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DECARBONISING AND DIVERSIFYING DEFENCE in the United Kingdom and United States: A WORKERS' ENQUIRY FOR A JUST TRANSITION

FULL REPORT

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Please note that, while we have been as inclusive and participatory as possible, the advisory board, financial supporters, academic institutions and interview participants do not necessarily agree with the interpretations, conclusions or recommendations of this report. In addition, any errors or omissions are the responsibility of the research team only.

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EXECUTIVE SUMMARY

This study highlights the views of a cross-section of current and former defence workers on transitioning the defence sector to environmental sustainability in the United States (US) and the United Kingdom (UK). It is framed by the ethos of 'Just Transition', a call for entering into social dialogue with workers around what the transition to environmental sustainability means for their lives, identities, jobs and communities. Within this, the project focuses on 'decarbonisation' and 'diversification' as two key processes that are particularly relevant to the defence sector. The definitions used for the key terms are as follows:

- Defence sector: 'Those currently or formerly involved in the design, manufacture and use of defence equipment and the research and development associated with this'
- Decarbonisation: 'The process of reducing the carbon emissions which contribute to climate change'
- Diversification: 'The broadening of defence sector business to non-military business fields'
- Just Transition: 'A framework developed by trade unions and communities to secure workers' rights and livelihoods and community well-being when shifting to sustainable production'

Context

In the context of new and necessary net zero, biodiversity and sustainable development targets, dialogue with workers can improve policies and plans; reduce resistance to change; and support a more rapid, effective and equitable transition. Yet consultation with defence sector workers on transitioning to sustainability has rarely been evident to date. This project aimed to address this gap and uncover what a transition to net zero and wider environmental sustainability in the defence sector might mean for the people that work in the industry and their communities.

Compared to many other sectors, the global defence sector appears to be at an early stage in transitioning to sustainability. With the requirement to prioritise safety, reliability, and performance, and in a context where it has not been expected to be as transparent as other sectors, it may have been less ready to address its environmental issues. In addition, some of its infrastructure and operations may be more difficult to decarbonise than in many other sectors and, since deployment cycles can span decades, it may be a long time before changes are seen.

Defence policy and operational standards drive much of the decision-making around production in the defence sector. Defence workers are, therefore, subject not only to companies' business decisions but also to political and governmental considerations. As such, their views may not be sought and there can be an assumption that they are uninterested in wider environmental and social issues. They also face the challenge that jobs are declining in both the US and UK defence sector due to automation and job relocation in the search for more lower labour costs and less stringent environmental standards. In the context of these social and environmental challenges and the lack of dialogue with defence workers to date, it is timely to consider the Just Transition of the defence sector and the views of the workers in relation to that.

Although it is difficult to ascertain the environmental impact of defence as it tends to be exempted from CO_2 targets, many reports suggest exceptionally high rates of greenhouse gas (GHG) emissions, pollution and use of non-renewable resources from this sector. Defence organisations in the US, UK and beyond generally accept this to be a problem, or at least that they need to work on this, as does any other sector, and are now addressing environmental issues in recent reports and

statements. The defence sector has been working to reduce its environmental impact in recent years, particularly through new technological innovations. However, there has been some criticism that these documents, discourses and activities focus disproportionately on technical change, with inadequate attention to arms control, diplomacy and human security as more transformative alternatives to reducing the carbon emissions and other environmental harms associated with defence.

It is important to note that decarbonisation, alone, while of critical importance, does not equate to the diverse environmental aspects of Just Transition, which can relate to a wide range of environmental issues where humanity is currently, or in danger of, overstepping planetary boundaries. It may even include ending the production of certain goods and replacing with others. Hence, this project includes debates regarding 'diversification' as a possible part of a Just Transition of the defence sector. Even so, diversification will be unhelpful in reducing environmental impact if the alternative jobs created are just as environmentally harmful. It is not necessarily the case that switching from defence manufacturing to equally carbon-intensive or otherwise ecologically damaging alternative industrial production would reduce environmental impacts. However, transferring to 'green' jobs or aspects of production and service that are less environmentally harmful would do so. It should also be noted that the defence sector is unique in that the use of its products often leads to considerable further environmental harm through destruction of property and nature and through post-conflict reconstruction. These emissions, and other downstream environmental impacts, are critical to an assessment of the relative merits of converting defence, yet there is very minimal data available on this.

Method

The main strand of the project was a 'workers' enquiry' - a method that encourages workers to think about and articulate their situation in the productive process. Fifty-eight interviews were carried out with self-selected (i.e. they responded to announcements or other communications about the research) current and former defence sector workers in the US and the UK. We held 'international trade union dialogue' and 'international expert dialogue' focus groups, with representatives including the International Trade Union Confederation, and key unions with defence sector members in the US and the UK. Anonymised findings from these interviews were then discussed with our advisory committee which included representatives from defence companies, government departments, NGOs, academia and trade unions.

Worker Views

Decarbonization

Most of the workers interviewed understood the term 'decarbonisation'. They generally supported decarbonisation of the defence sector and were personally concerned about climate change. These workers described numerous decarbonisation and other environmentally progressive activities that were already underway in their company, department and sector. Many thought that more could be done, however, and that it should be a greater priority. A few of the interviewees were concerned that outsourcing and offshoring could be used in the drive towards decarbonisation, as a way of reducing domestic emissions, and that this this would reduce the defence work available in their own countries.

Diversification

Few of those interviewed had heard of the term 'diversification' before the study. Several considered that the defence sector is already diverse in the sense of manufacturing civil goods alongside military goods and using knowledge from one sector to benefit the other. Though few had heard of the concept before, when given the project working definition, the interview participants were divided in terms of their support for, and resistance to, the idea. Of those who were in agreement, some would only support a version of diversification that would broaden defence company business to encompass civil, while others wanted to see a more general scaling back of defence operations and production. The former group argued that the defence sector is essential and needs to be adequately equipped to be able to respond to known and, as yet unknown, threats. The latter spoke about how the public funds spent on defence could be better used for other purposes, including addressing the environmental crises, and that other means of dealing with conflict would be preferable and less environmentally harmful than using weapons. This latter group sometimes preferred the term 'conversion' to 'diversification'.

Just Transition

Again, most of the workers were unaware of the term before the study. They were positive about the concept, once explained, and endorsed its importance. The point was made that support for decarbonisation among workers would depend on there being a Just Transition. Some expressed hesitation or scepticism because of the history of unjust transition, though were not opposed to the values embodied in the concept i.e. greening the sector, consultation with workers, support for workers and communities in the transition. In general, workers tended not to anticipate that their jobs would change significantly or be lost as a result of decarbonisation. This was mainly based on the notions that that governments are, ultimately, always committed to defence; that sustainability initiatives were more likely to transform areas of their work, rather than completely change their jobs; and that the workers had transferrable skills that would always be in demand. Particularly in the US, workers stated that their politicians saw support for defence spending as necessary for electoral victories. However, some of those interviewed felt that there was a general job insecurity in the sector due to automation and outsourcing and, therefore, it could be hard for workers to focus on decarbonisation and lowering the emissions of the defence sector when these other issues are pressing. Workers made the point that, if jobs need to change, they need to be equivalent in terms of pay and status. There needs to be suitable replacement employment and upskilling of workers through training programmes. Several workers noted that because defence workers are often highly skilled and well-paid, it may be challenging to create equivalent low-carbon jobs. The point was also made that efforts need to be made to include particular disadvantaged and marginalised social groups in these debates to achieve a Just Transition. In general, Just Transition was considered to require adequate advance planning, with input from all key stakeholders, particularly workers; sufficient resources; and local and national government leadership and support.

Scope of change

There were very different views about what the scope of change should be in the defence sector with regard to the transition to sustainability. This reflected the range of interpretations of Just Transition that were evident, from 'jobs focused', to 'environmentally focused', to 'society focused'. Many emphasised that it would be important to constrain the change towards what could be done without impacting negatively on the current defence capacity. Others, mostly but not entirely, former (rather than current) soldiers and defence workers, felt that it is critical to scale back

production and operations to adequately reduce the negative environmental impacts of the defence sector and that less than that would be 'green washing'. These approaches, in turn, linked to the workers' understandings of what needed to change to achieve a Just Transition. Some workers were more focused on technical change, others on behavioural change, and others on systemic and political change.

Agents of change

The interviewees saw change regarding diversification, decarbonisation and Just Transition as being the responsibility of, and being initiated and driven by, a variety of agents including the national government, the public, defence companies, unions and defence sector workers. Tensions were evident between different Just Transition priorities. For example, some had proposed motions regarding decarbonisation within their workplace union branch but it had been difficult to pass these where this was seen to be a threat to jobs.

Drivers and challenges

A frequent point made by the workers interviewed was that a key driver for transitioning to sustainability is security, including the likelihood that climate change would undermine military assets, destabilize societies and trigger civil conflict. Other perceived drivers included the threats to human and ecological health and wellbeing arising from the climate crisis; and public pressure to reduce the defence sector ecological impacts. The main barriers to transitioning were considered to be technological factors, in terms of reducing emissions while maintaining the operational standards required for defence; human factors, including attitudes, habits, identities and culture; cost, to the government, companies and customers; and the political-economy, including the drives for profit and power. The solutions that the workers interviewed considered would help to overcome these barriers included government and company incentives, regulations and policies; contractual requirements; becoming more cost-efficient (wasting less); and trade union organising around these topics, including engaging workers in social dialogue.

Dialogue

Almost all of the workers interviewed expressed an interest in being consulted on plans for decarbonisation, diversification and/or Just Transition to a greater or lesser extent. Yet, the majority of workers interviewed had not been consulted on any of these by their company, union or government. Several of the workers interviewed had tried to make proposals to their company, or seen others do so, that were not taken up. They were given the impression that such ideas were considered to be a distraction from their main job. The workers said that inclusion in these conversations was important in order for the workforce to feel part of the process and, therefore, less resistant to any accompanying change. They also felt that they had a strong contribution to make in terms of knowing the reality of implementing policies on the ground.

International Expert and Trade Union Leader Views

Within the international expert dialogues, some questioned the assumption that defence is more carbon intensive than other sectors on the grounds of inadequate emissions monitoring across sectors. It was generally agreed, however, that this debate might be a distraction as all sectors would need to reduce their emissions to meet net zero targets.

Those who were opposed to diversification argued that changing to civil production would not reduce GHG emissions (since civil was no less harmful in this respect), and that the defence industry was fundamentally necessary for national protection, or in some cases, the wellbeing of humanity.

Those who supported diversification raised the concern that there would not be enough funds to deal with climate change if society continues to invest so highly in military products. Some expressed that a large part of military activity is not actually contributing to our real security needs. The point was also made that defence was linked to colonialism, for example, in terms of the extraction of resources, testing of weapons and the US bases around the world. It was argued that, since oil has been a major source of military conflict, reducing its use would automatically drive diversification as there would be less need for defence operations.

Most of the group agreed that decarbonisation and the wider Just Transition would require government incentivisation and regulation. A few considered it important to ensure there was good accounting and monitoring of the defence sector as the basis for this, so that there could be checks against standards.

Regarding the concept of Just Transition, it was noted that some companies and organisations might avoid using the specific term, although would still be addressing the issues that relate to JT. The point was made that, in some cases, Just Transition was not being discussed because job losses are not considered likely to occur as a result of decarbonisation of the defence sector.

In the international trade union dialogue, representatives said that, in relation to Just Transition, particularly where diversification was considered as an element of this, there were worker concerns regarding (1) pay, which is usually better in the defence sector than in the 'green' sector or other manufacturing work; (2) attachment to defence jobs, with workers generally being very proud of helping with the defence of their country; (3) maintaining the quality requirements for the military, which tends to be higher than that of civil; (4) trust - how to demonstrate to workers that good jobs will be part of this transition. It was noted that workers not only focused on their own jobs but also took into consideration the wider issues pertaining to their work. This indicated interpretations of Just Transition beyond solely a 'jobs focus' and towards a 'society focus', with some workers highlighting the social value of the defence sector and others questioning this. A key message from the group was that investment is needed and social dialogue is important. Unions need to make sure that their members are involved in Just Transition planning. Training to take up alternative employment was seen to be crucial. It was also felt that working towards a Just Transition could build on and enhance greater workplace democracy.

The importance of the global supply chain, offshoring and lack of protective government policies were important issues for the trade union group. It was reported that the Just Transition concept was not chiming well with some workers, as they could see that jobs are being lost. The international trade union representatives discussed how they have been working at making sure that global supply chains are run in a way which doesn't undermine workers' basic rights. They are working on connecting employees in different countries to ensure that workers across the supply chain have a voice.

Conclusion

The study indicates the range of opinion and attention to nuance and complexity among an occupationally and geographically diverse group of defence sector workers in the US and UK. Although it is a small study and generalisations cannot be made from the self-selecting sample, their statements provide helpful insights and highlight numerous issues that could be investigated further by researchers, companies, governments and unions. We strongly urge readers to also look at the testimonies of the workers presented here to better understand the depth of thought, consideration, knowledge and caring that is evident.

The project is currently missing the voices of workers in Eastern Europe and the Global South who are now increasingly working on US and UK defence contracts. To achieve a Just Transition along the supply chain, the structural interdependencies and inequities that have resulted from outsourcing and offshoring means that enabling Just Transition in Eastern Europe and the Global South is going to require changes in policy and practices in the United Kingdom and the United States.

It is evident that Just Transition is not solely about jobs for these workers but also environmental and social justice. As long as their immediate interests are not threatened, the workers seemed to enthusiastically embrace the transition to sustainability.

The need for transparency, funding and regulation are key themes emerging from the literature, document analysis, expert dialogues and workers' perspectives in this research. However, worker inclusion in the planning and decision-making is undoubtedly the strongest message. Defence sector workers are an important source of expertise and can be a moral compass in the necessary Just Transition of the defence sector. There needs to be more formal engagement with them to make the most of what they bring to the endeavour to create a sustainable future.

Key Recommendations

Recommendations based on the worker interviews can only be tentative, given the small sample size of the participant cohort. However, putting this data in the context of the other aspects of the study, including the advisory committee inputs, literature review, document analysis, and focus group dialogues with relevant international experts and worker leaders, we can more confidently offer the following recommendations for consideration:

FOR COMPANIES:

- Set up structures and programmes so as to include workers at all levels in decarbonisation and diversification planning and implementation
- Create contractual clauses for companies along your global supply chain to comply with, or improve upon, US and UK environmental and employment standards
- Make your GHG emissions and other environmental impact data publicly available
- Work with suppliers to estimate upstream emissions and environmental impacts for each product and identify opportunities for switching to more environmentally benign inputs
- Understand the downstream emissions of customers for each of your products and solutions

FOR UNIONS:

- Create more opportunities for education and dialogue around decarbonization, diversification and Just Transition with rank-and-file defence workers
- Increase work on building solidarity with, and including the perspectives of, workers in Eastern Europe and the Global South who are supplying the defence sector
- Prioritise unionising the 'green' sector and improving job security and pay in this sector so that these jobs begin to become more attractive to workers

- Press for company forward planning, with consultation from rank-and-file workers, to ensure a Just Transition for their workforce

FOR GOVERNMENTS:

- Enact legislation to include defence sector greenhouse gas emissions in national carbon accounting
- Supply significant ring-fenced funding to enable the defence sector to decarbonise and address its other environmental issues, including the retraining of workers
- Create contractual obligations for private companies that supply the MoD/DoD to work to high environmental standards and reduced greenhouse gases
- Consider transitioning security policies and budget priorities to a 'human security' approach, addressing the global and national poverty, inequality, health and environmental crises and investing in the jobs that would accompany this
- Set up a UK-wide Just Transition Commission, and US-wide equivalent, to ensure that workers' voice is central to guiding net zero and other environmental policies

FOR NGOS:

- Link up with trade unions on relevant shared interests around achieving a Just Transition
- Consider focussing on the defence sector as a possible contributor to the problems and solutions you are working on

FOR WORKERS:

- Propose decarbonisation, diversification and Just Transition education and dialogue in your company and union
- Demand greater consultation and inclusion in company decision-making on these topics

INTRODUCTION

It is now clear that humanity faces multiple environmental crises requiring urgent and profound changes to our societies (IPCC, 2021; IPBES, 2019). In particular, global carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions need to be rapidly reduced and at least halved by 2050 (compared with 1990 levels) (IPCC, 2018). High Income Countries will need to do more, with reductions required of between 80% and 95% by 2050. There will be equity and justice challenges associated with managing this rapid transition as captured in the 'Just Transition' (JT) concept. Unions and their allies succeeded in pushing for JT to be included in the preamble to the Paris Climate Agreement which called for '[t]aking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities' (UN, 2015: 4). Since then, JT has gained global prominence through the 2018 Silesia Declaration on Solidarity and Just Transition. This declaration, now endorsed by more than 50 national governments, warned that public policies to reduce emissions will face social resistance if they are not accompanied by measures to protect livelihoods for those whose jobs will be lost or transformed (UNCCC, 2018a; 2018b). Hence, 'social dialogue' between governments, companies, trade unions and civil society is at the core of JT (Smith, 2017). This means engaging in discussions about what JT means for people's lives, identities, jobs and communities. Such a process of dialogue can improve transition discourses, policies and plans; reduce resistance to change and subsequent backlash; and, thereby, support a more rapid, effective and equitable transition (UNFCCC, 2019).

