisition Safety & Environment Management Systems (ASEMS) and, in particular its underlying Project Oriented Environmental Management Systems (POEMS). The team also ensures compliance with estates related environmental legislation and policy including advice on waste policy and Environmental Management Systems, and the management, storage and movement of fuels and gases on DE&S sites.
Dir Health Safety and Environmental Protection (HS&EP).	Formed in response to the 2018 Review into the MOD Head Office Governance of Health, Safety and Environmental Protection. They are currently in the process of receiving the environmental protection responsibilities from DSA. HS&EP also provide assurance of the Department's Safety and Environment Management Systems (SEMS).
TLBs	Delegated responsibility for acquisition and infrastructure funding. Keen to set their own sustainability strategies and net zero targets within the delegated model
TLB and ALB Sustainability Champions	Primarily at 2* level TLB and ALB champions have responsibility to cohere and champion internal TLB sustainability activity
Functional Owners	Primarily Head Office based and own associated functional strategies and policies that will need to better incorporate sustainability to deliver the Government's intent as well as defence's net zero plans. Key

OFFICIAL

OFFICIAL

	functional owners are: <ul style="list-style-type: none"> - Support (CDLS) - Finance (DG Fin) responsible for scrutiny and approvals as well as accounting for the effects of climate change - Commercial (CCO) responsible for supplier management and contractual arrangements
DCDC	Author of GST proving the context for planners, policy makers and capability developers which identifies climate change and several underpinning factors as a key trend that needs addressing.
Defence Green Network	Recently formed from the Defence Environmental Professionals network. The Green Network has a growing membership of almost 800 and provides linkages to other TLB and ALB internal green/sustainability networks. Best practice is shared amongst members as well as being used as a challenge forum for new initiatives

Figure 7 – Climate Change and Sustainability Roles

4.3.2 Sustainability Governance.

The NAO observed that defence currently has in place limited oversight arrangements for sustainability. The following are the key Head Office meetings which cover sustainability:

- **Sustainable MOD and Energy Steering Group (SMESG).** Prior to 2018 the Department’s sustainability activity was cohered through the SMESG which was jointly chaired by DCDS(MilCap) and COO as the then Departmental Sustainability champions. It has not met since Jul 18 and hence the focus for Departmental sustainability activity has been lost. The locus for many of the supporting working groups have also been lost which has led to a fragmented approach to sustainability, a lack of ownership and clarity over approach and responsibility. The limited sustainability oversight arrangements were identified by the NAO as an area of weaknesses in their May 2020 Sustainability overview.
- **Defence Safety and Environment Committee (DSEC).** Since mid-2020 in addition to environmental protection issues it has been agreed that the DSEC will oversee defence’s sustainability agenda. The DSEC is supported by the DSEC Steering Group chaired by D HS&EP. There is not equivalent forum for sustainability recognised in the Defence Operating Model.

A fuller list of all external and internal sustainability and environmental meetings is at Annex G which includes the 25 Year Plan Board and the Public Sector decarbonisation board.

Observation: *The self-evident lack of a central senior focus point to draw together, deconflict and prioritise defence activity means that, to date, activity is not being consistently cohered or adequately overseen within Head Office’. The governance and resourcing of climate change and sustainability needs to be resourced and formalised to ensure that defence can meet its and the UK ambitions.*

4.3.3 Resources

FMC infra, is the lead head office team for sustainability, with only a single Full Time Equivalent dedicated to sustainability policy. Due to their infrastructure focus, activity is skewed towards the estate. This team is not currently responsible for the security implications of climate change nor the activity required to adapt and make resilient defence capabilities to the effects of climate change. Without central ownership there has been limited early interventions within capability planning processes and/or decision making.

Across TLBs/EOs there are highly skilled specialist staff covering areas such as: sustainability; climate change; environmental protection; ecology; forestry; archaeology; heritage, and town planners whose work, in some areas, was viewed as best practice by the NAO. Currently these personnel are primarily employed to meet legislative requirements and to protect defence interests;

OFFICIAL

refocusing along with resourcing, to include improving defence's approach, especially in relation to natural capital assets would be a positive step forward.

Observation: Defence needs the right capacity and capability to deliver the Government's and its own sustainability ambitions; and to ensure that the implications of climate change are understood and an integral part of capability planning processes both in Head Office, the TLBs and more importantly ALBs, specifically DIO and DE&S need to advise and support implementation activity.

4.3.4 Sustainable Procurement

Sustainability in equipment procurement is monitored throughout the acquisition cycle – from setting requirements to disposals. At a corporate level, the DE&S Environmental Strategy outlines the roles and responsibilities of all involved in the acquisition process. DE&S has also implemented an integrated Acquisition Safety and Environment Management System (ASEMS) that is aligned with the ISO 14001 methodology. Each DE&S team responsible for the procurement and support of equipment, systems and services is required to comply with ASEMS. It provides a corporate overview of both safety and environmental aspects and helps teams to identify and assess risks to both elements throughout a project lifecycle. As part of ASEMS, DE&S teams are required to maintain and apply the Project Oriented Environmental Management System (POEMS), which is a specific methodology for identifying, assessing, managing and monitoring environmental issues in all projects. The application of POEMS across all DE&S projects ensures consistency of approach in relation to equipment acquisition. Environmental Assessments carried out by contractors should be subject to Def-Stan 00-051.

Where relevant, environmental requirements are defined in contracts, evaluated in the tender process, and monitored and managed throughout the life of the contract to ensure the MOD's requirements are being met. MOD has a number of Defence Conditions that place obligations on suppliers to deliver sustainably including requirements around the timber that is procured, packaging and the use of hazardous materials. The commercial function is also currently assessing which contracts are expiring in the next five years and TLBs/Commands plans for them. The information gathered will inform the wider strategy and will assess how a change in approach could reduce emissions. The procurement process is also being further assessed to what additional sustainability credentials can be incorporated.

Observation: While defence has the tools in place to meet its current environmental responsibilities, there is evidence that they are not having sufficient impact on the procurement process.

4.3.5 Sustainable Information, Communications and Technology (ICT)

Sustainable digital technology is about ensuring that digital systems are designed, manufactured, managed and used in a way that minimises environmental and social impact. Used well, ICT can support flexible working and add flexibility to operations and provide alternative solutions to printing documents. Conversely inappropriate ICT can increase energy use, encourage unnecessary printing and create an expensive hazardous waste burden when disposed all of which will be tracked as part of the proposed suite of new GGCs. Defence Digital is finalising its Strategy for Sustainable Digital Technology, 2020 – 2025 which will have six clear aims:

- [For Digital to a be a] net zero Department
- An embedded circular economy in digital technology
- Digital services that promote sustainable outcomes
- Resilient operations and supply chains
- Ethical, traceable and assured supply chains
- An educated and responsible workforce

With the correct resourcing to delivery these goal and ambitions, more efficient work solutions can be rolled-out supporting a more diverse and inclusive workforce. It will also provide greater

OFFICIAL

OFFICIAL

transparency of our supply chains lessening the risk of unethical and polluting work practices by manufacturers.

Observation: *the widening of the newly proposed GGCs demonstrates the importance of ICT as an enabler and a means of improving defence's approach to sustainability. Defence should ensure that its strategy for Sustainable Digital Technology is fully resourced, implemented and monitored.*

4.3.6 Sustainable Infrastructure

Sustainability and efficiency requirements are embedded into the contracting, design and construction phases of infrastructure programmes and projects as required by MOD policy (JSP 850), Infrastructure Function PI 01/2020 and the Government Construction Strategy (GCS). This will ensure that the department maintains a long-term approach to its business and addresses social, economic and environmental impacts and opportunities for infrastructure projects. JSP 850 is supported by the Sustainability and Environmental Appraisal Tools (SEAT) Handbook which sets out the processes for conducting legislative and policy environmental and sustainability appraisals (including statutory Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA)) and provides detailed guidance for project managers to meet either local authority planning requirements and/or to meet MOD policy in bio-diversity, commuting, land contamination etc.

Observation: *The SEAT handbook and approach to sustainability appraisals have been highlighted as best practice across central government by the NAO. Defence needs to ensure the continued value of this artefact by ensuring it is continuously updated and drives the desired behaviours across the Infrastructure enterprise.*

The Government Buying Standard for New Build Construction and Major Refurbishments requires that:

'An appropriate environmental assessment method such as Building Research Establishment Environmental Assessment (BREEAM) or an equivalent (e.g. Civil Engineering Environmental Quality Award (CEEQUAL), Defence Related Environmental Assessment Methodology (DREAM) etc.) appropriate to the size, nature and impact of the project must be carried out on all projects using the Treasury Green Book or other appropriate guidance provided by government.'

'Where BREEAM is used, all new projects are to achieve an "excellent" rating and all major refurbishment projects are to achieve a "very good" rating, unless site constraints or project objectives mean that this requirement conflicts with the obligation to achieve value for money. Where an alternative environmental assessment methodology is used, projects should seek to achieve equivalent ratings.'

DREAM was developed by DIO to address the unique nature of MOD buildings and provide the MOD with an equivalent to the industry standard, BREEAM. Wherever possible, DREAM should be used in preference to other assessment methodologies as it is specifically tailored to defence construction and buildings. Like BREEAM it requires new builds to achieve an 'excellent' rating and major refurbishment a 'very good'. Overall compliance for 19/20 is 69.4% which has been primarily impacted by 17 new buildings at Laikipia Air Base in Kenya. Previously compliance has been as high as 98%. In the past DREAM has not always kept pace with BREEAM updates, resulting in there being an imbalance between credits and assessment ratings enabling credits to be gained for more routine activity. There is a review ongoing against the latest BREEAM requirements and how credits are awarded, and an updated version DREAM is due imminently. However, both DREAM and BREEAM do not assess energy consumption of the building when in operation unlike other methodologies such as NABERS.

OFFICIAL

Observation: In addition to the ongoing review of DREAM and the need to realign with the current BREEAM requirement defence should consider whether a more accurate measure is used which reflects the operational usage of our built assets.

4.3.7 Scrutiny of Sustainability in Projects

Examination of sustainability considerations is a part of the scrutiny process for both infrastructure and equipment projects. In the infrastructure domain this is conducted by progressively working with Statements of Requirement to build in sustainability at an early stage. DIO conducts its own in-house scrutiny using its technical services specialists. For the equipment programme the evidence from POEMS is similarly scrutinised. Scrutiny would be improved with greater underpinning policy with which to hold TLBs to account. Recently JSP 655 Defence Investment Approvals, has been updated to include new criteria accounting for changes in legislation including the Public Services (Social Value) Act 2012, the Modern Slavery Act 2015 as well as the commitment to net zero Greenhouse Gas emissions by 2050 within the Climate Change Act 2018. It also encompasses changes to policy such as JSP 850 Infrastructure and Estate and MOD Policy Instruction 01/20. The changes to JSP 655 will help ensure that it is considered across other lines of development including equipment and digital platforms. More work is required in this space, to update templates and provide additional guidance to steer project teams further.

Observation: Defence's extant scrutiny process already incorporates sustainability considerations on all projects/programmes, but it is not having sufficient impact to make a material difference. As defence's ambition and policy alter the scrutiny community should consider additional training to ensure that remain aligned to current policy/guidance.

4.3.8 Overseas Bases

A sustainable approach is also being developed for defence's overseas bases. This approach includes increasing the use of renewable energy across all bases, as well as other measures relevant to specific bases such as more sustainable transport, improved waste management, and mitigation of the effects of climate change. This Strategy is in the early stages of development, but there are some sustainability projects already in progress.

Falkland Islands. The Falkland Islands already have some wind power capacity and are looking at options for other sources of renewable energy to provide maximum resilience and are collaborating with the Falkland Islands Government on waste management. As well as conducting a climate change risk assessment the viability of organic provision of fruit and vegetables via either conventional or Hydroponic farming is being assessed.

Cyprus (Administrator of the Sovereign Base Areas and Commander British Forces Cyprus) have developed their own Sustainability Programme Mandate for next steps as well as doing ongoing work on a 'Green Strategy' to map out the path to 'net zero'. The Mandate is the direction for a co-ordinated strategic programme that aligns BFC/SBAA to MoD Sustainability Principles.

British Indian Ocean Territories (BIOT). Working with both FCDO and defence, the Zoological Society of London (ZSL) carry out regular visits to monitor levels of plastics pollution as an indicator for the rest of the world. Plastic reduction and collection from beaches is also regularly carried out by British Forces BIOT

4.4 MOD GHG Emissions Baseline

Emissions are categorised into three 'Scopes'. Scope 1 covers direct emissions from owned or controlled sources. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting organisation. Scope 3 includes all other indirect emissions (not included in Scope 2) that occur in an organisation's value chain.

OFFICIAL

The MOD currently reports its emissions either as part of the GGCs, covering Direct (Scope 1 – Burning fossil fuels on the estate) and Indirect (Scope 2 – bought in (from the National Grid) electricity and heat (gas) and delivered (LPG and heating oil)) and Scope 3 (Business travel only), or through its Annual Reports and Accounts (ARAc), covering all the GGC emissions plus Capability Energy (Scope 1 – direct Burnt fossil fuel capability consumption). Previously the Department has externally published a Sustainability report which captured Departmental performance against all GGCs as well as heritage, biodiversity etc. This report has now been combined with the ARAc.

	Reported Estate Emissions (tons CO ₂ e)	Reported Capability Energy Emissions (tons CO ₂ e)	TOTAL (tons CO ₂ e)
GGC	783,000		783,000
ARAc	783,000	1,826,000	2,609,000

Figure 8 – Total Report Emissions

Observation: Defence’s total emission footprint (incorporating estimated scope 3 supply chain emissions) could be significantly greater than previously identified. Defence will need to consider the role it wishes to take in changing its supplier behaviours to minimise scope 3.

Defence’s estate emissions account for 50% of central government’s emissions. However, if considering a Departmental trajectory to net zero, these baseline positions do not incorporate the full scope 1, 2 and 3 emissions generated by the Department or our value chain. There are gaps in our data capture which does not adequately capture emissions from Service Families accommodation, rail and road business travel, food, waste and water. Work conducted as part of the CC&S Review found that if these factors were incorporated into the MOD footprint, emissions increase from 783,000 tCO₂e (the GGC reported position) to 3.8mt CO₂e, a fivefold increase. Acknowledging that there are missing emissions and the need to incorporate scope 3 emissions from our supply chain, the total is estimated at 5mt CO₂e. An increase of 650%. Getting to net zero will not be possible if all defence’s scope 3 emissions are included.

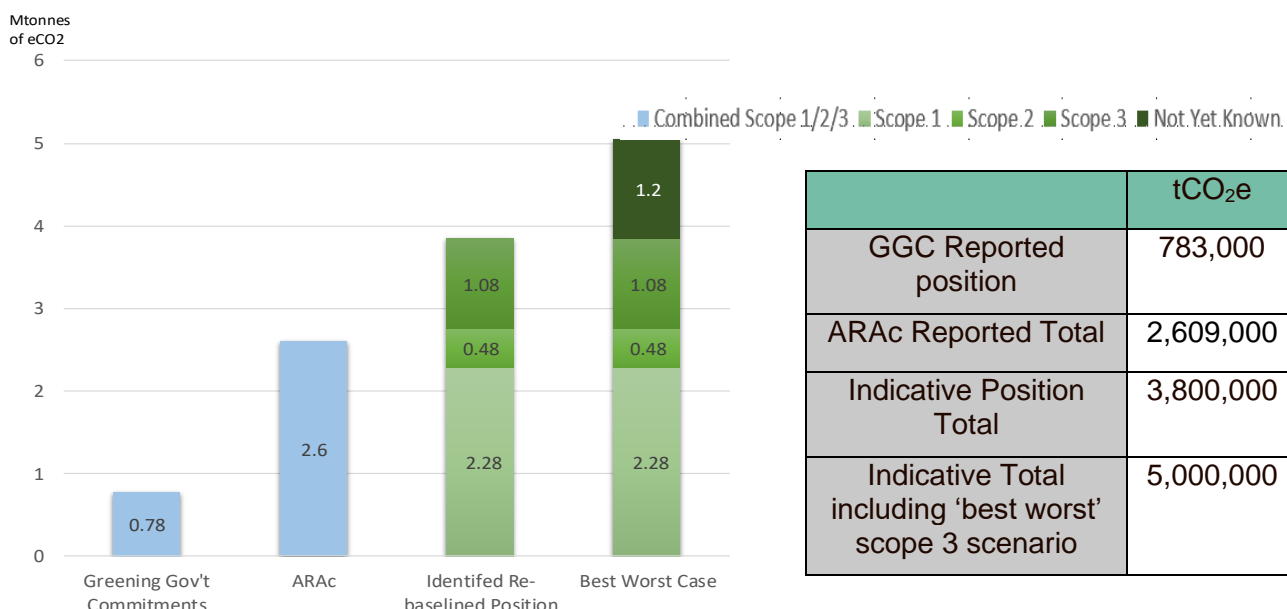


Figure 9 – Comparison of Departmental Emissions footprints

OFFICIAL

OFFICIAL

Another way of looking at defence's emissions is looking at where the emissions are generated from. As an operational department it should be no surprise that the majority of defence's emissions come from its capabilities, as shown below:

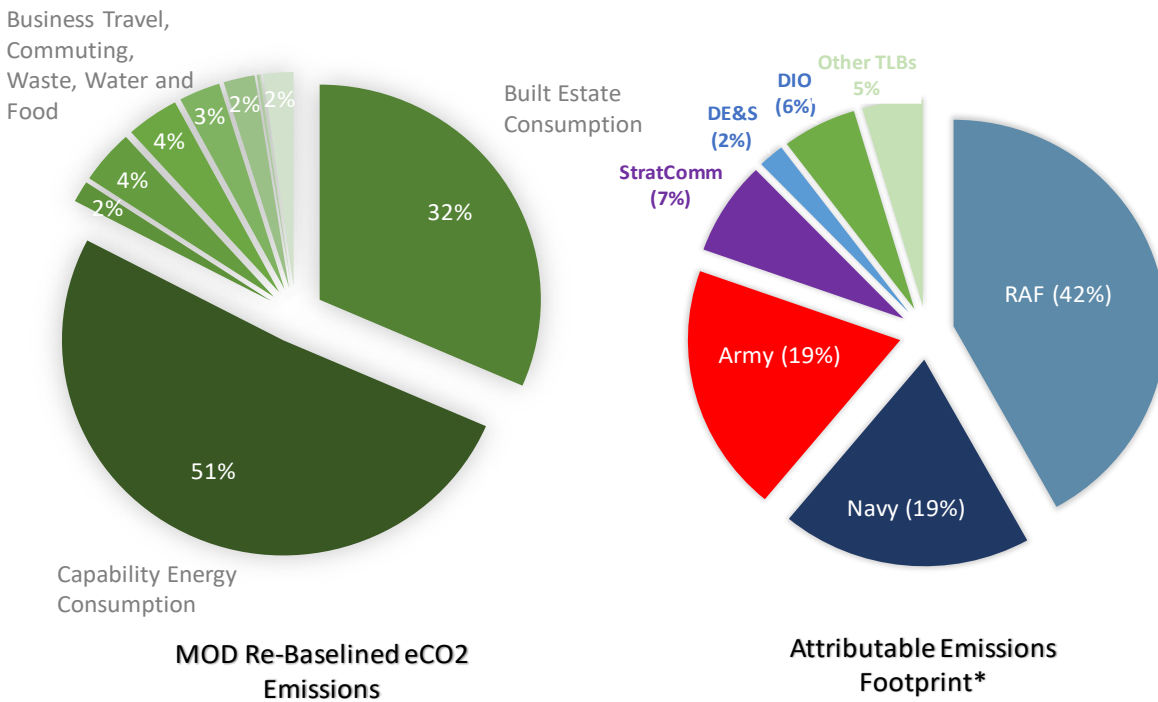


Figure 10 – Where do Defence's Emissions come from?

In looking at understanding MOD's true emission baseline it is important to note that our current reported position has omissions especially on equipment emissions (including fluorocarbons⁴⁶) and its scope 3 supplier emissions. We do not yet understand, at a more granular level, the extent of defence emission generating activity which is the first step in targeting effective reduction methodologies. For example, across the MOD, digital technology is used widely: its operational energy use alone makes up 36% of total ICT energy use across Government. More sustainable provision of ICT through cloud services for example, could significantly reduce the energy consumption of data centres on the MOD estate and hence the overall estate emission footprint.

Observation: Defence needs to have a set of agreed methodologies against its direct and indirect emissions to support the identification of its baseline.

Observation: Defence must ensure all fluorocarbons are identified and where viable less damaging alternatives sourced.

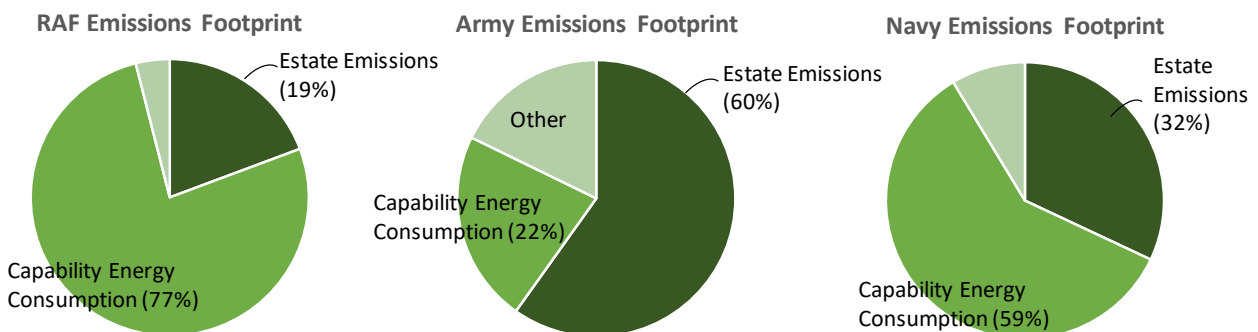


Figure 11 – Comparison of the Emission Footprint of the Three Single Services

⁴⁶ Fluorocarbons are used primarily for cooling and firefighting rather than energy consumption. The CO₂e per tonne of fluorocarbons is much greater than CO₂ itself ranging from 12 to 22,500 more damaging.

OFFICIAL

OFFICIAL

The breakdown of the three Single Services clearly demonstrate that the majority of the RAF's and Royal Navy's emissions result from the fossil fuel consumed by their respective capabilities. The Army, however, have the largest estate and number of built assets and as a result the majority of their emissions are from the Estate. While these emission figures are still indicative, they show that capturing Defence's baseline and whether the emissions are direct or indirect is fundamental to defence's ability to meet net zero, and to be able to disaggregate emission reduction targets to the TLBs and ALBs. Defence Analytics are currently supporting work to identify a validated baseline position, underpinned by a clear data standard and derived through the use of validated methodologies. This work is due to conclude by Mar 21. This will ensure that future Defence Plans have informed emission targets to drive the right TLB behaviours.

Observation: To drive defence's net zero approach a validated emissions baseline needs to be captured, to enable emissions to be allocated to all defence's organisations through the Defence Plan and thereby drive the required decarbonisation activity and behaviours.

While there is growing understanding of defence's emissions baseline there is no forecast trajectory of how we were going to meet net zero 2050 as defence does not track the greenhouse gas emissions implications of its decisions. Without this information defence does not know how far it is from net zero or even whether it has achieved it. To develop a Departmental net zero plan, emissions and sustainability considerations need to be factored into defence's decision making processes, for instance at the start of any requirement setting activity or as part of business case option analysis. This will ensure that defence can track the emission implications of its decisions.

Observation: To identify and track defence's ability to meet net zero the emission implications of defence decision making must be captured and monitored.

