Strategic Command

Defence Support

Towards Self Sufficiency of Operations for Defence

A Defence Support Concept Note

Document Information

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Foreword

Defence Command Paper 2023:
Defence is already being impacted by climate change. We must face the reality of operating in a harsher climate and adapt accordingly, enhancing both our capabilities and our operational advantage. Defence is also committed to playing its part in meeting the Government's ambitions for greater sustainability and resilience, including targets for Net Zero. These two objectives – contributing to achieving Net Zero and being more effective – are not mutually exclusive, as highlighted in Defence's recent Sustainable Support Strategy. *We will move from a model of sustaining at reach, to one which is **designed for self-sustainment**. In this way, environmental technologies will give us the means for a revolution in how we operate and fight. (Page 36, para 32)*

The delivery of Defence Support, which comprises Logistics, Engineering and Equipment Support, consumes around a third of the annual Defence budget[1]. It is a highly complex endeavour which must deliver Support across the globe at scale and intensity (including Warfighting) to enable Operational Advantage to our Armed Forces. The Defence Command Paper 2023 outlined how Defence must respond to a more contested and volatile world; one in which the delivery of Support is becoming more challenging.

In terms of challenges, The Support demand signal is likely to increase for the future force; increasing energy requirements to enable more powerful computing and autonomy being prime examples. The future force will be required to operate in a contested environment where lines of communication, digital networks and infrastructure will all be targeted. Protection, dispersal and concealment will become essential. The future force will also operate in degraded and confused environments where competition for finite commercial resources will increase. And we are already operating in an era of unprecedented climate change where we need to both adapt to new realities and mitigate the risks posed by further change.

So how can Support respond to these challenges and continue to enable Operational Advantage? Defence must move from a model of sustaining at reach, to one which is designed for self-sufficiency: Towards Self-sufficiency (TSS). Not only will this help to reduce the demand signal, along what could be extended lines of supply, but it will also make the future force more resilient and agile. Self-sufficiency will be driven by military necessity and this concept does not advocate an approach of 'do without'. It explores how Defence can 'do differently' to better exploit what it already has. The concept examines how Defence approaches the supply of Energy, Water, Food and Materiel and can utilize Waste as a resource to become more self-sufficient. In doing so, the it provides a framework that will influence the delivery of future capability through self-sufficient approaches and technology. Ultimately this will enable Defence to deliver Operational Advantage through Support.

Defence Support, Deputy Head Futures

[1] DSN Report 2017, issued at the end of the Defence Support Network (Programme) concept Phase.

Toward Self Sufficiency of Operations for Defence – A Defence Support Concept Note

1 Contents

Version table

Version Number	Description	Date	Author	Comments
1.0	1st Edition	18 Jan 24	Maj SI Ahmed	Approver: DH Futures

1. What is the vision for the future?

1.1. Military Self-Sufficiency is the ability of a force to operate without relying on external assistance or resources. It is the capability to produce and procure the necessary operational resources at the point of use, resulting in increasing independence from the Support Enterprise where this will deliver operational advantage. The degree of Military Self-Sufficiency will vary with respect to the character of an operation within the Integrated Operating Framework (IOF) as detailed in Figure 1. As Support intensity grows, Self Sufficiency offers the potential to reduce the demand for commodities such as energy, food, water and even equipment spares, by generating them at or close to the point of use. As a result, the future deployed force will be able to operate with increased agility[2], higher operational tempo and increased resilience. This mindset will be embedded across Defence, from the capabilities, products and services that we decide to procure and the way that we procure them, through to how we operate and support them through life, and how we treat them at the end of their usefulness[3].