Yet, to date, climate change responses have tended to be top-down, expert based and institutional (Copland, 2019; Kythreotis et al., 2019). It has been noted that the term 'Just Transition' is rarely used outside the political and technical literature, or by the people who are likely to be most closely affected (Webster and Shaw, 2019). JT is still perceived negatively among some union representatives, who tend to see it as a conversation about job losses (ibid.). In order to be successful, JT dialogues will need to present a response to workers' needs, concerns and aspirations.

The Decarbonising and Diversifying Defence project specifically focused on the defence sector since, arguably, it is particularly environmentally problematic; has a declining, and therefore, vulnerable, labour force; and is going through a period of intense policy-making and planning regarding decarbonisation that this study can contribute to. The project builds on the work of the recent 'Just Transition Listening Project' which recommends that additional research be carried out on sectoral transitions (Cha et al., 2021; 2022). This workers' enquiry intends to be of direct use to defence sector companies, workers and trade unions in the United States (US) and the United Kingdom (UK). It will also be of use to governments and civil society agencies engaged in decarbonisation and other sustainability transitions, in the US, UK and beyond.

The project has the following objectives:

1. To inform the development of Just Transition policies and plans in the US and UK defence sector

2. To understand how Just Transition is being understood, defined and contested by workers in this sector

3. To gain insights into the views of defence sector workers on actual, proposed and potential decarbonisation and diversification strategies

4. To consider how Just Transition can best respond to defence sector workers' needs, concerns and aspirations

DEFINING TERMS

While the focus of the study is Just Transition, enabling a wide discussion of environmental impacts, it is framed in terms of decarbonisation and diversification as these are the main debates regarding the sustainability of the defence sector at the present time. Therefore, the key terms relevant to this project are 'defence sector', 'decarbonisation', 'diversification' and 'Just Transition'. While we were interested in understanding how workers defined these terms, we also wished to agree some working definitions at the outset. After discussing among the research team and the advisory board, we agreed the following definitions:

- Defence sector: 'Those currently or formerly involved in the design, manufacture and use of defence equipment and the research and development associated with this'
- Decarbonisation: 'The process of reducing the carbon emissions which contribute to climate change'
- Diversification: 'The broadening of defence sector business to non-military business fields'
- Just Transition: 'A framework developed by trade unions and communities to secure workers' rights and livelihoods and community well-being when shifting to sustainable production'

All four terms were based on prior research but adapted to enable us to reach a consensus among the research teams and advisory board. For example, the definition for 'defence sector' is based on the UK Business and Industrial Strategy's description as 'those companies involved in the design and manufacture of defence equipment and the research and development associated with this' (BEIS, 2017: 11). However, our definition also includes workers in the military or employed by government defence departments, as well as those employed in supply chain industries for which defence is only part of their productive activity. In general, it is difficult to accurately quantify and define 'defence jobs'. For example, in the United States, defence production is included in a number of NAICS (North American Industrial Classification System) categories, including as 'fabricated metal products', 'transportation equipment', 'electronics' and so on, but not disaggregated into defence and civil production. This lack of clarity regarding defence jobs is also difficult as a result of the Bureau of Labor Statistics occupational categories. The 'green book' US National Defence Budget estimates enumerate DoD employees but not contractor employees (DoD, 2021a: 268). This means that military-industrial workers cannot be readily identified as a separate category. The situation is further complicated in that workers can be working on defence contracts and civil contracts simultaneously.

The term 'defence diversification' has also been called 'arms conversion' or 'transitioning to socially useful production', though has also been understood to mean expansion into a different business field or alternative products. This might mean businesses moving out of military work or, alternatively, finding additional business in other military markets or new civilian markets while continuing the current military work. Our definition draws on the NET (2018a) definition as 'the broadening of business to non-military business fields with the intention of reducing or stopping arms production' (NET, 2018a: 6). Just Transition, as defined here, builds on descriptions of JT as encompassing interventions needed to secure workers' rights and livelihoods when economies are shifting to sustainable production to fight climate change (e.g. TUC, 2019; Webster and Shaw, 2019).

SECTORAL AND GEOGRAPHICAL FOCUS

The project focuses on the defence sector as evidence suggests that it produces exceptionally high rates of greenhouse gas (GHG) emissions, pollution and use of non-renewable resources (Bigger and Neimark, 2017; Crawford, 2019; Belcher et al., 2020, Parkinson, 2020a). A range of environmental issues have confronted the military and wider defence sector for more than four decades including those resulting from military exercises and weapon decommissioning (see, for example, Durant, 2007, on the US military and Parkinson, 2020a on the UK military). According to Scientists for Global Responsibility, the world's militaries combined, and the industries that provide their equipment, are estimated to create 6% of all global GHG emissions (SGR, 2021a; SGR, 2021b).

However, there is, as yet, inadequate collection of data to precisely quantify this and, thereby, some contention around the figures. New attempts to systematically gather and disseminate the data, including via the Military Emissions Gap website (2021), should help to clarify the position. Under the Kyoto protocol, militaries were exempted from CO_2 targets, after lobbying from the United States government. In March, 2021, congresswoman Barbara Lee attempted to overturn this by introducing a resolution aimed at monitoring and reducing the carbon footprint of the US military. It called for the Department of Defense to set clear annual emission reduction targets in line with the 2015 Paris Agreement and the National Defense Authorization Act. The resolution declared it to be the duty of the Department of Defense to monitor, track, and report GHGs from its operations (House of Representatives, 2021).

Furthermore, while many defence companies are now aiming to cut Scope 1 and Scope 2 emissions - those related to their operations and energy usage, respectively - these emissions account for only a small fraction of the defence sectors emissions. The majority of their associated emissions tend to be beyond their direct control, being a result of the parts and materials they procure (Scope 3 upstream emissions) and from the usage of the products they sell (Scope 3 downstream emissions).

We focus on the US and the UK, as they are the two largest global defence exporters on a rolling 10-year basis (DFiT, 2020). The US is currently 1st in terms of national military spending and the UK 5th in a global league table, with US and UK defence expenditures rising in 2020 to $778 billion and $59.2 billion, respectively (SIPRI, 2021). According to one recent study, the US military emits more CO_2e (carbon-dioxide equivalent) than most nation states (Belcher et al., 2020). It has also been found to be the single largest institutional consumer of hydrocarbons in the world (Bigger and Neimark, 2017).

Both the US and UK governments now have ambitions to achieve net zero emissions by 2050. The UK has a new legally binding reduction target of 78% by 2035 and the US is considering the 'CLEAN Future Act' bill. Since defence accounts for 50% of UK, and 80% of US, government emissions, there is increasing recognition that decarbonisation of the defence sector is vital to achieve these net zero ambitions (Barry, 2021; Frazer-Nash, 2020). It has been noted that 'You cannot ask citizens to reduce emissions but not have militaries do it. It is important for public acceptance' (Duvic-Paoli, in Frazer-Nash, 2020: np). In addition, the defence sector in the US and UK are now recognizing that climate change, particularly in the form of the increasing number of extreme weather events, rising sea levels and desertification can potentially accelerate insecurity and armed conflict. The UK Ministry of Defence has stated that this will not only increase demands for international and domestic humanitarian assistance but will also have negative effects on UK bases and deployed forces, both at home and abroad (MoD, 2021a). In the US, President Biden spoke of climate change as the 'greatest threat' to US national security during his electoral campaign (ABC News, 2021). In June 2021, NATO leaders confirmed their shared political commitment to reduce defence

emissions, labelling climate change a national security issue and a 'threat multiplier' (Bowcott et al. 2021; Crawford, 2019). The NATO (2021a) action plan states that 'Climate change is one of the defining challenges of our times. It is a threat multiplier that impacts Allied security, both in the Euro-Atlantic area and in the Alliance's broader neighbourhood' (np). It states that it will develop a method to 'contribute to formulating voluntary goals to reduce greenhouse gas emissions from the military' (np.). A further NATO Communique (NATO, 2021b: np) asserts 'We agree to significantly reduce greenhouse gas emissions from military activities and installations without impairing personnel safety, operational effectiveness and our deterrence and defence posture' and advocates that NATO assesses the feasibility of reaching net zero emissions by 2050 (NATO, 2021b: np.).

Hence, the US and UK military and the wider defence sector have been looking closely at how to reduce resource use and emissions in recent years. In 2020, the UK Climate Change Committee (CCC, 2020) suggested that the Ministry of Defence decarbonise buildings and fleets and examine the potential for alternative fuels for land vehicles, ships and aircraft. Following this, in 2021, the MoD published its 'Climate Change and Sustainability Strategic Approach' (MoD, 2021a), a blueprint for responding to climate change. Similarly, in its 2020 'Sustainability Report and Implementation Plan', the US Department of Defense (DoD) offered details about how it will integrate sustainability into its mission and operations (Bowcott et al. 2021). Subsequently, in 2022, the US army released its first Climate Strategy with targets to achieve 50% reduction in army net GHG emissions by 2030, compared to 2005 levels, and to attain net zero GHG emissions by 2050 (US Army, 2022). In these US and UK government documents, both procurement and supply chain are seen as essential to achieving overarching sustainability goals (Barry, 2021). Defence sector companies are also now making strong statements of their sustainability intentions within and along the supply chain and have introduced many new sustainability innovations in recent years (see section of this report on companies).

JUST TRANSITION - DECARBONISATION OR DIVERSIFICATION?

As a project framed around 'Just Transition', 'decarbonisation' and 'diversification', it is important to consider how these three concepts fit together. Decarbonisation alone, while of critical importance, does not equate to the diverse environmental aspects of Just Transition, which can relate to a wide range of environmental issues where humanity is currently, or in danger of, overstepping planetary boundaries (Steffen et al., 2015). A transition to sustainability cannot always be achieved through using alternative materials and energy sources but may even include ending the production of certain goods if they lack social value beyond providing jobs and increasing GDP. While there have been claims that we can decouple economic growth from resource use and waste, a review of relevant studies indicates that this has not been borne out in practice (Vadén et al, 2020). Therefore, degrowth proponents argue, given that we are facing a number or urgent environmental crises, perhaps humanity should now focus only on producing that which has genuine social value (e.g. Hickel, 2021). It seems important to consider this for all sectors, including the defence sector. Therefore, we have included the debate around 'diversification' in this discussion of Just Transition of the defence sector.

Despite the important steps forward in terms of decarbonising and addressing the environmental issues associated with the defence sector outlined above, there has been some criticism of the recent government and defence company reports and plans on defence sector decarbonisation (e.g. Parkinson, 2021). A key criticism is that they focus primarily on technical change, including controversial fuel replacements, such as nuclear and biofuels (Bigger and Neimark, 2017; Gardner, 2017), rather than arms control, diplomacy and human security. Critics ask for more consideration

of 'diversification', i.e., the 'broadening of business to non-military business fields with the intention of reducing or stopping arms production' (NET, 2018a: 6). They argue that the defence sector is extremely expensive for the state and its citizens since, in the main defence hardware producing countries, defence industries are heavily subsidised by the state via citizen taxation (CAAT 2014). Given that funds have to be found for climate and biodiversity mitigation, these subsidies might be better used.

However, diversification will be unhelpful in reducing environmental impact if the alternative jobs created are just as environmentally harmful. We are not aware of any broad comparison of defence compared to other sectors in terms of overall environmental performance. The assessment is particularly difficult given the different aspects of the defence sector, its lack of transparency, and a lack of comparable data (whether Scope 3 is included etc). However, some calculations of GHG emissions in the UK by sector indicate that the military-industrial sector has larger direct emissions than nine others, including vehicle manufacture, plastics, water and waste management, and glass and ceramics (Parkinson, 2020a). However, more research is needed on this topic. Switching from defence manufacturing to alternative industrial production may not always reduce environmental impacts but, certainly, transferring to 'green' jobs or aspects of production and service that are less environmentally harmful would be more likely to do this. Also, as Parkinson (2020a: 17) notes, '…the military is a unique sector, in that the use of its products, i.e. weapons, often leads to considerable further GHG emissions, including fires from burning buildings, fuel depots and vegetation, healthcare for civilian and military survivors, and post-conflict reconstruction'. These emissions, and other downstream environmental impacts, are critical to an assessment of the relative merits of converting defence, yet we have very minimal data on this.

Advocates of diversification also point to a potential 'peace dividend' which can be gained from the transfer of resources from military to civilian use. It is considered that this transfer will lead to improved economies by avoiding the harm to people, property, markets and the environment that conflict causes. It is also considered less environmentally wasteful to create products and services that can be of immediate benefit to the public (e.g. sanitation systems in the Global South) rather than products where the best-case scenario is that the weapons will never be used. It has also been argued that the defence manufacturing sector is already shrinking so diversification is, not only desirable, but necessary (NET, 2018a).

Background to the calls for diversification of the defence sector

Throughout the 20th century, defence was closely tied to foreign policy ambitions, such as deterring the Soviet Union and fortifying NATO (Mc Loughlin, 2022). As such, the defence sector had a close relationship with the government in the UK and the US. A 'Cold War coalition' (Brenes, 2020) consisting of business, politicians and trade unionists ensured that a consistent supply of military orders kept their employees and constituents in employment. The defence industry was both concentrated in certain areas and dispersed so that as many political representatives as possible would be impacted by the cancellation of a defence contract (Mc Loughlin, 2022). Consequently, the defence coalition was bipartisan, with some previously anti-war Democrats fighting to retain defence work in their local districts (Brenes, 2020). In the UK, as in the US, the Cold War defence economy was recognised for its role in sustaining employment, particularly in areas such as shipbuilding that were in decline (Hartley, 1997). Defence was a feature of wider economic and industrial strategy, both for 'New Deal' liberals in the US (Brenes, 2020) and social democrats in the UK (Mc Loughlin, 2022).

In the US, Eisenhower's (1961) 'military-industrial complex' speech stimulated academic and political interest in the influence of the international defence industry. A 1962 United Nations report

argued that defence put a 'heavy economic and social burden on most countries' and absorbed 'a large volume of human and material resources of all kinds, which could be used to increase economic and social welfare throughout the world' (UN, 1962: 47). From the mid-1960s, an increasing number of US academics examined the military-industrial complex. Melman (1964: 131) made the case that the resources used for arms could be reapplied to civilian industries to 'greater economic security and a sense of well-being without precedent'. His influence extended beyond the US, for instance to the Stockholm International Peace and Research Institute, set up in 1966. In the US, George McGovern, the Democratic senator and 1972 presidential nominee, introduced a bill for a National Economic Conversion Commission in 1963, but it was held back by Democrats and Republicans (Brenes, 2020). In the UK, the left-wing of the Labour party sought to convert the defence industry. They set up a defence study group in 1974, publishing a report, *Sense about Defence* (Labour Party, 1977). Although it was rejected by the Labour government, it was the most comprehensive statement on industrial conversion and diversification in the UK to that point, including a list of alternative technologies that defence workers could apply their expertise in, from renewable energy to civilian transport (Mc Loughlin, 2022). At the same time, the workers at Lucas Aerospace and Vickers put forward proposals for diversification into socially useful production, but they were impeded by management and trade unions (Wainwright and Elliott, 1982). Under the leadership of Michael Foot, Labour adopted a policy of converting defence into 'socially useful production', but the party was heavily defeated at the 1983 general election and defence expenditure increased in the mid-1980s under the Conservatives.