4.4.1 Carbon Sequestration and Natural Capital Opportunities.

Carbon sequestration is the process of removing CO₂ from the atmosphere. While carbon capture technologies are being developed and are integral to the UK Government's recently announced 10 point plan the best near-term opportunity is to enhance natural sequestration opportunities through restoring peatlands and wetlands, conversion of arable farming to grassland or woodland and/or other flora as well as changing farming practices.

Defence, with its estate stewardship role has a significant opportunity to offset its emissions. Defence does not hold a validated natural capital baseline which would articulate the amount of CO₂ removed from the atmosphere across the defence estate. An indicative figure for the offset potential currently of the Defence Estate is 260,000 tCO₂e pa, which is negated by the condition of our peatland and the rural management of our estate for grazing which could result in the defence rural estate actually being a net emitter.

Observation: The current sequestration opportunity offered by defence's rural estate is essentially negated by its condition and the use of the land for grazing.

With investment to improve the condition of defence natural capital, further investment in tree and other flora planting and a change in rural management practices including soil conservation there is the clear potential for defence estate to sequester significant amounts of CO₂ – perhaps as much as 1.3 mtCO₂e pa. With support from the Forestry Commission, which has designated specific support to MOD in some newly created positions, 750ha of land has been identified for tree-planting. The areas identify have a woodland military training need, thereby securing their long-term development potential. If successful, a total of 1.5-2M trees could be planted. Defence has also recently joined the Northumberland Peatland Partnership and is assessing ways to improve the condition of its peatland and indirectly mitigate flash flooding and enhance the unique habitat of many designated species. Peat restoration will cost and for MOD there is the added complexity that many of our peat reserves are in training areas, requiring UXB clearance before work can begin. For example, the

OFFICIAL

OFFICIAL

impact zone at Otterburn training area is on peatland and has been in use in excess of 100 years. This limits restoration activity to outside the impact area. However, defence is already working with Cranfield University to help identify its natural capital baseline and further work will identify near term investment opportunities to optimise the offset potential of the defence estate including its peatland. The Army has also commissioned Exeter University to undertake a detailed sequestration/treescaping study on 4 Army Sites.

Observation: Defence must have a thorough understanding of its natural capital to identify its carbon sequestration and bio-diversity opportunities.

Under the Environment Bill development projects will have to demonstrate on-site biodiversity net gains or provide off-site compensatory habitats. DIO is developing a roadmap for the implication for the rural estate and actions needed such as, new policy, processes, guidance and assessment tools. It may require the creation of 'habitat banks' to secure against future developments/major disposals. Project Marker, working with the Environment Agency at Thorny Island in the planned sea-wall realignment to create salt marsh and flood plain habitat, could have the potential to be 'banked' against future development.

There is scope to deliver increased output of climate and biodiversity goals through greater investment in the four devolved nations training areas which indeed might create scope for larger scale land rehabilitation and carbon sequestration initiatives (especially in Scotland and Northern Ireland) with minimal impact on military utility of the training estate. There is also scope to devolve many more projects to establishment level. Small projects present the opportunity to not only promote local biodiversity and small-scale carbon sequestration but make a positive impact on the human environment and be part of the positive alignment of the built environment for mental as well as environmental health.

Observation: To optimise the sequestration opportunity of defence's rural estate and to enhance its natural capital value extant activity needs to be built on and lifted into a UK wide strategic programmatic approach with investment prioritised into those areas with the greatest effect.

4.4.2 Current Built Estate Emissions Reduction Activity

While the majority of defence's emissions reduction to date have been delivered through the estate rationalisation, the move to gas-based heating and the greening of the National Grid supplied electricity, there are two groupings of activities underway across the Estate. The first is pure de-carbonisation activity directly reducing the estate emissions footprint; the second are activities reducing defence's energy consumption, thereby reducing direct cost.

Many of the local initiatives above are aligned to the net zero ambition agreed by the Infrastructure Joint Committee in Sept 19 for '*net zero and resilient infrastructure – designed, constructed and operated to enable decarbonisation by 2050*'. However, the scale of additional activity required to deliver this extant ambition is significant and will need to be brought into coherent themes and/or programmes of activity to ensure implementation and secure the required funding across defence's delegated model.

Observation: Defence decarbonisation work has been tactical and based on what funding is available. A decarbonisation programme needs to be established which identified to TLBs those activities that will realise the greatest emission reduction benefit per £ invested. Wider factors such as resilience and return on investment will also need to be considered as part of this approach.

It should also be noted that as part of the UK's and therefore defence's approach to net zero the move away from fossil fuels on the estate will ultimately lead to a substantial increase in utility costs even with current emission reduction activity; the increase in cost is driven both by electrification as well as increased demand from sources such as electric vehicles and synthetic training. See figure 12 below:

OFFICIAL

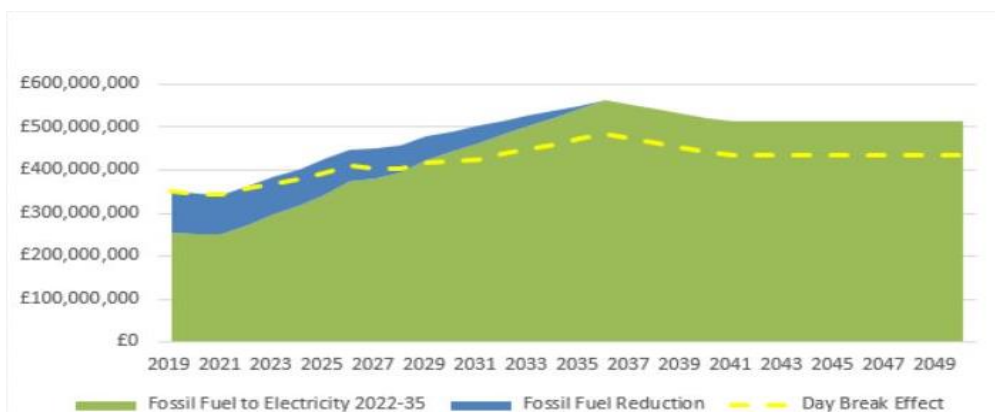


Figure 12 – Energy Mix and Cost to 2050

The defence estate is in the process of re-orientating to focus on both sustainability and emission projects. DIO is in the process of implementing several operating model changes that will see an enhanced sustainability service to defence and ensure that we are able to effectively fulfil their role as Estate steward. These changes will be vital to advise on and cohere the delivery of TLB sustainability requirements as well as produce an agile process to attract funds from other government departments. As it is likely that this type of funding will continue it will be vital to ensure that TLB and DIO have some flexibility to secure funding for decarbonisation activity. As part of this operating model pre-existing governance forums such as the Defence Utilities Group will need to be restructured to support pan-enterprise activity.

Observation: *Currently defence’s processes and those of other large central government departments are not agile enough to draw down on the BEIS decarbonisation fund. Defence must adapt its processes and work to ensure that these funds are made multi-year to secure the significant investment required to drive decarbonisation activity on defence’s existing estate.*

4.4.3 Equipment Approach Projects.

The DE&S Environmental Strategy recognises that equipment is required to operate in a number of challenging and hazardous conditions, therefore as part of their strategic approach they have agreed to:

- Seek opportunities to reduce the fuel/energy consumption and emissions from the Equipment, Systems and Services we procure;
- Engage with Front Line Command (FLC) Capability Sponsors, Head Office and industry to promote the sustainability agenda to ensure it is fully considered in project decisions;
- Work with FLC customers to determine an action plan to reduce equipment emissions;
- Determine and rank the direct carbon emissions from the equipment we deliver and support, including fuel consumption and F-Gas usage.

Further improvements by DE&S include the strengthening of environmental screening and scoping requirements within POEMS. Def Stan 00-051 (Environmental Management Requirements) is being updated by the end of Mar 21 to enhance the guidance section in part 2. The standard is used to place environmental management requirements on contractors providing products, systems and services.

DE&S is also working with Cranfield to move their environmental training courses to an on-line format. The Environmental Awareness, Sustainable Development in Defence Acquisition Workshop and the POEMS course are all being delivered virtually. From Jan 21 all procurement projects that fall under the Public Contracts Regulations 2015 will have the application of a minimum 10% weighting for social value criteria in the tender methodology. Defence Commercial will extend this to contracts for military requirements from Jun 21.

4.5 Climate Change

Global Strategic Trends noted the impacts of a changing climate. “Floods, droughts, storms, heatwaves and heavy rainfall are all expected to become more intense and possibly more frequent. Military equipment will need to be able to operate in these increasingly extreme conditions.” Yet this has not featured much in defence planning to date.

Work is currently going on across government to delineate what impacts climate change have on organisations and the current draft definition proposition from FCDO, which MOD has contributed to, states: “On the one hand, insecurity and conflict may undermine a country or region’s resilience and ability to adapt (e.g. displaced people may be more vulnerable to climate hazards). This means efforts to address conflict can increase resilience. On the other hand, efforts to support resilience to climate change can contribute to efforts to build stability (e.g. improving natural resource governance).”

While Global Strategic Trends highlights environmental stress as a key trend that requires action and the increasing disruption and cost of climate change and increased demand and competition for resources as focus areas that need action there is no discernible sign that these interventions have been taken forward and embedded in any of the potential Sec Pol & Ops frameworks.

Observation: *Defence should consider climate change as a non-conventional threat and respond accordingly to ensure that its capabilities and force structure are adapted to and resilient to the effects of climate change.*

4.5.1 Climate Change Roles and Responsibilities

In addition to those outlined above at Para 4.3.1, the roles and responsibilities for the impacts of climate change on defence fall across head office and across defence as follows:

Stakeholder	Responsibility
VCDS	VCDS owns Defence Force Development.
DG SEC POL	Responsible for provision of Policy advice to Ministers and the Department on UK Homeland Security Policy and Defence Security & Resilience. This includes the direct and indirect effects of climate change on defence.
DCDS (MSO)	Lead for military strategic planning to ensure coherent military responses to threats, he supervises and orchestrates subsequent delivery. Directs and oversees ability to mount and sustain all defence operations and commitments linked to climate change (HADR, MACA)
DI	Threat implications of a changing climate
Def Log & Support	Operational advantage of a more sustainable and non-reliant on fossil fuels force.
DST (R&D)	Research development
dstl	Research development
JFD	Defence force development

4.5.2 Climate Change governance

Cross government governance

There are only a limited number of forums with responsibility on climate change:

- **The Climate Action Strategy (CAS)** chaired by the Prime Minister and considers matters relating to the delivery of the UK's domestic and international climate strategy. SofS for Defence is not a member.
- **The Climate Action Implementation Committee (CAIC)** considers matters relating to the delivery of COP26, net zero and building the UK's resilience to climate impacts. It is chaired by the Secretary of State for Business, Energy and Industrial Strategy. SofS for Defence is not a member.
- **National Security Implementation Group on Climate change** chaired by BEIS develops options and implements the Government's strategy on climate change and sustainability. The NSIG meet on a monthly basis and MOD at senior officials' level is a member.
- **The X-WH climate security community of interest.** A newly created forum at desk level between FCDO, MOD and other interested departments and considers climate change as a stress multiplier, both domestically and internationally. This cooperation, developed in the spirit of the fusion doctrine, enables all the stakeholders from all departments to share thoughts, lessons learned, good practice and to develop common and articulated strategies to tackle with climate change effects in the UK and abroad. This community of interest is also working to delineate what climate security really means and ensure that all government departments are considering this challenge in the same way.

The implications of climate change on security are only now being truly understood and taken forward. The Government's Integrated review currently identifies the MOD as the lead department for climate security.

Internal MOD governance

The effects of climate change on defence could be addressed through the following boards in the department, so as to address both the implications on our equipment and estate but also on the operations we might have to conduct in a climate changed world. Currently there is no consideration of climate change in these boards/meetings, and so climate related implications are only rarely and sporadically collated and acted on.

- **The Military Capability Board (MCB)** is chaired by the DCDS (MilCap) and governs the process of turning defence policy into military capability. The MCB is held on a monthly basis and reports to the Defence Force Development Board and where appropriate, the Executive Committee.
- **The Joint Commitments Strategic Steering Group (JCSSG)** assesses the policy demand on the Current Force with the capability we and our allies and partners have available and advises Ministers on where best to balance these. DCDS (MSO) and DCDS (MilCap) co-chair the JCSSG which assesses commitments up to three years ahead. The JCSSG provides assessments of capability performance on exercises and on operations. These include measures of how each capability performs, and lessons identified from how commanders have used the capabilities in real and realistic operational settings.
- **The Joint Requirements Oversight Committee (JROC)** chaired by VCDS, the committee scrutinises requirements at an early stage of the development of a programme and has recently agreed to consider the effects of climate change on all programmes.

Observation: While there is a degree of incoherence in understanding the implications of climate change within defence this is also mirrored across central government. As defence looks forward it should consider how best to coordinate and lead activity to ensure that our capabilities, force structure and training are cognisant of the implications of climate change.

4.5.3 Resilient infrastructure

Establishment Climate Risk Assessment. Defence's Climate Impact Risk Assessment Methodology (CIRAM) assesses the risk at site level against a number of climate factors, using future weather UK Climate Projections (UKCP) provided by the Met Office against a range of scenarios. Current policy is that all sites classed as Critical National Infrastructure should have a CIRAM undertaken every 5 years. To date 176 sites are covered by a CIRAM yet there is evidence that only a few sites act on their assessments to inform their establishment infrastructure plans and/or site developments. To enhance its utility DIO are developing a tool to look for patterns and strategic trends at TLB and defence level capturing data, for example, against severe weather related callouts.

Observation: *Defence should consider mandating CIRAMs for all its major establishments to ensure that the climatic risks to its estate are continually assessed, understood and managed. Further consideration is required of its value to acquisition teams to assess the climate conditions in which capabilities could be deployed.*

4.5.4 Defence Research and studies

Literature on climate change and its implications is extensive, but there is hardly any research over and above Global Strategic Trends on its effects on the military. To aid the development of this Review several research projects were commissioned from RAND, the Met Office, dstl and others. A summary of key research is at Part 4.

4.5.5 International Comparisons

Engagement with our international partners and NATO has identified that the approach taken by nations' defence ministries varies widely. Some such as Sweden and the Netherlands are actively engaged with reducing their environmental impacts and carbon emissions. Other nations are much less mature. Those within the European Defence Agency have been part of the Consultation Forum for Sustainable Energy in the Defence and Security Sector with the aim of driving the transition towards 'defence sustainable energy models'. It is recognised that most of the respondents are concentrating either on climate and security or sustainability, but few are considering both aspects simultaneously. There are opportunities for cooperation as several other countries are considering ways to address all the challenges caused by a changing climate.

As there is a growing appetite among allies and partners to discuss climate related topics and more specifically the effects of climate on global security the ability for international collaboration should be considered as part of COP26. Defence involvement could be the factor to bring together militaries from other nations to reach a common statement on the need to tackle this issue collectively and act jointly both to adapt to the challenges caused by the effects of climate change and to mitigate the impacts of the military on the environment. The intent to incorporate climate security as a dedicated side event into COP26 has been supported by two Wilton Park events held in Oct 20. Wider outcomes from Wilton Park and the CDS Strategic Forums are below:

- **Wilton Park events.** Wilton Park conducted 2 events for the MOD in Oct 20 (in association with the International Military Council on Climate Change & Security, the government of Luxembourg and Rolls Royce), bringing together countries likely to cooperate in this area. The first event on, Sustainability of the Military Apparatus, generated agreement of the necessity for action, but not what that action should be. The second event, addressing security risks and threats from climate change suggested, at least among participants, that the debate over the connection between climate change and security risk has been won.
- **CDS Strategic Forum 20-2 and 20-3.**
Two CDS strategic forum dedicated to climate change and sustainability took place in 2020: "*Balancing resilience and sustainability: the challenge for defence in a climate-changed world*" and "*Defence and Climate Change: Time to Act*". Both put an emphasis on the relevance of this topic for defence and raised the opportunity to be seized in terms of UK leadership with the planned COP26:

OFFICIAL

“There is an opportunity for defence to take the lead in adding defence and the military implications of climate change to the agenda of the United Nations Climate Change Conference (COP26) to be held in November 2021. There are many opportunities for international military collaboration, including with NATO and the European Defence Agency’s Energy and Environment Programme.”

4.6 Wider Activity

4.6.1 Current Innovation Activity

Linked to some of the Estate Emission Reduction pilot projects the Innovation Fund has already enabled the demonstration and hands-on use and assessment of sustainable projects, such as: a solar powered carport which enables the onsite charging of electric cars, trials of micro-wind turbines deployed on boundary fences and a civil-sector facing challenge to identify improved capability to account for the distortion of wind-farms on radar systems. Other work includes:

- **Logistics Technology Investigations Project (2019-22).** Part of the project is focussed on fossil fuels, alternative energy and what actions can be taken so that defence can achieve net zero GHG emissions by 2050. It will provide a cost benefit analysis of possible opportunities to reduce fossil fuel usage and identify suitable trials to demonstrate effectiveness.
- **Emerging Technology for Defence Programme** is leading an RAF funded DASA innovation study under its Defence Efficiencies project which is investigating the efficacy of novel Bio-Remediation Technologies from University College London, Sheffield University, and Liverpool John Moores University that will provide environmentally friendly methods to remediate fuel contaminated land.
- **Future Contexts Project (itself within the Future Threat Understanding and Disruption Programme).** As part of this work dstl is currently carrying out scoping work to consider the potential impacts of climate change on defence capability. They are also working with the Alan Turing Institute and the Meteorological Office to consider whether the Global Urban Analytics for Resilient Defence (GUARD) model could be used to understand where Climate Change may induce conflict hotspots. This is an extension of previous work to understand generic societal contributors to potential conflict areas.

Looking forwards FMC Infra and DIO supported by the Innovation team will conduct horizon scanning to identify the most promising innovation in the private sector that can help to reduce estate emissions and improve sustainability. It commits to collaboration with the construction, property and FM technology sectors on technological innovation. The Estates and Infrastructure ideas space has also been created, to encourage the development of ideas on sustainability and net zero, in relation to the defence estate and infrastructure.

Observation: Defence’s innovation fund has already been used to support sustainability and net zero activity this should continue and, if possible, expanded.

4.6.2 People and Behaviours.

MOD continues to modernise its approach to ensure it provide an adaptable and sustainable workforce that adjusts quickly to evolving demands, maximises the use of talent, and that attracts and retains the right talent. The people transformation programme and the diversity and inclusion strategy along with a range of welfare supports and concepts such as flexible services help to enable recruitment and retention (military and civilian) and to fill skills gaps by attracting the right talent. Ensuring that the Department is seen as an organisation that places sustainability at the core of its activities and is working to mitigate its emissions is important to attracting high calibre talent. Sustainability and net zero ambitions will not be achieved just by employing SQEP and updating policy. To engender real change the correct behaviours by all staff need to be inculcated

OFFICIAL

OFFICIAL

with an understanding of sustainability and what actions they can take day-to-day as well as major decision making.

Observation: Mandating sustainability training into military and civilian core training could be a sensible approach. Work with the Defence Transformation behavioural insights team could support this and help in the development of other ways of raising awareness.

4.6.3 Sustainable Defence Support

Working with TLBs and with the emergent Defence Support organisation, work thus far has largely been in establishing the baseline of understanding. This has involved assessing legislation and policy (both current and future requirements), and how technology and novel approaches, such as the Circular Economy, can be harnessed and evaluated so that it delivers advantage broadly for Defence and against the more specific needs of the Defence Support Strategy. The work, therefore, is informing concept development and being brought to life by Commands, Defence Support centrally and through relationships that are building with industry and academia.

Within the Joint Enabler area, methodologies for comprehensively quantifying Greenhouse Gases emissions within Supply Chains are being explored, and the baseline 'as is' assessment will be an initial measure for wider Performance Excellence assessments. The principles of the Circular Economy are currently adopted in an inconsistent, fragmented and poorly optimised manner across the supply chain, and so will be investigated more thoroughly through further research. Equally, the Innovations, Research and Experimentation programme for 2021/22 will develop a greater understanding of how to apply existing and proven technology to the military environment. Areas to be looked at include: microgrids to make deployed bases more sustainable; a better understanding of synthetic fuels; identifying how deployed rations can be made more sustainable; approaches that reduce the flow through the supply chain; more precise data analytics; and use of advanced manufacturing, robotics and automation.

While near term opportunities to significantly reduce capability energy emissions by adapting equipment platforms is relatively limited, work is ongoing across the Support Function.

- **Sustainable Aviation Fuel (SAF):** Def Stan 91-091 was reviewed and reissued Sep 20 with a significant Green Agenda amendment. Up to 50% SAF blends have been cleared for use on MOD platforms, which also benefits the commercial market by removing the barriers to SAF supply and is a big step forward for net zero 2050. Currently, there is no UK production of SAF, but with the specification change and the government backing for the setting up of a UK SAF clearing house there is now an incentive to begin. Using defence FY19/20 figures, the best-case scenario with 50% SAF would be a reduction of 0.3mt CO₂e or just under 10% of defence's total emission once in use.
- **Fluorinated Greenhouse Gasses (F-Gas):** The Defence Strategic Fuels Authority is working with Project Teams to ensure all platforms which use F-Gas, have a plan to implement one of the 3C's strategy: Continue, Convert, Change. This is so that the MOD can reduce its use of F-Gas to an operational minimum.
- **Fuel Enterprise Study (FES):** FES is currently in its second year reviewing how to improve the Defence Fuel Enterprise (DFE). Elements of the study are looking at how we can reduce our fuel holdings and thus, supporting infrastructure. In addition, it is looking at how the DFE is managed and cohered with a vision to bring together the DSFA, fuels buying team, elements of infrastructure management and in addition, add a green energy focus, forming a new Defence Energy Organisation.

Observation: Support offers some of the most tangible opportunities to minimise defence's environmental impact lower emissions (future use of sustainably produced fuels), embracing the circular economy or by building resilience into operation (deployable solar).

OFFICIAL

OFFICIAL

4.7 Climate Change and Sustainability Report Governance

As existing sustainability forums were in abeyance to support the development of the Climate Change and Sustainability review 4 separate forums have been created:

- **Climate Change and Sustainability Implementation Group (CCSIG):** The CCSIG was created in Feb 20 to execute all responsibilities associated with defence's climate change and sustainability agenda. This includes driving change, setting standards, stakeholder engagement across defence, and providing assurance to the Secretary of State and Permanent Secretary through the Holding to Account processes. It convenes all Head Office areas, TLB 2* champions, functional owners with responsibilities for sustainability and reports to the DSEC. The primary objective of the CCSIG is to deliver defence's responses to climate change and the challenge of net zero GHG emissions by 2050. The group addresses opportunities and risks while ensuring that defence continues to deliver capability requirements to the required levels of effectiveness.
- **Group of Experts (GoE):** The GoE was created in May 20 to act as an independent body of 12 high-level influential and expert people from the UK's academic, industry, think tank communities who had advise the MOD on how to tackle climate change and sustainability. All along the review process and more specifically around four dedicated round tables, they provided insight on how to deliver a coherent, realistic and ambitious climate change and sustainability strategy.
- **Defence Suppliers Forum (DSF) Climate Change and Sustainability Steering Group:** The DSF enables collaborative MOD / Industry senior engagement and is supported by the ADS group. The Executive Group co-chairs are supportive of the idea to establish a Steering Group, after the report lands.
- **Defence Climate Change and Sustainability Programme Management Group:** The Programme Management Group met for the first time in late Jul 20 and is led by the Aviation Defence, security and Space Group (ADS). The Group consists of volunteers and has agreed to take forward a number of actions in support of the implementation of MOD climate change and sustainability strategy and contributed to challenge the recommendations and milestones of the report. The group also considers how the CC&S review fits into wider initiatives and policy work such as the Defence & Security Industrial Strategy (DSIS).