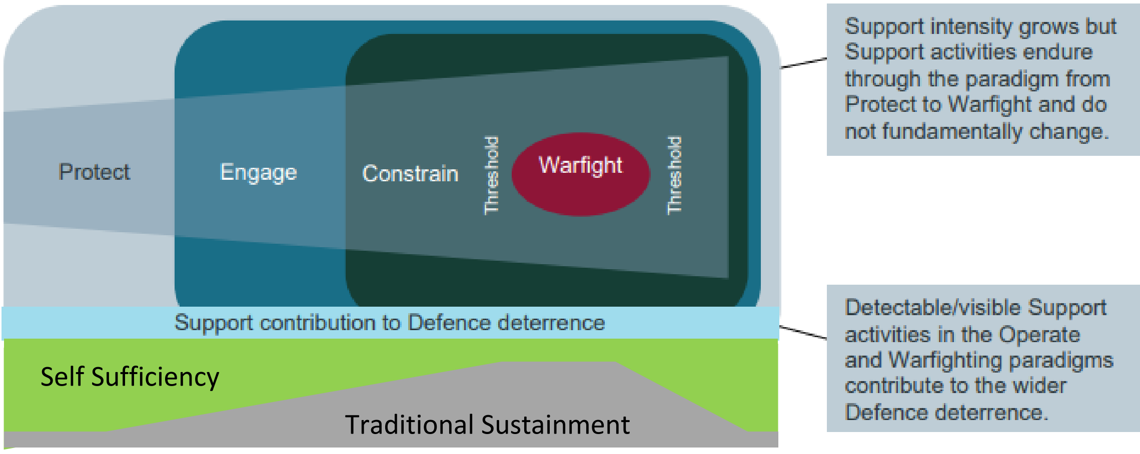

Figure 1 - The Role of Support Across the IOF

1.2. This vision can be achieved by using a range of technologies, methodologies and processes, intelligently designed into the way that the force operates and supported by new behaviours and cultures. This concept focuses on how self-sufficiency can be used to enhance the overall effectiveness of a force. It identifies 5 measurable areas of supply which are key to unlocking greater self-sufficiency. These are **Energy, Water, Food, Materiel and Waste[4]**. The perfect example of a self-sufficient force is one that deploys with a set of equipment and resources that allows it to operate indefinitely in a location by understanding, managing, and recycling resources in these 5 areas. The future force will be able to apply self-sufficiency at the time and place that it delivers the maximum operational advantage given the scenario. The degree of self-

[2] The ability to respond quickly to the unexpected, maintain sharpness of though, remain effective under arduous conditions, be flexible in overcoming the unforeseen and adjust rapidly (RLC Operational Handbook)
[3] The Sustainable Circular Economy (CE) for Defence should be read as a companion concept note.
[4] Any substance or object which the producer or the person in possession of discards, intends to discard or is required to discard. MoD Waste Strategy 2015.

sufficiency will be scaled to ensure that the Warfighter is always afforded the maximum benefit, alongside reduced demand on the Support Enterprise.

2. Delivering Operational Advantage through Self-Sufficiency

2.1. Operational advantage from self-sufficiency starts with accepting that there will be an increasing demand and competition for global resource[5]. This anticipates a growing demand for a widening range of resource. At a fundamental level this is the competition for the global supply of food, water and energy. It also covers the mineral resources that are required to develop and sustain military technology. At the macro level there is direct commercial competition for the development of civilian technology which has a far greater demand signal than UK Defence, its allies and even its adversaries. By better understanding what is needed to support an operation, pressure on these resources can be reduced, resulting in a more self-sufficient supply chain.

2.2. The future operating environment is likely to be less predictable, with more disruption to global supply chains, civil unrest and risks to UK interests overseas. More frequent weather events, overlaying the actions of enemies and neutral actors, will change the environment local to a deployed force[6]. A self-sufficient force will be less reliant on the supply chain and will be more resilient in this dynamic environment. Increased resilience in the supply chain will allow more choice of how we interact with the local population, reduce the likelihood of resource competition in theatre, eliminate dependencies or stimulate investment and development.