Several factors have historically impeded diversification in the defence industry. In both the UK and US, the defence industry has facilitated broader foreign policy ambitions that involve cutting-edge technologies to stay ahead of adversaries. Given this strategic imperative, private defence companies were given 'cost-plus contracts' where the state would absorb overruns (Hartley, 1997). Instead of offering new alternatives, defence companies in the UK and US tended to enhance existing technologies, often at significant cost to the state (Kaldor, 1982). Having heavily subsidised the defence sector since the 1940s, the UK government took most of the industry into public ownership in 1977 to retain jobs in aerospace and shipbuilding, as well as to retain political oversight of the arms industry (Mc Loughlin, 2022). In some instances, this served to run down the successful civil side of some defence companies, such as Vickers at Barrow-in-Furness, UK, which had a thriving commercial manufacturing output until it was deliberately reduced in the 1970s so that the company could focus on submarines and warships (Mort and Spinardi, 2004). By the end of the Cold War, and with military spending reduced, many defence companies who had been over-reliant on state contracts were ill-prepared to capitalise on the opportunities provided by the 'outbreak of peace' (Southwood, 1991). In the UK, although the defence industry was largely privatised in the 1980s, it continued to rely on state support in the form of military work. As was the case in the Cold War, the sector existed outside of competitive market conditions as the government absorbed significant cost overruns and delays, as was seen in the case of the Astute-class of submarines built by BAE Systems which entered service at £800 million over the initial budget (Jones, 2018). Given the sectional interest of business, politics and trade unions, the defence sector has proved difficult to reform into the current century (Chin, 2004).

Case studies of previous and recent attempts to diversify, from UK, US, Italy, Germany, Estonia and South Africa can be explored to further identify the facilitators and barriers to diversification of defence. These include:

- The Barrow Alternative Employment Committee (BAEC, 1987)
- The Lucas Aerospace Plan in the 1970s (Salisbury, 2021)

- Vickers 1920s (Unite, 2016)
- Prior UK Defence Diversification Agency set up in 1999 (Spinardi, 2000)
- The United States Defense Industry Adjustment programme (OEA, 2015; 2021; OLDCC, 2022)
- The US 1988 Base Realignment and Closure (BRAC) Act (Unite, 2016)
- IRI in Italy 1990s (Felice, 2010)
- Bremen Industrial Defence Conversion Program (CP) 1980 (NET, 2018a)
- Estonian shipyards 1990s (NET 2018a)

One of the most current and relevant (to this report) example of this is the US Defense Industry Adjustment Program which has the goal of helping companies and communities become more resilient and attract new work so they're less dependent on the defence industry. They assist regional businesses with market diversification planning, implementation assistance, and business/technical support services needed to respond to the cancellation of DoD contracts and/or downsizing (e.g. see Arbor, 2021). These transitions are funded through the US Department of Defense Office of Local Defense Community Cooperation (OLDCC, 2022), (previously the Office of Economic Adjustment, OEA, 2015). The Office of Local Defense Community implements, for example, the requirements of the Base Realignment and Closure Act of 1988 (BRAC). This necessitates 5 years notice of any US military base closure to be accompanied by long-term, focused and fully resourced interventions at Federal level.

In the UK, there are now networks calling for a new government Defence Diversification Agency (DDA) that could provide coordination, assistance and funding to diversification (e.g. New Lucas Plan, 2016). It is envisioned that this agency would '…help to repurpose workers' jobs which are threatened by any downturn in military contracts', stating that the key industries which could fulfil this role include wind energy, marine energy and energy efficient/ renewable energy powered shipping (New Lucas Plan, 2016: np). It is emphasised that the new jobs would be created to meet social needs beyond defence in the short and long term so that 'The role of the DDA would not simply be to assist Defence manufacturers to find civilian markets for their products' because 'Experience has shown that is often expensive and unproductive, and the Defence industry often abandons such work when there is a prospect of future upturns in military contracts' (New Lucas Plan, 2016: np).

Some UK NGOs have joined this call, for example, the NFLA (2019), advocating a UK Just Transition/Defence diversification Agency. The DDA aims would be:

- To encourage diversification of the local economy in areas strongly dependent on Defence employers, making those areas more resilient to changes in the national or international security situation.
- To move skilled workers from the defence sector to alternative industrial sectors which provide clear social or environmental benefits (CAAT, 2020).

Several UK trade unions have also supported this call. In 2017, the Trade Union Congress called for a Shadow Defence Diversification Agency where 'the first task of the shadow agency would be to engage with plant representatives, trade unions representing workers in the defence industry and local authorities, to discuss their needs, capacities and listen to their ideas' (TUC 2017: 1). Local trade union groups also voted to lobby the Labour Party to establish a Shadow Defence Diversification Agency during that period (e.g. BTUC, 2018).

Those who oppose diversification, point to the importance of the basic premise of security policy since World War II, that there should be a Defence Industrial Base (DIB), whereby, instead of converting civil production to manufacturing military equipment in times of war, nations maintained their own defence industries, constantly ready to respond to threat. Yet, in more recent times, pressure on public funds means there has been more effort to make wider use of cheaper, non-specialised Commercial, Off-The Shelf (COTS) technology wherever possible (PWC, 2005). A study of actual closure, and subsequent redevelopment efforts, of three US defence facilities: Bergstrom Air Force Base in Austin, Texas; DuPont's Eleutherian Mills in Wilmington, Delaware; and the Brooklyn Navy Yard in New York, suggested that defence conversion can generate greater economic activity than prevailed before the closures (Preble, 2014). Another study by economist, Heidi Garrett-Peltier (2017), looked at how many jobs are created in a variety of domestic sectors for every million dollars of federal money spent in the US. She found that, the number of jobs created for every $1 million spent on defence would be vastly greater if spent in other areas, from 21 percent (for wind energy development) to 178 percent (for elementary and secondary education).

Overall, though, it has been found that there is little history of success with regard to previous attempts to diversify. Unite (2016: 3), in a review of defence diversification initiatives, argues that the failures in the UK have been down to 'lack of government support; the unwillingness of defence companies to diversify; barriers to entry in new or adjacent markets; or a combination of all three'. They note that there has been more success in the US, as with the economic adjustment initiatives. For diversification to be successful, Unite (2016) proposes legislation that creates a statutory duty for the Ministry of Defence and its suppliers to consider diversification. This will help to overcome the reluctance of defence companies to take the risk of entering new markets.

Very recently, the pressure to offshore production particularly seems to make job creation in non-military fields difficult. Other issues include the different quality and timescales needed, with lower standards applying to civil production. While the conversion of publicly owned military bases to non-military has had some success in the US, converting production in private sector manufacturers has been much more problematic. The US United Steelworkers (USW) union identified the important effects of globalisation on jobs in defence manufacturing and note the distinction between base closures and other forms of transition, advocating for the quality of the new jobs and the involvement of workers and their representatives in the transition (in Unite, 2016). For success, then, it appears that diversification requires adequate advance planning, with input from all key stakeholders, including workers; sufficient resources; and local and national government support.

Just Transition

The term 'Just Transition' (JT) was developed by trade unions and taken up by academics, environmental activists, governments, NGOs and supra-national institutions to highlight and address the equity and justice challenges associated with steering society towards ecological sustainability (Stevis et al. 2020). There is still a considerable divergence in views as to definitions and scope of the JT concept (see Räthzel et al., 2021) but it generally tends to focus on workers, the workplace and production in the context of the transition to sustainability. It often focuses on the labour issues involved in attempts to regulate and reduce emissions from industries which tend to create large amounts of GHGs. There has recently been an increase in JT work and scholarship among academics and NGOs as the need to reduce GHG emissions while addressing social justice issues in impacted regions has become more apparent (Pai et al., 2020). However, a general lack of familiarity with the term remains, though organisations discuss the same issues using other concepts (JTI, 2020).

Where the term is used, there are a range of interpretations. In a recent scoping review of JT policy and practice in 27 OECD countries between 2015 and 2020, Krawchenko and Gordon (2021) note that the interpretations of JT span 'jobs-focused', 'environment-focused', and 'society-focused' models. The 'jobs-focused' interpretation advocates for the workers and communities impacted by environmental and climate policies utilised in the transition to sustainability. This tends to be the position of labour unions representing workers from environmentally damaging industries. The 'environment-focused' interpretation of JT focuses on the main objective of shifting to a zero-carbon economy, examining production and consumption patterns. The 'society-focused' interpretation tends to be the broadest, considering JT as a means to improve the lives of workers and their communities, as well as to address the problems of society as a whole, advocating for system transformation. In this latter interpretation, equity, justice and inclusion at local, national and global levels are seen to be vital elements of JT. The type of interpretation of JT has important implications for campaigns and policy responses.

The Just Transition Initiative (JTI, 2020) also suggest a framework for conceptualising different interpretations of Just Transition. They use the dimensions of 'scope' and 'social inclusion', with scope encompassing the distributional impacts associated with transitions and the underlying intentions of transition planning, and social inclusion assessing the recognition and procedural justice aspects. These dimensions are intended to capture both the impact and process of transitions. JTI (2020) note that the wider dimension of JT has emerged from the environmental justice (EJ) movement, with some elements pushing for a more expansive view of JT that considers the wider societal issues regarding healthy environments (substantive justice), fair distribution (distributive justice) and inclusion in environmental decision making (procedural justice) (see model of EJ outlined in Bell, 2014).

Even in the narrower sense of JT, progress is only recently being made. Many countries are now investing in green energy, but without linking these to economic and regional development plans or to justice, including procedural justice elements requiring stakeholder involvement in decision-making (Krawchenko and Gordon, 2021). Most studies suggest that the overall impact of environmental policy measures will be favourable in terms of jobs though losses are likely to occur in particular economic sectors, regions and communities, especially where there are minimal opportunities for economic diversification (UNFCCC, 2016). The general Just Transition literature points to a key challenge in the lack of similarly lucrative jobs available as alternatives to the jobs that are being lost as a result of climate policy (JTC, 2020). The sectors that have come to replace these tend to be lower-paying positions and less secure jobs in the service industry. Individual losses in wages and security for workers have ripple effects across communities (Eisenberg, 2019; Cha et al, 2022).

It is recognised that industrial transitions not only directly impact the workers employed in those sectors but also their wider communities. Yet policies to support communities through JT are not always evident - there can be the assumption that workers are mobile and can move to seek new employment (Krawchenko and Gordon, 2021). This ignores the social connections and place-based identifies that people develop with and within their communities. Social dialogue and accountability are repeated themes in the JT literature for fair and effective sustainable transitions. Mechanisms for JT accountability, such as the Just Transitions Commissions in Wales, Scotland and Ireland are important for ensuring effective JT policies and programmes.

THE TRADE UNIONS

There are four key trade unions covering the UK defence sector - the Public and Commercial Services Union (PCS), Prospect, Unite and GMB. All have supported Just Transition and decarbonisation (Prospect/GMB/Unite/Unison, 2018) but the GMB has been opposed to diversification (GMB, 2017). Employment in the UK defence industry has been in decline for several decades, with direct employment falling by almost two thirds since the 1980s (NET, 2018a). Hence, retaining defence jobs has been a major focus of the work of these unions over this period. There has been particular efforts to respond to the recent UK government's Integrated Defence Review (Gov.UK, 2021) with calls to ensure jobs are protected. Major unions such as Unite and PCS have backed the idea of diversification. Unite (2016) published a report calling for lessons to be learnt from overseas attempts at diversification, legislation to impose a statutory duty on the Ministry of Defence and its suppliers to consider diversification, and public investment and financial support for diversification (Unite, 2016). The GMB, which represents many defence industry workers, has opposed defence diversification, for example, supporting the replacement of Trident, submarines armed with ballistic missiles able to deliver thermonuclear warheads (GMB, 2017).

In the US, the defence sector is covered by a range of unions including the American Federation of Government Employees (AFGE); International Union of Electrical Workers and Communication Workers of America (IUE-CWA); International Federation of Professional and Technical Employees (IFPTE); United Auto Workers (UAW); International Association of Machinists and Aerospace Workers (IAM); and the International Federation of Professional and Technical Engineers (IFPTE). All of these unions fall under the umbrella of the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO), which represents over 12 million workers across 57 labour unions.

AFGE have been focused on recent lobbying in support of provisions within the 2022 National Defense Authorization Act (NDAA) to ensure defence job security and improve pay (AFGE, 2021). The IFPTE advocated for the Infrastructure Investment and Jobs Act and the Build Back Better bill, noting that these would support well-paid union jobs, strengthen the economy's competitiveness and resiliency, and address climate change challenges (IFPTE, 2021). The UAW is promoting electric vehicles as its main platform for addressing climate change and promoting jobs, arguing that the shift to sustainability is an opportunity to re-invest in US manufacturing and should be accompanied by secure and well-paid jobs. The IAM has been very focused on job losses in the midst of the pandemic. It advocated for and won the successful passage of the Aviation Manufacturing Jobs Protection Program (AMJP), which is part of the Biden administration's American Rescue Plan. They have also been leading a campaign to 'Buy American' Defense Expansion, an amendment championed by the IAM and US Rep. Donald Norcross (D-NJ) to dramatically increase domestically made procurement requirements in major defence programmes. The legislation would increase Buy American requirements for major defence programmes from 55% to 60% upon the Bill's enactment, increasing to 75% by 2029 (IAM, 2021). However, there have been local IAM initiatives to scale back and diversify defence. For example, for more than 15 years, John Harrity of the IAM has been pressing for diversification of the defence sector, noting 'the national security implications of energy policy, including the global destabilization and threat to US interests of advancing climate change' and advocating for shifts in DoD purchases and funding to 'non-weapon research, development and production of energy technology essential to our security' (Harrity, 2014: np.).

The AFL-CIO has been championing Just Transition, in terms of consultation with workers and their unions; fundamental rights, including the ILO core labour standards; social protection; and wage

guarantees, including prevailing wage rates for skilled workers in the relevant industries (Trumka, 2020). Brad Markell, executive director of the AFL-CIO's industrial union council and chair of its energy taskforce, has argued that the renewable sector tends to be anti-union and to create low-quality jobs (Oliver, 2021). Therefore, importance of worker participation in decision-making around sustainability transitions is emphasised in their work. For example, the AFL-CIO has released a statement highlighting that '…the fastest and most equitable way to address climate change is for labour to be at the center of creating solutions that reduce emissions' (AFL-CIO, 2017: np.).

Hence, maintaining the quality and quantity of defence sector jobs has been a central focus of the unions in the US and UK. Both have seen declines in employment as the result of the increasingly capital-intensive nature of the work, more automation, globalised supply chains beyond the US and UK, variations in defence spending, and the competitive arms export market (NET, 2018a). Although it is difficult to estimate the number of defence jobs, it is reported that there were approximately 133,000 people directly employed by the defence industry in the UK in 2020, a decrease of 17 percent since 2010 (Burgueño Salas, 2021). In the US, we have only been able to identify numbers of military jobs which in 2020, amounted to 1.33 million workers on active duty, down from 1.5 million in 1995 (Duffin, 2021). Although military spending has recently increased in the US and UK, this may not translate into more jobs because of automation, outsourcing and the balance of materials and energy spend, relative to labour. Therefore, the question of maintaining defence jobs continues to be a primary issue for the US and UK unions which cover this sector.

GOVERNMENTS

Governments can be key drivers of decarbonisation, diversification and Just Transition. In both the UK and US, they are focussing on reducing GHGs while increasing and maintaining the defence sectors. The UK government has just carried out an Integrated Review of Security, Defence, Development and Foreign Policy (Gov.UK, 2021) and has announced an investment of £16.5 billion into defence over four years, the largest military investment in 30 years (MoD, 2020a). The UK Cabinet Office (2021) has also recently announced new measures requiring businesses to commit to net zero emissions by 2050. They must publish clear and credible carbon-reduction plans before they can bid for major government contracts, including those in defence. The different constituent governments of the UK are at different stages of considering Just Transition. For example, the Scottish Government has a Just Transition Commission, which includes Richard Hardy, National Secretary for Scotland and Ireland of the trade union Prospect, representing members in defence (Scottish Government, 2021).