Observation: *In considering its approach to sustainability and climate change, defence will need to leverage the considerable knowledge and momentum built by these forums to drive the required policy, process and behavioural change.*

OFFICIAL

A suggested sustainability strategy



PART TWO

Chapter Five – The Strategy: a proposition

5.1 Introduction

Despite the fact that climate change and sustainability were acknowledged at Defence Board level as an issue that had to be dealt with in 2007, defence has no systematic or systemic approach to the issue and its effect; as a result it is now behind some other countries' militaries and is starting to address this issue from a relatively low base. It has responded to government targets on an individual target by target basis but has left most of the innovation and development of a more sustainable defence to the energies of concerned individuals. The issue of climate change and security has not been tackled recently. Whilst there is much good work already going on, as the NAO observed, there is no overarching policy guidance, direction or strategy at departmental level. This is both inefficient as it will lead to many different approaches to the same issues and is also potentially wasteful. Indeed, remaining fossil fuel based is very likely to increase cost in the longer term. Further, as there is no clear leadership on this issue, the many opportunities to influence security policy and deliver defence efficiency are being missed.

This report proposes a strategy and a way ahead. It cannot direct defence to follow it, and inevitably it will require constant updating and revision as the budgets, environment and government direction change over time. It should be used as a handrail and guidance, rather than followed slavishly. However, there is also a clear imperative – to ensure all aspects of defence are adapted to take account of climate change, each area should look to see how to develop their response, which this strategy tries to lay out, and move from this firm base rather than start from scratch or develop significantly alternative solutions.

This strategy, a call to action supplemented by a plan for the first 5 years, proposes the overarching approach that delivers three equal outcomes: an enhanced operational capability in a climate changed world; the potential for global leadership of climate and security; and a route for defence to reach net zero by 2050 (Scope 1 and 2). It suggests clear direction to ensure climate change and sustainability policy is taken into account in all defence decisions, while at the same time allowing local initiatives to flourish. There is growing support for this approach within the department and within wider government. Defence's purpose is to protect the people of the UK. In order to do so it must remain fit for purpose by embracing the latest innovation in this field as in any other. Climate change is an increasingly important societal issue, and defence can lead and support society through its actions while changing the way defence thinks and operates, offering significant opportunity for enhancing UK prosperity. Climate change must be seen as an opportunity to improve operational effectiveness, resilience and be financially advantageous, rather than an unnecessary drain on resources. Indeed on the estate, there is a unique opportunity to lead the rest of the nation through experimentation and development, for the benefit of defence and the UK.

In order to deliver on a defence wide basis, this proposed strategy will also focus on how to embed broader sustainability issues (e.g. biodiversity and skills) within the process and procedures of the Department, suppliers and the wider defence community. Critical to delivery will be embedding a culture of climate change and sustainability within consistent decision making, which will require a change in behaviour. Creating this environment will require visible and committed senior leadership, changes to processes and formal mechanisms, the opportunity to learn and improve understanding, and a clear narrative as to why this is important. This is a mindset change, always to look for the opportunity to reduce the impact of defence on the climate, and to look for the impact of climate on defence's operating capability.

To date, defence has largely seen climate change and sustainability as an infrastructure issue. This must change, as all aspects of defence are affected by the changing environment in which defence will fight and operate. It is therefore insufficient to look at just one narrow area when addressing the issues. This strategy would address all the issues and provide an approach to tackle them, to change the narrative and to increase momentum.

To enhance the UK's operational resilience, defence must preserve the freedom of manoeuvre to be

OFFICIAL

able to operate in all conditions throughout the world, build the resilience of existing bases and understand the increased likelihood of deployment for disaster relief. Opportunities should be grasped to be a global leader on climate and security, leading the international debate and building resilience abroad. There will be much to do – the UK's prosperity will to an extent be dependent on tackling the disruptive effects on geopolitical stability that climate change will create.

To reduce emissions towards a target of net zero by 2050 and become more sustainable, the central idea is to set a Defence Carbon Budget, based on today's emissions and reducing over the next 30 years to achieve net zero by 2050. This budget will be broken down by TLB, with the intent to be reviewed every 3 years and adjusted as necessary.

The strategy is built on the data available at present within defence, largely in response to targets set. However, those targets do not cover the totality of the issue, so the data is not fully fit for purpose. Therefore, a key part initially is to allocate sufficient resource to develop the information and data sets required to be able to make the correct decisions through an increasingly accurate baseline. This strategy must evolve over time and so is designed to produce detailed actions early and a sense of direction in later years. However, to stay relevant and be able to pick up on all the opportunities that will become apparent over the next 30 years, it must remain both adaptable and agile. This strategy must be constantly updated, at least every 2-3 years.

Defence is highly complex and the scale and nature of its various parts are such that there is neither a simple single solution nor any easy approaches that can be taken. As a result, this strategy will provide a persistent and accelerating approach rather than a single immediate response. If the allocation of resources, technology and ways of working remain as they are, defence will not adapt its capability, act as a global leader or reach net zero.

Therefore, this proposed strategy looks for the most viable route to change, taking into account existing contracts, requirements and demands, rather than attempting to change everything immediately. However, in the next 6 months there will be several sector specific government strategies (e.g. transport, heat and buildings etc) that will increasingly drive the speed and requirements of defence's approach. Technologies, processes and procedures that reduce rather than eliminate emissions, for example, should be accepted as an interim step if necessary. This will disappoint some but is a realistic approach to such a complex set of issues as defence holds.

The strategy would develop a concept to 2050, through 3 epochs (which should be seen as a broad guide rather than rigid sequential operations).

EPOCH 1 (0-5 years) – Taking Action. In the first 5 years (2021-2025), defence must deliver a step change in the projects that are already planned so that change can be seen to be happening; initially these will mostly be opportunities on the estate. Epoch 1 must include working with suppliers to identify ways to reduce emissions in the supply chain through the equipment and contract requirements defence demands in the future; and create the skills base to be able to operate carbon budgets and an understanding of sustainability in the broadest sense. A comprehensive baseline and database needs to be built and populated to allow decisions to be made and to develop a detailed plan for all themes for Epoch 2 and 3. Targets need to be set in Defence Plan 21, many of which will be in line with or as a result of governmental targets. Immediately, Defence should be represented at COP26.

EPOCH 2 (5-15 years) - Minimising and fitted for the future. Building on the successes from Epoch 1, in the next 10 years (2026-2035) defence must look to reduce emissions significantly using existing and emerging technology, maximise opportunity to enhance the global response to the threat that climate change poses to current and future operational capability and to build resilience into the estate, supply chain and future equipment. Defence should be committing significant R&D through the next Defence/Spending Review to determine how to use emerging technologies for its benefit.

EPOCH 3 (15-30 years) - Harnessing the future. In the final 15 years (2036-2050), defence must be doing everything it can to harness novel technologies to build resilience, reduce emissions and build on the development of the defence response to the UN SDGs, which will in

OFFICIAL

OFFICIAL

turn increase efficiency and operational effectiveness. If the investments have been made in the previous 2 epochs, many of the benefits should be enjoyed.

This is a 30-year strategy and will probably take 30 years of consistent application to deliver. But that is not a reason to delay starting to deliver on the outcomes. Defence must start to address the 2050 ambitions *now* in order to achieve success. Even without detailed plans for the next 30 years, unrealistic in such a changing technological and dynamic environment, there are a large number of opportunities that should be grasped and invested in now, as 'no-regrets' moves, to build on the momentum of the Government and among the people of defence.

5.2 Strategic ambitions 2050

The following should be achieved as the strategic ambitions by 2050 for climate change and sustainability in defence.

1. Defence **acts and is recognised as a global leader** in response to the emerging geopolitical and conflict-related threats being exacerbated by climate change;
2. Defence has **adapted** to be able to fight and win in ever more hostile and unforgiving physical environments;
3. Defence has **reduced its emissions and increased its sustainability** activity and as a department has contributed to the UK legal commitment to reach net zero emissions by 2050.
4. Everyone in the defence community is actively contributing to a sustainable defence; society recognises our contribution to national climate challenges and global climate security. Sustainable behaviours in defence result from integration of appropriate concern for the environment and waste, feeding through to how all decisions are made and duties carried out.
5. A net zero built estate with an optimised rural estate sequestering at least the irreducible minimum of CO₂e emissions from those areas of Defence where transformation away from carbon has been impossible.
6. By 2050 the MOD rural estate will be a net sequester of carbon fully supporting the MOD in achieving the net zero target while aligning to national and regional biodiversity initiatives and contributing to the improvement of soil, water and landscape across the United Kingdom.
7. Defence is recognised as a global leader in climate change and security. It protects UK citizens through any severe, complex or concurrent climate emergencies faced and the effects.
8. Capabilities are optimised to the future environment and defence only uses fossil fuels where otherwise unavoidable
9. By 2050 defence has proven itself as a fast follower of green technologies wherever possible with sustainability at the heart of all procurement processes and decisions. Working collaboratively with industry defence has driven the right behaviours and outcomes into procurement and supplier and contract management to achieve our carbon net zero ambition.
10. Support and logistics use highly sustainable, efficient modern technologies and techniques which dramatically improve outcomes while reducing footprint. Support is totally resilient to dealing with any new, challenging and extreme situations, directly or indirectly produced by the climate.
11. Defence has all the data and analytics capability needed; this feeds through to making optimal decisions and most effectively meeting the defence purpose.

OFFICIAL

OFFICIAL

12. Climate change & sustainability are drivers of defence research, development and innovation. Defence effectively accelerates the translation of discoveries from civilian science and technology to defence applications in low/zero-emission and green renewable technologies.

5.3 Guiding principles

The following should be considered as guiding principles to meet the strategic outcomes:

1. The response to climate change and sustainability in defence must be led from the top and consistently applied across all areas and at all levels if it is to succeed.
2. Opportunities must be taken to enhance operational capability and resilience whilst taking account of the impact of climate change and the need for sustainability; operational capability should not be compromised solely to deliver a sustainable solution in line with meeting net zero emissions by 2050.
3. Defence should adopt an approach of constant adaptation and continuous improvement to ensure developments outside are adopted and harnessed. Defence should embrace the concept of 'fast follower'⁴⁷ in technologies common to non-military markets.
4. All policies and decisions should rigorously analyse and take account of the effect on defence's sustainability.
5. An incremental approach to increasing understanding of the nexus between climate and security, and the route to net zero (through interim solutions) should be adopted where necessary.
6. Defence is a cross-section of the UK, having impact and operations in every aspect of the economy. It is therefore important that it reflects and aligns to wider UK strategy and government direction and actively encourages cross sector collaboration with other government departments, industry and academia.
7. Defence should play a full part in developing wider government strategy and policy.

⁴⁷ A 'fast follower' approach requires investment in a horizon scanning capability and a close relationship with industry to ensure that any technological developments are quickly available to be adapted to defence needs. This should be a 2-way exchange where there is the possibility of influencing sensitive intervention points during development and where 'fast follower' can lead to early investment in 'settled' technology.

Defence's strategic ambition 2050



1. Defence acts and is recognised as a global leader in response to the emerging geopolitical and conflict-related threats being exacerbated by climate change.



2. Defence has adapted to be able to fight and win in ever more hostile and unforgiving physical environments.



3. Defence has reduced its emissions and increased its sustainability activity and as a department has contributed to the UK legal commitment to reach net zero emissions by 2050.



5.4 Strategic Approach

5.4.1 Behaviours and Communication

Ambition 2050

Everyone in the defence community is actively contributing to a sustainable defence; society recognises our contribution to national climate challenges and global climate security. Sustainable behaviours in defence result from integration of appropriate concern for the environment and waste, feeding through to how all decisions are made and duties carried out.

Target - 2025

A sustainable behaviour improvements programme has yielded provable cultural change, reduced emissions and provided enduring, growing benefits to the Defence environment. Incentives for people across defence have changed, as has the tone of discussion and understanding of climate change and sustainability.

Recommendations, to be delivered within Year One:

- A sustainable behaviours programme should be established with education, training, communication and incentivisation at its core. This programme should seek to integrate sustainability into leadership, recruitment and business processes and systems.
- The way that climate change and sustainability affect every job now and in Defence's future workforce should start to be understood. The career pathways and opportunities should be mapped and professional frameworks adapted.
- A communications plan for both internal and external audiences should seek to grow awareness of Defence's commitments on climate change and sustainability, inspiring understanding among our people, the wider public, industry and international partners.

Behaviours. Tackling the consequences of climate change and sustainability across defence offers the opportunity to engage all defence people in a common theme which is seen as important nationally and globally. The intent is to ensure that the whole defence community, including serving personnel, families, civilian staff, and private sector partners will be mobilised to improve defence's sustainability in every aspect of what it does. For this to be realised, the effect of climate change and the need for sustainability needs to be embedded, so that it becomes an intrinsic part of the culture.

There needs to be concerted, consistent and visible championing from the top of defence, through clear actions and decisions by the leadership, which make material and visible difference. There also needs to be a process to engage the newest and longest serving to ensure that the guiding principles, incentives and initiatives resonate with current and future generations and reflect their concerns and perceptions. It cannot be assumed that everyone in defence understands either the need or the imperative for this addition to the culture, and therefore an education programme that ultimately helps every person in defence must be created, as part of normal education interventions, with the opportunity for some to become defence environmental professionals.

Defence must adapt to the variations climate change will pose over the next 10-20 years and this will require different, novel skills – such as engineers capable in hydrogen or modular nuclear, and those with a deeper understanding of the emissions profiles of all elements of defence. In order to tackle this successfully, defence could be a leader in re-skilling and up-skilling its people as it continues to adapt to the future. These skills will be in increasing demand in the future, and unless they are brought in-house, there will be a constant burden on the defence budget from consultants and advisors.

OFFICIAL

Communications. A Defence Green Network and a champions forum already exist and could prove the basis of driving awareness and change at every level of defence internally. This should prove only the start of a much wider communications push, both inside and outside of the Department, as climate and sustainability continue to rise up the agenda. The intent of our communications should be to ensure that all are aware of defence's climate change and sustainability goals, encouraging support and enhanced credibility to its initiatives.

Defence has the potential to act as a catalyst and inspiration to parts of industry, and to other parts of government. The international engagement opportunity and imperative is clear; with the goal of persuading other militaries to seek sustainability and decreased harm to the planet. Defence needs a wider strategic narrative on national resilience, mitigation and sustainability issues, to capitalise the significant interest it could generate as it embeds sustainable culture and policy. The successes it achieves could yield press interest and public engagement opportunities, for example by introducing circular economy principles to uniforms, or recyclable plastics in ration packs; bold actions like these would provide a different angle with which to engage others. Defence should also grow its reputation in how it maintains and preserves its natural capital. Little is known about its successes in the preservation of its many SSSI outside the biodiversity field.

For internal audiences, the communication plan should build a momentum of support within the Department, and a coalition of interested and engaged staff, to catalyse sustainable behaviours and activities at all levels, and in all processes. The success of any behaviour change initiatives will rely strongly on leadership communication, from the centre and at establishments.

Externally and internationally, the communication plan should allow for best practice advice to be sought from experts as well as reinforce defence's lead role on mitigation and adaptation activity. Good communications will reinforce defence's ambitions and successes providing a virtuous circle of better behaviours, sustainability and reputation.

Education and Professionalisation. Defence has IEMA corporate membership which should support the provision of education and training opportunities throughout defence organisations.⁴⁸ Developing a professional skill framework for sustainability, clarifying the career pathways and promoting the advancement opportunities would grow skills and opportunities. Sustainability may form a small component of someone's role but could have an impact. Professionalisation should be promoted such as through the Associate, Practitioner and Full IEMA individual memberships. All defence functions should understand how sustainability interacts with their professions. In the same way as health and safety has become a requirement of induction programmes, sustainability should be a duty of care among defence staff.

Incentives and motivation. There are already requirements mandated by government on many areas, through the GGC, the environment bill and government objectives such as for the 'white vehicle (non-operational)' fleet. Every effort must be made to meet these commitments where they are practical and affordable, and Defence should go further where it can. This is key to embracing sustainability and to meeting where possible the UN Sustainable Development goals.

Many of the core drivers of motivation and behaviour are held in defence leadership⁴⁹, in particular: business prioritisations, empowerment, modelling of good behaviours, enforcing restrictions and accountabilities. Leadership of sustainability in practice means building sustainability into leadership training, organisational key performance indicators, assurance mechanisms and decision-making processes.

At a team or department level, sustainable behaviours should be incentivised by delegating ownership over carbon emissions reduction and rewarding good behaviours. Formal structural incentives are essential, which will require amendment to budgetary structures as well as current delegations within and between TLBs. At an individual level, incentives could include recognition, via introduction of an emissions league table as well as non-financial recognition. Sustainability

⁴⁸ See: <https://www.iema.net/>

⁴⁹ This follows the Capability, Opportunity, Motivational behavioural model (COM-B) adapted to defence purposes by defence transformation. See: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096582/>

OFFICIAL

OFFICIAL

incentives should extend not only to staff, but to contractors where procurement, remuneration and bonus structures are based around sustainability measures. This needs to be reinforced by amending the policies and processes to make it easier to incorporate all aspects of sustainability in business decisions.

To motivate the right behaviours defence must ensure that effective monitoring and measuring mechanisms are in place. Introduction of smart meters is recommended, which would allow access to real time data the effect on environment at personal, team and organisation's level can be seen.

The intended effects on day-to-day business. A clear benefits framework is required which links the behavioural change programme to emissions reduction, reduced waste outcomes, successful implementation and use of new systems. Examples of areas that must be improved are vehicle use, food recycling and general waste disposal, where targets should be set to reduce further the amount sent to landfill both in the UK and at overseas bases, water and paper. Maximum use should be made of the lessons identified through the Covid-19 experience in reducing the unnecessary travel and increasing use of online services. A mindset shift will spill over into how families in defence conceive of sustainability and this will have positive benefits. Visible changes will generate public confidence that climate change is being tackled by defence and the government. This would encourage further innovation and potentially greater understanding of defence from different parts of society, including many seeing defence as an employer of choice due to its approach.

OFFICIAL

5.4.2 Governance and Head Office

Ambition 2050

Climate change and sustainability is fully embedded into key governance, finance, commercial strategies, policies and processes as business as usual.

Target - 2025

A climate change and sustainability directorate co-ordinates and coheres the defence approach owning the carbon budgeting process and policy. The other organisations of defence are appropriately staffed to meet expectations.

Recommendations, to be delivered within Year One:

- Establish an adequately resourced Head Office team whose activities are governed at the highest levels of defence and who are responsible for delivery of Recommendations.
- Establish a sustainability NED on the Defence Board.
- Re-role and formalise the extant Climate Change and Sustainability Implementation Group as a working group of the DSEC.
- Deliver a Defence-wide consultation on carbon budgeting, alongside a robust and thoughtful data validation and initial target-setting exercise.
- Set up the appropriate external oversight, transparency mechanisms for delivery of any agreed recommendations. Explore cross-Government representation and input. From an emissions perspective, this is a shared endeavour which could call for a different kind of collaborative approach.

Introduction

The breadth of potential outcomes for defence's role in climate and sustainability is wide. A negative outcome would significantly impact finances, capability and reputation and in time it could undermine the defence purpose. However, the central staffing required for driving a successful outcome is modest. To set itself on the right footing defence needs to build a new multidisciplinary Directorate to coordinate and cohere an approach equal to the challenge and opportunity. A new Directorate would drive parts of the agenda in Whitehall; for example, HMG has already pinpointed climate security leadership as sitting with defence. With the significant increase in Government's activity in this area, defence needs to be able to react appropriately. The directorate would maintain the internal stakeholder relationships needed across TLB/FLCs and Functions as well as with industry and international actors.

In early years, the Directorate would establish systems needed to keep up with change. These systems will endure and evolve for many years to come. Having acknowledged the NAO criticism and seeking to centrally coordinate the response, well-designed and flexible systems are needed. Climate issues will continue to manifest in new policies and developments. These should be matched by the expert staff to deal with and effectively integrate them into how Defence works.

Cross-Whitehall/ Government relationships. The challenge of net zero requires a different type of cross-Whitehall relationship to the one defence is used to. As their scope and ambition expands, national policies will need to be produced with greater involvement of Defence and a greater understanding of Defence's part in the agenda needs to be created. There are nine national strategies due next year, ranging from Industrial Decarbonisation, Energy, Hydrogen to National Adaptation strategies. Given that defence is responsible for half of central government's emissions, if defence is unable to succeed in these areas, neither will the rest of government.

Data and policy engagement should be the core of the relationship. Defence should show its willingness and cooperation via transparency and inviting external oversight where

OFFICIAL

appropriate. The strength and quality of its data will be the key to building understanding from other departments while showing the appropriate targets for - and the right scale of - investment.

The new directorate would be responsible for leading the (ever-growing) parliamentary, consultation, public body reporting and stakeholder/comms work, as well as capturing and sharing best practice and new knowledge. Future legislation and policy considerations may include carbon taxes which at present would leave defence highly exposed, or more stringent national carbon budgets which defence is not prepared for. The impact and reach of changes are certain to grow; as are the opportunities through mechanisms such as green funding. They should be met with well-informed defence input and briefing.

On the international stage, aside from its climate security role, a successful UK defence approach to net zero would prove a model for others to follow. The climate continues to prove a high level of priority in international engagement. These activities require a suitably resourced and expert Head Office team to coordinate them.

Head Office Governance. The NAO report stated that there was weak governance at the centre of defence on climate change and sustainability.⁵⁰ The new Directorate should review the strategy and expand the plan. This would fill the gap the NAO noted of: “central oversight of climate and sustainability as a single set of issues... [providing] assurance that the activity taking place is sufficient to deliver the desired outcomes”.

Reporting through the Defence Safety and Environment Committee and ultimately to the Defence Board as necessary, the Directorate should have the mandate to establish the necessary cross-Defence programmes and policies. A sustainability NED on the Defence Board, with experience, credibility, and ability to scrutinise decisions at the right level and advise on ‘leadership from the top’ would also be a valuable addition. The current CCSIG should also be re-roled accordingly, as a Steering Group under the oversight of the DSEC, to ensure the implementation of the CC&S strategy. While climate change is already captured across five Defence Board risks, the Directorate would bolster risk analysis and mitigation on the effects of increasing climate change and of failing to adapt. On an ongoing basis, the Directorate should ensure sustainability policy is up to date and build targets and recommendations in the Defence Plan for the TLBs to implement.

Carbon targets. Given the trajectory of national carbon budgets, work introducing defence carbon targets should commence in good time. Targets around emissions should be written into the Defence Plan to meet the GGC requirements. Defence needs to build on good work already completed to expand and standardise understanding of its emissions footprint. Comparable measures are needed for the full scope of emissions across TLBs/ FLCs. This should be externally accredited and should lead to a standardised ‘currency’ of emissions and a carbon accounting framework. Through commercial processes, defence’s supply chain and contractors would have to contribute emissions projections consistent with the rest of the emissions picture.

The most effective way of achieving the right ownership of carbon budgets would be through the use of a carbon budget/allowance construct. Carbon budgets would be managed like finances; with affordability, projections and appropriate controls required. By delegating the ‘budgets’ to TLBs, and as appropriate to establishments, taking account of their specific emission profiles, ongoing management would be placed where the action is taken. The Head Office team would monitor the progress against the overall budget, hold to account, and drive accountability. Similarly, the Head Office would adjudicate the concept of carbon budget trading, through a detailed understanding of the specific different constructs to each TLB/ALB; as with finances, Head Office would retain certain controls over emissions output. Bedding carbon targets into assurance mechanisms will be crucial, such as through quarterly performance reporting. Head Office would alter requirements and its projections as necessary and as legislation, policy, and new technologies continue to evolve.

⁵⁰ Environmental Sustainability Overview, NAO, pg 10 (2020). <https://www.nao.org.uk/wp-content/uploads/2020/05/Environmental-Sustainability-Overview.pdf>.