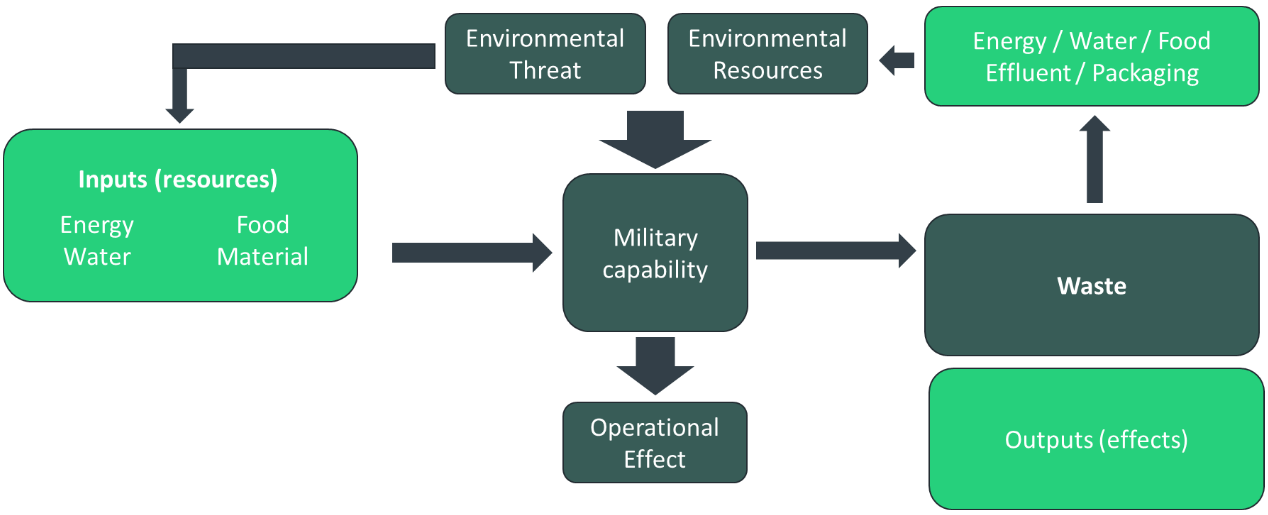

Figure 2 - Schematic of a Self-Sufficient Operation

2.3. The Sustainable Support Strategy (SSS)[7] sets a target of delivering Operational Advantage through greater self-sustainability on operations. This is supported by the

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[5] Global Strategic Trends 6, The Future Starts Today
[6] Ministry of Defence Climate Change and Sustainability Strategic Approach
[7] Sustainable_Support_Strategy_2022.pdf (publishing.service.gov.uk)

UKStratCom Climate Change and Sustainability Sub Strategy[8] which has also set the objective of delivering Sustainable Operations. Both strategies acknowledge that environmental sustainability can be the solution to the future force rather than an imposition on it. The concept of self-sufficiency of operations unites these two ideas to offer a solution where Defence can become more effective while also reducing its exposure to environmental risk and mitigating the extent to which its activity adds to the causes of climate change. It is increasingly clear that this concept is coherent with developing single Service concepts and strategies for tackling the Climate Change and Sustainability challenge[9].

3. Timeline

3.1. The evolution of TSS is aligned to the MoD Climate Change and Sustainability Strategic Approach. This will ensure that Defence stays in lockstep with the drive towards sustainability across industry and wider society.

3.1.1. Epoch one (2023-25)
Identify and quantify how self-sufficiency contributes towards the agility, operational tempo and resilience of a deployed force. Trial new and emerging equipment and infrastructure solutions up to and including an operational context. Understand the work of partners and allies.

3.1.2. Epoch two (2026-2035)
Widescale adoption of a self-sufficient approach in the delivery of Joint Operations by exploiting new technology. Adoption of the principles of self-sufficiency in specific equipment and operational infrastructure programmes. Alignment of effort with the work of partners and allies.

3.1.3. Epoch three (2036-2050)
Alignment between operational infrastructure and wider equipment programmes as the deployed force consistently operates at the technological limit of self-sufficiency alongside and in combination with partners and allies.

4. Why is Military Self-Sufficiency important for Operations and how can we deliver it?

4.1. Operating across the world, UK Defence is required to deliver effect across a range of climatic scenarios. Adversaries with a limited geographic range may be better adapted to a specific region that exposes the ‘climate flank’ of UK forces that are optimised for global relevance. A self-sufficient mindset aims to rapidly understand and generate our

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[8] UKStratCom Climate Change and Sustainability Sub-Strategy

[9] Chapter 2 of the SSSDP Baseline Report identifies that UKStratCom, Royal Navy, Army and Royal Air Force sustainability strategies incorporate self-sustainment on operations as ambitions for their visions of the Future Force.

own 'climate specialism' resulting in an increasingly diverse array of technologies and techniques for operating in different climatic environments.

4.2. This approach will drive the requirement to understand the operating environment and plan for the deployment of suitable equipment for the scenario. It will support the need for generic equipment architectures so that we can mix and match capabilities and the need to contract more effectively for Commercial and Military Off The Shelf (COTS/MOTS) equipment so that we can rapidly adapt to the region in which we are operating. More sophisticated decision support tools will be needed to understand the mix of capabilities that might be required for a given operation. Visibility of data defining how much energy, water, food and materiel we use today, in connection with how much of that is wasted, will be vital to moving towards self-sufficiency. The use of modelling and simulation, combined with large language models of our support data offers the opportunity to rapidly identify what capability is required for a given operation to best deliver operational advantage.

4.3. History shows a general trend of increasing Western military reliance on Strategic Lines of Communication (SLOC) for sustainment[10]. Technological development has consistently improved the ability of a force to package and transport supplies over increasingly long distances at greater speed, volume and accuracy. While the act of supplying a force has become technically easier, it has generated a reliance on over the horizon support. These long lines of communication are increasingly vulnerable to environmental and geopolitical threats, a fact that adversaries will seek to exploit with direct and indirect actions. Military Self-sufficiency is the opportunity to rediscover how we can 'live off the land' to a greater degree through better synchronisation of operational effect and resource demand.