The UK MoD notes that climate change will mean the military has 'to fight and win in ever more hostile and unforgiving physical environments' (MoD, 2021b: np.) and sees the transition to sustainability as offering opportunities. For example, they state that 'New energy systems could offer the operational edge against adversaries' (MoD, 2021: 14). In 2019, it was reported that the UK Army chief, Gen. Mark Carleton Smith, has publicly stated that the British Army needed to embrace climate security or it will have difficulty recruiting young people, since they are often very concerned about the climate (Sengupta, 2019).

The 'Climate Change and Sustainability Strategic Approach' document (MoD 2021a) states that UK forces must become less dependent on fossil fuels. Over the next five years, actions include monitoring emissions and identifying reduction targets, with a focus on the defence estate, including barracks, docks, airfields and training areas. Following that, it will continue to be a goal to reduce emissions significantly using existing and emerging technologies. There is to be increased use of robotic and autonomous systems since it is considered that they will have lower emissions

than those with crews. Military aircraft are expected to use a greater percentage of sustainable fuel. The British Army is putting solar panels on its bases and planting 2 million more trees on its estate. Every UK government department has its own climate targets, called the Greening Government Commitments, which aim to reduce their in-house emissions by 40% from 2010. The MoD has to date managed a 42% reduction from 2010 and has, therefore, met its targets. There are some good examples of transitioning, including the solar installations at the MoD's Worthy Down defence college, which have significantly cut energy costs, and the solar farm on the former Lyneham airfield which is currently the largest solar farm in the UK, providing electricity for the site and 10,000 homes. UK Ministry of Defence climate strategy document (MoD, 2021a) includes the use of biofuels especially in military planes, more drones/ robotic/ cyber technologies, more nuclear power in warships and at bases, and use of carbon offsetting.

In the US, President Biden has re-joined the Paris Agreement and made historic commitments to climate action. Considered to be the largest institutional consumer of energy in the world, the US Department of Defense (DoD) has an important role in enabling the US to fulfil those commitments (e.g. Powers and Wu, 2021). Military leaders have been expressing concern about the US military's dependence on fossil fuels for almost 20 years, for example, in 2003, when James Mattis, then-commander of the 1st Marine Division stated that the military must be 'unleashed from the tether of fuel' (in Douglas, 2017: np.). Over the last 5 years, the US army has been electrifying its vehicles and weapons systems (Judson, 2017) and the US navy has deployed hybrid energy ships, although some have now been suspended (Defense Brief, 2020). Since 2009, the US navy has been working toward a goal to obtain half of its total energy from alternative sources by 2020. It is claimed that 'This commitment to alternative energy is spurring private-sector investments in renewable energy technologies that are driving costs down, not only for the navy but for all consumers' (Reinhardt and Toffel, 2017: np.).

Last updated in 2018, DoD Directive (DoDD) 4715.21, 'Climate Adaptation and Resilience', stated that the DoD must assess and manage risks associated with the impacts of climate change on DoD missions and installations and strengthen resilience to the impacts identified. Following this, the recent DoD report 'Department of Defense Climate Risk Analysis' states that 'Climate change is reshaping the geostrategic, operational, and tactical environments with significant implications for U.S. national security and defense' and that 'Working within the whole-of-government, and in coordination with allies and partners, DoD will strive to prevent, mitigate, account for, and respond to defense and security risks associated with climate change' (DoD, 2021b: 2). Some recent administration reports have raised concerns about the US defence industry's reliance on aspects of the global supply chain vulnerable to disruption; and competitor country suppliers, identifying some lack of domestic capacity regarding technologies that would be necessary for a green transition, such as lithium-ion batteries (DoD, 2018) and rare earths metals (IEA, 2021; Williams, 2021). In addition, recent research suggests that, while DoD public statements and reports indicate perception of climate change, a security threat of strategic importance, climate security is only selectively integrated into planning and decision-making (Burnett and Mach, 2021).

COMPANIES

In the US, some of the main defence companies have been focussing on sustainability in recent years with differing commitments to net zero. General Electric has set a goal to be a net zero company by 2050 - encompassing not only GE's operations, but also the Scope 3 emissions from the use of sold products (GE, 2020). Also responding to the climate crisis, Honeywell, in 2021, committed to becoming carbon neutral by 2035. Honeywell said that it would reach that goal in its

operations and facilities through a mix of initiatives, including investment in energy-saving projects and conversion to renewable energy sources. The company states that, since 2004, it has already reduced GHGs by more than 90% (Honeywell, 2021). Another major company, Raytheon Technologies claims that their engineers are working diligently and creatively to reduce emissions through improved engine performance with better fuel economy, the development of hybrid electric propulsion and improving the operational efficiency of the fleet (Raytheon Technologies, 2021). None of these companies discuss diversification or Just Transition as part of their decarbonisation strategies, as far as is apparent from their current publications.

In the UK, some large defence companies have been more ambitious in terms of their deadlines. BAE Systems have committed to achieving net zero GHGs across their operations by 2030 and across their supply chain by 2050 (Sutcliffe, 2021). Rolls Royce have also committed to net zero by this date (Rolls Royce, 2021c). GKN Aerospace aim to achieve net zero GHGs by 2050 (GKN, 2021). As with the US companies, their reports and statements on decarbonisation focus primarily on technical solutions with little on social aspects and virtually no discussion of diversification, Just Transition or consultation with workers in the transition to sustainability. There are also no reports of social dialogue with workers in their supply chain industries.

It is argued that, since the defence sector has a history of pioneering innovative technological solutions, it is well placed to innovate to address new environmental threats (e.g. GLOBSEC, 2021). It is certainly the case that there is much technological innovation within the defence sector that might help address some of the environmental issues. For example, the industry is working on its objective of achieving net zero emissions by investing in battlefield electrification techniques, including the use of electric propulsions in military aircraft as well as testing hydrogen fuels (StartUS, 2022). The sector has also been working on reducing the weight of defence equipment to improve performance and reduce fuel consumption. This includes 3D printing which enables the production of components and parts while using significantly less material than in traditional manufacturing (e.g. Accreate Labs). It is also reported that Boeing, GE, NASA and the US Air Force are investigating the use of liquid hydrogen fuel cells (Dimitrova et al., 2021). In 2021, the US army began to work with companies on a Power Transfer Cohort programme, exploring electric and hybrid technologies for its future fleet. Similarly, the UK MoD is working with NP Aerospace, General Dynamics, Supacat, and Magtec to develop hybrid versions of the Foxhound and Jackal 2 armoured vehicles.

Some of these technologies have spin-off civil environmental benefits. For example, GE was recently selected by the Defense Advanced Research Projects Agency (DARPA) to lead a four-year project that could simplify the transport of potable water to troops in the field and address water scarcity around the world (GE, 2020). In another example, BAE Systems is developing flap-free technologies that make aircraft lighter and more fuel efficient (Dimitrova et al., 2021). In addition, Safran and General Electric are reportedly collaborating on an engine powered by sustainable aviation fuel that is 20% more fuel efficient than current aviation propulsion engines (Dimitrova et al., 2021). Since September 2021, MoD defence procurement policy requires all suppliers to commit to net zero 2050 and publish a carbon reduction plan. This can help encourage sustainability innovation among businesses, but the MoD could also include progress monitoring against these plans.

SCOPE AND PROSPECTS FOR CHANGE

Suggestions and initiatives for effective decarbonisation of the defence sector from military leaders, defence companies and defence analysts have included: Setting supply-chain

decarbonization requirements aligned to national targets for all suppliers; leveraging assets, such as land, to generate renewable energy or capture carbon; using biofuels for powering ships and some aircraft; Introducing electric unmanned aerial vehicles (UAVs) (see Bowcott et al, 2021); increasing the energy efficiency of platforms and installations; using clean distributed-energy generation and storage; electrifying vehicle fleets (e.g. US Defense Secretary, Lloyd Austin, in Vergun, 2021); using more efficient engines, lightweight materials and more aero- or hydrodynamic designs (IATA, 2019). Of particular relevance for jobs is the idea of reducing the use of manned vehicles, as illustrated in the following comment that 'The determination to reduce emissions also offers the opportunity to expand thinking on uncrewed equipment types (drones, uncrewed land and sea vehicles)' (Richard Nugee, Climate Change and Sustainability Strategy Lead for the UK Ministry of Defence in Owen-Burge, 2021: np.). It is generally recognised that some aspects of the defence sector will be difficult to decarbonise, particularly those with high emission intensity, such as space launches (Bowcott et al, 2021). It is, therefore, argued that net zero in defence will need to involve pursuing offsets (ibid.).

As indicated earlier, the company and government strategies have been criticised for weak carbon reduction targets and methods. For example, while the MoD strategy highlights a large decrease in military GHGs over the last ten years, Parkinson (2021; 2020a, 2020b) argues, drawing on National Audit Office data (NAO, 2020) that these reductions have been achieved largely through increased renewable energy feeding into the national electricity grid; reduced overseas military operations; and military base closures which occurred as part of austerity policies linked to the global financial crisis. Parkinson notes that very little of the reduction has been achieved through particular actions on the part of the military solely to reduce emissions. Some reductions that occurred as a result of cuts to military spending have begun to reverse, with an apparent 24% increase in military GHGs since 2017 (MoD, 2020b). The NATO spending target of 2% of GDP on national militaries has been criticised as likely to increase military GHGs (Lunn and Williams, 2017). It is also alleged that the strategies do not acknowledge the environmental impacts of engaging in war, such as the impacts resulting from the bombing of fossil fuel depots, destroying habitats, destruction of buildings and infrastructure that then has to be rebuilt (Darbyshire and Weir, 2021). Others have asked for consideration of the climate impacts of nuclear weapons (Witze, 2020). Furthermore, as Parkinson (2021; 2020a; 2020b) points out, some alternative energy sources will be low in carbon emissions but continue to be detrimental to the environment. For example, nuclear power will increase radioactive contamination and biofuels can reduce biodiversity and compete with land for food. Finally, all the strategy documents, but most relevant to the governmental strategies, lack policies to avoid war - diplomacy, arms control and disarmament treaties.

WORKERS INCLUSION IN DECISION-MAKING

A particular omission from the strategies of the governments and companies is discussion of how to include workers in the process of transitioning. The idea of 'social dialogue' across governments, businesses, trade unions and civil society is fundamental to Just Transition, according to many trade unions (ETUC, 2019; Smith, 2017). Hence, the UK Trades Union Congress has called for a UK-wide Just Transition Commission to ensure that workers' voice is central to guiding net zero policies (TUC, 2020). Social dialogue means discussing what transition means to those affected and to their communities. How to frame this dialogue is important for engaging workers and developing effective policy and programmes.

A report on defence diversification in an international context (NET, 2018b;1) concludes that 'the best ideas and innovations come from the workers and affected communities' and, therefore, that

workers and communities must take the lead in making decisions for diversification, but in the context of a broad partnership involving all stakeholders (NET, 2018a:2). The main UK defence unions have stated that 'The test for any just transition is whether those most affected are allowed to lead the debate and have ownership of the priorities. If not, it cannot be a just transition' (Prospect/GMB/Unite/Unison, 2018: np.) Yet, a survey run by the UK Prospect union found that 65% of those responding answered with a 'no' when asked 'Does the government do enough to engage defence workers when shaping defence industrial policy?, compared to less than 5% replying 'yes' (Prospect, 2021).

Webster and Shaw (2019) have noted that the concept of Just Transition is rarely used beyond policy literature or those who are likely to be most affected. Some have resisted the term as masking what is likely to involve job losses. Therefore, unions and advocates of Just Transition have emphasised the need for 'social dialogue' with those affected, leading to practical and feasible plans that respond to the workers' legitimate concerns.

Workers' sense of identity is often bound up with the work they do and may support self-esteem and pride. Due to the pressure of 'cognitive dissonance', people who are employed in environmentally damaging industries will justify it to themselves. However, confronting them without understanding this pride and identity can be very counterproductive (Bell, 2020; 2021b). Joe Uehlein of the US Labor Network for Sustainability asserts that environmentalists have not adequately understood the primacy of work in people's lives so their messaging does not resonate with the needs and aspirations of working people (Labor Network for Sustainability, 2018). Sometimes, there are no other jobs available except in the environmentally harmful industry, so it is always important to engage workers in considering alternatives. There are many examples of environmental groups that have alienated workers by failing to consider their needs and concerns (see Bell, 2020). As Räthzel and Uzzell (2012) point out, work for many not only is about survival but also provides dignity, identity and solidarity so that when whole industries are attacked as environmentally harmful, those who work in those industries can feel similarly attacked (Räthzel and Uzzell 2012).

The extent to which workers have the power to transform their work, workplace and what is produced and consumed is of great importance in terms of achieving a Just Transition. Some consider involving workers in discussing technical solutions only, whilst others advocate a more radical approach. For example, the Trade Unions for Energy Democracy (2018) initiative advocates a 'social power approach' where current power relations are challenged, including through public/social ownership and democratic control over key sectors. There are many emerging and ongoing Just Transition debates, particularly in relation to gender, participation and community engagement (e.g. Bell, 2021a).

Participation in decision-making, in general, is widely applauded but often considered to be inadequate in practice. Concerns range from the manipulation of participants and tokenistic use of participation to legitimize decisions, to more fundamental critiques that society does not currently equip people with the necessary information or equality required effectively participate in decision-making (e.g. Mansbridge, 1990; Benhabib, 1992; Fraser, 1992). Participation clearly depends on the quality of the process and a number of models and theories have been proposed for improvement (e.g. Arnstein, 1969; Dryzek, 1990). Bell and Reed (2021) summarise these debates and propose a new model which aims for (i) equality between participants that respects and values different knowledges and contributions; (ii) flexibility to recognize, evaluate and integrate contributions that are drawn from different knowledge bases; (iii) authenticity; (iv) transparency; (v) access to the resources and support necessary to actively participate; (vi) representation based on democratic

mandate and (vii) freedom to deliberate all issues and options. This workers' enquiry intends to amplify the voices of defence sector workers building on this model of participation, respecting and valuing diverse perspectives, knowledge bases and topics for discussion.

METHOD

The main strand of the project was a workers' enquiry which is a method that encourages workers to think about and articulate their situation in the productive process (Brown and Quan-Haase, 2012). This method is useful for creating theory and practice grounded in workers' experience and has a history of use when shifts in production are taking place or where these changes could be on the horizon (Woodcock, 2021). We, therefore, spoke to past and present defence sector workers (aged 18+) about their perceived actual and potential changes to their work and lives arising from current JT, diversification and decarbonising policy and plans.

The project used a mix of triangulated data collection methods, including a literature review, document analysis, semi-structured interviews with defence sector workers and focus group discussions with defence sector worker representatives and relevant 'experts'. We used these methods as a recognized ways to research workers whose perspectives have received limited attention (Bryant, 2006).

The literature review involved a critical analysis and in-depth overview of previous research on Just Transition, defence sector decarbonisation and diversification, ensuring the project built on a comprehensive foundation of existing knowledge and ideas. Sources included databases, reference lists, library searches, grey literature and internet search engines. The document analysis focused on policy documents, media reports and websites. The key objectives were to understand the government, business and trade union plans and policies on Just Transition, decarbonisation and diversification. This process was conducted in line with recognised protocols for document analysis (e.g. Bowen, 2009). The documents were viewed as media through which social structures and power are expressed.

The worker interviews investigated the perceptions, aspirations, concerns, ideas and interest of workers in the UK and US defence sector in Just Transition, decarbonisation and diversification. We defined defence sector workers as those who currently or formerly work, or worked, in the defence sector or for a company that supplies the defence sector, including military and civil service defence sector workers. The definition of 'worker' is contended but usually means 'employee'. Under UK government law, a person is generally classed as a 'worker' if they 'have a contract or other arrangement to do work or services personally for a reward' (UK Gov, 2022: np.). Therefore, we include managers at various levels in this study, though we placed the main focus on front line/non-managerial workers. We interviewed 58 workers, 30 in the UK and 28 in the US, mostly online or by telephone due to Covid restrictions. The interviews continued until we reached the point of 'data saturation'.

We recruited as diverse participant cohorts as possible to reflect a range of identities, backgrounds and occupations using community knowledge, contacts, and pre-existing relationships (see Appendix 1 – demographic data). Our links with community organisations and relevant trades councils, trade unions and defence sector companies aided this process, assisting in recruiting participants. We aimed to recruit workers with a wide range of perspectives and backgrounds. More than 200 large and small organisations were approached including the large defence sector companies, for example, Rolls Royce, Honeywell, BAE systems; smaller defence supply companies; the main trade unions that cover the defence sector in each country; defence interest groups, such

as US Military, US Airforce, Defence Forum, and Defence and Security Portal Facebook groups; veteran organisations, including Veterans for Peace in the US and UK and AMVETS (American Veterans); and community-based environmental groups, such as WE ACT for Environmental Justice New York. We complied with all Data Protection legislation by asking our contacts to pass on a 'recruitment text' (see Appendix 2) to their contacts so that workers would get in touch with us if they were interested in participating, rather than us having any of their personal data in advance.