OFFICIAL

OFFICIAL

Such significant systems change cannot be implemented all in one go; much more detailed consultation and planning, alongside the building up of the dataset is required first.

The New Directorate. The CC&S directorate's roles and responsibilities would be to:

- Own delivery of the CC&S Review recommendations, establishing the policy and developing the Implementation Plan for epoch 1 required through 2021-25.
- Preserve and enhance military capability as related to climate change and sustainability, inputting on the legislative and policy agenda and holding appropriate expertise on green technology and doctrine.
- Implement the carbon budgets construct in Defence.
- Leverage expertise to the benefit of international engagement; in particular COP26 and leading on climate security.
- Own the relationship with public bodies:
- EAC and NAO recommendations
- GGCs and wider targets
- Manage cross-cutting programmes, for example on sustainable behaviours and systems change
- Be the central data hub for climate change and sustainability in Defence

The Directorate would report to DCDS (MilCap) as Policy Owner for Sustainability and would be an outward-facing organisation in Head Office. Recommendations in this Report have been purposefully written with the functional agenda and head office structure in mind. There are clear lines for crossover and input within the sections.

OFFICIAL

5.4.3 The Estate

The majority of defence's actions to date have taken place on the estate. The estate is a valuable asset which represents defence's best and most immediate opportunity to begin the process of reaching net zero by 2050, and also has the potential to offset the irreducible minimum of emissions (under current technology) from operational capability and equipment.

To achieve this, there must be 3 separate opportunities taken by the estate. The highest priority is to reduce the emissions from the estate by reducing demand, increasing efficiency and moving away from fossil fuels, starting with the top 35 emitting-sites, already identified. The primary cause of emissions is from the built estate, through the majority use of non-renewable energy for heating and light of the estate's 117,000 buildings. Stable technology exists now and must be introduced to reduce the demand (e.g. LED lighting) and reliance on fossil fuels (primarily gas) across the estate, by replacing them with renewables, battery power and ultimately green grid providers⁵¹. This will require, in almost every case, a survey of the electrical infrastructure capacity before switching to alternative supplies. But ultimately it will result in savings. And it need not be expensive if utility suppliers, who have their own environmental targets to achieve, are proactively engaged. Already, electricity companies are paying local councils to allow them to install charging points for electric vehicles on their streets, and water companies offer free services to reduce future demand for water. If the approximately 220 non-operational sites across defence were to adopt improved energy data management to improve 'spend to save measures' to achieve a 15% reduction, there would be a saving of over c£50 million per year. There is significant opportunity for creating microgrids and alternative local energy production such as from biomass.

Cross-government grants are now available and must be made use of. Incentivisation of adopting more sustainable practices must be created at the appropriate level, including changing accounting practices to allow establishments to retain savings they are able to deliver for reinvestment. This gives opportunity for local and regional partnerships, to the benefit of defence and the local community. Defence is cooperating with other government departments on the MEP scheme across 12 sites in phase 1 and a further 10 in phase 2. Some sites have already made progress in exploiting local sources of renewable energy to save money and increase resilience. For example, RAF Marham takes energy from a local biomass energy generator and work is progressing to replicate this at Leeming and Benson.

Several RAF stations have already demonstrated that built environments can also develop an intensive, diverse biodiversity network across their areas, developing existing 'no-mow' policies by expanding tree planting, creating habitats around sustainable urban drainage systems, and adopting a pollinator strategy. In effect, they are moving from 'tidy' to 'useful'. This will require a mind shift among some people.

The second opportunity is to ensure that the rural estate is used optimally to combine both its primary purpose – defence training – and to be as sustainable as possible. This will initially require a survey of the entire rural estate (already commissioned) and then decisions on each part of the landmass. The rural estate is a diverse mosaic of landscapes, including the largest concentration of SSSIs and SACs in single ownership in the UK, all managed to provide a range of challenging environments for military training and the testing and evaluation of military technology. Climate change threatens the integrity of the estate with the likelihood of the greater incidence of wildfires, as peatland and grassland dry out in extreme weather events, flooding from increased rainfall and a rising threat from non-native invasive species and plant diseases which thrive in the changing climatic conditions. Improving the climate change resilience of the military training estate is a key requirement. It is imperative that CIRAM is employed systematically to develop an understanding of climate-based risk on the estate and on-site management must utilise this information in decision making for adaptation and mitigation.

The training estate contains a large area of peatland, moorland, and wetland. Maintenance of this habitat in good condition through appropriate grazing strategies and targeted initiatives will

⁵¹ The National Grid is due to be 'greened' by 2032.

OFFICIAL

maintain stored carbon levels, reduce wildfire risk, and make these areas more climate resilient. The DIO Forestry Strategy is already engaged in an ongoing replacement programme for mature trees as well as extensive new broadleaved plantings sited in conjunction with a military requirement to enhance the training experience. The development of long term (20 years plus) integrated land management plans promoting carbon sequestration, and agroecological carbon farming should create wider environmental and biodiversity gain through the development of diverse habitats, clean water, healthy soils, agricultural produce and timber. Tenant farmers will be encouraged to plant trees, engage in upstream water management, and adopt carbon farming measures to improve their soil systems and sequester carbon, while still enabling the delivery of military training.

The third opportunity is to look for optimal sites for renewable emission-free energy generation, to build resilience of supply and reduce cost. To diversify energy streams, renewable energy production and energy efficiency measures need to be focused on the estate, embracing biomass production, solar, heat pump, wind, tidal and hydropower as part of an integrated decarbonisation and resilience plan that includes battery storage (noting that heat decarbonisation will require greater electrification). This offers opportunity for engagement with the local community. There is significant opportunity for the defence estate to be used for experimentation, including by other government departments. The opportunity to 'smooth out' energy demand, store excess energy for future use (as battery-electricity or hydrogen) offers the potential for significant reductions in demand from the grid, and cheaper prices.

Any future disposal of any of the estate must be scrutinised carefully, to be judged whether the sale price is value for money, compared to the potential opportunities for energy self-generation or storage (and the resultant savings/income generation possibilities), or for increasing biodiversity and opportunities for sequestration. The disposals through the DEO programme must be judged as financial good value and from the perspective of lost opportunity for defence to reach net zero; potentially, defence should look at long lease of land rather than sales. Embodied carbon should be taken into account for all new developments and refurbishments.

5.4.3.1 The Built Estate

Ambition

A net zero built estate with an optimised rural estate sequestering at least the irreducible minimum of CO₂e emissions from those areas of Defence where transformation away from carbon has been impossible.

Target - 2025

Defence has reduced its built estate emissions by 30% to meet The Greening Government Commitment target. It has a funded pathway to net zero built estate, offset by sequestration and greening of the grid by 2032.

Recommendations, to be delivered within Year One:

- Top 35 Emitting Establishments to have had Energy Surveys
- Policy on building standards for new-build raised to operational net zero with associated uplift in financial settlement
- All Defence estate initiatives cohered with clear prioritisation set, against defence's initial net zero roadmap, by a central Head Office team to leverage economies of scale across TLBs

OFFICIAL

OFFICIAL

Introduction

The estate currently contributes 30% of defence's carbon emissions. Such a large proportion of the total emissions coupled with the maturity of carbon reduction technologies and approaches drives a priority to focus on the estate. The diversity of the built estate offers opportunities now both to sequester emissions in line with expected government direction and reduce emissions and associated running costs. Further, the built estate offers opportunities to create environmental value through improved biodiversity, for example, wild meadows in place of mown lawns within camps. Estate-focused initiatives have plans drafted which can be refined quickly to enable rapid investment decisions and can be implemented now. But if meaningful progress is to be made, these initiatives must be embraced by each and every organisation within defence both in the UK and overseas.

Logic for this Approach. The changes outlined below are not simply about reducing emissions. The over-riding logic for this approach is the need for resilience and security, both financial and operational, offered by reducing energy demand and diversification of energy supply. The advantage of reduced emissions is an important and associated benefit. It is critical to understand current embodied and operational energy usage so that defence can

- model/predict its future consumption
- develop whole-life asset class strategies and asset class solutions underpinned by such information
- measure interventions against a baseline information set to ensure value is being driven by the implementation of all solutions.

However, these activities are technically complex and Defence must develop its tools, techniques and skills base to reflect this. More widely, the built estate needs to be designed in terms of how it delivers intrinsic benefit to those who interact with it to improve the lived and work experience of our people.

The focus of defence will be on the following:

Reduce extant emissions. The highest priority is to reduce the emissions from the estate as it stands and move away from fossil fuels. Initially, to reduce demand, this must be built around updating the Utilities Management Bureau with BEMS that ensure buildings only consume the most minimal amount of energy when operating. The top 35 emitting sites have already been identified by DIO as part of the IEES. The primary cause of emissions from the built estate is through the majority use of non-renewable energy for heating and light of the estate's 117,000 buildings. By the end of Epoch 1 (2025), 134 sites, covering 80% of the estate's emissions, will have been surveyed for electrical and heat emissions and will have a costed, decarbonisation plan for balance of investment decision making. No later than 2040 the Department must have stopped all use of fossil fuels to produce energy on the estate to enable the achievement of net zero built estate by 2040. It must be noted that these initiatives must continue to be prosecuted after 2040 if the Department is to achieve overall net zero against its irreducible emissions by 2050.

Net zero building Standards⁵². Future new-builds must be built as sustainably as possible, with consideration given to both achieving net zero (effectively zero) across its full lifecycle; construction or acquisition, operation, maintenance and disposal. Consideration of the supply chain is needed prior to construction and once the building is being used. Defence will work with the Government Construction Board to bring together other large-scale Government Departments to signal intent to the construction supply chain regarding future needs and design standards. In consultation with the Green Building Council, the Green Building Standards will be used to inform the Department's work on setting future policy and construction standards. This 'whole life' sustainable approach to

⁵² A paper recently submitted to the JSP315 2* Steering Group was endorsed and agreed an interim baseline operational energy targets for new builds and major refurbishments to be raised to operational net zero with associated uplift in financial settlement. This was an update to Building Performance Standard 0.1 due to be published on the KID site in Jan 21.

OFFICIAL

OFFICIAL

infrastructure will also need to consider how people interact with the building to ensure that their activities do not unnecessarily increase the energy demand.

Refurbishment and Retrofitting. Refurbishment already planned should be carried out with new, sustainable technologies to deliver incremental improvement in line with existing plans. This should include the obvious low-tech approach of improving insulation and other systems to ensure the quality of life for the tenants is upgraded. Sustainability should be prioritised in the evaluation of future contracts and, although existing contracts should not be broken solely to impose a sustainable outcome, existing suppliers should be incentivised to identify appropriate sustainability opportunities for mutual benefit. Future refurbishment and redevelopment opportunities not yet planned or budgeted for must be developed to respond to the changing economic cases for different technologies to prioritise low carbon decisions and a whole life cost approach. A building retrofit strategy will also need to be developed noting that the costs of retrofit technology will likely reduce over time, as will the number of buildings requiring retrofit (assuming new build standards are uplifted to net zero). Thorough evaluation of the embodied carbon in existing buildings must be conducted when assessing the cost effectiveness of refurbishing and retrofitting or demolition.

Renewable energy. As defence moves away from fossil fuels to heat its buildings and power its vehicles, its demand for electricity will increase significantly. If this is to be affordable in both financial and environmental terms, sites for renewable emission-free energy generation must be identified and developed, notwithstanding the tension surrounding the requirement for defence to divest surplus land. Creating defence's own energy supply not only increases resilience but also offers value for money (in payback through mitigating the costs that accelerating electrification will drive⁵³). It is worth noting that, until the national grid has been 'greened' (as per government intent) this will also reduce defence emissions in the short to medium term.

Reduce water consumption. Fresh water is a vital resource to enable defence. Irregular rainfall is making it harder to predict availability and rates of abstraction of water are already at levels that are not sustainable. By minimising water use MOD will help mitigate the effects of drought and water shortages, guard against rising costs and health hazards, preserve the environment, and reduce the greenhouse gas emissions associated with abstracting, distributing and treating wastewater.

Waste management. The 25 Year Environmental Plan sets the direction for resource efficiency and waste reduction through increased resource productivity, reduced volume of 'residual' waste generated and reduced consumption related greenhouse gas emissions. Defence will adopt the principles of the waste hierarchy, moving away from disposal towards recycling and reuse across the defence estate and coupled with sustainable procurement and waste reduction.

Key Enabling Actions. Beyond the actions outlined above, there are a number of estate focused enabling actions that defence must take in Epoch 1 in order to achieve the target of a net zero estate by 2040:

- **Metrics.** Measuring progress in reducing overall emissions is a key enabler in delivering net zero. While the importance of data is covered elsewhere, the estate will benefit from regular benchmarking against appropriate built estates in the public and private sectors. Defence should also seek to learn from industry best practice in the delivery and operation of sustainable infrastructure, potentially through partnerships and secondments with organisations already achieving net zero buildings.
- **Whole life costings.** Defence should move to a whole life cost model for its built estate that encompasses the financial cost of building, operating, and disposing of the asset. Furthermore, if defence is to demonstrate that it is meeting its emission reductions (both mandated and ambitions) then it will need to take an approach to CO₂e such that it can produce a through life balance sheet of the cost in financial and environmental terms of its

⁵³ Running costs will increase as electricity is currently approximately six times the cost of gas per kWh of energy generated.

OFFICIAL

OFFICIAL

built estate. This should reasonably be supported by re-orientating operating models to offer better sustainability support and advice to TLBs/ALBs. Adoption of a 'triple bottom line' reporting approach against the sustainability and net zero credentials of defence's organisations will support the transparency and understanding of defence's progress.

- **New-build standards.** Work is underway to uplift the Department's operational carbon target standard for new-build to net zero. This is a vital initiative that must be implemented if defence is to achieve its GGC target of 30% reduction in estate emissions by 2025 and, longer term, a net zero built estate by 2040. Further benefits include lower running costs (as the buildings are more efficient) and improved lived and work experience of our people who interact with these buildings. To support this work, the Department will need to develop techniques and skills to be able to accurately assess the embodied and operational energy use of its asset types. A true 'cradle to grave' approach will articulate the total cost of ownership in both financial and carbon terms that considers the totality of design and construction encompassing such elements as materials and orientation.
- **Government Policy.** There remains unresolved tension between the interpretation of International Financial Reporting Standards (IFRS) 16, spending on exploitation activity and the definition of 'surplus land'. The consequence of this is that the Defence cannot enter into a commercial partnership to generate renewable energy, and land identified as being available for such activity is likely to be deemed surplus. When an asset or area of land has been declared surplus, it must be disposed of within 2 years⁵⁴ meaning that opportunities to use land for renewable energy generation for resilience (and net zero emissions) could be missed. Notwithstanding the likely tension with the government's wider need to release land for housing development and wider value for money arguments such as capital receipts, defence should undertake a risk and benefit based renewable energy assessment on all sites due for disposal. This would support the government agenda of achieving net zero for the UK by 2050 while increasing the Department's freedoms in how to achieve it. In tandem, consideration should be given to interpreting IFRS16 so as to allow development of capital-intensive initiatives that offer mutual benefit to defence and the private sector.

Conclusion. The built estate is an area where significant emissions can be rapidly abated with mature technology available now. Furthermore, while the 30 years to achieve overall net zero by 2050 seems a long time, there are no exemptions from public opinion. Defence, alongside the other government departments, must be seen to be making progress, particularly in those areas where investment in sustainable solutions also improves military capability through financial probity and increased resilience. It is on the estate that this will be most visible.

5.4.3.2 The Rural Estate

Ambition 2050

By 2050 the MOD rural estate is a net sequester of carbon fully supporting the MOD in achieving the net zero target while aligning to national and regional biodiversity initiatives and contributing to the improvement of soil, water and landscape across the United Kingdom.

Target - 2025

The development and implementation of the Natural Capital register has laid the foundation for resource planning and new initiatives funded to enable maximum carbon sequestration on the estate, while allowing a single point of data capture to collate biodiversity interventions and so facilitate effective communication within MOD, DIO, OGDs and partners.

⁵⁴ as specified within the Housing and Planning Act 2016

OFFICIAL

Recommendations, to be delivered within Year One:

- Develop a natural capital register and modelling tools for the defence estate.
- Ensure maximum engagement of tenant farmers with the new agri-environmental programmes across the estate.
- Engage with local Nature Partnerships and Nature Recovery Partnerships to ensure MOD sites at all scales are making an appropriate contribution to biodiversity.
- Develop and implement the Nurturing Nature programme on establishments to support the pollinator strategy, develop small scale woodlands and habitats with community involvement and extend the 'no mow' initiative.
- Develop a series of test and trial sites on the tenanted estate in England to develop ELMS type strategies, land management plans and extension support on a range of landscape types.

Approach

The MOD rural estate is predominately grazed grassland, with significant areas of woodland, wetland, and farmland. It encompasses both National Parks and areas of high conservation value in which military training operates and is managed by a variety of organisations including the DIO, tenant farmers and NGOs. Largely based on acid soils and peat it is a substantial natural carbon store for the UK. Nevertheless, through changing elements of its land management, particularly in relation to soil, it has a great opportunity to enhance its carbon sequestration function, while at the same time increasing biodiversity and environmental resilience to climate change.

The estate needs to embed sustainability at the heart of its management in order to adapt long established practices to the goals of net zero and the 25-year Environmental Plan by reducing its emissions of GHG, increasing carbon sequestration while protecting and developing biodiversity. To achieve this significant change the development and implementation of a natural capital asset register and establishment of a carbon baseline is essential and will enable appropriate land use choices to be modelled and costed across the estate.

Increasing the carbon sequestration capability of the estate will come from different opportunities, all of which should be adopted. Extensive tree planting will provide long term investment in carbon storage as well as promoting water infiltration and stabilising soils. Rehabilitation of peat and bog land areas will ensure that there is no further degradation and that their sequestration function is optimised. Finally, the agricultural sector should embrace the new agri-environmental programmes while at the same time seeking to adapt the agricultural practices on the estate to both reduce emissions and actively sequester carbon through improved soil, grazing and input management. To promote biodiversity, the MOD should embrace conservation opportunities at all scales not only on the training estate, but on areas of establishments, housing, storage and test and evaluation facilities to develop appropriate conservation environments. It should also seek to embed itself in key national and regional conservation initiatives, particularly those focused on pollinator recovery and build links with conservation NGOs both as a project partner and as a critical friend.

OFFICIAL

Defence leadership could improve global climate security and protect our citizens



5.4.4 Climate, Security and International

Ambition 2050

Defence is recognised as a global leader in climate change and security. It protects UK citizens through any severe, complex or concurrent climate emergencies faced and the effects.

Target - 2025

The UK's global credentials on climate security are recognised and have continued from the momentum of 2021 and the implementation of the climate change and security strategy. The UK is highly respected for extending its mil-to-mil relationships on climate security, building advanced horizon scanning capabilities and enhancing resilience.

Recommendations, to be delivered within Year One:

- Build a coalition of militaries to make a declaration at COP26, securing substantive commitments on adaptation, resilience and mitigation.
- Build a cutting-edge climate threat horizon-scanning capability, integrated with partners inside and outside of Government.
- Explore the interest, options and feasibility for new types of partnerships helping build resilience capacity in others, at home and abroad.
- Encourage NATO to further evolve its position on adapting to and mitigating against the effects of climate change seeking that the climate angle be mainstreamed in NATO policy and capability development.

Introduction

Climate change is an acknowledged stress multiplier felt most severely in already unstable regions.⁵⁵ But it will impact UK citizens from our coastal and fishing communities right through to the City of London and the risks climate change poses to global economic stability. Stresses such as heightened natural resource competition, livelihood loss and food price shocks can lead inexorably to increased security threats when governance systems are unable to cope, contributing to civil unrest and, in extremis, violent conflict. Such instability affects the UK's partners and UK's direct interests. The consequences of climate change will have profound implications for national security. UK Defence should play a leading role in supporting wider HMG objectives for climate change, protecting prosperity and climate-proofing the defence purpose.

Climate threat horizon-scanning and analysis. UK defence needs to upgrade its horizon-scanning and threat analysis to meet the challenge of a changed climate. The extended, global, complex nature of the problem calls for integrated predictive data analysis to reveal potential risks and prompt the right questions. A climate threat horizon capability would cover meteorological conditions, environmental consequences and (the less predictable) human factors and scenarios across the world. Building on expertise in the UK Met Office, a picture is needed looking out to 30 years which is within the lifespan of much UK defence equipment or permanent bases. It would map risks, model possible scenarios and quantify probabilities to inform everything from defence's global engagement to build global resilience to where to focus investment against flooding on the defence estate.

The complexity of climate security data and actors calls for a cutting-edge technological solution. Defence should devise a machine-learning/ AI or Big Data horizon capability on climate and security threat modelling. This should update alongside the latest open source research, knowledge and events while being readily available to strategists and to defence's leadership.

⁵⁵ As in: IMCCS The World Climate and Security Report 2020 (2020)

OFFICIAL

Intelligence transfer of climate forecasting across government departments is currently haphazard and efforts at the moment are likely duplicated. Coordination is key to obtain the right level of resourcing for a consequential tool as well as for sourcing the widest set of inputs. The approach should be multidisciplinary and at some level integrate non-traditional actors and partners into the intelligence-gathering picture. While climate change is global in nature, its impacts are felt in local context. These need to be treated on their own merits and the bigger global picture should not lose sight of complex variation across local ones.

Horizon-scanning can identify directions, factors and questions; it cannot determine solutions, which will need to be carried out in partnership. A new tool or capability should form part of a wider set of early-warning mechanisms around governance, natural resources, energy and climate as well as identifying the issues for UK and defence assets. It could be used for example to study the effects on non-resilient materials in equipment, for testing, evaluation and experimentation.

This understanding from climate threat and resilience horizon-scanning would be an increasingly valuable asset. Defence's horizon scanning and data approach should eventually be used as an asset internationally, for building capacity in others and supporting defence engagement through UK expertise.

The imperative and opportunity of International by design. The most proximate reason for action on climate change is the threat it poses to future UK and global stability. As the opportunity for pragmatic global leadership remains open, UK defence should take it. Leading by example would build international coalitions for greener and more sustainable militaries. This would multiply UK defence's emissions reduction as it starts to be able to offer expertise to other militaries on the subject. Combined with expertise in adaption and resilience, UK defence would find new and different avenues for international engagement with partners. This might be strategically important as climate starts to create geopolitical tectonic shifts. Further, UK defence's work must remain interoperable as new technologies, environments and challenges emerge. Novel technologies may be needed to operate effectively in a climate changed world. All this must be met by an internationally adept and collaborative UK defence. Unfamiliar shifts in geopolitics through climate change, such as oil rich nations losing influence and economic power, are to be expected.

The cooperative approach encouraged on the international stage should be mirrored by the way defence engages with its industry partners. By becoming a leader in sustainable military technologies, UK industry could support production of homegrown technologies and stand ready to seize on the new markets for export.

NATO. For NATO, UK defence's priority should be leading the Alliance to adapt to and mitigate against the effects of climate change and seek that these considerations be mainstreamed in policy and capability development. NATO is preparing for the challenges of the future through the Secretary General's NATO 2030 initiative and the Reflection Process, so now is the time to make sure that the impacts of climate change are centred in the Alliance's strategic assessment of threat and planning. As part of NATO's Projecting Stability concept, UK defence should increase efforts with partner countries and other international organisations.

UK defence should seek to act as a pragmatic but stretching bar for NATO partners' ambition and must ensure that all allies are involved and play their part. UK defence are ahead of allies on many parts of the climate and defence agenda and should demonstrate how a climate lens bolsters rather than undercuts military readiness and capabilities through advantages like mission self-sufficiency and superior resilience of bases. UK defence's futures and analysis should be the envy of others in the Alliance and a testament to the benefits of appropriately integrating climate and sustainability issues to decisions throughout the defence sector.