4.4. A self-sufficient force will have a greater awareness of its demand signature and will be more precise about when and where it requires resupply. The pace of military operations is often dictated by when a force reaches the limit of the ability to supply resources. The future force will require re-supply less often than the adversary because they will be able to make their supplies last longer, but for the same or increased military effect. Reduced dependence on the Support Network at specific points in an operation may allow a force to deploy beyond the reach of existing lines of communication for longer periods or continue to be effective while the network adapts to a changing scenario. Self-sufficiency in some areas, such as energy, water and materiel (such as feedstock for advanced manufacture techniques) will create headroom in the supply chain for other sustainment stocks. Certain ammunition, complex equipment or spares may prove challenging to fabricate close to the point of use and this additional headroom will be used to increase their availability to the deployed force.

4.5. Demand for resource will be reduced by the recycling of in-theatre waste to produce new resource. New technologies will allow waste to be processed to deliver energy, water or feedstock for advanced manufacturing technologies. Smart management of electrical energy demand and the use of renewables will reduce the volume of fuel use, freeing up capacity or reducing demand. Support Information Models will be used to

[10] Defence Science and Technology Futures: Self Sustainment Hypothesis Final Report

present demand data in new ways that deliver more accurate demands so that resource can be prioritised to the most important activities in the operation. These models will be visible at the tactical, operational and strategic levels providing a common understanding of the Support picture.

4.6. Examination of operations in Mali[11] in 2022 identified that water, energy and food continue to be moved over long distances. Over a 12-month period, over 750,000 litres of bottled drinking water were transported to the operation from the Netherlands. Water supply already employs the principle of generation as close to the point of use as possible, but Defence continues to generate the requirement to transport bottled water over thousands of kilometres to support operations. Power generation in Camp Bastion consumed around 70% of the non-aviation fuel used in theatre operating approximately 250 electrical generators[12]. The 2012 PowerFoB experiments demonstrated that improved demand management could have reduced fuel consumption by up to 37%, but little progress has been made in realising this benefit. These are areas where it is relatively simple to capture use data to demonstrate where new and emerging technology could be used to eliminate or reduce the reliance of over the horizon supply. Advanced manufacturing techniques combined with greater supply chain visibility and vehicle health monitoring offer the same potential for military materiel. The ability to reliably generate energy, water, food and materiel resources at, or close to the point of use will result in a force that has a lower dependency on external support. This is inherently more agile and resilient as resupply becomes less of a limiting factor to the tempo of operations or when operating at reach.

4.7. The future force will need to think beyond the enemy and consider how self-sufficiency will affect many other actors, particularly the local population. A self-sufficient force will draw less water from local aquifers and will not produce as much waste to be disposed of locally. It may be able to supply energy to the local grid, or better manage the impact on local business and trade of the support footprint. Increased resilience in the supply chain will allow more choice of how we interact with the local population, reduce the likelihood of resource competition in theatre, eliminate any dependency at all or stimulate investment and development in a way that delivers our operational objectives more effectively.

5. Support Benefit Hypotheses

5.1. Emerging technologies will allow a deployed force to be increasingly Self-sufficient which will deliver increased Operational Advantage through greater agility, higher operational tempo and increased resilience.

5.2. This concept tests the hypothesis above by bringing together the five technology areas: **Energy, Food, Water, Materiel** and **Waste.** These conceptual areas are interdependent within an operational context and changing how one is delivered will

[11] Army Advanced Development Programme Climate Change and Sustainability work on deployed operational modelling, 2022.
[12] Energy Security Forum Quarterly Journal Vol.3 (6)

have an impact on each of the others. For example, production of water and food, the transport of material and the treatment of waste all require energy. By changing how we supply water, food, material and waste may increase or decrease overall energy use. This is described in more detail in Figure 3 below. The self-sufficient approach aims to identify where operational advantage can be found, for example by reducing the energy used to treat waste and create water and food, more energy becomes available for the synthesis of material through advanced manufacturing processes.