The interviews were semi-structured and lasted for up to one hour. Questions did not ask about the company or workplace but discussed the issues more generally, for example:

• Are you aware of any policies or plans for decarbonisation/diversification/Just Transition that might apply to your type of work?

• Have you ever been asked, either formally or informally, what you think about these policies or plans?

• How do you think these policies or plans will impact on yourself/your family/your workplace/ your community?

We also held two online focus group discussions. The first was an international expert dialogue and the second was an international trade union dialogue. Representatives were invited to each focus group with the greatest representation possible across unions, sectors, gender, ethnicity and other intersectionalities. The final groups consisted of 9 in the first focus group and 8 in the second focus group. See Appendices 3 and 4, respectively, for a list of members of these focus groups.

The primary data was analysed thematically using the Framework Method (Ritchie and Lewis, 2003) as it fits the case study method and the type of data that was generated. The themes were drawn from the existing literature, where available, as well as inductive coding processes. We used computer assisted qualitative data analysis software (NVivo) to assist with data management during this phase.

RELIABLITY, VALIDITY, GENERALISABILITY

Since the topics that this project covers are very contentious, it was important to consider the validity and reliability of the findings. It is recognised that the data collected depends to some extent on the context and sample (Denscombe, 2007). The strategies we used to achieve both reliability and validity included being as 'reflexive' (Gouldner, 1970) as possible; explaining context; making the process transparent; being open and honest about the sample and how the research was carried out; carrying out thorough documentation of the research process; collecting as much data as possible; using triangulated methodology; integrating the research with the existing literature; and checking our interpretations during the interviews and informal conversations, as much as possible.

The interviews were semi-structured, in that we asked a number of key questions each time, but the additional questions varied between interviews, sometimes taking the form of a conversation. This technique was considered to be a flexible way of eliciting information which could be modified according to the unfolding interview statements, whilst maintaining an overall structure, allowing space for 'probing' and following interesting and unanticipated themes (Moser and Kalton, 1985; Fielding, 1993). The interviews were planned to be 45 minutes in length but, in practice, varied between 25 and 70 minutes. The difference in length usually depended on how much rapport there was; whether the interviewee was providing relevant material; and whether the technology through

which the interview took place was conducive to a long conversation (e.g. stable internet connection).

The topic guides and interview questions were developed after operationalising the key terms 'decarbonisation', 'diversification' and 'Just Transition'. The terms were discussed among the research team and with the advisory board until we reached consensus on working definitions. As outlined above, in practice, these pre-formulated questions were used for outline guidance only, as we found it more useful to ask specific questions for each interviewee so as to bring out their particular knowledge and experience. We also adopted this approach because the focus of the questions came to change with our own ongoing analysis. Interviews rely for their quality on the nature of the interactions with the interviewees. Therefore, we worked in a way that is known to contribute to quality interactions, including showing empathy, establishing rapport, listening intently, restatement, clarification and persistence. We also sometimes gave our own opinions and thoughts, in line with what has been called a 'feminist research approach' (Ritchie and Lewis, 2003), where, 'The researcher feels free to step outside the formal role of the neutral asker of questions, expressing their own feelings and giving information about themselves…' (ibid.: 140).

This helped to maintain rapport and we found that the responses and subsequent exchanges led to important insights. Many researchers have highlighted the need to gain the trust of the interviewee in order to obtain the most honest and considered answers. This method seemed to be effective in this respect.

We did not aim to be objective, in the sense of 'value free' in this study but rather to be 'engaged' understanding that knowledge is subjective, the result of historical and cultural processes, and constructed on the basis of power. Even so, the aspiration to be objective, in the sense of being aware of our subjective position at all times whilst attempting to see beyond it, was our aim. Kincheloe and Mclaren (2000) argue that this is aided when the researcher is 'reflexive', acknowledging their own assumptions, values and ideologies.

Therefore, an important element of ensuring reliability and validity was to consider our 'positionality'. The term 'positionality' describes an individual's world view (Savin-Baden and Major, 2013; Rowe, 2014; Holmes, 2020). It is important to explain the positionality of the research team and advisory board in recognition of the fact our research is influenced by our values and beliefs, shaped by political allegiance, religious faith, gender, age, ethnicity among other factors (Marsh *et al.,* 2018). We know that positionality influences how research is conducted, its outcomes, and results (Rowe, 2014). Therefore, to balance out the impacts of this, we ensured that the research team and advisory board for this project came from a range of different backgrounds, as follows:

Of the research team (10):

- 8 identify as women, 1 as male, and 1 did not wish to say
- 3 identify as BAME/PoC, 6 as white, and 1 did not wish to say
- 3 identify as from a working-class background, 6 as middle-class, and 1 did not wish to say
- Age - 2 x 18-31; 4 X 31-50; 2 X 51-66; 1 X 67 plus; and 1 did not wish to say
- 4 living in the UK; 6 living in the US
- 7 had prior support for decarbonisation of defence
- 6 had prior support for diversification of defence
- 9 had prior support for Just Transition of defence
- 2 have personally worked in the defence sector
- 5 have family that work or worked in the defence sector

We also worked with an advisory board that covered a range of different perspectives from government, defence companies, trade unions, academics and NGOs with prior work or interest in defence decarbonisation, diversification or Just Transition. The advisory board was made up of the following individuals who gave their time voluntarily to the project.

- Brendan Donegan, Programme Lead for 2050 Calculator and Team Lead for Just Transition. Dept. Business, Enterprise and Industrial Strategy, UK Government
- Mika Minio-Paluello and Anna Markova, Policy Leads on Industry and Climate, UK Trade Union Council
- Sam Perlo Freeman, Research Coordinator, Campaign Against the Arms Trade
- Sam Mason, Policy Officer, Public and Commercial Services Union
- [ANONYMISED], Chief Technologist, [ANONYMISED international defence company]
- Erik Kojola, Assistant Professor, Sociology, Texas Christian University
- [ANONYMISED], Business Development Manager, Energy Transition, [ANONYMISED international defence company]
- John Harrity, Board Member, Labor for Sustainability
- [ANONYMISED], Director of Climate Change and Sustainability, [ANONYMISED UK Government Dept].
- Miriam Pemberton, Associate Fellow, US Institute for Policy Studies

We do not compare the US and the UK interview data here, due to there being differences in the sample between the UK and US cohorts. This is largely due to differential response rates from certain communities. For example, although more than 40 defence companies were contacted in each country, there was more success in accessing interviewees via the companies in the UK. When we accessed interviewees via the companies, there was more of a tendency to recruit workers that were more senior in the company. For more information on this, see Appendix 1 which provides data on the make-up of the sample, particularly on sectors, roles and how accessed.

As this is a qualitative study, the sample was not intended to be representative, in terms of demographics, of the wider defence sector community. However, we did wish to recruit across a range of identities, geographies and occupations. We have had some success in this (see Appendix 1), though our cohort are predominantly white and male and, therefore, in further studies we would wish to broaden this. We did not ask about union membership, but we know that approximately a third of the participants were recruited through the trade unions and will, therefore, be union members. We cannot say the proportion of US and UK defence sector workers that are unionised due to the diverse range of unions that cover the defence sector. However, we know that 23.7% of the UK workforce (BEIS, 2021) and 10.3% of the US workforce (BLS, 2022) are members of trade unions. It might, therefore, be argued that this study focused disproportionately on unionised workers. However, we felt it was important to interview union members and representatives as these workers tend to have high levels of awareness of the relevant employment issues.

While our sample is not large enough for us to generalise about defence sector workers, we have been able to gain insights and understanding. Triangulated with the literature review, document analysis and focus groups of international experts and worker representatives, the comments and statements help to illustrate some of the debates as well as raise a number of questions and point to directions for further research. This triangulation has also enabled us to propose some recommendations for consideration.

ETHICS AND CONFIDENTIALITY

The principles of integrity, honesty, confidentiality, voluntary participation and fairness were adhered to throughout the study. In terms of protecting the research participants, accepted protocols with regard to ensuring informed consent and confidentiality, were followed, as discussed below. In addition, we were careful to avoid causing harm, discomfort or distress by showing respect for privacy, values and beliefs and responding in a sensitive way. We also sought to represent the participants in a fair way, ensuring that we did not use their words to imply a meaning that was clearly not intended. Furthermore, we carried out the research openly and ensured that we included the greatest range of participants, in terms of social categories, as well as beliefs.

It was also important to consider confidentiality so that we could include a wide range of interviewees and they could speak as freely as possible. Studying the defence sector raises some challenges as, like some other industries (e.g. pharmaceuticals), worker confidentiality is often emphasised. Before project commencement, a full application for ethical approval was made in each participating university. We drew on our previous experience of interviewing workers in differing sectors, including defence, and relevant prior studies (e.g. Deschaux-Beaume, 2018). It was made clear to prospective interviewees, in all communications prior to interview, that they would not be asked about, or expected to disclose, any confidential information about their company, trade union or any other person or organisation. The highest standards of confidentiality were maintained throughout. All interview data has been anonymised, including individual, company and third person names and identifiers. Fully informed consent was taken and workers were told that they can withdraw from the study at any time, without explanation. However, we did not offer confidentiality to the focus group participants as these were 'experts' and high-level representatives. This meant that their statements were not intended to be anonymous so that we could show the public position of the officials and agencies they represented. Even so, we sought their agreement to publish the quotes that are in this report. Two preferred, at that stage, to maintain anonymity regarding their quotes and also not to be named as members of the focus group. Three of our advisory board members also asked for anonymity. Hence, our methods emphasised confidentiality, respect for diverse views and the right to withdraw from the research up to the publication of the report.

INTERVIEWS

DECARBONISATION

There was generally confidence about understanding the term 'decarbonisation' among the workers interviewed (e.g. UK007; UK010; US001; US003). However, a substantial proportion had not heard the term before we approached them about the study (e.g. UK009; UK008; UK014; US013) or said they were unclear about its meaning (e.g. UK016). Several made the point that they were interested in a wider consideration of environmental impact, beyond solely climate change (e.g. UK006).

The interviewees described numerous decarbonisation and other environmental activities that were already underway in their company, department and sector. This included phasing out of old equipment (e.g. UK010); moving their office building locations to public transport hubs (e.g.UK009); increasing mentions of sustainability terms, such as 'net zero', 'carbon neutral' etc. on meeting minutes and intranet sites (e.g. UK008); recycling water (e.g. US023); recycling other waste (e.g. US021); biodiversity initiatives (e.g. UK018); complying with environmental legislation (e.g. UK017); using simulators instead of live training (e.g. UK013; UK018); new solar panels on roofs (e.g. US015); switching to electric or hybrid cars (e.g. US021); monitoring hazardous substances around the factory (e.g. US023) and staff voluntary activities, such as beach cleaning (e.g. UK003). To some extent, these changes were seen to be consistent with changes across manufacturing, where practices can be brought in from wider industry that reduce carbon, and were seen as changing in line with evolutions in governmental regulations and legislation (e.g. UK001; UK011). For example, UK022 said,

> *I don't think it'll [decarbonisation] be that hard because civil has the imperative to decarbonise and will decarbonise and the technology is so similar between civil and defence that they can't really decouple. So, what civil does, defence will have to do anyway, so it will just kind of happen. There won't be a, kind of, need to change anything per se. it'll just follow on (UK022).*

In general, the workers we interviewed noted that a lot of work on transitioning to sustainability was already taking place but more could be done to address the environmental impacts of the sector (e.g. UK003; UK004).

There were different understandings, among the workers interviewed, of how much the defence sector contributes to climate change and other ecological problems, relative to the civil sector. Some saw the contribution as far greater than civil (e.g. US006), others as about the same (e.g. UK022) and others as probably less (e.g. UK025). Most agreed, however, that there was work to do, regardless. For example, interviewees said:

> *My understanding is that military and the defence sector are extremely polluting. There's not really two ways around it. It's always been the case and I don't think it's going to be that different in the future. If we take a look at the navy, for example, those ships guzzle many, many hundreds of gallons of fuel within seconds, whereas a normal marine ship – like a merchant vessel – would consume about half the amount (UK002).*

> *They [the US military] are the biggest user of fossil fuels and the biggest contributor to the carbon footprint, and a lot of people don't realise it. It's one of those things that, here, people take for granted. We see jets flying overhead every day – dozens*

of them – and how much fuel does one of those jets use? It's incredible … An F-35 uses as much fuel as 1,900 cars, so people don't realise the extent to which the military is major contributor to climate crisis … people just don't really realise (US006).

I'd probably say, 'less,' because it's not as big a sector, to be honest. A lot of the civil sectors tend to be much larger and control a lot more things, so they'll have a bigger impact, but I think it does have its own impact. It's not particularly efficient driving tanks round for training exercises and stuff… the only upside of it is that it does maintain lots of large spaces, which don't then get used for other things …So, for example, Salisbury Plain – it's quite a good one – that's just pretty much left to be as it is. All they do is the training there – it's not getting built on any time soon, so it does preserve things in that way (UK025).

No, I don't think it contributes any more than the non-defence sector but I think defence has maybe thought is doesn't have a part to play, because it's quite difficult, and maybe the defence people think about platforms, pieces of equipment, tanks, ships and aeroplanes. It's very difficult to make those more sustainable and more environmentally friendly in terms of fuels that they use and the emissions they produce and, therefore, defence has always thought it's exempted from doing something because it's too difficult. "Everyone else needs to fix their problems and we'll continue as we are". I don't think that's a sustainable position any longer. I think that's the problem, that we have buried our head in the sand for a little bit too long and now we've got to play catch up and I think that's going to be the real challenge (UK007).

Some of the interviewees also noted the lack of information on what the defence sector emissions were and highlighted that these are not included in the national accounting, as discussed here:

One of the things we're pushing for now is something that they are supposed to have been doing for a number of years, is reporting their emissions – you know, how much emissions do they [the defence sector] generate? They don't do it, and who's gonna make 'em do it. Nobody can enforce that, so it's another unknown that they're covering up (US008).

…their [the defence sector] emissions aren't in with the COP26 declaration. The military is exempt from having the finger pointed at them so to speak…They are not part of the deal. The governments have said they are gonna be carbon zero… but the military isn't in that deal, they are not part of the deal. They are exempt from cutting their emissions, although supposedly they are trying to (UK020).

It was recognised that it would be easier to decarbonise some parts of the sector than others, as UK011 explains here:

I think it could be quite achievable in sustainable buildings, for instance, and sustainable infrastructure. I think that it will be more problematic in, I was going to say, some of the more traditional defence equipment they use. You know, jets, tanks, that sort of thing. So, I think it could be very beneficial in some areas and relatively easy to attain, but I think there are some areas that it's going to be very difficult, if not impossible (UK011).