International Fora. In the short-term, UK Defence should act in tandem with wider UK leadership on the international stage with the G7, G20, Presidency of the UNSC and COP26 summits in 2021. UK defence's role should be to support wider HMG by leading the debate about climate change and security and securing military momentum. UK defence should build a coalition of the willing to make a declaration at COP26 of the importance of security to understanding the full implications of

OFFICIAL

OFFICIAL

climate change. Militaries are beginning to recognise the threat and opportunities and the UK-hosted COP26 is well-timed to procure substantive commitments from others.

Climate emergencies – Upstream capacity building Understanding and qualifying the probabilities of climate change could help to show where early action and resilience-building can be directed to prevent further disaster, wider conflict or political breakdown. The climate threat horizon scanning described above could build a compelling case for well-targeted preventative measures and resilience building both in the UK and overseas.

UK Defence should consider new mechanisms for building climate security resilience which could stave off the need for larger and more costly interventions when disasters do occur. In upstream capacity building, a new approach, different to classic capacity building of recent decades should be considered. UK Defence in the past may have taken a lead from others. Strategic initiatives with the recently dissolved UK Department for International Development often proved hard to progress⁵⁶ despite good intentions manifested in productive though ad-hoc in-country collaboration (often personality-led). On climate, a targeted and bold approach should be taken, with defence in the drivers' seat by design. Without the DfID partnership⁵⁷, this is also by circumstance.

Defence should seek strategic alignment between climate threat-assessment, UK and UK Defence interest, specific evidence-based intervention choice and collaboration partner. Several models should be considered for deploying support. The opportunity to tap into reservists or establish funding mechanisms direct with local actors to deliver programmes⁵⁸ should be considered. This could complement direct and coordinated mil-to-mil or mil-to-civ engagement. The new directorate could build work up with and through the defence attaches network. Defence taking a clearer role in climate and sustainability also offers the opportunity to consolidate success in biodiversity and wildlife operations, making up a modestly-sized but highly impactful climate and sustainability resilience portfolio.

⁵⁶ For example: the idea of a UK hospital ship shared between MOD and DfID, ultimately deemed unfeasible.

⁵⁷ DfID was rolled into the old Foreign and Commonwealth Office in September 2020. Defence should seek to understand better what of the old DfID portfolio and ODA funding hold defence implications

⁵⁸ Obstacles appear to exist in MOD for establishing programme funding or administering ODA. These should be reviewed.

OFFICIAL

OFFICIAL

5.4.5 Operational capability

Ambition 2050

Capabilities are optimised to the future environment and defence only uses fossil fuels where otherwise unavoidable.

Target - 2025

A 'climate lens' is consistently and appropriately applied across military decision-making. No decisions on future capabilities are made absent of evidence-informed assumptions on a climate changed world. By applying the 'climate lens,' defence has started to realise operational advantage and ensured its plans are resilient.

Recommendations, to be delivered within Year One:

- Develop a set of Defence Climate Assumptions for capability development which provide long-term reasonable scenarios, consequences, and questions which can be considered throughout the process of making capability choices.
- Build the case for a living lab concept and portfolio aiming to realise operational advantage through sustainable and resilient military technologies and methods.
- Review and adapt training and medical plans so that they broadly anticipate the trends driven by climate on their areas: more simulation, less reliability on vulnerable training sites, different types of extreme weather exposure, etc.

Introduction

Achieving defence's purpose relies on operational capability being effective and resilient, now and in the future. Defence will miss important parts of decisions if it does not integrate clearer assumptions about a climate changed world. Defence should therefore develop and integrate an evidence-informed, defence-specific 'climate lens' to key points of strategic, capability development and planning processes. This should not only be about harsher environments the armed forces will inevitably operate in, but also how the landscape for adversaries, allies and regions will be affected and what other countries are doing to prepare themselves.⁵⁹

Sustainability and the future operational environment should be consistently and appropriately considered in devising operational requirements. This should be done in a nuanced way which reflects the complexity of the future landscape and the specific risk profile of climate effects. If the nuanced shift of including a 'climate lens' is implemented well, it will produce new operational edges against adversaries, new and unique capabilities, and greater agility and self-sufficiency. Climate change will subtly alter the net assessment against adversaries and open new space to secure advantage.

UK defence must put itself ahead of the curve in integrating climate change and sustainability considerations into strategy, force design and capability choices. It should use the foresight of climate science in a balanced way and apply them to the defence context. Adaptation should be an enduring and continual process. Ultimately, holistic decisions on capability should now require a 'climate lens' as a norm in processes.

Adapting to the future operating environment. Equipment and force design should be optimised and adapted for a climate changed world of +2° and 4°C in accordance with the recommendations of Committee on Climate Change. To achieve this, defence should devise and implement a 'climate lens' into capability and force planning by developing reasonable, evidence-informed assumptions, integrated across key points of the process. Robust Defence Climate Assumptions would set out reasonable scenarios and consequences, helping sponsors appropriately consider

⁵⁹ One practical application of climate threat horizon-scanning capability described earlier.

OFFICIAL

environmental factors. These assumptions would inform strategic Defence Planning Assumptions and eventually the balance of defence operational activity.

Defence climate assumptions would assess regions at heightened risk, the effects of extreme weather, hotter seas and how climate stresses impact personnel. The useful and practical outcome should be a simple decision-making tool, particularly useful for informing long-term planning, but integrated across all. The 'climate lens' tool should provide support to decision-makers in balancing its considerations within the broader set of influences they face. From a climate threat perspective, it would provide a core and singular basis for asking and answering key questions.

Before climate assumptions are set out, simple inclusion of open-ended climate and sustainability sections in capability documents should be used to provide a temporary stopgap. User requirement documents and selected force development templates should have separate 'climate and sustainability consideration' sections, asking for anticipated reliability, adaptiveness and environmental impact.

Operational adaptation stretches well beyond choices about the future. Activities needed now include finding answers to questions such as: what equipment needs to be stress-tested today for harsher environments and if necessary refitted (and when) and how should wargaming adapt so that it accurately mimics future conditions. Interoperability should also be considered in terms of which new partners and which new technologies might be in use and what engagement should take place today to influence them toward the best UK defence outcome.

Taking the operational advantage opportunity. Using a climate and sustainability lens is not just about threats and constraints but also about capitalising on concepts and technologies which offer better endurance, resilience and are fitted for a climate changed world. The elements which offer an operational edge could include: AI-enabled planning; self-sufficient deployments; semi-autonomous and uncrewed platforms; electric, quieter, stealthier propulsion (engines); use of in-field additive manufacturing (aka 3d printing). All of these are more sustainable, resilient to climate change while reducing reliance on fossil fuels⁶⁰. The 'climate lens' should nudge defence to consider expanding the use of smaller, more efficient, remote-controlled or uncrewed options such as minesweepers or drones which work in harsher environments.

The array of technologies and programmes, such as RAF ASTRA or Army's Cap GM-sponsored Battlefield Electrification continues to grow and evolve; potentially reaching a size for consolidation and optimisation. Those programmes already underway should form the foundation of a broader portfolio under a living lab umbrella, maintained by Defence Innovation. As the volume of programmes and the proliferation of technologies grow, it makes sense to set a clear ambition under a uniform structure and with a consistent narrative. The living lab would avoid duplication while finding and building links within the portfolio for expansion and growth; it would link the wider international and research community with the platform; it identifies where leverage with partners exists, where new ones can be found, and crowd-in funding.

Defence should monitor where other militaries are in terms of adaptation and preparedness. Futures, horizon-scanning, Intelligence gathering will all inform a fuller, dynamic picture.

Strategy, concepts and doctrine. Defence should conduct periodic reviews of climate assumptions in strategy-setting, operating concepts, doctrine and joint operational planning. Key documentation should be updated (e.g. the Innovation Priorities, the Acquisition Handbook) to ensure the right focus on climate threats and opportunities are understood and acted on, broadening the parameters of force resilience.

⁶⁰ For example: advantages are addressed from an Army perspective in Environmental Sustainability in Defence: How can new and emerging technologies support the British Army in meeting its sustainability requirements? Lynch et al. RAND Europe, 2020. And from a Support perspective in: Roadmap for Sustainable Defence Support, KBR. <https://www.kbr.com/en/insights-events/thought-leadership/roadmap-sustainable-defence-support>.

OFFICIAL

The IOpC⁶¹ with its focus on integrating efforts across defence domains while drawing on wider UK talent to deliver competitive, diverse multidimensional capabilities provides a useful framework for defence's response to climate change. Many of the challenges and opportunities presented by climate change extend beyond defence's remit, requiring an increased need for collaboration with different and new partners and agencies. The IOpC strongly advocates for greater societal resilience, underpinned by cohesion, trust, shared values, social habits and behaviour to respond to the threat of sub-threshold attacks, which undermine cohesion. In addition to human-made threats, societal resilience is also vital vis-à-vis natural disasters. As climate-related emergencies are set to become more frequent and intense, a proactive building of societal resilience could be an important step towards an effective handling of these emergencies⁶².

Defence should also track the attitudes of society in a way that informs it about its role toward the climate. An increasing military response to climate emergencies might result in the need to redefine the Defence contribution. While a change of attitudes and expectations about Defence's role could be gradual, Defence must be alert to the possibility of a rapid tipping-point event which creates a greatly increased sense that climate is suddenly a clear and present danger.

Covid-19 put Defence at the centre of the national response. The unprecedented volume of MACAs Defence faced during Covid-19 should not be assumed a one-off. A future nature-derived 'black swan event' should benefit from the foresight afforded by science on climate stresses, alongside the experience of Covid-19. The lessons from the Covid-19 experience should therefore be implemented with an eye on future climate stress, while processes are in place to adapt to climate stress.

Defence should also continue its attendance at the Climate NSIG and clearly set out its role in wider climate security activities, coherent with national resilience tasks and in consultation with wider national security partners.

HADR/ MACAs. Defence should anticipate greater incidence of natural disasters affecting both the homeland and overwhelming UK Overseas Territories. The need for cooperative mechanisms with different types of partners at home (e.g. the emergency services) and abroad (e.g. NGOs) will grow and good preparatory coordination, shared understanding and goals would pay dividends. A certain level of wargaming should take place with constraints and climate instability scenarios factored in, testing mission endurance. In line with IOpC principles, improving coordination, information and resource sharing is paramount. Defence should improve collaboration with multilateral and regional partners (e.g. via UN OCHA, Lancaster House), OGDs (e.g. via PJHQ; SJC) and NGOs, drawing on liaison officers, reserves and volunteers. Defence should improve intelligence sharing, exercise regularly with OGDs, NGOs and multinational partners and share experiences and lessons more broadly and transparently. This would be underpinned by a coherent communication strategy for HADR/MACAs extending the integrated partnership approach.

Training and Medical. Personnel training will face more extreme weather environments and disruptions. Defence must ensure that its bases, training areas and training requirements are resilient to the effects of the changing climate, so that it can continue to train and operate effectively.

The 'climate lens' will point to the need to understand where defence training environments could become less viable or reliable. Synthetic training (simulations) across all five domains should be expanded. Simulation realism is constantly improving, even for land and maritime. There are very significant operational capability, financial and sustainability advantages in embracing new

⁶¹ See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922969/20200930_-_Introducing_the_Integrated_Operating_Concept.pdf.

⁶² The link between the needs of climate response and the platform offered by IOpC is made in: Crisis Response in a Changing Climate, Retter et al., RAND Europe pg 12-13. (2020). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/930787/dcdc_report_changing_climate_gsp_RR-A487.pdf.

OFFICIAL

OFFICIAL

synthetic training options. This would also mitigate the vulnerabilities in any real-life environments that defence relies on while more safely simulating extreme ones. It would also reduce emissions, a critical advantage especially in the air and maritime domains.

Extreme weather has already had a deadly effect in training environments through heat stress.⁶³ The requirements in a climate changed world stretch beyond temperatures. Climate change will increase the demands on personnel, who may have to operate in climate-degraded conditions more frequently, affecting psychological well-being. Medical assistance and protective equipment requirements will become more complex. Higher temperatures or higher rainfall levels affect increase the rate of transmission and geographical reach of diseases and infections. All these angles need to be factored into medical planning.

⁶³ As seen in heat stress deaths in recent years. For example: <https://www.independent.co.uk/news/uk/home-news/sas-recruitment-deaths-three-soldiers-died-brecon-beacon-exercise-charged-negligence-british-army-mod-a8032731.html>

OFFICIAL

OFFICIAL

5.4.6 Procurement and Industry

Ambition 2050

By 2050 defence has proven itself as a fast follower of green technologies wherever possible with sustainability at the heart of all procurement processes and decisions. Working collaboratively with industry defence has driven the right behaviours and outcomes into procurement and supplier and contract management to achieve our net zero ambition.

Target for 2025

The notion of defence as a fast follower which interrogates the sustainability and carbon angle in procurement is well-established.

Recommendations, to be delivered within Year One:

- Undertake an initial deep-dive analysis to take stock, mapping the whole life carbon footprint of the equipment and support plan against cost of carbon considerations identifying where interventions to reduce equipment footprint can be most effectively directed.
- Implement appropriate weighting to low carbon options in the acquisition assessment. This should incentivise industry to offer whole life low carbon solutions for new equipment while also exploring lower emission modifications to old ones.
- Develop fast follower strategies to exploit low carbon technological opportunities.
- Build a route to net zero compliance system.

Introduction

Operational equipment use counts for over 50% of Defence emissions. To play its part in achieving net zero emissions by 2050, defence should own its contribution to the UK's carbon footprint and potential impact in the market. Either way, it will need to adapt its approach so that its systems evolve in lockstep with the low carbon opportunities developed for the civil markets. Private sector behaviour is already changing, through a combination of financial institution and shareholder demand. Other buyers and consumers are shifting gears. UK defence is already considered behind other defence equipment buyers in not asking more of its suppliers to provide low carbon solutions in line with market developments. The private sector is already looking beyond the internal combustion engine and defence risks being left with outdated carbon fuel systems requiring niche support or incurring huge expense to modernise. It is imperative that defence is proactive in helping achieve net zero emissions by 2050 both as a major contributor to the problem but also to keep up with change. Finding the right balance can produce planning which is both aspirational and deliverable.

Front end requirements. Success will come from the ability to innovate in technology and capability planning to deliver low carbon opportunities. To meet these climate change and sustainability aims, consideration must be incorporated into all procurement processes as all parts of defence are affected, but especially at the front end of the requirement setting where opportunities to do things differently, and to configure to be able to adopt emerging technologies, are likely to have the most leverage in meeting the requirements for net zero emissions. The front-end requirements setting must dovetail and interface with the broader system of carbon budgets and targets. This will require a more agile and innovative approach through the use of 'adaptive pathways' rather than specific requirements defined at the beginning of the process. A much more persistent whole life approach must be taken – understanding the true cost and trade-offs through life, in an environment where the acceptable standards will be constantly changing.

OFFICIAL

OFFICIAL

Fast follower. Defence's ability to meet all its objectives will in some cases depend on the availability of additional capital funding, and it is unlikely that defence would add real value in trying to lead the way on developing the new technologies needed by others.⁶⁴ Rather, defence needs to commit to a 'fast follower' strategy of firstly configuring so that it is sufficiently agile to adopt new technologies. It should look at its future requirements where innovative capability solutions offer benefits in terms of cost, time performance and sustainability. There is a very significant potential cost penalty if Defence cannot move away from commitment to current power solutions at the design stage. Also expensive would be to focus on transforming existing fleets outside set refurbishment or mid-life upgrade timelines. Placing contracts now for equipment which may be in service well beyond 2050 must take into account adaptation to the changing environment. Defence would otherwise find itself a long way behind the commercial sector by 2035-40 in terms of its reliance on carbon-based fuels.

Defence needs to ensure that it embraces new technologies as early as possible but only when they are mature and stable enough to be viable; defence should not be an initiating outlier in this field, at great expense. At the same time, defence should be a leader in international efforts to align defence capability to a changing climate and moving to net zero. It can achieve this as a 'fast-follower' of innovations developed in the private sector, and a constant adapter to the evolving demands society and the environment. This has the potential to add significantly to UK prosperity, using defence spending power to deliver rapid expansion of UK innovation, if defence creates a genuine horizon scanning capability, able to take advantage of emerging technology.

Relationships with industry. Every chance should be used to harness the whole of industry, including SMEs, to work in a cross-sector integrated partnership with defence, so that the opportunities of innovation, new ideas and new and emerging technologies can be taken advantage of as soon as practicable. A joint understanding, formally agreed via the DSF, would allow defence and industry to look always for the most sustainable way to meet future equipment requirements; this will be a new model of procurement and of mutual benefit. Defence could look to provide a blueprint, jointly with industry, on how to make the whole of the defence enterprise sustainable.

Cost. There is growing evidence that the defence industry is already moving into more sustainable products faster than defence is requiring it to do so. As a result, it is conceivable that now and in the future, requirements that do **not** have a sustainability statement will cost more; the assumption that a more sustainable product is likely to be more expensive does not need to be true. Becoming a minority user of fossil fuels in the future through ignoring the potential for non-fossil fuels in today's requirement setting is likely be more expensive than timely adoption of volume solutions developed for the civil sector.

⁶⁴ The 'living lab' concept for sustainable military technologies is for military applications though it is possible that the platform could have the second-order outcome of accelerating new civilian technologies.

5.4.7 Support⁶⁵

Ambition 2050

Support and logistics use highly sustainable, efficient modern technologies and techniques which dramatically improve outcomes while reducing footprint. Support is totally resilient to dealing with any new, challenging and extreme situations, directly or indirectly produced by the climate.

Target - 2025

Support understands its dependencies and chosen approach on cleaner, resilient energy options (particularly: fuels and storage) and has started to realise operational benefits from greater self-sufficiency in deployments.

Recommendations, to be delivered within Year One:

- Engage NATO partners, exploring a shared approach and options on transition to lower/zero carbon fuels and more environmentally friendly oils, lubricants and gasses.
- Commence development of an Energy and Fuels sub-strategy with the aim of setting out the approach needed to transition away from fossil fuels and how to obtain more resilient, sustainable, deployable energy systems.
- Explore new collaborative approaches and mechanisms with international allies and partners, NGOs, partners in UK government, agencies and wider civil society.

Introduction

A more sustainable Defence offers significant operational advantage in the support, logistic and associated supply chains. Support also offers, after the estate, the greatest short and medium term opportunity for both reducing emissions and meeting the UN Sustainable Development Goals. Contracts serving Support functions in defence represent about 30% of the annual defence budget, and so the opportunity to make material change both for defence and for its suppliers is significant. In some areas, Support should cross-fertilise the benefits it realises to other parts of defence. The Support focuses, which could pave the way for others are: sustainability innovation, circular economy principles, and energy and fuels.

Self-sufficiency and Innovation. Self-sufficiency in deployments would reduce logistic resupply, strategic lift requirements, costs and save service personnel lives. Aspirations for improving operational resilience and achieving better sustainability converge in Support operations. Camps and bases which self-sustain more effectively would be less vulnerable. They would also relieve pressure on local communities, the environment, the logistic supply chain and other operational units protecting the resupply.

Self-sufficiency as a core Support principle would prove critical in a climate changed world where defence may operate in environments where traditional planning assumptions no longer apply. Extreme environmental conditions could rupture supply chains, destroy local infrastructure, degrade communications and diminish transport options. Greater self-sufficiency is a requirement of the future operating environment and Support should lead in early exploration of this.

To do so, Support should follow French and Dutch examples via creation of a living lab platform. A living lab would be a real-world test bed and incubator for sustainability innovation in military environments. It would lead the way through challenges, trialling and translating technologies for more resilient deployments. Potential areas for investigation include: energy production and storage, water management, food and light-weight solutions.

Maintenance. Innovative approaches to maintenance are needed to produce less waste and more resilient bases. Support must look to optimise engineering and logistic operations with policies on predictive maintenance techniques. Predictive maintenance offers greater availability from fewer

⁶⁵ Support covers logistics, maintenance and equipment support

OFFICIAL

platforms. New and emerging technologies could reduce supply chain throughput and help platforms go further for less. The opportunities from supporting actors in innovative maintenance should be championed too. Additive manufacturing (3D printing) could produce spare parts in the field. Autonomy/ AI could be used for less wasteful warehousing. AR/ VR could be used to provide remote support in analysis, diagnosis and control for engineering and medical activities.

Circular economy. Support, through its policies and processes, should introduce the concept of a circular economy into defence. Circular economy principles look to shift consumption from ‘taking and wasting’ materials to ‘reducing and reusing’ them instead. In practice, this means opting for recyclable materials from the concept and design phase and designing products for their ability to regenerate or be repurposed.⁶⁶ Defence should look to remove non-sustainable materials in all its supplies, potentially starting with logistic packaging. As the organisation responsible for contracts such as food, it could make a bold statement for defence by dispensing with single use plastics and transitioning to other packaging options. The recycling of food waste in the UK through use of food banks would also prove an engaging and inspiring objective supporting wider mindset shifts toward circular principles.

Energy and Fuels. Defence's reliance on fossil fuels will not change significantly any time soon. However, an assumed continued reliance on old forms of energy and power is misguided. Deep reliance on fossil fuels today belies the long-term eventuality that they will one day be a legacy technology without a large civilian market. There is an operational imperative in a 'green Defence', that defence is not left with inadequate platforms using fuels which will eventually become harder to source and less effective than alternatives as well as prohibitively expensive.

Defence's power and energy demands are set to increase and become more complex, especially as capabilities develop to keep up with a continually evolving modern battlefield. Support is already a leader in Defence exploring synthetic fuels and it should build on this internationally; for example leading NATO in fuels policies, to encourage significantly greater use of non-fossil fuels where appropriate.

Defence will also require reform in energy in 3 areas: permanent bases, deployed bases and platforms/equipment. Despite the lack of a stable energy landscape today, as technology evolves rapidly, there are already some technologies sufficiently mature to be implemented. Many meet performance requirements and reduce emissions; some offer operational advantage. For example: portable power technologies such as solar-powered batteries can offer additional stealth capabilities, limiting noise and reducing the risk of detection.

Overall, the landscape is still in its early-stages though promising commercial investigations continue. No single solution yet exists to deliver sustainable energy that is reliable, fit for purpose and cost effective. Furthermore, technology adoption alone will not achieve our emission and operational goals. It will take a coordinated, whole system analysis and defence wide change to our current energy operating model. A hybrid approach of many different technologies and renewable resources is needed to begin with.

Support should take the lead in expanding the approach and articulating a revised energy and fuels strategy for defence. The energy landscape is moving and evolving at a rapid pace. The approach taken by defence should not be one of investing huge amounts of resources into research and development. The ‘fast follower’ approach should be adopted where, as soon as the most appropriate energy systems on the market to fit our bespoke needs is found, defence should pounce on the innovation and speed up the translation to its military application. Defence will need to be proactive horizon scanners to continually search, assess and procure new technologies that best suit our requirements in the most cost efficient and carbon neutral manner.

⁶⁶ As described in Sustainable Roadmap for Defence Support, KBR, 2020.