		Demand made by the process involved in creating				
		Energy	Water	Food	Materiel	Waste
Supply of a resource type	Energy	<- Requires energy for ->	• Extraction • Treatment • Transport • Recycling	• Transport • Cultivation • Waste disposal • Preparation	• Operation of equipment • Transport • Cooling • Advance manufacture	• Collection • Sorting • Disassembly • Assembly • Processing
	Water	• Cooling • Production of hydrogen feedstock	<- Requires Water for ->	• Preparation • Growing feedstocks • Cleaning • Waste disposal	• Cooling • Cleaning • Advanced manufacture	• Cleaning • Cooling • Support for human operator
	Food	• Production of hydrogen feedstock • Production of energy	• Production of wastewater	<- Requires Food for ->	• Support for human operator	• Support for human operator • Feedstock
	Materiel	• Feedstock • Spares • Inventory	• Feedstock • Spares • Inventory	• Feedstock • Spares • Inventory	<- Requires Materiel for ->	• Feedstock • Spares • Inventory
	Waste	• Feedstock	• Feedstock	• Feedstock	• Feedstock	<- Requires Waste for ->

Figure 3 - An illustration of how supply of one resource creates a corresponding input in other resource types.

5.3. The technology areas that have been identified cover each of the 5 NATO classes of supply as shown below. These classes remain relevant to the concept and will be at the core of how this concept is tested in the short term. Using the technology areas is expected to be more useful in demonstrating the interdependence of these resources and also avoiding being limited by existing cultures, behaviours and doctrine..

5.4. Each conceptual area is made up of individual support hypotheses which are identified below. Each hypotheses aims to identify where operational advantage may lie to encourage research and experimentation to provide evidence to bring the concept to life.

NATO	Energy	Food	Water	Materiel	Waste
Class 1 – Items of subsistence (food and forage)		X	X		X
Class 2 – Supplies for which allowances are established by tables of organisation and equipment (clothing, weapons, tools, parts, vehicles).				X	X
Class 3 – Petroleum, oil and lubricants (POL)	X			X (O&L)	X
Class 3a – Aviation fuel and lubricants	X			X (O&L)	X
Class 4 – Supplies for which initial issue allowances are not prescribed by approved issue tables (for example fortification and construction stores).				X	X
Class 5 – Ammunition, explosives and chemical agents.				X	X

Figure 4 - NATO Supply Class comparison

6. Energy benefits hypotheses

6.1. By better understanding energy demand in the context of an operation, Defence can optimise energy supply to ensure that energy is always available when it is needed and in a suitable vector. While platform energy use is relatively easy to understand and predict, electrical power generation on operations is less so. Electrical demand data is not recorded making it difficult reconcile fuel use in generators with actual energy consumption. A range of research and analysis has consistently shown that the Defence approach to electrical power in the field is not efficient. This will become increasingly relevant with the proliferation of Remote Autonomous Systems and more power-hungry digital systems. In the face of a global energy transition away from 'fossil fuels', the Defence Operational Energy Strategy (DOES) identifies the range of potential energy sources for Defence to exploit. Understanding and optimising Defence energy use will play a key part in exploiting this change.

6.2. A self-sufficient approach starts with a better understanding of demand and the application of technology solutions to ensure we only produce what we need, when we need it. Over the horizon supply of fuel will be reduced by use of local production with excess energy stored close to the point of use to be deployed when required. New forms of generation and energy storage will be seamlessly networked together so that production is always capable of meeting demand, but transportation of stored energy[13] is reduced. This approach provides a common picture of energy use across an operation while power generation itself can be dispersed or concentrated depending on the situation. **Energy will become more relevant than fuel**.

[13] Such as fossil fuels or charged batteries.

	Energy Hypotheses
E1	Demonstrate delivery of the same or enhanced operational effect using less energy.
E2	Exploit alternative energy sources across the theatre of operations.
E3	Create sustainable energy from waste materials.
E4	Optimise energy use to create additional capacity in the supply chain.
E5	Use energy, instead of cost, as a common metric for support performance.

Table 1 - TSS energy hypotheses

7. Water benefits hypotheses

7.1. Global Strategic Trends 6 identifies water as key global commodity, but by 2050 half of the world's population are unlikely to have reliable access to clean water. This will be exacerbated in the places where defence operates. Reducing wastage and improving recycling of water will reduce the impact of the force on the local population. As with energy, this relies on better visibility of water production, consumption and waste.

7.2. Water is one of the most abundant resources on earth, and yet military forces spend a considerable amount of energy getting it to a point where it can be consumed. Defence will continue to produce water stocks as close as possible to the point of consumption by exploiting new technologies that extract water from new sources for lower energy costs. This will be supported by closing the water cycle as far as possible, capturing wastewater and finding ways to treat it so that it can be reused where safe to do so. **Harvest and recycle with increasing efficiency**.