There was broad support for decarbonisation across all our interviewees, although some wanted it to be a greater priority than others. There was no outright resistance to decarbonisation, in principle, but a number of workers were concerned with how to balance it with other considerations, as discussed later. Interviewees were concerned about climate change and believed that their company or department needed do their bit, alongside everyone else (e.g. UK025; UK028; US018; US019). For some, it made simple economic sense to decarbonise, as the following interviewees outlined:

> *To be fair with you the British army, believe it or not, are very, very adept at actually not only 'make do and mend', but utilising what they've used once over and over again and it's simple as, it's down to, cost. It's a cheaper option to reuse equipment that has been damaged and put back into service. Now, they all do it on a battlefield because it's getting the equipment out to the battlefield, but the British army have been doing it for years because it reduces actual operations cost (UK017).*

> *Yes. I think if, at the end of the day, if a company has gone and developed something and spots an opportunity business wise, and they can go and do something that is sustainable and for a different good, you know, then absolutely do it (UK006).*

However, in the United States, where there tends to be greater controversy about climate science than in the UK, a few interviewees spoke about how their colleagues were not on board with the current scientific consensus that climate change is caused by human behaviour, especially among those with Republican sympathies, as these interviewees describe:

> *I talk to all my [trade union] members, regardless of whether you believe in climate change, because I would say probably more than 50% of my membership lean to the right and so we probably have a more dense membership that believes that climate change isn't manmade…(US002).*

> *…you've got so many people that are just non-believers. Here in Texas – last year – last February – we started getting this freeze down here. There was 200 people that died because of it – millions of people didn't have any power – water freezing up – stuff going on just because of that. We'd never seen anything like that before here in Texas, and I've lived here all my life. …You look at all the fires that's going on in California in the last five years – look at the fires that have gone on in Colorado – the droughts that are happening right now. I don't know what else you can show people to make them understand that ''Hey, we've gotta change'' (US022).*

> *I hate to say it but a lot of the green energy, manufacturing …it's politicised and it's been something that, for example, the right isn't too fond of. They think that it's all just crap so, unfortunately, a lot of workers in manufacturing agree with that. We need to show them that this is the future and that we're going to have more buy-in if they are able to be involved in the process …(US026).*

Hence, there was broad support for decarbonisation among the interviewees. This would be expected as the interviewees were self-selecting in that they decided to approach the research team if they wanted to participate in the study. It might be unlikely that they would participate if

they were opposed to decarbonisation. However, their statements indicate their motivations, reservations and nuances of perspective.

DIVERSIFICATION

With regards to diversification, most of the research participants had not heard of the term before being approached about the study (e.g. UK005; UK008; US013; US021). Some thought they knew what it was but gave definitions that were not relevant to sustainability, JT or arms conversion. For example, they initially interpreted the concept of 'diversification' as relating to increasing the demographic diversity of the workforce (e.g. UK016; UK025); using different materials or technologies to achieve decarbonisation (e.g. UK017; UK022); moving away from the use of, and investment, in fossil fuels (e.g. UK002); diversification of types of conflict (UK006); and spreading risk through diversification of purchase decisions (UK018). However, some did understand the term (e.g. US001; US009; US011; US017), albeit with differing interpretations. Some understood diversification as primarily about increasing civil production within defence sector companies, without reducing the defence component, as in these comments:

> *Diversification for me, in my industry, means doing not only defence products but it also means civil and other related, or non-related activities. If you look at [ANONYMISED] we have a civil business, we have the defence business which covers air, land and sea… It's a diverse portfolio but it's not wholly dependent on defence (UK001).*

> *I think it makes all kinds of sense to integrate, if you will, the work force training that is going to be required both for military and civilian use. But, again, defence contracts come and then they go, and so we should always have that ability to be flexible enough to move people from the military side to civilian application (US0017).*

Others interpreted diversification more radically as scaling back on defence operations and production. For example, UK004 stated:

> *… the ability for the UK to defend its borders and to maintain its position in a global environment where there are significant emerging threats is absolutely necessary. So I wouldn't necessarily advocate that there is a diversification of the defence sector and certainly not that it should be deprioritised or considered to be something that is not necessary (UK004).*

Like decarbonisation, a number of the workers interviewed considered that diversification was already happening in the defence sector. Some made the point that the defence sector is already diverse in the sense of manufacturing civil goods alongside military goods and using knowledge from one sector to benefit the other, as in the following comments:

> *The military have started to cherry pick civil products for use in defence and then maybe there are companies out there looking at what the military are doing and thinking ''what's the civilian applications for those concepts?'' Again, taking stuff from civil applications, like drones and remote-control vehicles, etc., and then put them in the battlefield and I suspect there are companies out there looking at what the military are doing, that are looking for civil applications for that technology (UK016).*

If you can machine an artillery shell, then you can machine other things. It's interesting looking at it from diversifying away from defence, but it's also interesting to look at going the opposite way. If we find ourselves in a war fighting situation, then industry has to adapt to a defence need. Historically, if you look at the last century, Britain has managed to do that fairly successfully… It is possible to diversify and it goes both ways but there needs to be a will to do so and there also needs to be the business case to do so and the economic pull (UK001).

I would say, in my career, probably close to 80% was commercial. But even some of that leaks over to defence…. Not big, not a large percentage of the work I did, but I worked in one of the largest machine shops in the country for [ANONYMISED]. So, we supplied machine parts support to various divisions (US017).

As part of explaining that diversification was already happening, some of the interviewees mentioned a number of off-shoots from the defence industry that are now used in everyday civil life, such as superglue, mobile phones and navigation systems. The point was also made that, conversely, civil innovations contribute to the defence sector. Several of the workers interviewed also discussed how military assets are already being used for humanitarian needs. The following comments illustrate these points:

Defence tend to spend more heavily in R&D than the civilian sector and a lot of things that you use on a day-to-day basis were originally defence projects. If you have got a GPS, there is only one reason you have got a GPS and that's because we needed higher accuracy in defence. There's lots of examples I could give you - radar, radios, a lot of things, it all comes from the defence sector (UK013).

I think the general consumer market is now actually feeding stuff into defence because I think the rate and demand that the general public are putting on tech companies in particular is so great… look at mobile phones, if it had been down to pure military influences, we wouldn't have the mobile phones that we have today, absolutely not. That is, for me, has been driven by the consumer… (UK006).

Some interviewees gave examples of previous attempts at, or discussions of, diversification that they had witnessed or been involved with, as in these comments:

[Diversification] - We know that up in Scotland because we have got Faslane on our doorstep and CND and the STUC, Scottish Trade Union Congress, put out a document about maybe probably ten years ago now, putting the road to re-use the workers that are working in Faslane to make wind turbines, tidal power and all these sort of things (UK020).

Right, well yeah, we've been working on - at some point along the way it became more politically palatable to say 'diversification' rather than 'economic conversion' - but we've been working on one or the other which is the same thing since the 90's. We have a progressive caucus in our union in [ANONYMISED] to make things that are more socially useful and not destructive, so we're real familiar with the concept. We tried at one point…to see if we could get a part of the defence law that if a company made defence products that they had to have standing committees of workers and management to meet regularly to discuss what other products the

company can make other than military products, but of course that didn't go anywhere (US011).

Yeah, there was a big push when Covid was going on, the …union had a pretty big campaign that they wanted to shift towards making [ANONYMISED civil product] when there was a massive shortage and the company didn't go along with it. I don't know how realistic that hope was. We are a very specialised shop and it's primarily a machine shop and the components that go into making [ANONYMISED] …it's not the same thing as a jet engine. I was not optimistic that that was going to happen and it ended up not happening (US015).

Though few had heard of the concept before, when given our working definition, the participants were divided in terms of their support for, and resistance to, the idea of diversification. Of those who were in agreement with diversification, some would only support a version that would broaden defence company business to encompass civil, while others wanted to see a more general scaling back of operations and production. In terms of broadening defence company products and activities to include more civil outputs and operations, some of this was based on a perception that their workplace was over reliant on the defence industry and that diversifying would provide more job security and business stability. It was also suggested that diversification could enhance innovation and business opportunities, as illustrated in the excerpts below:

I think it probably goes back to that 'spreading the risk' so, if we take an organisation in the supply chain, is it sensible for them to invest in other, or try and bid for, other work that isn't defence related? I think that's probably a good decision. You don't want to put your eggs in one basket (UK018).

From my perspective, my work, as I say, spans both civil and defence. I'm always looking for that civil opportunity, because a civil opportunity which is where the volume is and that's where the opportunity is to make money for the business. If I look at the [defence] product I'm currently working on, you're looking at maybe volumes of, what, 300 units over 15 years, which in the scheme of things is next to nothing. Nowhere near the volumes you'd see in [civil] automotive (UK001).

As a small company, it's attractive – I think – to small companies because, just in the purely financial sense as well, it diversifies where your money is coming from, which is helpful (UK029).

…there's the benefit that, if they diversify, they're not going to be dependent only on government funding. With different administrations funding gets either cut or they get increased so they're not going to be totally dependent on that. I think they're looking there for growth or as a safety net as far as not being completely dependent on government (US023).

Most of the defence sector workers interviewed were more supportive of looking at military systems that might have a civil application as opposed to movement away from military to purely civil production. However, some of the workers were interested in a more focused defence sector with some limits on arms production and sales as elucidated in the following comments:

Moving the defence into a format that is more focused towards home rather than abroad. I would be interested in that… I do think that the military and the defence

sector do get involved in some things that either they shouldn't, or that they should not prioritise as much as they are. One example would be investment in arms in Saudi Arabia. I'm not in agreement with that… Defence should always be a last resort. That's kind of the point really. It should never be a first strike initiative. It should always be the last line because every other option has been exhausted. If there is this feeling that we're not doing enough talking and we're not getting to grips with the situation beforehand and resorting early to military action or defence action, then yeah, I absolutely agree that there's more to be done there (UK002).

Do we really need any more weapons? I don't think I can answer that…I think we do need, given the current state of play with the world, I think we do need some kind of defence but, in the same token, are we producing too much? (UK005).

Just greenwashing isn't going to do it. Just putting solar panels up isn't going to do it. So we're trying to stress that the only way to really lower emissions of the military is you've got to make the military smaller. By the way, do we really need to update all our ICBMs [Inter-Continental Ballistic Missiles]? Don't we have enough to blow up the world three times over, or five times over? Why don't we take those resources and use them someplace else where they really should be? (US008).

Well, when they call the military out to set up COVID testing centres, that really is because there was no-one else to do it. So, I feel that circumstances are that this flexibility, diversification, whatever you like to call it, it needs them to be able to respond to things which are not necessarily specific to, you know, security as such, it's the more social side of it. And climate change, flood defence, a whole heap of stuff… it is, in my opinion, way, way overdue that they have an international rescue or a domestic rescue or diversification within the military that they can adapt and to target these things (UK023).

As in some of these comments, a number of the interviewees spoke about how the money spent on defence could be better used for other purposes, in line with the ideas of 'peace dividend' proponents. Some of the interviewees proposed that other means of dealing with conflict would be preferable and less environmentally harmful than what the defence sector offered. These points are illustrated in the following statements:

So, if we weren't spending as much [on defence] or if we were taking that money and putting it towards social needs, those could have a great impact on the quality of life for most Americans in terms of stuff like national healthcare and a lot of the safety net things that, say, most countries in Europe take for granted because they don't spend as much money on weaponry as we do … I also think just, in general, the zeitgeist of this country, the mindset of this country is so militaristic that it's disturbing on a daily basis. We just exalt the military so much and people like imagery of death and I don't think it's good for the kids. I think it adds to the climate that leads to mass shootings and all this stuff (US011).

… wars do directly cause, in terms of the amount of, you know, the emissions the military produces, I mean, I think of the US as producing emissions equivalent to, sort of, several small countries. But I suppose the biggest one is the amount of resources that are taken up, like 40% of the discretionary budget of the US is

military… taking up enormous amounts of resources that could be transferred to mitigating the causes of war (UK019).

I think that the thing that people respect about the military is that, in general, civilians they go "well, these people are putting their lives on the line to protect us as civilians or us, the country". So, the military presents itself as a figure of protection … There's, sort of, this thing that people just grow up with respecting the people in the military, not understanding that they are the – they're just the face, the attractive face, for a vast network of military industrial production which poisons ground water and makes workers sick and eats up our tax dollars and has many, many other effects that are harmful. Not only does the US military not protect us, you know, in any meaningful way, it is actively harmful (US004).

…they use this depleted uranium to make artillery shells for piercing tanks and armour. And it works quite well. It's been used in Iraq a lot and still being used by the military today. However, when these armour piercing shells explode, they make this depleted uranium into uranium dust and spread out all over the environment. Mutations of our own military and the local populous have created a lot of deformed children. Same happened in Vietnam with Agent Orange. A close friend of mine was affected by Agent Orange. His son was born deformed and died in his arms at age five. A very sad story and yet that's one of many from not considering the consequences of what the military uses as weapons (US003).

The irony of having to use a lot of oil to engage in conflict relating to access to oil was also mentioned in some of the discussions with defence workers, as in the excerpt below:

You talk to anyone amongst your ranks – equal to you, above you or below you – everyone seems to have a good head on their shoulders. When you say, "don't you think it's odd that we're using a lot of oil and then we're fighting for more oil?", a lot of them would be, "yeah, this is kind of ridiculous and redundant. We should be getting out of it"… I mean, no-one wanted to be in war. No-one wanted to have this perpetual cycle of use oil, fight for oil, use oil and fight for oil. No-one had that sentiment. Amongst my friends that I've had conversations with on these kinds of subjects, no-one would feel like it was necessary to keep using oil and that. We're all pro alternative energy (US019).

Most of these more negative views of the defence sector came from ex- workers, particularly ex-military. However, some current workers also expressed these opinions. A few of the current defence sector workers expressed guilt and discomfort about working in the sector and, for that reason, would be happy for their jobs to transform into civil roles, particularly working towards a sustainable transition:

In terms of my job, I do feel a little uncomfortable with the defence as a whole but there are things that I can do and I can encourage those around me to do in order to behave in a more sustainable and less wasteful way…(UK002).

I'd certainly do a greener job if the money was right and it's in an area where I could actually assist and use my expertise or skills (UK028).

I would support that [transferring resources from military jobs to renewable energy] on a personal level. I'm sure many defence operations would not… I am uncomfortable working in the defence industry at large so I am looking to make that move already because I'd rather be working for a business that's good for the planet rather than what I would really see as bad…For me, I see it as a potential route to a more fulfilling career because it's important for me to work on things that I care about (UK022).

I'm in a weird place because my politics don't really line up with the work that I do and so, on the one hand, I am really grateful that I have such a secure job in a secure industry but, on the other hand, it would be wonderful if my job didn't necessarily have to exist (US015).

I would jump at that [changing to a green job] in a heartbeat. …Well, I guess, it's funny because one of the reasons that I didn't wanna come to work at [ANONYMISED defence company] was because of the defence industry. I didn't wanna work in a factory and I didn't wanna work in something that supported making machines of war. Obviously, over time that's worn away but I've always said to people here that if something happened and we didn't have to have war anymore and we didn't have to make, you know, military engines and, you know, that kind of thing, I would be happy to lose this job and find another. And, if it was in a renewable resource, research or job, that would be fantastic. …I would feel better about my life if I did that. … I feel that it's important that I do my job properly in order to keep people safe…. Would I prefer to do something that was more relevant for the world? Absolutely! (US013).

As with all the interviews, workers expressed nuanced views and understanding of complexity, beyond being broadly for and against. For example, some issues in implementing diversification were also raised by those that were generally supportive, as US011 and US001 discuss here:

The obvious positive is that it [diversification] makes the world safer and at the same time as, hopefully, providing for people's needs or not spending as much, one or the other, so that's pretty clear. The only little wrinkle in economic conversion stuff is that defence workers get paid high wages, we get paid high wages because the work is very sophisticated and difficult to do, so if everybody goes from making an engine for the Joint Strike Fighter to making toasters, well toasters just don't bring the same price, so what's the impact on wages of that? There has to be some kind of figuring out of that part of it (US011).

For me, hopefully, it [diversification] will mean I can have a career for another 20 years or for however long I plan on working. I never worry about that. But I think, for family and community, hopefully, it will mean we can roll out technology more affordably … The detractors or the negative aspects will probably be in figuring out how to maintain the, I'll call it, military product quality while integrating commercial aerospace applications or technologies. I will say the commercial industry typically has less restrictions than military applications (US001).