OFFICIAL

OFFICIAL

5.4.7.1 Viable Deployable and Equipment Energy: Options

Deployable Bases. Required to provide power to 30-600 personnel. Currently powered predominately by diesel generators, which are expensive and have a vulnerable logistical supply chain. During Afghanistan and Iraq (2003-07), 3000 US troops and contractors were killed in fuel convoy attacks.⁶⁷ To reduce the logistical burden “tactical energy nodes” should be considered, employing renewables, SMRs or other means to produce energy locally and subsequent conversion to the appropriate medium (i.e. synthetic fuel, electrical storage).⁶⁸

Current Technology Options

1. **Microgrids.** As per permanent bases, provide power management to deployed bases. Will allow generators and renewable energy systems to be scaled for average load usage, not peak, when used in conjunction with energy storage systems, providing cost savings.
2. **Renewables.** As per permanent bases. Wind and solar power efficiencies depend on environment deployed to and should be selected accordingly. Should be used in conjunction with microgrid and additional reliable energy source to provide energy resilience.
3. **Energy storage.** Reduces the number of generators or renewable systems required, allowing for ‘quiet times’ where energy demand is met by stored energy. Conventional batteries have been more common than Redox Flow in the past, being more modular and scalable. However Redox Flow may be safer and cheaper at certain scales.
4. **Synthetic Fuels.** Carbon neutral, volume of carbon emitted during combustion is equivalent to volume of carbon extracted from the air during synthesis. A high-density fuel, produces similar energy output to fossil fuels but with little to no pollutants, such as sulphur dioxide.⁶⁹ Compatible with existing engines, with potentially the least retrofit impact on existing systems. The end goal would be to have a base that can self-synthesise its own fuel to provide base resilience and decrease the logistical burden. However, technology is still immature as they require large quantities of energy and water for production; synthetic fuels are more expensive than fossil fuels and not yet suitable for implementation.

Platforms and Equipment. Defence’s platforms, ships, aircraft and land vehicles are driven predominately off hydrocarbons, with aviation fuel being the dominant emission contributor.⁷⁰ Platforms that have been modified with electric drive systems still require diesel to power their generators. Future platforms will require even more electric power to support engines, high power radars, directed energy and electromagnetic weaponry. The employment of electric power brings the operational advantage of greatly reduced acoustic signature. The two major challenges are how to power the propulsion system and equipment on platforms to be able to operate within a variety of environments.

Current Technology Options

1. **Synthetic Fuels.** As per deployable bases. Their high energy densities make them suitable for long missions and are compatible with existing platforms and equipment, requiring minimal integration costs. A blend with fossil fuels can provide an intermediary step. They are more expensive than fossil fuels, while the benefits gained are both environmental and one of resilience, reducing our dependency on gas and oil.⁷¹
2. **Hydrogen.** Proton Exchange Membrane fuel cells are the most applicable for motive power with pure hydrogen, they are lightweight and compact for the given power requirement. The power density is the highest of any fuel cell type, with only water as a by-

⁶⁷ <https://www.ginetiq.com/insights/electrified-battlespace>.

⁶⁸ Research Technology and Innovation Group, (2020), Powering Future Operations: net zero Challenges and Opportunities, (7)

⁶⁹ <https://royalsociety.org/-/media/policy/projects/synthetic-fuels/synthetic-fuels-briefing.pdf>.

⁷⁰ Research Technology and Innovation Group, (2020), Powering Future Operations: net zero Challenges and Opportunities, (2)

⁷¹ <https://royalsociety.org/-/media/policy/projects/synthetic-fuels/synthetic-fuels-briefing.pdf>.

OFFICIAL

OFFICIAL

product. They require little maintenance and run near silent, with minimal heat signature. However compressed hydrogen (generated by renewables) to fuel the cells is difficult to store, requires high pressure, and hydrogen is highly combustible. Hydrogen is not mass-produced and is four times the cost of gasoline, per gallon. There are potential clear cases for it, perhaps long endurance drones, but as the volumes increase then the challenges surrounding transport, generation and safe storage also increase.

3. **Flywheels.** Produce high power outputs, suitable for directed energy weapons and other auxiliary equipment. Can be charged rapidly through energy recovery systems on platforms, provide pulse power and are scalable. Safety concerns remain if they overcharge, requiring a charge limiter and secure storage.
4. **Capacitors.** Traditional or dielectric capacitors store electrical charge between two plates separated by a dielectric. They can deliver very high power but can store very little energy. They may form part of the power solution for direct energy weapons.
5. **Supercapacitors.** Supercapacitors or Electric Double Layer Capacitors can be thought of as intermediate between batteries and traditional capacitors in terms of energy capacity and power capability. Charge quickly and operate in -40°C to $+65^{\circ}\text{C}$, but have a high cost per Watt of energy. They can often find use in a power train to supplement a battery (protecting it from high power pulses) or capacitor (providing a quick recharge buffer).
6. **Advanced Batteries.** Utilisation of high energy batteries on platforms in a hybridised system will improve fuel efficiency. Hybridisation is likely to be required given the lack of charging infrastructure in remote areas and that some batteries will not produce high enough power outputs. They have minimal noise signature, allowing for silent manoeuvre and watch. Many different technologies are being investigated to improve energy and safety. These include solid state electrolyte batteries, graphene current collectors, new anodes (Si, Li metal) and cathodes (high nickel, low cobalt metal oxides, sulphur).

Implementation

The energy landscape is moving and evolving at a rapid pace. The approach taken by defence should not be one of investing huge amounts of resources into research and development, but a “fast follower” approach should be adopted, where we procure the most appropriate energy systems rapidly developing on the market to fit our bespoke needs. There are a plethora of commercial companies who are already developing new systems, it would be uneconomic for defence to commit resources when the work is already being achieved elsewhere. However, there will still be a requirement for defence to invest in the development of niche power solutions for specialist applications. As such defence will need to be proactive horizon scanners to continually search, assess and procure new technologies that best suit our requirements in the most cost efficient and carbon neutral manner.

Recommendations

1. **Energy technologies outlined are viable now or soon to be and should be considered for application.** There is no one system that fits all scenarios, thorough assessment of the domain needs to be achieved prior to selecting which system(s) are best employed.
2. **Defence needs to adopt a “Fast Follower” approach to energy and power technologies rapidly developing within the commercial sector.** Identifying niche capabilities and prepare for their adoption, while influencing the market to service defence’s specific requirements.
3. **Adopt mature technology immediately.** Permanent and overseas bases are where the most mature technologies can be easily integrated. This should be capitalised upon to gain the greatest immediate emission and cost savings.
4. **Implement monitoring systems to analyse the efficiency of new technologies on military bases and platforms.** Data should be used to identify where the greatest

OFFICIAL

OFFICIAL

emission savings can be made, expose areas of weakness and better understand the energy/power demands of either the base or platform.

5. **Strengthen defence's access to energy and power specialists and build a collaborative approach across government.** Will enable defence to identify and influence new emerging technology quickly.
6. **Technology is only part of the solution.** Defence should be willing to accept new ways of working and address legacy policies to allow for the inclusion of sustainable energy.

OFFICIAL

OFFICIAL

5.4.8 Commercial

Ambition 2050

Climate change and sustainability is fully embedded into key governance, finance, commercial strategies, policies and processes as business as usual.

Target 2025

By 2025 all new contracts are awarded with sustainability as an integral part of the investment decision making. Defence demands clear sustainability requirements to drive a stepped and well-incentivised change in behaviours and outcomes. We require industry to demonstrate that they, and their supply chains, have a clear and progressive carbon net zero plan in order to do business with us. These standards are set in collaboration with BEIS and wider government and are incorporated into defence standards and guidance.

Recommendations to be delivered within year one:

- All investment decisions should have sustainability considerations at the heart
- Procurement standards, guidance and training should be issued to reflect Defence and wider government net zero ambitions and sustainability requirements.
- Strategic outcomes-focused sustainability steering group should be created in the Defence Suppliers Forum to enable cross government and industry collaboration on key challenges and opportunities including both how carbon could be measured and how performance could be assured down the supply chain;
- Commercial should leverage the Strategic Partnering Programme to communicate the aims of the carbon net zero strategy, to drive behaviour through transparency of a Strategic Supplier's Defence CO₂ footprint and provide support on the introduction of new policies.
- Commercial will agree a supplier accreditation standard with colleagues across Government and give early warning to industry on ensuring they are adapting to the net zero challenge.

Introduction

Defence should take maximum advantage of new contracts and renewals to insist on revising existing practice to incorporate key sustainability, social value and circular economy principles. Achieving defence ambition requires a progressive agenda where Commercial works with an industry base committed to sustainability and incentivised to exploit innovative solutions. Commercial will play a key role ensuring requirements are clearly identified, sustainability is at the heart of investment decisions and defence follows through on its net zero commitment. The ambition applies across defence's contracting landscape - for equipment, construction and service contracts, even down to commodities.

Commercial principles. The Commercial community should set out principles for further integration via the functional strategy:

- Defence seeks to do business with suppliers who can demonstrate they are actively adopting sustainable approaches and solutions and have a clear plan to achieve the Carbon net zero target. This approach extends to the supply chains that they manage and are part of, starting from raw materials and finishing with disposal. Commercial policies should increasingly reflect and drive this agenda.
- Commercial will ensure that requirements are set which are reflective of and demanding of market conditions and the current status of technologies and manufacturing practices across buying categories. Commercial will encourage innovative solutions both at the

OFFICIAL

OFFICIAL

outset and through life where appropriate. Defence will seek to ensure that sustainability is a core value in requirements.

- Commercial will ensure that sustainability is at the heart of investment decision making for all contracts, providing visibility and understanding of choice where that exists. Commercial will make use of the Social Value Act provisions to ensure that an appropriate weighting is attached to sustainability for each defence investment decisions.
- In its contract management approach, Commercial will look to ensure that delivery of sustainability is incentivised throughout the life of the contract and that, where commitments have been made, these are delivered. Commercial will monitor carbon targets and outputs on a contract by contract basis where appropriate and continually challenge suppliers to meet and exceed these targets. Commercial will consider how best to provide this assurance of delivery and sustainability.
- Extant contracts will not be specifically broken, incurring cost, to insert sustainability options. Instead, every natural break or review point will be used to improve the sustainability of the contract and contractor, minimising emissions and looking to introduce the principles of the circular economy.

OFFICIAL

5.4.9 Finance

Ambition 2050

Climate change and sustainability is fully embedded into key governance, finance, commercial strategies, policies and processes as business as usual.

Target - 2025

Climate change and sustainability is appropriately resourced, meaning defence is equal to the challenge in the future. A carbon budgets system is managed in tandem with defence's financial system. Emissions and social value are appropriately factored into assessments of cost-effectiveness.

Recommendations, to be delivered within Year One:

- Agree a set of 'Greener Defence through Finance' principles to be prioritised and delivered through the Finance function and directing future change in the Finance functional strategy.
- Prioritise whole-life costings in appraisal, which should start to include fuller carbon valuations and disposal considerations. Scrutineers should have the power to reject insufficient or incomplete whole life assessments going to appraisal committees.
- Support the new climate change and sustainability directorate to transpose best practice on financial management and controls to carbon management and controls.

Introduction

Defence should take advantage of technology as it settles, and as prices inevitably become cheaper – the cost of renewables has rapidly dropped in the last 10 years, and is likely to continue to do so, with the Government predicting, for example, that electric cars will be cheaper than diesel/petrol equivalents by about 2025. Taking advantage of an environment where products will become cheaper over time is possible and desirable for a stretched Defence budget where there are other priorities. At the same time, the volume of change is such that defence must take every opportunity to start early and continue to invest over time – it cannot afford to leave a significant investment to a shorter period, later.

This implies a different type of balance of investment and forecast which integrates an analysis of affordability from a financial perspective with one from an emissions and sustainability angles as well. Financial strategy will need to include carbon value (in line with or exceeding HMT guidance), link to the data on defence emissions and work to ensure that defence meets its emissions reduction requirements.⁷² Defence should be looking to incrementally adapt toward a fundamental transformation realised within the next five years. If integrated smoothly, there will be a balance of investment across the following 25 years which could achieve net zero.

Greener Defence through Finance principles. The Department's financial system will undoubtedly play a central role in achieving a climate-proofed defence purpose. What the financial system offers defence today should ultimately be mirrored by what the carbon budgets systems will offer defence in the future. Analysis, assurance, projections and dynamic data will be a part of that carbon system, with 'controls' managed in head office. The two systems – financial and carbon - should work to mutually beneficial aims. The carbon system should be built to smoothly interface with the financial one. Ultimately, carbon budgeting gains force through the cost of missing emissions targets. As an early-stage call to action, 'Greener Defence through Finance' principles are suggested below:

⁷² See: <https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>.

OFFICIAL

- Defence finance will play its part following or exceeding HMT guidance, methodologies and working internally to ensure carbon and sustainability concerns are managed.
- Carbon budget and financial systems will work in tandem, with defence emissions frameworks growing to mirror the structure of financial ones. This implies a degree of carbon trade between TLBs/FLCs.
- To allow the combined cost of carbon and finance to be taken into account, defence will use the government (BEIS) cost of carbon calculations in comparative bids.
- Defence will accept a degree of internally imposed and managed financial sanction where emissions targets are missed.
- 'Whole life costs' will be central to the approvals and scrutiny process with cost of carbon assessments a requirement. The approvals and scrutiny system will have the mandate to refuse incomplete or inadequate 'whole life' assessments.
- Sustainable financial decisions will be incentivised and flexible. This could be realised by eventually:
 - Allowing TLB/ FLCs to retain savings they are able to deliver at the appropriate level in cost of carbon/ social value; this may entail revising budgetary structures to properly incentivise carbon savings.
 - Providing flexibility between the carbon and financial budgets; providing equivalency in the 'currency' of finance and the 'currency' of emissions (I.e. carbon emitted as a debt; carbon sequestered as a credit). Equivalency could enable some level of virement between carbon and financial budgets, offering flexibility to TLB/ FLCs
 - Allowing the frontloading of through-life savings – in either carbon or financial targets - to the year the decision is taken.
 - Enabling 'invest to save' where investments can deliver emissions reductions earlier and in a cost-effective way.
- Social and carbon value will have the same status as cost value (with clear equivalency in cost value).

Scrutiny. Governance of the effectiveness of defence's response to climate change and sustainability should be built into all levels of scrutiny for new programmes and requirements. From the earliest stages of requirement setting to the Internal Audit Committee, the scrutiny committee should be looking to ensure that environmental factors have been considered and addressed effectively. This should cover both emissions and resilience to different environments. Net zero is a clear HMG policy objective and therefore investments by defence should consider its impact upfront and this should be further integrated. The scrutiny system will be central to ensuring cost effectiveness and proportionate consideration of emissions as well as other social disbenefits in their evaluations.

The government has an agreed set of carbon values to be used in policy appraisal and evaluation through Green Book Supplementary Appraisal Guidance. These should be treated as best practice and used in the defence context where applicable. HMT is clear that social value savings can justify higher upfront cost investment. A uniform defence process will be run through scrutiny vehicles like the Generic Evidence Table. Eventually, all new equipment should have a 'sustainability dossier' where the decisions on build, use and long-term disposal of an equipment are identified, and the trade-offs articulated.

OFFICIAL

5.4.10 Data

Ambition 2050

Defence has all the data and analytics capability needed; this feeds through to making optimal decisions and most effectively meeting the defence purpose.

Target - 2025

Data has laid the foundations for FLCs/ TLBs to actively manage carbon budgets. This has been realised through a single source data architecture managed in head office which is recognised as best-in-class by partners and allies.

Recommendations, to be delivered within Year One:

- Establish a single data-dashboard, understanding what the complete data set should look like, which can dynamically track and monitor mandated GGC and MOD sustainability indicators.
- Develop an accredited and standardised methodology for CO₂e capture that will be adopted across defence.
- Produce the first of an annual climate change and sustainability data report which is concurrently the foundation and framework for future carbon budgeting.

Introduction

Digital capabilities have the potential to be a major force for global sustainable development and a critical enabler in climate change mitigation and adaptation. The importance of data to Defence policy on climate and sustainability cannot be understated: achievement of the 2050 ambition – from global climate security leadership, to resilience, to net-zero – relies on high-quality data and analytics. Digital technology is also a significant energy consumer, so embracing the benefits of digital and data services should be combined with minimising any negative impacts. If it is to achieve net zero by 2050, defence must develop a detailed and real-time understanding of CO₂ emissions across all its infrastructure, equipment and operations. Current consumption must be baselined and subject to analysis to determine how and where to target action to enable cost-effective reductions. A major hurdle will be gathering the data; the utility of Structured and Non-Structured data is boundless, but the data must be exposed in the first place. Data needs to be acquired on emerging technologies and the potential efficiencies that might be applicable to each type of equipment. Furthermore, if defence is to develop into an adapted force capable of operating globally, predictive data on meteorological conditions and the environmental consequences of climate change must be captured and assessed, so that our future military capability is not adversely constrained.

Horizon scanning and analysis – emissions. The long-term nature of climate and sustainability requires defence to maintain detailed and credible long-term viewpoints across all data categories. Once the dataset is sufficient on carbon, equipment, impacts and costs, Defence should regularly update and maintain a 10-year window of understanding. This should be broader for threats and futures. On all data points, Head Office should assume an overview and contain the appropriate analytics functionality and relationships for using the data to best effect in international engagement, strategy and policymaking.

In managing defence emissions, good command of the horizon should mean a yearly review exercise with TLB/ FLCs on progress against targets and revising targets and assumptions into the future. This exercise would update anticipated effects from externalities such as regulation and policy, as well as the internally-owned emissions effects of plans (and their costs/savings). New

OFFICIAL

developments and understanding from the previous year would feed into this proposed yearly 'data review', which should be a collaborative effort across defence. The totality of the data would inform the risks and opportunities on the route to net-zero and inform several areas of defence policy and strategy, such as where investments could be most effective from the emissions reduction perspective. A standardised methodology, internal transparency and good stakeholder engagement is needed between head office and the TLBs and FLCs for a smooth process.

Digital sustainability and future opportunities. Digital technology is expected to reduce CO₂ emissions on a global scale by developing next-generation distributed grids, smarter cities, more efficient transportation systems and new industrial processes. Emerging technology such as AI, Big Data, Blockchain, Internet of Things (IoT) and Robotics will play a large part in climate change mitigation and adaption, through the precise control of complicated processes to minimise pollution and improve energy efficiency. Data is an instrumental part of climate monitoring and the battle against climate change; it is also the lifeblood of the automation and autonomy that is required to manage our estate energy consumption in real-time. However, the inter-connected and critical nature of many of these processes also bring their own set of cyber risks and vulnerabilities that must be effectively managed, and we must ensure that data collected and analysed for climate change purposes is suitably protected.

In pursuing the journey to Big Data, AI and IoT, it should not be forgotten that our data demands must themselves be sustainable. Data centre energy requirements exceed the national energy consumption of some countries; in 2018 they contributed about 1% of total global energy consumption. Hyperscale data centres deliver sustainability benefits but they comprise billions of electronic items all mined, manufactured and transported across the globe, with all the associated social, economic and environmental implications. As our data communications, processing and storage demands increase, defence must bear down on this embodied carbon consumption and the operating emissions of its digital technologies.

Data and people. Data analytics and management dashboards will be required to manage change and track improvements. However, data and understanding are insufficient if the ability to act on the analysis is not available. Defence will need to consider exactly with whom and where the capability to effect change resides to ensure that the data is not ignored. The contribution of defence personnel to digital sustainability must also be addressed. IoT devices together with smart meters and energy-management apps have the potential to help individuals minimise the resources they consume. But many remain unaware of the carbon footprint of small digital actions. With billions of people using the Internet and digital technology globally, small behavioural changes can have a significant cumulative impact. In conjunction with a central communications strategy for sustainability, displays of energy use and other key metrics at defence sites would encourage behaviour change and provide a sense of ownership of local issues. Responsible information and data management supported by improved user behaviours will become critical to exploiting our data universe in a sustainable fashion

Climate change related cyber espionage. The NCSC has identified the increasing range of hostile hack, leak, disinformation and criminal attacks related to climate change issues. It rates climate change related cyber espionage in 2021 as "almost certain" and identified, in the long term, the growing risk of cyber-attacks against critical national infrastructure and supply chains. It is crucial both that Defence get ahead of this threat via increased policy and operational focus and that it protects its unique digitally-held assets on climate and sustainability.

OFFICIAL

5.4.11 Research and Development

Ambition 2050

Climate change & sustainability are drivers of defence research, development and innovation. Defence effectively accelerates the translation of discoveries from civilian science and technology to defence applications in low/zero-emission and green renewable technologies.

Target - 2025

Other UK science and technology stakeholders are aware of defence's climate and sustainability priorities and are seeking ways to meet defence challenges. Networks of public, private and international researchers collaborate and engage on defence-relevant work around climate and sustainability.

Recommendations, to be delivered within Year One:

- Explore and set out a range of Defence climate and sustainability research priorities and question-sets and a multi-year engagement plan. This would be to create opportunities, build connections and amplify research benefits across UK government, industry and academia.
- Feed into a Fuels and Energy strategy, which should be the first priority for engagement and for building a wider science and technology coalition for Defence sustainability.
- Build on the Hacking4Sustainability pilots operating at universities as part of MSc courses.

Introduction

Defence will limit any R&D funding to investigating questions which have primarily military application. Defence should nevertheless make use of its significant role as a research funder and industry partner to further its aims for climate change and sustainability. Well-targeted engagement on defence's research, science and innovation priorities could lead to more sustainable, operationally advantageous equipment. This approach is at the core of achieving the 'fast follower' concept. An intelligent R&D engagement stance from defence would defer to the superior resources and mandate of others, while still using defence's influence to help speed the development of new relevant approaches based on its specific priorities.

Climate Change and Sustainability Priorities. With a research budget comparable in size to an entire UK 'research council' and its central position in the market, defence can prove influential in research fields that it opts to prioritise and use its networks and levers to shape. Defence should set out its priorities for climate change and sustainability research and advance them by engaging policymakers, funders and researchers within government S&T, across UK industry, academia and internationally.

The priorities defence sets out should cover questions and challenges around: understanding the impact of environmental change on equipment, materials and personnel; enhancing their resilience and sustainability; propulsion and energy systems; synthetic training (simulations); uncrewed vehicles and platforms, and; circular economy in the defence context.

The approach. Strong engagement from defence would mean others' research strategies and challenges can be designed with a better understanding of their potential national defence and security applications. Engagement from defence on its priorities, if done well, would produce more joined-up understanding across military, civilian and industry stakeholders realising new collaborations and ideas.

The approach requires first creating the set of defence priorities and questions and holding a clear picture of the maturity of the different key areas of research. After mapping these out, participation in networks would be targeted toward promoting the most promising areas for investigation

OFFICIAL

bringing together groups with converging research interests. Defence needn't invest in programmes upfront to nudge the direction of research toward its climate and sustainability research interests. Instead, defence should use cross-sector networks to help advance shared understanding and to direct momentum. It is right that better-positioned civilian businesses and organisations lead, while defence levers its role in public, private and international platforms supporting that collaboration. Defence's stance should be as a ready-made client for cost-effective sustainable military technologies which achieve operational advantage.

Defence should make full use of the growing community of academic study in climate and security, the environment and sustainability. A pilot Hacking4Sustainability programme, modelled on the successful MSc Hacking4defence programme has already been started at a number of universities. The benefits of using academia should become increasingly apparent and tapped into – to make significant change in the uncertain future of environmental and sustainability technology, defence should harness the intellectual capacity of the nation.

Long time-horizons. Defence should remain engaged across the range of research, science and innovation stages; from highly abstract early-stage through to the late-stage ideas, close to the point of commercialisation.

Early-stage research funded today will evolve into concepts needing a further 10-20 years before they achieve practical use. 10-20 years lies well within the time-horizon of a defence journey to net-zero; research carried out today could prove the difference for a seamless transition. Defence's role as a stakeholder would be to understand and support the case for the chain of discoveries needed in its priority areas, notwithstanding return on investment is unlikely for many years.

Shorter time-horizons. Where practical applications are already possible in a shorter timeframe, defence should consider using its resources to speed up the translation to military uses. Defence may eventually decide to play a bridging role between the early-stage and the latter-stage elements of the research, science and innovation landscape. For example: focusing on the so-called funding 'valley of death' where innovators find difficulty attracting investment in higher-risk ideas. In the meantime, defence should establish a 'Living Lab' concept as a catalyst of innovation funding, focused on specific areas (Living Lab hubs for land, sea, air, energy and fuel and deployments). The 'Living Lab' would consolidate and grow defence's small innovation portfolio on climate and sustainability in military contexts. With a modest budget for demonstrating, trialling and scaling new technologies and approaches, the 'Living Lab' would prove sustainable military concepts and offer a clear signal to the rest of the scientific community and pipeline.