	Water Hypotheses
WT1	Generate water stocks at point of use at same or lower energy cost to current methods.
WT2	Enable increased recycling of all operational wastewater.
WT3	Compare energy cost of water supply in relation to geographic location and operational intensity.
WT4	Reduce water consumption on operations.

Table 2 - TSS water hypotheses

8. Food benefits hypotheses

8.1. Military effects rely on energy, none more so than the people at the heart of our capabilities. Analysis of nutrition requirements will lead to a more sophisticated approach to powering our people. By identifying the right nutritional mix to support higher or lower activity level it will be possible to better tune the quantity and quality of food stuffs depending on location and activity levels. It may also prove possible to farm certain foodstuffs in theatre using vertical farming techniques, hydroponics, or to transport feedstock in bulk to allow additive manufacturing of food at the point of consumption. This would allow food to be transported in higher densities, reduce packaging or reduce or eliminate the need for local sourcing. **People at the core of the capability, nutrition at the core of the people.**

	Food Hypotheses
F1	Enable production of fresh food in theatre.
F2	Investigate in theatre 3D food printing as alternative to transporting rations.
F3	Enable improvement of food packaging to increase transportation density.
F4	Optimise human performance through improved nutrition

Table 3 - TSS food hypotheses

9. Materiel benefits hypotheses

9.1. A deployed force requires a wide range of materials to make use of the energy, water and food that it will be harvesting from the environment and deliver operational effect. Advanced manufacturing techniques will allow some of this material to be synthesised at the point of use, or at the most effective location in the supply chain, reducing the time and effort required to maintain platform availability. Such a system will be reliant on understanding demand before it becomes critical by applying data analysis techniques over large and growing stores of operational data. This will enable the use of automated systems to control the preparation and dispatch of materiel, or the synthesis of resources at the point of need. Large language modelling may be used to assimilate large quantities of data without the need for new and exquisite information systems. When combined with automated warehousing, loading and transportation systems it will be possible to reduce the number of people that are required to run such a system. This would in turn reduce the demand for water and food in return for an increase in energy demand. Understanding where to best apply these technology solutions will become more critical as **Information replaces inventory.**

	Materiel Hypotheses
M1	Exploit existing support information to understand current and improve prediction of future materiel demand.
M2	Measure impact of new technologies on future material demand.
M3	Exploit smart/autonomous systems to reduce energy cost of support activities.
M4	Quantify operational benefit of self-sufficiency.

Table 4 - TSS materiel hypotheses

10. Waste benefits hypotheses

10.1. Operations continually create waste. Human activity creates sewage which must be treated to prevent the spread of disease. Transport of food and material requires packaging made of plastics and cardboard. The operation of equipment leads to worn and failed parts, or contaminated oils and lubricants. Water cycles through an operation from its extraction from the environment to its ultimate return to the environment when it is no longer safe for use by people. In each of these cases, the produced waste has an intrinsic value, based on its energy content or material structure, that might be unlocked for use by the future force. Defence needs to change its perspective and begin to view waste as a potential resource. Sewage contains a high residual calorie value that can be converted into pure hydrogen, plastics can be converted into oils and lubricants, cardboard can be converted into biomass for heating or energy generation and scrap metal could be processed to create feedstocks for advanced manufacturing techniques. Finding new, reliable ways to convert waste products into useable resources offers the opportunity to change the supply chain, allowing resources that can't be created in theatre to have priority. Emerging technology will find ways to convert traditional waste products into new resource that will allow a force to continue to effectively operate. Waste will be converted back into one or more of energy, water, food or materiel. **Turn trash into treasure**.

	Waste Hypotheses
WS1	Understand nature and quantity of waste a deployed force produces.
WS2	Identify where a Circular Economy approach delivers improved operational effect.
WS3	Apply Circular Economy to operational activity.

Table 5 - TSS waste hypotheses

11. Assumptions

11.1. Self-sufficiency will be driven by military necessity. This concept does not advocate an approach of 'do without'. For example, rates of ammunition use are driven by the characteristics of the weapon system and the intensity of combat. Self-sufficiency may contribute to how that ammunition is generated or supplied, but the guiding principle is to ensure that the system has enough resource to operate when it is called for.

11.2. The approach to Self Sufficiency will need to be tailored in regard to threat and the specifics of the operation. For example, micro nuclear technology may offer the ability to synthesise fuels on operations, perhaps at a Sea or Air Port of Disembarkation. This capability is likely to have a large signature and may not be appropriate for high threat areas. Wastewater capture is likely to be more ubiquitous and might be useful on maritime combat platforms as well as combat vehicles or as portable devices. Photovoltaic panels or atmospheric water machines may not be as efficient in Northern Europe as they are in Africa.