However, there was also quite strong resistance to the idea of diversification among a number of the interviewees. The main objection was that the defence sector was essential and needed to be adequately equipped to be able respond to known and, as yet, unknown, threats. The point was

made that defence, therefore, should not be reduced, as argued, for example, by the following research participants:

> *I think it's [diversification is] irrelevant to the defence sector and counterproductive to the entire reason of defence. The entire reason of defence is to protect the nation. We can't do that without the tools necessary to do that job…. Moving away from funding the military or the defence sector to making the defence sector produce directly for civilians will then no longer be the defence sector… if we diversified from defence, … we would basically have no defence. We would lose our capabilities in order to defend ourselves and our interests both at home and abroad. That would, basically, not only render the nation mute but it would make them vulnerable to attacks that go on a day-to-day basis, both in the cyber infrastructure and on the ground when we're trying to protect our interests (UK002).*

> *Governments are constantly, no matter whom you work for, are juggling with budgets and they like to cut back. The trouble of it is, as we've seen, history is a great one for looking at this, they'll slash budgets in defence for other priorities, regardless of which political party is in power. And then, once they've done that, that capacity is gone and then, all of a sudden, that capacity is required and then they're running to catch up and history is littered with examples of this. …some US colleagues once said to me that "you can save a few bucks and it costs a few lives" and that metaphor has never been truer… No-one's got a crystal ball and this stuff will come out and bite you. I mean, the Falklands was a great one on that… These things happen and nobody knows about them until they hit … the way you live today has been bought in blood and a lot of people forget that. I don't, because once upon a time I was one of the individuals to stand in on a bloody war. But it's bought in blood, end of… I'd like it not to, I really would, but unfortunately that's the way of it (UK017).*

> *…it's the fact that countries need the defence industry and you don't want to whittle down the skill base too much that you might lose it. You're always gonna need some kind of capability to build weapons and design and build weapons (UK022).*

> *We do need a defence force in this country – there's no two ways around it. Every country does, but there's plenty of other areas, I think, where skills could be reused to support those green jobs – I don't think we need to be taking them from defence (UK030).*

> *…a strong defence is what you have to have in order to show the world that you can take them on, and the United States … some people would like to call it 'the protectors of the world' … (US007).*

> *Now, I personally, if somebody says, "right we are gonna have less of a military force, we will just defend the UK, any other country gets a problem we won't help them out", someone tries to invade say the Falklands again, "no we won't go and help them" … I think the public would be outraged if, and Argentina has done some sabre rattling over the years, if we withdrew all of our forces from the Falklands and then Argentina went in, there would be outrage… I would suggest, look at history, look at World War II, we tried to do the goodwill thing, we tried to do the*

right thing, we ended up having to go in to help out Poland. So, look at history, history has shown that the people that often can do the negotiations …are those that have the forces to back up what they are saying (UK015).

The point was also made that it may be somewhat defeatist to talk about diversification in the context of job losses. It would be better to fight to keep the jobs, as US020 discusses here:

I'm all about, "Give us as much work as we can handle". If not, we hire more. Sure. I mean, increasing commercial would be good because it's work but I wouldn't want to look at it like, "Well, we'll just land on commercial because we're losing all of this [defence work]". I would like to find ways of keeping a lot of that military stuff here in the country. It should be - our tax dollars are paying for it (US020).

The argument was also made that defence sector technologies would be inappropriate for diversification. This, it was argued, is because they need to be constantly updated with new equipment such that it would be detrimental to fall behind and because the technologies are overly complex for civil use, as discussed here:

My opinion is that it [diversification] won't work, for the simple reason being is that you stay number one in the defence sector, be it BAE systems, be it United States Military, be it UK, whatever, by innovation. And innovation will always take precedent over everything else because the moment you don't do innovation, and you're not doing research and development into whatever, then you fall behind the curve and then the competition has got the jump on you. And in this world, unfortunately, those with the biggest deepest pockets will always be at the forefront and be at the top of the pyramid (UK017).

…there wouldn't necessarily be a sensible civilian use for some of the equipment. It's overly complex for civilian needs so the cost of the equipment to pay for the development and testing would be prohibitively expensive for its - to make it financially viable for roll out into other industries… defence buys things and tends to want to use it for a long time because upgrades cost money. If you've got technology evolving at such a rapid pace you can easily find yourself in a position where the equipment you've got is now no longer supported by the company that you've bought it from because it is so out of date. It's a double-edged sword. You get the benefits and I think if defence wants to reap the benefits of a system like that then you would need to put yourself in a position where it can more rapidly evolve to changes in the technology market and configuration control (UK010).

UK010 went on to say that it would be easier for some companies to diversify than others because, having a predominantly defence sector brand might limit sales, as described here:

…it could be fairly easy for some of them. For [ANONYMISED company] is an interesting organisation because it makes all of our commodities that we like, like TVs and phones, and all of our daily electricals. It also makes autonomous century turrets and sniper turrets. They are not known as a massive defence contractor. They are known as a, their reputation and their business is very much known from its civil applications. It would be more difficult, I think, the other way round. If you've got the [ANONYMISED defence manufacturers] breaking into this sort of market, there becomes ethical issues from the market. Some people don't want to

buy from companies that make a significant proportion of their money from arms sales… (UK010).

It was also argued that, if one company or country reduces its defence production, another will step in, as implied in this comment:

If there's one thing that I have seen over my years, someone is always going to want a bigger stick and when there's a demand for sticks someone's going to start selling them. I'd like it not to be the case but, unfortunately, that's what it is. I don't think it's [diversification is] achievable, not at this point any way, not at this point in the Earth's cycle (UK010).

Some workers interviewed felt that diversification was unlikely to happen without incentivisation, since the defence sector tended to be more profitable and well-resourced than the civil sector:

I guess if defence companies are finding that they're earning sufficient profit from just focusing on defence sales and defence technology then they're not, sort of, forced to change and look at other opportunities. Again, I suppose it's about incentivising companies to do that. I think there are probably lots of opportunities but they're not being pursued at the moment (UK007).

I don't think it's a priority for the defence sector because I think it is more lucrative to be in the defence sector and be paid public money to develop defence products than it is to be in private sector and take the risk with no guaranteed return (UK022).

The point was also made that diversification was not a government priority whereas decarbonisation currently is. Therefore, there is government budget and impetus for decarbonisation, whereas there is not for diversification (e.g. UK029).

JUST TRANSITION

Most of those interviewed said they had not heard the term 'Just Transition' before they were approached to participate in this study (e.g. UK018; UK027; US001; US007). Several said they had heard of the term before (e.g. UK022; US002; US008; UK011) though some of these had vague understandings of the term. A few had a concrete understanding, often based on personal experience, as in this example:

…that happened in Aberdeen, now, because one of my laddies works in Aberdeen, and Aberdeen was like the boom town of the oil business for 30 years plus. And now it's tailing off and there is a lot of guys that used to be on mega bucks and are now seeing that the party is over so to speak, so what they are trying to do is to get a Just Transition in different work for them (UK020).

Once the concept was explained to the interviewees using the project definition of Just Transition as 'A framework developed by trade unions and communities to secure workers' rights and livelihoods and community well-being when shifting to sustainable production', workers were mostly positive about the concept and endorsed its importance (e.g. UK002; UK016; US010; US013).

Various interpretations from a 'jobs focus' to an 'environmental focus' to a 'society focus' were apparent, as in the statements below:

[Just Transition] - this is definitely a priority. As a worker myself, that's a priority. To say that it's not a priority would just be self-sacrificing for no good reason. The defence has to prioritise its workers otherwise there's no defence. …if we don't support our workers and we don't provide for them, we're not going to have a good morale. We're not going to have workers that are dedicated towards defence and they're certainly not going to commit or provide as much loyalty as we would like if they don't feel that we're going to support them. Definitely, defence has to consider that workers do have to be valued (UK002).

The positives [of Just Transition], clearly, are not increasing the division within society – that's one of the key things we see at the moment. I certainly don't remember it in my lifetime as being as divided a country as we are and, if we start leaving people behind on this transition, then it's gonna get worse, and that's not good for anyone.…The biggest positive is the fact that we can maybe put ourselves back together again and, if we're all pulling in the same direction, then we can achieve things that maybe we otherwise couldn't, and part of that is gonna be achieving that net zero position for 2050 (UK030).

…if you don't talk about what is gonna happen and you don't actually convince people that they're gonna be okay after the jobs change … the political backlashes in the large part are derivative of that … I mean, coal miners and auto workers have had a sort of reactionary trend over the last, over the last 30, 40, 50 years because of deindustrialisation and globalisation. There wasn't a Just Transition for them and we can see that it's been poisonous politically … It's been disastrous because they have gone from, you know, voting kind of economically to voting culturally and allowing their problems to be scapegoated on, you know, this or that marginalised group … (US010).

[Just Transition] - I think it's absolutely critical that they think about this. When we think about our communities then we have to think about the total future. And if all we're caring about is how much [money] we're making now in the defence industry and, you know, supporting war-based efforts and supporting just building bombs and building fighter planes and tanks and helicopters and that isn't thinking about the community. That's just thinking about a personal gain or a company gain. I think they absolutely need to think about that. That is thinking about your community, that is taking care of your community. It's looking at what else can you do to diversify, to protect humanity and animals and life in general (US013).

Labour will either support decarbonisation, or they will oppose decarbonisation. That will be based on whether we do have that Just Transition, or not (US017).

A few did not think there would be a need for a Just Transition in defence because the transition to sustainability would increase jobs or because their jobs would still be needed, as US025 and US012 highlight here:

Well, it's going to create more jobs for us because the more we work towards changing the way that we are doing things and, I mean, we should have been on this a long time ago, let's be honest. …it's exciting to see the expansion of new technologies in trying to get away from the fossil fuels and trying to make this

planet a better place for my children, my grandchildren and theirs and isn't that what we do as people? (US025).

I guess I don't understand what a Just Transition for us means because why would you transition away from doing work that you know needs to be done for the next 30 years? There's not, like, an eco- jet engine or helicopter engine, right, unless [ANONYMISED defence company]'s gonna make it. So why would we lose any work? …. I mean they're still gonna need helicopters and jets so I don't see us losing work anytime soon… you know, military engines are out in the field for 20 years. We're making new ones right now. They're gonna need replacement parts and they're gonna keep buying them for the foreseeable future. That's not gonna change any time soon and they need to be made somewhere, so they should be made in a union US plant (US012).

Some of those interviewed considered Just Transition primarily in terms of specific policies to reduce environmental impact without reducing overall military production, while others included transitioning away from defence products and towards civil in their idea of Just Transition, as in the following excerpt:

I would say about the MoD is, it has a lot of very experienced people and a lot of knowledge and a lot of ability and one of the abilities is the number of engineers and technical people that we could redeploy, reuse to manufacture those civil type requirements, etc., whether it be ventilators or whatever for hospitals or whatever. So, yeah, I think there is a core expertise there that is very focused on defence but could equally work with industry or work with other people to develop and to produce those items (UK011).

There was a feeling that Just Transition plans need to be in place in advance of being required to prevent valuable workers leaving. UK014 states that, when there are rumours of job cuts or restructuring,

…usually what happens is, the ones who are most able, most capable and most qualified and have got the most gumption I suppose will likely leave sooner. So, in some ways you're actually building a problem for yourself very quickly if you don't get that right and part of that is – actually, I'm seeing that at the moment because of some of the things that are going on in my organisation. So, very good people with skills that are hard to buy-in, certainly very hard to train, are just walking out because they say "well, you don't care about me so I'm getting another job"… if you treat people correctly and you show them a landing which suits them or negotiate one with individuals that, you know, to show them that the organisation actually cares about them, you won't lose them in that way and you'll keep your staff on board (UK014).

The role of unions and companies in ensuring a Just Transition was mentioned by some interviewees, as illustrated here:

Well, unions have got to get involved with making sure there's definite transitions to allow people to go from one industry to another… but they have to have things in place for people to do so, but they've got to spend a lot of money on getting people trained up. It's not going to fit everyone. Not all workers will want to move

so what are they going to do with those staff that don't want to move? Where are they going to go? What are they going to be offered? (UK028)

I think it [Just Transition] would be beneficial because it would start to make companies morally and ethically responsible for the decisions that they make regarding their workforce. There is almost a bit of, you've become a commodity. The individual isn't an individual anymore for an awful lot of these large companies. You are a commodity that can be used and once you are exhausted you can be cast aside and another can be brought online. I dislike that model a lot…You don't want wide scale devastation of small parts of a country. It's a benefit to nobody… You can't just let people starve. You need to make sure that people are looked after… and I think that shouldn't just be something that is born by government. If the company then decides that they're going to have a huge economic impact locally then they need to bear some of that responsibility (UK010).

Many of the workers did not anticipate that their jobs would change significantly as a result of decarbonisation (e.g. UK001; UK005), unless they were already working on sustainability issues (e.g. UK004). Most of the workers interviewed considered that there were no threats to job security arising from decarbonisation (e.g. UK009) or diversification (e.g. UK022). This was mainly based on the notions that that governments are, ultimately, always committed to defence; that sustainability initiatives were more likely to transform areas of work, rather than completely change their jobs; and that the workers had transferrable skills that could always be used. For example, US015 and UK008 said:

Not from my personal situation. We are one of, if not <u>the</u>, largest supplier for at least the United States military and US engine programmes have hundred year lifespans. So, as long as we continue predominantly servicing defence, I think that the plant is not going anywhere, I don't think my job is going anywhere. We've survived cuts, the cuts are never really that large but we've survived changes in defence funding, we've made it through Covid primarily because we were mostly servicing defence programmes. So, I tell most people that the ocean is probably going to take my job before outsourcing does (US015).

I don't think it's a big threat because I think the people in our industry have skills which are more widely adaptable to other circumstances. …There's no doubt there'll be people who are uncomfortable with certain things [changing] but I don't think we're talking something as significant as reference to closing of the mines (UK008).

Even so, it was recognised that some jobs and companies would no longer exist in their current form, as UK027 highlights here:

I don't see it [job loss] as a particular threat and I think in the long-term it's a change of workforce we're going to have to make anyway. I mean, we're not going to have as many internal combustion engines but we'll need a lot more electric motors. So, if you're in an internal combustion engine business, whether you're making civilian cars or not, as a business and as an individual there is a pretty identifiable change that's going to have to be made and we won't be artificially keeping internal combustion engine lines running because we might lose jobs. But I don't think that's a defence specific point. It's economy-wide (UK027).

A few also spoke of some fears among other colleagues and union members about potential job losses when transitioning to sustainability as US022 discussed here:

> *I think the fear is there just because, you talk about moving away from fossil fuels – aircraft are probably one of the biggest polluters that we have … being in an [ANONYMISED union], in particular, that's the one I can speak to – our existence is based off of building these polluting aircraft and cars. … I think the Unions look at it as, "We'll lose all these members – we'll lose all these jobs". I think, there is a way to get around that, and that's just by simple, honest communication and showing 'em jobs are still there. They'll be there because, if you're building something that's green-friendly, somebody's gotta do that work – somebody's gotta build this infrastructure, somebody's gotta build it and I think part of the problem is people are afraid to talk about that (US022).*

However, several of those interviews mentioned a precarious ongoing context, as a result of cuts to defence and an increase in automation, as illustrated in the following excerpts:

> *I think the main threats which have been ongoing for years is the fact that our employment is very often based on political decisions, not always decisions that are rational, or based on a strategic approach. There is, at the moment, a review going on across the whole of the department in terms of meeting some financial constraints… Those are the things that I think are concerning people at the moment, whether that be posts being disestablished or got rid of or, alternatively, them being outsourced (UK003).*

> *Budget is gonna be the key thing with that – there's limited budget that comes from Government for defence anyway. We've seen it coming through where… there's a number of programmes that defence are looking at to try and reduce their costs – only so much of that can come through saving electricity, for example – there has to be budget cuts elsewhere, so we know that they look to shave down (UK030).*

> *Every time we turn around, the company wants to meet with the union to tell us that there's another job they want to send out because it's just too costly to do work here… Unfortunately, what goes to the wayside is quality. I think if the general public knew what was going on… it's not a matter of if, it's when, planes start falling out of the sky, and we're starting to see it and a lot of it's to do with cutting corners. "'Fast, fast, fast, production, production", sending stuff to anywhere but here. When it comes back, it's so bad that we have to fix it (US019).*

> *[Concerns about job security] – maybe a bit for the guys nearer the bottom of the chain because, at least for the British Army, they are downsizing it quite a bit, as far as I know. A lot of stuff's been taken over by technology, and I think the plans are to have a bit less of a 'boots on the ground' presence, so there is maybe a little less job security for it but, as jobs go, I'd say it's one of the more secure ones out there (UK025).*

> *Their funding [DoD] – obviously, like most budgets – goes predominantly for personnel and, when they start looking at other ways they wanna spend money, that's where they cut this personnel and, what's special with DoD – if you cut a*

project – if you cut a plane, or ship, or a programme, then you cut the employees that were with that programme. Now, they don't do it by firing people – not the way they would in private industry. What they do, it is by accretion, and what they do, it is by not hiring more and so, ultimately, what happens is you have fewer people doing more work (US007).

Defence is always shrinking, is probably the best way to put it, so if you look at when I first started in defence back in 1986, it was a lot bigger, a hell of a lot bigger and, as we moved forward and technology advances, defence itself has shrunk. Our forces aren't as big as they used to be, they are more reliant on technology than they used to be … so it's been difficult, and it is difficult (UK013).