Research to date. As part of the review a significant amount of research has been undertaken by dstl, the Met Office and RAND, among others. A compendium of their papers is at Part 4.

OFFICIAL

Appendix 1 to Chapter 5 – Year 1 Recommendations

Behaviours and Communication

- A sustainable behaviours programme should be established with education, training, communication and incentivisation at its core. This programme should seek to integrate sustainability into leadership, recruitment and business processes and systems.
- The way that climate change and sustainability affects every job now and in Defence's future workforce should start to be understood. The career pathways and opportunities should be mapped and professional frameworks adapted.
- A communications plan for both internal and external audiences should seek to grow awareness of Defence's commitments on climate change and sustainability, inspiring understanding among our people, the wider public, industry and international partners.

Governance and Head Office

- Establish an adequately resourced Head Office team whose activities are governed at the highest levels of defence and who are responsible for delivery of Recommendations.
- Establish a sustainability NED on the Defence Board.
- Re-role and formalise the extant Climate Change and Sustainability Implementation group as a working group of the DSEC.
- Deliver a Defence-wide consultation on carbon budgeting, alongside a robust and thoughtful data validation and initial target-setting exercise.
- Set up the appropriate external oversight, transparency mechanisms for delivery of any agreed recommendations. Explore cross-Government representation and input. From an emissions perspective, this is a shared endeavour which could call for a different kind of collaborative approach.

The Built Estate

- Top 35 Emitting Establishments to have had Energy Surveys
- Policy on building standards for new-build raised to operational net zero with associated uplift in financial settlement
- All Defence estate initiatives cohered with clear prioritisation set, against defence's initial net zero roadmap, by a central Head Office team to leverage economies of scale across TLBs

The Rural Estate

- Develop a natural capital register and modelling tools for the defence estate.
- Ensure maximum engagement of tenant farmers with the new agri-environmental programmes across the estate.
- Engage with local Nature Partnerships and Nature Recovery Partnerships to ensure MOD sites at all scales are making an appropriate contribution to biodiversity.
- Develop and implement the Nurturing Nature programme on establishments to support the pollinator strategy, develop small scale woodlands and habitats with community involvement and extend the 'no mow' initiative.
- Develop a series of test and trial sites on the tenanted estate in England to develop ELMS type strategies, land management plans and extension support on a range of landscape types.

Climate, Security and International

- Build a coalition of militaries to make a declaration at COP26, securing substantive commitments on adaption, resilience and mitigation.
- Build a cutting-edge climate threat horizon-scanning capability, integrated with partners inside and outside of Government.
- Explore the interest, options and feasibility for new types of partnerships helping build resilience capacity in others, at home and abroad.
- Encourage NATO to further evolve its position on adapting to and mitigating against the effects of climate change seeking that the climate angle be mainstreamed in NATO policy and capability development.

Operational capability

- Develop a set of Defence Climate Assumptions for capability development which provide long-term reasonable scenarios, consequences, and questions which can be considered throughout the process of making capability choices.
- Build the case for a living lab concept and portfolio aiming to realise operational advantage through sustainable and resilient military technologies and methods.
- Review and adapt training and medical plans so that they broadly anticipate the trends driven by climate on their areas: more simulation, less reliability on vulnerable training sites, different types of extreme weather exposure, etc.

Procurement and Industry

- Undertake an initial deep-dive analysis to take stock, mapping the whole life carbon footprint of the equipment and support plan against cost of carbon considerations identifying where interventions to reduce equipment footprint can be most effectively directed.
- Implement appropriate weighting to low carbon options in the acquisition assessment. This should incentivise industry to offer whole life low carbon solutions for new equipment while also exploring lower emission modifications to old ones.
- Develop fast follower strategies to exploit low carbon technological opportunities.
- Build a route to net zero compliance system.

Support, Maintenance and Logistics

- Engage NATO partners, exploring a shared approach and options on transition to lower/zero carbon fuels and more environmentally friendly oils, lubricants and gasses.
- Commence development of an Energy and Fuels sub-strategy with the aim of setting out the approach needed to transition away from fossil fuels and how to obtain more resilient, sustainable, deployable energy systems.
- Explore new collaborative approaches and mechanisms with international allies and partners, NGOs, partners in UK government, agencies and wider civil society.

Commercial

- All investment decisions should have sustainability considerations at the heart
- Procurement standards, guidance and training should be issued to reflect Defence and wider government net zero ambitions and sustainability requirements.
- Strategic outcomes-focused sustainability steering group should be created in the Defence Suppliers Forum to enable cross government and industry collaboration on key challenges and opportunities including both how carbon could be measured and how performance could be assured down the supply chain;
- Commercial should leverage the Strategic Partnering Programme to communicate the aims of the carbon net zero strategy, to drive behaviour through transparency of a Strategic Supplier's Defence CO2 footprint and provide support on the introduction of new policies.
- Commercial will agree a supplier accreditation standard with colleagues across Government and give early warning to industry on ensuring they are adapting to the net zero challenge.

Finance

- Agree a set of 'Greener Defence through Finance' principles to be prioritised and delivered through the Finance function and directing future change in the Finance functional strategy.
- Prioritise whole-life costings in appraisal, which should start to include fuller carbon valuations and disposal considerations. Scrutineers should have the power to reject insufficient or incomplete whole life assessments going to appraisal committees.
- Support the new climate change and sustainability directorate to transpose best practice on financial management and controls to carbon management and controls.

Data

- Establish a single data-dashboard, understanding what the complete data set should look like, which can dynamically track and monitor mandated GGC and MOD sustainability indicators.
- Develop an accredited and standardised methodology for CO2e capture that will be adopted across defence.
- Produce the first of an annual climate change and sustainability data report which is concurrently the foundation and framework for future carbon budgeting.

Research and Development

- Explore and set out a range of Defence climate and sustainability research priorities and question-sets and a multi-year engagement plan. This would be to create opportunities, build connections and amplify research benefits across UK gov't, industry and academia.
- Feed into a Fuels and Energy strategy, which should be the first-priority for engagement and for building a wider science and technology coalition for Defence sustainability.
- Build on the Hacking 4 Sustainability pilots operating at universities as part of MSC courses.

PART THREE

Chapter Six – Laying the Foundations

Introduction

The choices defence makes in the next five years will determine the success or otherwise of its transformation. We must become a resilient, agile organisation, poised to meet, rather than contribute to, the security challenges of a changing climate. No-one yet has all the answers as to how this will be achieved, but that does not exempt defence from starting the journey. There is much on which we must act now. If we do not, we will fail to lay the foundations required to seize the opportunities presented by future technologies. These are the technologies required to maintain our global military pre-eminence and, as highlighted by CDS in September 2020, ‘compete below the threshold of conflict’ in a climate changed world. Placing defence on a sustainable footing, and publicly demonstrating this repositioning, is a major part of the defence transformation outlined in CDS’s Integrated Operating Model, enabled by the recent financial settlement and championed by the Secretary of State for Defence in December 2020.

6.1 The Strategic approach

The strategy proposes a series of targets for the first year across a number of functional areas⁷³, and these should now be formally allocated to their functional owners to deliver. Looking ahead to the end of Epoch 1, these targets are vital first steps in delivering tangible progress by 2025. Some of these will require investment by defence but the majority are focused on the cultural, mindset, and behavioural changes required across the Department. It is embedding these into our DNA over the next five years that will deliver the necessary transformation.

Investment questions are secondary to understanding what must be done as a military community to lead, across Whitehall and beyond, while ensuring the UK remains secure on its route to net zero. Defence already has the lead on climate and security through the Integrated Review. With the largest procurement budget, landmass, and carbon footprint in central government, we must make our assets available for experimentation and lead the field in this transformational endeavour.

Leadership. Leadership will be required from the very top of defence, both to take the necessary decisions and drive through the policy and process changes, and also to role model the expected culture and behaviours. Delivering sustainable behaviour change is a programme in its own right that must be established now with education, training, communication and incentivisation at its core. Communicating this vision internally and externally will inspire our people, the wider public, industry and international partners yielding demonstrable cultural change, reduced emissions and enduring, growing benefits to the defence environment.

Now is the time, ahead of COP26, to start this leadership by building a coalition of militaries to make meaningful declarations on adaptation, resilience and mitigation measures while also encouraging NATO to be bolder in its climate related ambitions. There is one chance now to be the first major military to declare a net zero ambition. This must not be missed. Building on the success of this declaration, and maintaining the momentum generated by this report, we can step up as the global leader in climate security; extending military to military relationships and elevating the UK’s global credentials.

Operational Capability and Support. To support and enhance these credentials DCDS (Mil Cap) must apply an appropriate ‘climate lens’ for all military capability decision-making. A set of Defence Climate Assumptions must now be developed against which future capabilities are tested

⁷³ collated at App 1 to chapter 5.

OFFICIAL

throughout their development that will ensure that decisions on future capabilities consider a climate-changed world. This not only sends a public signal of intent but also starts to realise operational advantage through increased resilience in our future equipment.

Operational capability is nothing without the logistics to support and maintain the equipment and with over 50% of emissions generated by running our equipment, this is an area where the foundations for progress must be laid now if we are to transform our capability by 2050. Development of an energy and fuels sub-strategy is a vital step in choosing an approach on cleaner, more resilient energy options by 2025. For example, on the use of synthetic aviation fuels (SAF), initial work by Air Command indicates that up to 50% of SAF could be mixed with conventional fuel in the future (to deliver around 30% emissions reductions). The barrier to defence making use of this technology now is the prohibitive expense (SAF is nearly four times the price of conventional fuel). But these prices will reduce over time. Forging relationships to explore shared approaches with NATO partners, international allies, NGOs, and across government, agencies and wider civil society will be crucial to successful integration of such technologies.

Science, Research and Development. R&D has an integral role to play here, exploring and setting out a range of defence climate and sustainability research priorities, question-sets and multi-year engagement plans in areas such as the energy and fuels sub-strategy. Defence is already working closely with dstl and CSA has also made sustainability part of their strategy. Working hand in glove with these organisations, we must clearly communicate our climate and sustainability priorities to our science and technology stakeholders so they can seek ways to meet our defence and security challenges.

Industry. In collaboration with FMC and DE&S, the defence Chief Commercial Officer must develop our relationships with industry through procurement and commercial partnering if we are to exploit future technologies at a pace to maintain operational advantage. We must engender the notion of defence as a fast follower which interrogates the sustainability and carbon implications of our procurements and investment decision making and exploits low-carbon opportunities. Initiatives such as appropriate weighting to low-carbon options during capability acquisition assessment must be adopted now to send a clear message that sustainability is an integral part of investment decision making.

Working with our supply chains, both current and future, we must understand their carbon footprint and how that can be abated through the publication of procurement standards which reflect defence and wider government net zero ambitions and sustainability requirements. Defence must work, and be seen to be working, only with those companies that can demonstrate their commitment to sustainability, social value and circular economy principles.

Head Office, Commercial and Procurement. Our commercial and procurement approach must be underpinned by changes in our financial decision making. Carbon (or CO₂e) budgets must be managed in tandem with defence's financial system which appropriately factors emissions and social value into assessments of cost-effectiveness by prioritising whole-life costings, including the *carbon* cost of operation and disposal. An important first step in understanding how defence will resource our future ambitions will be engagement with DG Fin on a set of 'Greener Defence through Finance' principles. These will look to be prioritised and delivered through the Finance function and signpost future change in the Finance functional strategy.

Working alongside the existing functional leads across the Head Office, a Climate Change and Sustainability (CC&S) Directorate will be established to coordinate and cohere the recommendations from this report. The relationships it builds across government will be critical in the success of the shared endeavour to reduce emissions across the public sector. The Directorate must set the standard for the staff in the defence organisations to meet CC&S expectations.

The first steps of this nascent team will be to deliver a defence-wide consultation on carbon budgeting; this must be collaborative if it is to succeed in the delegated era. As important will be

OFFICIAL

OFFICIAL

the veracity of the data on which CC&S decision making is founded. With CIO, the CC&S Director will establish a single data dashboard informed by an accredited and standardised methodology for CO₂e capture that will be adopted across defence. Annual reports, the first of which will form the foundation and framework for future carbon budgeting, will demonstrate the creation of a single source data architecture, managed by Head Office, and recognised as best-in-class by partners and allies.

6.2 How are we going to deliver this?

To deliver these ambitions, a number of artefacts, such as the carbon budget regime, sustainability rules for procurement and commercial, financial principles and Defence Climate Assumptions outlined above will need to be developed. To make progress these must be embedded in our business as usual activities by 2025, and ideally sooner.

An iterative, collaborative (both within and outside of, defence) process of design, trial, review, improve and implement must be started now if we are to leverage best practice from across our partners and deliver the sustainable transformation prioritised by the Secretary of State for Defence at RUSI in December 2020. The strategy has been unable to get into the level of detail required to set these foundations properly and more work, resource and effort is therefore required. But without redesigning our approach to these fundamental enabling activities we will be unable to 'match our ambitions to our resources...be more transparent in our equipment programme and ruthless in our decision making' (SofS, 2020).

The scale of ambition. These ambitions largely do not come at a cost to defence, at least initially. But if the work is not begun *now* we will fail to embed the mindset change in our organisation that is *the* fundamental enabling action in this hugely ambitious transformation. There must be clear tasks set out in the Defence Plan towards achieving these ambitions. Sustainability must be a corner stone of subsequent Integrated Reviews and clear prioritisation of sustainability ambition must be highlighted in future Spending Reviews.

The stakes for this endeavour could not be higher, but this is opportunity not threat. The ambitions set out in this strategy offer a significant element of the 'opportunity not just to transform defence but to create thousands of highly skilled jobs at home; harnessing our advantages in science and technology, research and development; driving exports and generating prosperity; and enabling us to build back better and level-up across the four nations of our United Kingdom' (SofS, 2020). Defence, by stepping forward now, can lead across Whitehall and the global military community, sending a clear message to our adversaries and cementing our position among the pre-eminent militaries in the world.

6.3 Where we are now?

The funding of sustainability-based initiatives has achieved mixed success during routine budgeting cycles. As a result, defence is pursuing several low-level sustainability-based projects (many of which are currently limited to pilot studies). These are captured in Figure 14, which represents defence's current baseline assessment of CO₂e emissions out to 2050. Against a Do Minimum Option, it is anticipated that the 'greening of the grid' will make the most significant contribution to net zero. However, these emissions reductions cannot be claimed against MOD GGC. **The current approach is not ambitious enough to address the scale of expected government mandated action to achieve a 30% emissions reduction from the estate by 2025.**

OFFICIAL

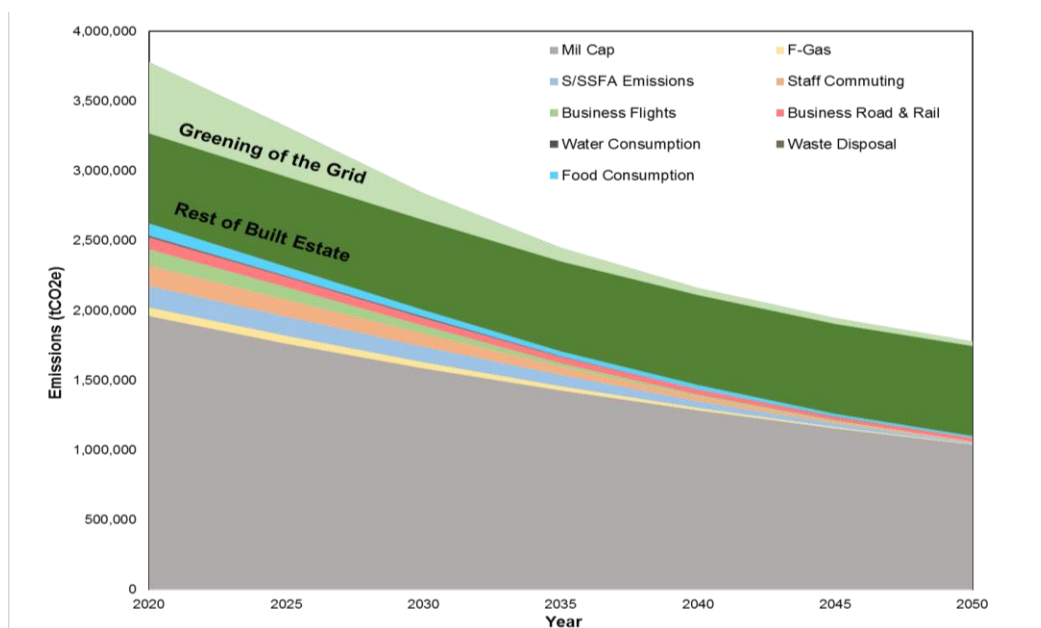


Figure 14: Current Baseline and Projected CO_{2e} Emissions Profile to 2050 with Greening of the Grid (GGG)⁷⁴

The options available to defence now are set out below in priority order starting with that which must be done to meet Government legislation.

6.4 What must we do and what are the choices?

Inevitably there are areas where investment will be required, but there are choices. This next section sets out the options available to defence now to build resilience against a future shaped by climate change and to begin its sustainability transformation. The over-riding logic for this approach is the need for resilience and security, both financial and operational, offered by reducing energy demand and diversification of energy supply; the advantage of reduced emissions (in line with government direction) is an associated benefit. This strategy acknowledges the sustainability work that is going on at TLB level, but Head Office now needs to set clear priorities against which initiatives can be judged to ensure that investment delivers maximum returns for defence and meaningful progress is made. If defence does not take the opportunities now, it will be unable to afford them in the future. They are set out in priority order against the following financial framework:

- **First equal.** Legal and government mandated targets
- **First equal.** Securing OGD funding for sustainability initiatives to preserve the defence budget
- **Second.** Building a database to allow decisions to be made.
- **Third.** Schemes that offer a financial return on investment
- **Fourth.** Schemes that offer the highest reductions in emissions but will come at a net cost to defence

Defence will start its transformation away from carbon to a more financially and environmentally sustainable footing by prioritising improvements to the built and rural estates. The estate offers opportunities now both to sequester emissions in line with expected government direction and reduce emissions, and associated running costs, from the built estate. Considering the rural estate, opportunities must be taken to improve the environment and biodiversity if defence is to maximise the benefits from the introduction of the ELMS (replacing current agricultural subsidies;

⁷⁴ Silt Chart Notes and Caveats at Annex H

OFFICIAL

the BPS). A number of estate focused initiatives are both technologically mature and have extant plans drafted which can be quickly refined to enable rapid investment choices.

Legal and government mandated targets. Against the four priorities set out in the introduction, there are a number of initiatives at sufficient maturity to enable defence to invest quickly to achieve the mandated targets. These are outlined below:

- **Greening Government Commitments:**
Invest in **DEO** for low carbon construction new build if defence is to achieve its internal target of a 10% reduction (against 2017 figures) of its kWh energy use. This equates to a 25% reduction in CO₂e emissions.
 - Currently, any new buildings constructed as part of DEO will be built or refurbished to existing standards which means that they will continue to be a net emitter.
 - Work is ongoing with DEO's commercial partner, Mace Construction Consultants, to refine the options for the overall construction programme; further work will be required to understand the detail of uplifting buildings from the current JSP315 standard to net zero.
 - This target includes changes to behaviours (estimated no cost) to deliver c.3% energy savings per annum on top of those from DEO.
- Invest in **Building Energy Management Systems (BEMS)**. These are integrated, computerised systems for monitoring and controlling energy-related building services, plant and equipment, such as heating, ventilation and air conditioning (HVAC) systems, lighting and power systems. Savings are in the region of 5% energy use per annum.
- **Infra to support ULEV.** This does not offer a return per se but is required to enable the government mandated ULEV targets. Note that the estimates are against user and visitor projected demand out to 2032. As the rate of internal combustion engine retirement accelerates, there is likely to be a requirement for further charge points thereafter. This includes:
 - **MOD technical estate** to deliver the infrastructure necessary for the conversion of the Defence White Fleet to ULEV.
 - all **UK-based SFA** to be ULEV-enabled.
- **Sequestration.** In anticipation of forthcoming targets on natural capital, investment is required now to maximise defence's sequestration opportunities from the rural estate to offset the irreducible minimum emissions at 2050 where it has been impossible to move away from carbon. Analysis is required to baseline the sequestration potential of the rural estate. Concurrently investment must start now in woodlands and peatland restoration.

Attracting OGD funds for reducing emissions on built estate and increasing sequestration opportunities. Work in this area must be focused on influence efforts to ensure multi-year availability of funds. While the current challenge is the short-term nature of these initiatives, the MOD needs to be agile enough to take advantage of these opportunities when they occur, leveraging funds for sustainability in order to preserve the defence budget for military outputs.

6.6 What we could do?

There are further 'spend to save' projects that will deliver return on investment, either financially or through better understanding of our energy needs, should defence choose to invest. These are outlined below:

OFFICIAL

OFFICIAL

Building a data base to allow decisions to be made

- Establish a **CC&S Directorate** to focus on establishing a data led approach to driving defence sustainability transformation. Note this has been agreed and is covered in more detail in the Governance & Head Office sub-chapter.
- **Sub metering** expansion to all principal MOD sites has the potential to drive behavioural change as well as enable targeted interventions in management of energy demand. It will also improve significantly the accuracy of data collected from defence sites.

Those schemes that offer the most return on investment over time

The **Modern Energy Partners** project seeks to apply a combination of innovative and established energy efficiency measures, demand management and low carbon power and heat technologies that are practically deployable to maximise impact and payback. Extrapolation from pilot schemes indicates it has the potential to deliver a c.60% reduction in CO₂e emissions. The schemes are indicatively broken down as follows:

- **LED lighting.** This should be prioritised alongside BEMS as there is no reliance on any other works. The reduction in energy demand delivers an immediate financial saving year on year.
- **Building fabric and decarbonising heating systems.** These two measures should be coupled as the building fabric requirements will be driven by the requirements of low-carbon heating. Ideally, defence should stop investing in new fossil fuel heating systems on asset replacement as soon as possible and switch to installing low carbon systems. This investment timing should therefore align with the general asset replacement investment programme and is unlikely to be completed, possibly even started, in Epoch 1. It is expected that the cost of retrofit will reduce over time as technologies mature and proliferate, and the number of buildings requiring retrofit reduces in line with replacement infrastructure programmes such as DEO. This does not exempt defence from starting a 'no regrets' retrofit approach towards the end of epoch 1 leveraging external sources of funding such as the BEIS public sector decarbonisation scheme.
- **Electrical system upgrade.** Note that the uplift in EV charge points will place a significant extra burden on the existing electrical networks within sites. Coupled with the increased demand resulting from decarbonising the heating system through electrification there will be investment required to upgrade and reinforce defence's electrical networks. The scale of this work will depend on optimising the mix of electrical and other renewable energy sources.
- **Renewable energy generation should be pursued** to increase security and operational resilience by generating our own energy, a resilience opportunity hitherto unavailable. The MEP approach considers the energy demand of individual sites rather than the energy supply potential of unused land. It assumes that, to meet the rising cost of electricity across defence (rising demand coupled with the higher price of grid supplied electricity when compared to fossil fuels such as gas) each location will have some form of renewable energy generation. It also does not look to over-produce energy that can be exported.

A longer profile may be more realistic to deliver a net zero estate by 2040 and a zero-emission *built* estate by 2050.

- **Ground mounted Solar PV** offers similar resilience opportunity outlined in the MEP renewable energy generation option above. It seeks to turn unused land into solar farms to reduce the cost of electricity for defence (payback around year 20). It is likely that a combination of both the MEP 'location demand' and wider 'opportunity for supply' approaches will be required. Defence will likely need to secure private finance to make either of these options attractive.