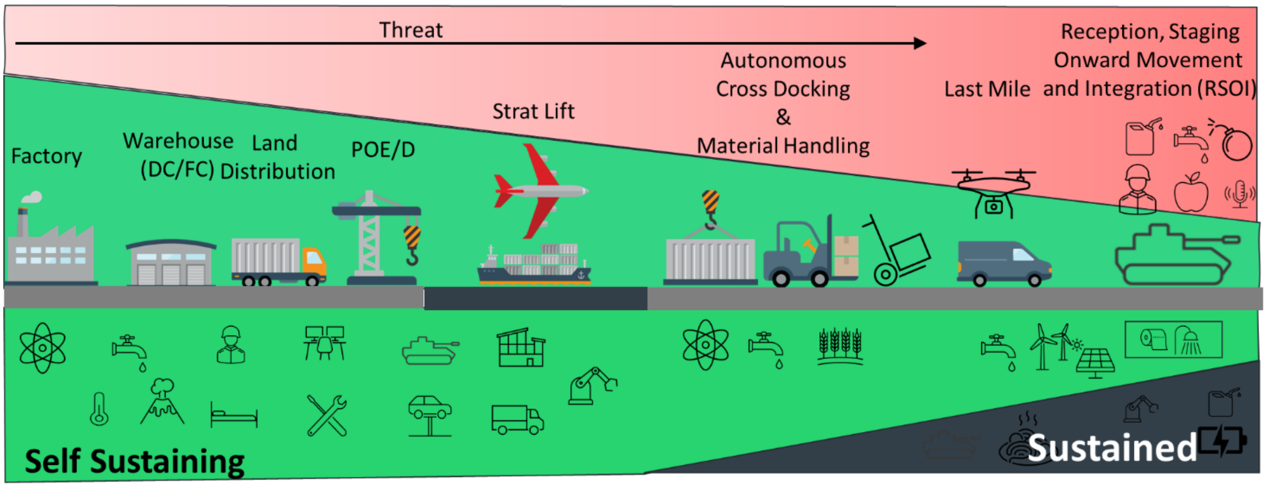

Figure 5 - Intersection of threat and self-sufficiency.

11.3. This concept assumes that there will be a natural limit to self-sufficiency. Figure 5 illustrates the idea that as threat increases, the deployed force will become more dependent on 'traditional' sustainment through a supply chain. This concept aims to test how far the 'green wedge of self-sufficiency' can go. This is expected to be defined by the time/space/weight penalty that emerging technologies will require. While these may not be practical for the manoeuvre force today, building confidence through use on the operational estate, or through rigorous experimentation, will be key to future exploitation. This is reflected in the idea that self-sufficiency is driven by military necessity. This concept does not advocate a 'do without' approach, rather it seeks to identify how Defence can do more with what is available. It assumes that Defence will be able to make use of the ideas and technology that are produced by the reaction to global climate change.

11.4. While a small number of materials can be recycled indefinitely, most recycled materials are of a lower absolute quality than the source material and therefore a closed loop is unlikely to be practical for all resources. However, recycling still offers plenty of opportunity to return materials into new uses where a loss of quality is acceptable i.e., plastic packaging into oils and lubricants.

12. Risks

12.1. One of the aims of this concept is to identify whether Defence Support can be more effective whilst reducing the impact on the environment. However, it is likely that there will be instances where the necessary military choice will have a negative impact on the climate. It is also possible that a self-sufficient approach may have a negative impact on the environment. In these instances, a climate aware approach will still lead to better decisions that seek to prioritise military effect in the appropriate context.

12.2. Developing a more self-sufficient force will require more capital investment (CDEL) to realise possible resource savings (RDEL) in the future. A through life value, rather than return on investment, approach is likely to be required to demonstrate value for support. The procurement of smart micro grids is likely to be more expensive than a like for like replacement of the existing power distribution equipment. However, smart micro grids will allow optimisation of electrical supply and demand which will reduce through life fuel use for the generation of electricity. While the upfront cost of micro grids is higher, the through life value outweighs this initial investment.

12.3. Cultural, behavioural and organisation inertia are likely to be significant blockers to change. Sustainability and self-sufficiency are novel approaches that may be misunderstood depending on personal knowledge and the circumstances of the workforce. While there is a ground swell of interest and support from across Defence to find more self-sufficient solutions on operations, a risk remains that any gains may be erased by falling into familiar patterns of risk management through oversupply. It is therefore important to increase understanding of these new approaches and the multiple benefits that may be brough to Defence.