OFFICIAL

OFFICIAL

Those schemes that offer the highest reductions in emissions (but will cost with little abatement).

- **Uplift the SFA estate** (net of reductions through DEO and FAM) to net zero standard. There may be payback over time from increased rates for SFA. Further analysis is required to understand the true cost of retrofitting the extant accommodation that will still be in use in 2050 and identify when is the most cost-effective time to conduct the building work.
- **Shift to 50% Synthetic Aviation Fuel.** Mixing 50% SAF would increase the cost of aviation fuel (based on the current difference between trading prices between conventional fuel and SAF and excludes the delivery premium added by suppliers which varies by volume and delivery location). However, in time it is anticipated that the cost of SAF will reduce as it becomes more readily available on the open market.

OFFICIAL

Annex A – IMCCS The World Climate and Security Report 2020

KEY RISKS AND OPPORTUNITIES

Key Risks: Significant or higher risks to global security under current circumstances

Risk 1. Climate change-exacerbated water insecurity is already a significant driver of instability, and according to 93% of climate security and military experts surveyed for this report, will pose a significant or higher risk to global security by 2030.

Risk 2. Though fragile regions of the world are facing the most severe and catastrophic security consequences of climate change; all regions are facing significant or higher security risks due to the global nature of the risks. For example, 86% of climate security and military experts surveyed for this report perceive climate change effects on conflict within nations to present a significant or higher risk to global security in the next two decades.

Risk 3. As reinforced by the 31 nations represented in the International Military Council on Climate and Security (IMCCS), an increasing number of national, regional and international security and military institutions are concerned about, and planning for, climate change risks to military infrastructure, force readiness, military operations, and the broader security environment.

Risk 4. Climate mitigation, adaptation and resilience efforts are increasingly urgent to avert the significant security consequences of climate change, yet some proposed solutions such as geoengineering could present negative second-order effects to global security, if not implemented carefully.

Risk 5. Rising authoritarianism, sharpened global competition and national agendas are hampering the needed cooperation among nations to address the security risks of climate change.

Key Opportunities: A path forward for global security cooperation on climate change

Opportunity 1. National, regional, and international security institutions and militaries around the world should advance robust climate resilience strategies, plans and investments, especially regarding climate implications for water and food security and their associated effects on stability, conflict and displacement, in their primary mission sets or lines of effort.

Opportunity 2. Security and military institutions should demonstrate leadership on climate security risks and resilience and encourage governments to advance comprehensive emissions reductions and adaptation investments to avoid those security disruptions. Military organizations can also lead by example through taking advantage of the significant opportunities to adopt lower carbon energy sources and make progress on other greenhouse gases beyond carbon dioxide.

Opportunity 3. Climate-proofing development assistance for vulnerable nations which are likely hotspots of instability and conflict, as well as climate-proofing other policies affecting those regions, should be a priority for conflict prevention. Assistance should be aimed at climate resilience challenges such as water security, food security, and disaster preparedness.

Opportunity 4. The international community should embrace a Responsibility to Prepare and Prevent framework, given unprecedented foresight capabilities regarding the unprecedented risks of climate change. This includes ensuring all levels of government and civil society, including all national, regional and international security institutions, are prepared for the security implications of climate change.

Opportunity 5. Security institutions around the globe should integrate climate knowledge and training into institutional frameworks to ensure that knowledge and understanding of climate change threats permeates the organizational culture. For example, climate security curricula should be added to national and regional training and Defence colleges, professional military education, and climate security should receive significant treatment in international security and military fora.

OFFICIAL

Annex B – Examples of Effective Outcomes (from DCDC research)

Adoption of green technology will result in a nimbler UK Armed Forces with a responsive posture and with reach:

- Increased use of solar, wind (including nuclear) power reduces the logistic footprint for power generation and hydrocarbon fuel supply, increasing agility and (partially) removing the logistic tail of fuel supply for ground power. In Afghanistan in 2013 one day's fuel supply was defined as 1,000,000 Litres which equates to over 18,500 tCO₂e a week.
- Increased use of solar power allows the reduction in the Air Transport footprint for deployment of logistical support, allowing more capacity for the fighting force. Of note, solar power has a lower IR signature than diesel generation so is better placed to reduce the signature of friendly forces.
- The ability to act with reach and agility is greatly enhanced by reducing the logistic tail. This could be enhanced by additive manufacturing (3D printing et-al) as it reduces the need to move, store and manage many spare parts by allowing on-site manufacture of what is needed.
- Batteries are used in almost all military capabilities and will be increasingly used into the future as systems move to 'more electric' or 'all-electric' platforms and as more electronic capability is produced. Fighting vehicles should increasingly become hybrid with batteries or alternative fuel sources being used to improve fuel efficiency and to provide silent watch and silent approach capabilities.
- A more digitised and data enabled battlefield will require more electronics to manage, process and transmit the increasing amount of data generated across all domains and this will require power. Improved sustainable energy resources can contribute to either increasing the endurance of such applications or reducing the carried mass of dismounted personnel and volume for the same power provision.
- Climate change and sustainability offers significant reinforcement for the direction Defence wants to take in terms of reducing the reliance on people through uncrewed and semi-autonomous vehicles, increasing synthetic training and increased resilience (the annual cost of UKAF training was estimated at £7.2bn in 2013). By increasing the synthetic environment and increasing the opportunity for greater numbers of smaller and cheaper equipment, there is greater opportunity for alternative environmentally friendly fuels to be used, thereby reducing emissions and increasing the effectiveness, sustainability and resilience of the Force.
- There is significant opportunity for savings to be generated as the cost of renewable energy reduces, whilst at the same time increasing resilience and self-sufficiency.

OFFICIAL

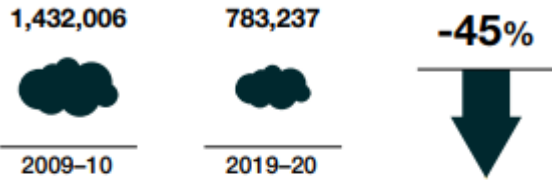
Annex C – Linkages to Defence Activity and the UN Sustainable Development Goals



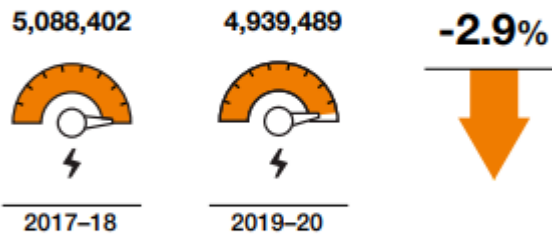
Annex D – Greening Government Commitment Performance 2016-20

Reduce Estate Energy & Business Travel

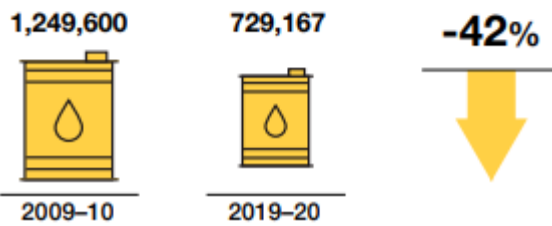
GHG emissions (Tonnes CO₂e)
Target: Reduce GHG Emissions from Estate Energy and Business Travel by 39.9%



Reduce estate energy consumption (MWh-year)

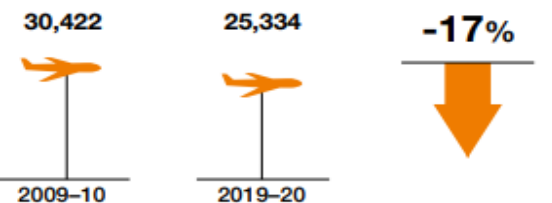


Capability Fuels ('000 litres)



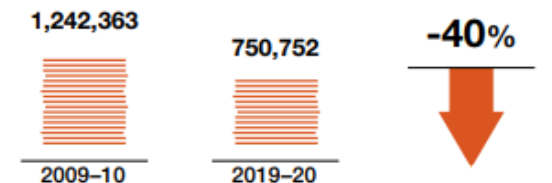
Reduce number of domestic business flights

(No. of flights)
Target: Reduce the number of domestic business flights by at least 30% (excludes front line command military flights).



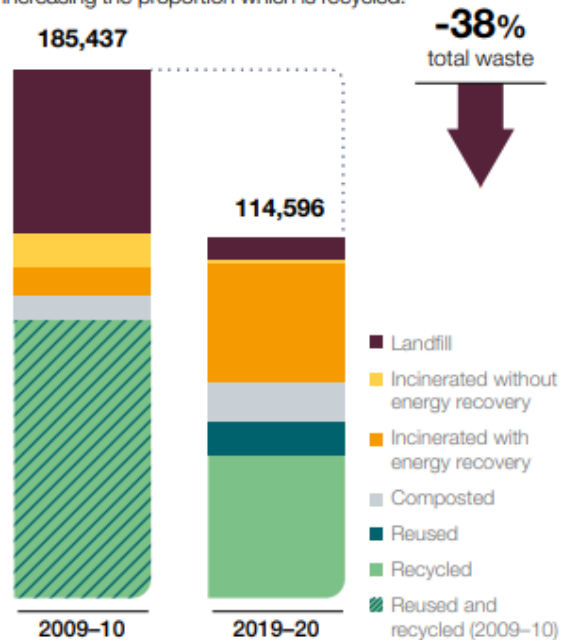
Reduce paper consumption (A4 Reams equivalent)

Target: Reduce paper use by 50%.



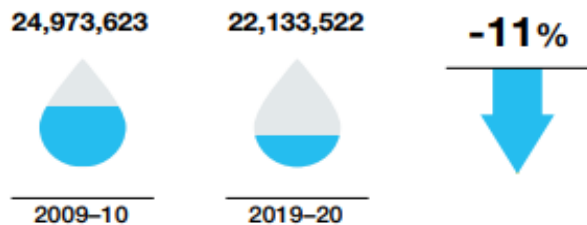
Reduce waste (Tonnes)

Target: Reduce the amount of waste going to landfill to less than 10%. Also continue to improve our waste management by reducing the overall amount of waste generated and increasing the proportion which is recycled.



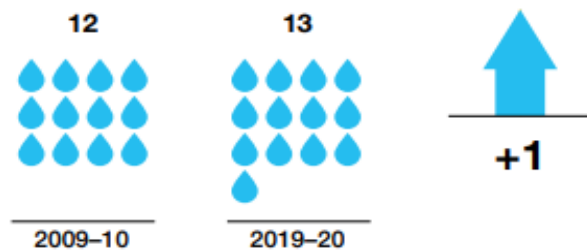
Reduce estate wide water use (m³)

Target: Reduce water consumption on sites in Great Britain by 15%.



Reduce office water use (m³-FTE)

Target – Reduce consumption at locations defined as the government office estate, to less than 6m³ per FTE.



OFFICIAL

Annex E – The main findings of the NAO Sustainability Overview published May 20

The Department has traditionally seen environmental sustainability as a subset of health and safety risks and hazards, making it a 'Cinderella issue'
The Department has identified that its oversight arrangements for environment matters have not been functioning well
The government's net zero emissions target will present a significant challenge for defence and will be considered as part of the 2020 Integrated Security, Defence and Foreign Policy Review
The Department has already achieved its GGC target to reduce GHG emissions by 40% from 2010 levels, but faces challenges achieving other GGC targets
A significant portion of the Department's energy usage is outside the of scope of the GGC targets, and these emissions are reducing at a slower rate.
Natural England has assessed 48% of the Department's English SSSIs as being in favourable condition, but more than half have not been assessed since at least 2011
In practice, the Department has made limited progress in improving the energy efficiency of its buildings.
The Department does not consider the cumulative impact of planned procurements
The Department is not monitoring compliance with mandatory government buying standards or its own environmental procurement framework

OFFICIAL

OFFICIAL

Annex F – CCC Recommendations relating to MOD:

Recommendation grouping	CCC Recommendation	MOD Response
Sustainability	<p><i>Implement plans for a net zero consistent, climate resilient estate.</i></p> <ul style="list-style-type: none"> • <i>Develop and implement plans to make all MOD buildings and vehicle fleets zero-carbon in the long term. Contribute to halving direct emissions in the public estate by 2032 at the latest.</i> • <i>MOD could also share learning related to its Estates Risk Assessment process with other government departments.</i> 	<p><i>In February MOD launched the Defence Climate Change and Sustainability (CC&S) Review³²¹ to develop the MOD's response to the UK commitment to bring all greenhouse gas emissions to net zero by 2050 (NZ50). The outcome of the review will be a refreshed defence climate change and sustainability strategy and subsequent implementation plan with a clear, agreed defence ambition and defined future state in support of NZ50 and a route map for Defence's NZ50 response over one to five years, five to fifteen years and beyond.</i></p> <p><i>In parallel with the CC&S Review MOD is developing an Infrastructure Energy and Emissions Sub-strategy and initiating on-site low carbon energy generation, net zero buildings, submetering/data management projects to inform wider adoption.</i></p> <p><i>The CC&S Strategy includes the development of a natural capital asset register for the defence estate which will allow the identification of opportunities for enhancing natural capital and carbon capture and storage on the defence estate, cognisant of the Defence Estate's primary purpose.</i></p> <p><i>The Department's bespoke Climate Impacts Risk Assessment Methodology³²² has been shared with OGDs.</i></p>
Sustainability	<p><i>Assess the potential for alternative fuels (such as low-carbon electricity, hydrogen or bioenergy) to be used for land vehicles, ships and aircraft, and consider opportunities to support wider use of low-carbon technologies in civil applications (e.g. through research or demonstration).</i></p>	<p><i>Part of the Logistics Technology Investigations Project (2019-22) is focussed on fossil fuels, alternative energy and what actions can be taken to address net zero Greenhouse Gas Emissions by 2050. It will provide a cost benefit analysis of possible opportunities to reduce fossil fuel usage and identify suitable trials to demonstrate effectiveness.</i></p> <p><i>The MOD Global Bulk Fuel Framework is being updated to enable the supply of aviation jet fuel containing alternative fuel blending components. Published on 12 Dec 20, this will have the potential for up to 50% alternative fuel blended with conventional jet fuel to be supplied to MOD.</i></p>
Resilience	<p><i>Provide assurance to the Committee that planning is taking place for domestic and overseas climate-related risks to operations (including risks to personnel and effective operation of equipment). These plans should include climate-</i></p>	<p><i>Defence includes climate-related risk in their annual Defence Capability Assessment. The intent is to make this explicit in future annual assessments. This will ensure that Commands take into consideration the impact of climate change and ensure that the capability programmes are sustainable and resilient. The Integrated Review will take into consideration the</i></p>

OFFICIAL

	<i>related risks linked to global conflict, mass migration and global governance set out in the UK Climate Change Risk Assessment.</i>	<i>future risks and threats to defence, of which climate change related risk will form an important part.</i>
Resilience	<i>Ensure the Department's strategy addresses the potential need for an increased role in climate-related disaster avoidance and relief in the UK and overseas.</i>	<p><i>Defence's policy and strategy for the next 5 years and beyond is currently subject to an Integrated Review. This will result in a series of Defence Tasks which will take into consideration the current and future risks to the Armed Forces and likely operations. Nascent policy in protecting the homeland and global positioning will form part of defence's response to disaster avoidance and relief.</i></p> <p><i>MOD is working with the Alan Turing Institute and the Met Office to consider whether the Global Urban Analytics for Resilient Defence model could be used to understand where Climate Change may induce conflict hotspots and potential for Humanitarian Assistance Disaster Response.</i></p>

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/928005/government-response-to-ccc-progress-report-2020.pdf

OFFICIAL

Annex G – External and Internal Sustainability and Environmental Meetings

Cross Government Meetings	Focus
NSIG committee for climate security	
Adaptation Sub-Committee on Climate Change Domestic Adaptation Board	Defra chair. Oversees cross-Government action on adaptation. It includes members from most government departments. Responds to the UK Climate Change Risk Assessment (CCRA)
The National Adaptation Programme	Defra chair. Sets the actions that government and others will take to adapt to the challenges of climate change in the UK. Develops the CCRA
Cross-Whitehall 25 Year Environment Plan Board	Defra chair. D Infra attends Environmental improvement main focus
Cross-Whitehall Sustainable Development Goals Planning & Performance Group	Temporary group to develop Gov report to UN on progress against the goals
Cross-Whitehall Sustainable Development Working Group	Ad Hoc in nature usually chaired by Defra and FCDO. Acts as a support group and to air ideas.
Defra and NFU species management	Focus on biodiversity
DEFRA Resource & Waste Strategy WG	Development of the resource and waste strategy for England
EU Environmental Defence Network	
EU Consultation Forum on Sustainable Energy in the Defence and Security Sector	On hold pending BREXIT outcomes
NATO Environmental Protection Working Group	Attended by Army
HMT/Defra Natural Capital Steering Group	Ad hoc group to determine the value of Gov NC
Marine Management Organisation Management Board	Biodiversity protection interest
Marine Planning Authorities UK	Biodiversity protection interest
Nature Recovery Network Partnership Management Group	Natural England Lead. FMC Infra has a seat, biodiversity improvement main focus
Biodiversity Net Gain Market Advisory Group	Biodiversity improvements
MOD/Natural England/SNH/NRW	Biodiversity protection interest
UK Environmental Regulators Liaison Meeting	EP main focus
Joint Nature Conservation Committee	Biannual meeting liaison meeting with FMC Infra. Key topics underwater noise and low flying in relation to protected species disturbance

OFFICIAL

OFFICIAL

MOD Meetings	Focus
DSEC	Perm Sec Chair. Focus on Environmental Protection
DSEC Working Group	Focus on Environmental Protection
Sustainable MOD and Energy Steering Group (SMESG)	3*co-chaired steering group (MilCap and COO), main focus on GGC progress and other internal targets i.e. capability energy reduction as set out in MOD Sustainability Strategy
Sustainable MOD and Energy Working Group (SMEWG)	Chair FMC infra. SME working group main focus on delivering GGC. Development of MOD Sustainability Strategy.
Climate Change and Sustainability Implementation Group	Temporary group, the intent is to formalise. Set strategic direction on all defence-related climate change and sustainability matters
DIO Sustainability Steering Group	To deliver against the DIO Sustainability Strategy
DIO Suppliers Forum	Led by DIO looks at best practice and ideas sharing with suppliers
DIO Waste Working Group	Chaired by DIO. Pan MOD waste management working group develop MOD waste strategy
ICT Sustainability Working Group	Chaired by Def Digital. Pan MOD working group looking to develop MOD ICT strategy and improve performance
MOD Industry Sustainable Procurement Group	Led by DES looks at best practice and ideas sharing
SDA Sustainability and Climate Resilience Working Group	Chaired by SDA. Include MOD and suppliers to work towards increased sustainability and climate resilience. Investigating supply-chain vulnerabilities.
Various TLB sustainability meetings	Format and aims varies by TLB
Westdown Working Group	Chaired by DIO. Looking at Carbon Sequestration and Natural Capital.

OFFICIAL

OFFICIAL

Annex H – Silt Chart Notes and Caveats

All three silt charts represent an estimation of potential emissions over the next thirty years. They are separated into three different scenarios, focused on changes to the built and rural estates.

Government greening of the grid (GGG) could reduce built estate emissions 41% by 2050, compared to 2017 baseline emissions (Silt 1). This is a notable reduction but built estate emissions are still significant at 680,463 tCO₂e.

Better Defence Estate proposals could reduce built estate emissions nearly 30% by 2025, compared to 2017 baseline emissions (Silt 2). This 339,208 tCO₂e reduction is based on a combination of measures which reduce emissions by 25 percentage points (GGG; estates rationalisation; behaviour change) and 5 percentage points (building energy management systems; and proactive maintenance), respectively. This also assumes a 10% reduction in energy consumption.

The rural estate could offset between 285,500 and 1,000,000 tCO₂e by 2050 (Silt 2). This assumes that sequestration is zero in 2020 as existing sequestration is likely offset by current agricultural practices and other carbon emissions in the rural estate. To achieve the lower bound, three rural estate Spending Review projects (peatland restoration; military and non-military forestry; other grassland and soil investment) must have continued investment past their original 2030 end date. The higher bound is an aspirational goal for future sequestration based on large scale investment in the rural estate over the next thirty years.

Other emission saving projects could reduce built estate emissions further (Silt 2). A residual 92,463 tCO₂e in 2050, as electricity consumption still generates emissions, does not account for all projects including the following: Daybreak and Prometheus; decarbonising thermal heating; and LED lighting. It is likely that these additional savings would help make a zero emissions estate by 2050.

Net Defence emissions could range between -15,070 and 699,430 tCO₂e in 2050 (Silt 3). This is based on total emissions (984,930 tCO₂e) less total sequestration (285,500 or 1,000,000 tCO₂e). It uses the estates estimates from Silt 2 and uses previous AADP Cohort 2 figures to show a general reduction in all other emission types apart from military capability. This is due to the introduction of synthetic aviation fuels which have the potential to reduce aviation fuel emissions by 18%, with a 30% synthetic blend. This could rise to 30% with a 50% blend, although it is unclear when this will be attainable. This means that a net zero Defence is possible by 2050.

The c.3.8m tCO₂e Defence emissions baseline is for scope 1 and 2 emissions only. Scope 3 emissions are excluded as they have yet to be validated. It is assumed that the baseline will rise significantly when accounting for scope 3 supply chain emissions.

Other climate-related obligations have been unaccounted for in the silts. Government Greening Commitments (GGC) and Ultra-low Emissions Vehicle (ULEV) targets are two examples of this. The latest GGC targets are being currently being drafted and ULEV infrastructure will likely reduce business travel emissions, not built estate emissions.

Silt Chart Specific Notes:

Defence's Potential net zero Trajectory to 2050 Silt Chart (figure 1)

- Estimates from the best available data as at December 2020.
- All data (apart from Built Estate, Sequestration, and Mil Cap) is from an AADP Cohort 2 forecast. Built Estate is based on DIO figures with a base year of 2017/2018. Sequestration figures are based on a combination of DIO and AADP Cohort 2 estimates, representing a range in sequestration based on current investment proposals (continued past 2030) and maximum potential by 2050. Mil Cap includes potential reductions from synthetic aviation fuel, building on AADP Cohort 2 data, though its emissions profile is unclear.

OFFICIAL

OFFICIAL

- Solid lines show costed and predicted sequestration. Dashed lines show more provisional estimates based on a range of future investments past 2030. Both lines are linear as there are no complete profiles. It is realistic to expect a curved line, flatter in epoch's 1 and 2 but steeper in epoch 3.
- Total emissions are circa 3.8m tCO₂e, this does not include scope 3 emissions. Future analysis will include an additional supply chain silt which will increase total emissions by an unknown, but significant, amount.
- For all headings apart from Built Estate, the chart assumes a general reduction in emissions based on AADP Cohort 2 estimates.
- The MEP estates extrapolation projects are not included, such as decarbonising thermal heating and LED lighting etc., but would result in lower Built Estate emissions.
- It should be noted that targets and conversion factors assumed in Built Estate emissions may change. Not all energy generated by fossil fuels can be transferred into electricity, leading to a residual in 2050.

Current Baseline and Projected CO₂e Emissions Profile to 2050 with Greening of the Grid (GGG) Silt Chart (figure 14)

- Estimates from the best available data as at December 2020.
- All data, apart from Built Estates (GGG, Rest of Built Estates), is from an AADP Cohort 2 forecast. Built Estates is based on DIO figures with a base year of 2017/2018.
- Total emissions are circa 3.8m tCO₂e, this does not include scope 3 emissions. Future analysis will include an additional supply chain silt which will increase total emissions by an unknown, but significant, amount.
- It should be noted that targets and conversion factors assumed in Built Estate emissions may change. Not all energy generated by fossil fuels can be transferred into electricity, leading to a residual in 2050.

OFFICIAL