13. Conclusions

13.1. Moving from a model of sustaining at reach to one which is designed for greater self-sufficiency will help provide a revolution in how we operate and fight. Self-sufficiency will ensure that military forces can operate with less dependence on external support; providing operational advantage when supply lines are disrupted or compromised by either adversarial or climatic threat. Self-sufficiency will also free-up capacity in our finite lines of communication for stocks that cannot be self-generated. In addition, self-sufficiency will enhance flexibility and agility in how we operate and fight, as by having the ability to synthesize necessary resources, a force can quickly adapt to changing circumstances and respond to new challenges as they arise. By harnessing technologies and approaches that generate self-sufficiency, we will also be generating an inherently more Resilient force by design.

Annex A – Experimental Scenarios (placeholder)

1. Three scenarios are being developed upon which analysis and experimentation can be carried out. These will feature locations in Central Africa, Northern Europe and South East Asia and support the testing of the Self Sufficiency hypotheses in different locations. It is anticipated that some technologies or approaches will not work, or work as well, in certain geographic regions. For example, solar is likely to be less useful in Northern Europe than in Central Africa.

2. In addition to these scenarios, figure 6 identifies a set of analysis targets which aim to test the hypotheses laid out in this concept. These targets will use existing support data to measure the potential benefits of new technology or techniques and help to identify whether new approaches will deliver the perceived benefits. This approach aims to guard against adopting technologies which drive additional support complexity or reduce operational effect by comparing the benefit to the user to the impact on the delivery of support.

3. **Each scenario is expected to have the following common characteristics:**

   3.1. Support hub occupied by 200+ personnel.

   3.2. Includes a transient population of personnel moving into and out of theatre.

   3.3. Likely to be a APOD or SPOD and have a significant through flow of equipment and materiel – consider demands specific to the role of the scenario i.e. supporting maritime or aviation assets.

   3.4. Contractors and Locally Employed Civilians are likely to be employed in this location delivering a range of activities. These impose burden on supply chain and effect needs to be quantified. Operational effect on local economies needs to be understood and quantified. Variable host nation infrastructures impact on how ‘integrated’ the force can be with the host nation.

   3.5. Threat level is variable. Location may be out of range of long distance munitions or be protected by robust air defence, but will represent an attractive target. What is the signature of the site and how does self sufficiency moderate this?

   3.6. There will be a security risk of insurgent, enemy special forces or similar asymmetric threats – impact considered as per the previous bullet.

   3.7. Climate consideration – cold wet / hot wet / hot dry, variable wind or solar availability. Variable heating/cooling loads. Weather/terrain impacts on equipment durability or service intervals.

Subject	Minimum	Target	Stretch	Goal - Using existing data (i.e. no additional monitoring)
Energy	Total quantity and type of fuel used across the exercise.	For a single vehicle type (for example Man SV) and for common generator set (24KW FEPS) - Fuel used, distance travelled, hours run and energy produced. Aim to develop characteristic energy consumption by activity.	For each equipment type - Fuel used, distance travelled and hours run.	For vehicles - quantify fuel use by hours run vs distance moved. For generators - quantify fuel used by hours run. Eventually correlate efficiency to service history information.
Water	Total quantity of water consumed by exercise (litres)	Across a deployment – litres of water supplied and breakdown of source i.e. bottled, host nation supply or produced at site from round water.	As target, but including estimate of what is consumed and what was handed back or oversupplied.	Energy cost of water supply to point of consumption per litre.
Food	Total quantity of food consumed by exercise (cost or weight)	Food ordered and delivered to the exercise – Fresh and boxed rations (by type/weight)	As target, but with more detailed breakdown by unit and potential calorific value.	Energy cost of food supply to point of consumption per kg/calorie.
Materiel	Volumes of materiel (spares, stores etc) consumed by exercise (volume / weight / number of units)	For a single platform, identify the materiel consumed and its point of origin i.e. did it ship with the exercise (planned) or did it have to be supplied during the exercise (contingent).	As target, but for multiple platforms or increasing detail in relation to energy usage. i.e. identify correlation between energy use and materiel use.	Correlate materiel supply to fuel usage - both energy cost of materiel supply and link to efficiency of fuel use.
Waste	Any data on waste produced by exercise - volume and type.	By location and activity.	Including disposal method.	Energy cost of waste treatment per unit volume or mass.

Figure 6 - Initial Data Requirements and Analysis Goals

Strategic Command
Defence Support