I've watched the organisations that I've worked for dimmish from having literally thousands of staff delivering the services that we now provide to, in some cases, dozens. So, the technology that I've helped to introduce has had many impacts for us. It's enabled us to do much more with much less but, initially, when each implementation has been made, we've always found work for people. I don't think I've ever seen a situation where we've had mass redundancies, as such, but it's always meant that, in the longer term, over a period of years, they have just not replaced people because we've managed to cut back on man or person power requirements (UK014).

We've had different rounds of automation and of speed up just by virtue of technology but there is coming a wave of automation that I think is going to be withering. Between robotics and the sophistication of computers, they're going to be able to do away with a lot of the people in a factory setting (US011).

I think artificial intelligence going forward will cut jobs, especially in defence because even now we've got drones. We use the drones for reconnaissance for actual strikes. You'll have somebody piloting the unmanned aircraft but you don't need as big a team to get that up as what we've got currently. Infantry-wise you can really see it going in some kind of robotic way (UK021).

A few remembered times when there were defence sector job losses and how they had struggled to save them via the unions, commenting on losses as a result of privatisation, casualisation and outsourcing in some parts of the sector:

So, you know, it was a difficult thing to try to figure out how we could continue to create opportunities for all these people that had lost their positions and there was just no place for them to go. There was so many people that were losing their jobs and that type of skilled labour just, even though they were highly skilled, there was no place to go. So many jobs in the aerospace sector were virtually gone and never coming back. There used to be a pretty strong automotive industry where they could have transitioned but that was gone completely and so, unless they're willing to take like a 50% or more pay cut, and work in machine shops or something, there was no more opportunities. So it was a difficult situation for just about everybody (US005).

When we first got privatised, we had about 600 [ANONYMISED union members] – we're now down to about 140…because they've either gone or been made

redundant. …The agency staff - I've got a few members in there, but I don't really push them to become [ANONYMISED union members] 'cause there's not a lot we can do for them. If the business want to get rid of them, they can get rid of them. It's very difficult to fight a case for them ….So, within our area – when we were [ANONYMISED], the company itself was constantly making redundancies, and they had a target they had to meet, and they were constantly getting rid of them … (UK026).

We had for the longest time, you might call it a virtuous circle or you might call it a deal with the devil, but what we had was, we pay taxes, the government takes tax money, they want to buy weapons so they give the money to these companies, the companies employ folks and we make the weapons and we get paid, but what's happened for the last 10 years or so is that's broken down so that now the Department of Defence is buying more overseas. … So we lost a lot of jobs to Poland and to China … (US011).

There's parts – crystals, chips – all kinds of things that are manufactured offshore for guidance systems and everything else, we're depending on the world supply chain to get those to us and, for me, it's just lunacy because the defence of our country; we should do all of that kind of work within our borders, in my opinion. I'm not a warmonger, but I believe in a strong defence, and our members are very proud that work in this defence industry – they're very proud of the fact that they produce the means of our defence, and they're proud of the fact they give our armed forces the tools with which they can defend us, and that's under threat, and it has been under threat for a long time (US024).

We have – most of the stuff [we make] is brought by the government, right so some of its – a lot of it is under the Buy American Act … which makes it that 50 or 55% of the parts that federal government buys has to be made in the United States. Due to free trade agreements, there's about 45 countries that count as United States, that count as that 55%. So, when I tell somebody that I just lost [ANONYMISED] engine parts to [ANONYMISED country], they almost don't believe me. They're like "well, doesn't that have to be made in the United States?" No, it absolutely doesn't. So, I think that's one of the big existential threats is the free trade agreements that allow defence work to move around the world. … So that's, I think, the biggest threat to our defence work (US012).

From what I understand, defence companies, they are required to have their employees here in the US but… the world is becoming so small that nothing is made just in one country anymore because different countries build different things. They make them cheaper, easier, and faster and they have economies of scale already set up and it really wouldn't make sense, I guess, for the US to be making rivets or small parts that maybe don't require that much technical stuff that could be easily built a lot cheaper somewhere else (US023).

A few of the interviewees also highlighted how outsourcing and offshoring could be used in the drive towards decarbonisation and sustainability, as a way of reducing domestic emissions and complying with environmental regulation in the US or UK. Workers spoke of their frustration with

environmental groups pushing for the closure of a polluting facility in the home country and then the facility being relocated to somewhere in the Global South US020 explains,

> *Well, it's actually scary. The more years I've worked in this industry, in the beginning, we did everything, we made everything, everything was done in the United States. We had so much work, we just didn't know what to do with it. Thousands and thousands of employees. Since then, we're offshoring and …instead of dealing with the environmental issue, they'll just send the work to another country that doesn't have the same restrictions that we do, and now… Our work goes everywhere; it feels like it's going everywhere but here (US020).*

Some of those interviewed also felt that, in this context of job insecurity and inadequate pay and conditions, it could be hard for workers to focus on decarbonisation and lowering the emissions of the defence sector. For example, US010, speaking of difficulties in making this a union priority, said,

> *The interest level [in decarbonisation, diversification and Just Transition among colleagues] is pretty non-existent, I think because, even for people that say that they care about climate change or things like this, and I mean I count myself … I care about climate change but I'm not doing a whole lot. I don't focus a lot of my work on that issue. And I think there are union activists that, like myself, that see so much work - there's so much [union] work to be done - and so to do another thing would be to take away from work that's being done and it is difficult to - for me, it's difficult to justify talking about making these committees and doing this or that about climate change when there is, when that's not gonna actually make anybody's life better in the short to medium term … there are people being abused by the boss, there are people that are unorganised, there are people that don't make enough money right now to pay the bills…. a lot of those problems they hit you harder than kind of the long-term abstract like we need to do something about climate change. And then for unionists who are not activists, you know, a lot of folks just wanna kind of clock in/clock out, pay their dues and spend time with their family which is not, you know, that's not a bad way to live …(US010).*

The point was also made that outsourcing to the Global South, itself, would have problems for decarbonisation and the wider transition to sustainability since it is difficult to control the environmental impacts of the overseas supply chain:

> *I talk about [ANONYMISED defence company] as green washing … We [the union] talk about wanting to do the green energy work that [ANONYMISED defence company] wants to do. We say, you can't be carbon neutral by 2050 if your supply chain is spread all the way round the world (US012).*

> *I think companies are outsourcing work to places where they don't have to be environmentally responsible and they can get cheap labour and that puts a lot of people in harms way overall which contributes, I think, to global warming, to pollution, to things that limit people's access to quality water, quality air and just their general health and safety (US013).*

> *I think a lot of the stuff that they've also sent out [offshored] reduces the emissions in our facility and, again, somebody has to emit that stuff…somebody's doing it. Whether it's on that side of the world or over here, it's still not right. But the easy*

way, again, is just to send the work out because they're trying to cut back on their emissions. They keep a real close eye on that…(US020).

Some of those interviewed felt that the sustainability agenda was a chance to increase jobs in the sector, though more local, greener production (e.g.UK017). UK024 considered that new skills and new staff would be required but it would have to be resourced to ensure jobs. Some of the workers recognised expansion and contraction in the sector according to the prevailing conditions, as discussed here:

It's a very interesting balance in industry. When you're in a general peacetime situation, the civil market booms. From an aircraft perspective, around late 90s, 2000, if you look at A320s as the sort of 737 family of aeroplanes doing short haul flights out around the world, they went from eight per week manufacturing to 60 up until the beginning of the pandemic. That was very much a boom industry. Now we've hit the downturn, civil need has not quite died, but it is drastically reduced. We're probably down in the 20 to 30 per month market at the moment, possibly even less. To balance that, you've seen government imbursement coming in which raises defence spending. There's a recognition from government that you need to keep skilled people employed as well as there being a generic defence need to satisfy that (UK001).

Diversification was sometimes seen as a way of saving jobs in a context where defence jobs were being lost. There was quite a strong feeling among the interviewees that they had transferrable skills that they could, and would, take elsewhere, if necessary. Therefore, it might be better to diversify within the company, rather than lose people to other companies:

… so, it's a very cyclical industry. When civil is up, defence tends to be down and vice versa. When civil is down, people leave and when defence is down, people leave. Once you have 20 to 30 years' service in the company and somebody offers you three weeks' severance for every year that you've been there and you know you can walk into another job, people leave. Particularly with my industry as well, we don't have a particular allegiance amongst the workforce just to doing defence work. A lot of people are there because it's interesting, cutting-edge engineering, rather than being for a missile as opposed to something which could go into a rail application (UK001).

A few of the workers placed the emphasis on the workforce as needing to be adaptable. UK011, for example, felt that some jobs might be lost but there would also be opportunities, so long as people were able to adapt:

I've got a horrible feeling that, probably, yes there would be threats to jobs, but I think there are also obviously opportunities there, it's just… I was going to say it always comes down to people and agility and flexibility of people and, again, that's the same with any transformation problem (UK011).

However, most of those interviewed placed responsibility on the companies to support workers in this transition and to ensure decent, equivalent replacement jobs. Workers made the point, that if jobs need to change, they need to be presented as equivalent and seen as upskilling, rather than deskilling.

It was argued that that there needed to be more discussion with workers regarding any job changes:

… if you were talking to somebody that was in a very high carbon intensive, you know, fuel pipelines and all of that type of thing, if you can kind of demonstrate the equivalency. So they might be working on an oil pipeline but if they were working on a solar farm there are equivalent type of engineering type skills and that type of thing, so it's not as if it's a completely new job, completely new role to them, that there is a bit of equivalency, it's just a different energy source and whatever. So, I think you can kind of get people bought in, in the sense that there is a certain amount of the job that is the same that they're doing … and a lot of, obviously consultation, about it because everyone's personal circumstance is different so I think there needs to be quite a lot of, I was going to say, in some ways hand-holding and sort of taking them gently through it (UK011).

…[If we] move to a more sustainable practice and people were either to lose their job or to lose the skills …I think it would mean that people would leave the sector and then that [would] …inhibit the future growth and the future ability of that sector to perform, in my opinion. … I would agree it would be preferred to move to more sustainable practices, but not at the expense of losing a skilled workforce where you can no longer perform as an industry. So making sure that those individuals do have a value, feel like they have a value and feel that they are employed into something that they are passionate about and that they can still support is important (UK004).

Several of the interviewees talked about current and upcoming training programmes linked to sustainability (e.g. UK016). It was generally considered that people would be happy to be retrained so long as the new job was of equivalent skill level and status, and building on skills already developed, rather than being required to leave those skills behind (e.g. UK0111; UK023). However, it was recognised that these programmes would require investment and that it would be harder for the private businesses than the government supported sector:

It's not going to be a financial benefit to the company to invest that much money in an asset that's going to be leaving the company, to go and work somewhere else. …They are not going to want to invest a huge amount in it. The military do a proportion of this. If you are leaving the military there is already schemes available where you'll go through a resettlement programme and you are given a certain amount of funds to go out. You can go and do some training course, you can go and do a domestic electricians course or a plumbers course. …Again, the military doesn't tend to have to worry about some aspects of that because it's not there to make a profit (UK010).

However, even with all the support from the military, the point was also made that there needed to be better support when workers move on, as these workers described:

Certainly, support for people moving onto different jobs even after they've left – I think they could probably help out a lot more with that. They do offer some sort of financial help with courses and stuff. Unfortunately, the list they actually have is pretty poor and the prices on there are really overpriced. … It'd be nice if they made an effort to actually put on some courses and stuff which were gonna be useful … actually paid for by the military rather than mostly paid by the person themself (UK025).

That's one of the main thing's that we've been struggling with in the US is where do all these veterans go? What capabilities do they have? How does their work in the military translate to civilian work? (US019)

Few of the workers discussed financial compensation in the event of having to change jobs in relation to climate mitigation efforts, although US020 discussed this briefly, stating:

Well, people getting laid off, we would apply for that Trade Adjustment Assistance where it's after the fact, the work's gone but there's monies that was there for retraining, schooling, stuff like that so maybe get you in a similar industry. Some monies that was available if you did get another job in another industry but weren't making as much money, you could get extra money to get you through for a little while, things like that, which I think are great programmes if people are going to end up losing their jobs over things like this (US020).

Hence, the workers interviewed articulated their concerns and aspirations regarding what a Just Transition might look like. This often related to what they perceived to be the likely or hoped for scope and pace of change, the topic of the next section.

SCOPE AND PACE OF CHANGE

There were very different views about what the scope of change should be in the transition to sustainability. Some workers were more focused on technical change, others on behavioural change, and others on systematic and political change. Many wished to constrain the change towards what could be done without impacting negatively on the current defence capacity (e.g. UK009). Within this perspective, most of the workers interviewed saw the scope of change in transitioning to sustainability in mostly technical, rather than behavioural or political terms. Interviewees described numerous technological solutions, past, present and future that could help with decarbonisation. This included the following:

I'll go back to tanks or armoured personnel carriers, they're always normally made out of steel or high-grade steel …but they were looking, what was it, 10 years ago now, I believe, they were looking at polymers and actually making vehicles out of this reinforced plastic… The drawback was it was expensive, obviously, because it was a new technology. The positive was it was lighter …you didn't need as much fuel to propel it forward or any other direction you wanted to go (UK017).

…we build composite aircraft engine components for commercial and military applications. The reason why our customers are putting composites into their engines is for lower weight, higher performance but, essentially, it comes down to if they can reduce the weight of the engine, reduce the rotating mass of the component, [so] the engine can run more efficiently and consume less fuel which ends up being a saving for our environment and for the operating customer…Within the defence sector we are also seeing, in the air sector, drones are being used which are either moving towards electric powered or hydrogen powered…Then the customer, of course, doesn't have to operate the product all of the time. From an Air Force perspective, they have the opportunity to use simulators. They're doing more simulator work so they're actually putting aircraft in the air for a lot fewer hours which, again, helps with the emissions, as well as the Air Force's operating costs (UK001).

… there is an interesting company [ANONYMISED] …and they claim to have revolutionised the wind turbine and they put out some pretty big projects from the Pentagon, some pretty big contracts, and I've gone to a couple of their presentations and it's really interesting. They said, when they patented the design, the US Patent Office said that that's like the first real change in the wind turbine since it was created. So that's pretty promising and they have – and so, basically, it's just very small. It's a very, very small wind turbine and they are able to generate the same amount of power (US010).

So there's an element of reducing carbon on heating, cooling, there's obviously the decarbonisation and removal of combustion engines in terms of EV and then you've got electricity generation of using PV, you've got huge amounts of land. So, it's a really holistic view that needs to be taken on this. There's so much opportunity there to reduce their carbon footprint. There's a lot of low hanging fruit (UK024).

I mean, from defence's point of view – obviously the legal requirement to decarbonise, they'd need to be net zero, and that's gonna be a significant challenge on its own. They are not gonna reach that without offsetting, and it's just a case of how much offset is required and whether there's gonna be enough offsetting available for everybody that needs to offset to be able to do that (UK030).

Some of those interviewed were keen to extend the debate beyond decarbonisation to wider environmental harms, as these interviewees discussed:

I think, when we're talking about our sustainability strategy, it's not just about net zero. It's also about the broader definition of sustainability which is also about supporting communities, ensuring that you're not having a negative impact upon society and people as you are going about your business (UK007).

[I want to focus on] the wider piece, what the environmental impacts are of what we are doing and how we can mitigate those moving forwards. We tend to operate in terms of— It's not really purely on carbon it tends to be the more holistic environmental concerns approach. I suppose it depends on how you want to address it. Yes, carbon is part of that. But it's not a significant part (UK010).

…the amount of waste is unimaginable. I've seen literally millions of dollars of snap on tools just thrown in the recycling bin out back. … I've never seen nothing like it in my life. …It's the same way with bolts, for example, bolts in a bin that somebody uses on this part of the rocket, they actually have an expiration date, a bolt, and if it's not used within a year then you throw them away and order some new ones (US002).

Some felt that it is really important to scale back production and operations and that less than that would be 'green washing' as argued here:

I would like to reduce the whole defence sector to decarbonise it. I think it's a bit of a trap to start, first of all they're going to start double glazing the officers' messes and all that kind of nonsense but I think, what is more dangerous is this idea, I think, there's a new synthetic fuel that's been promoted by the Formula One company of some kind which is, you know, it's a new fuel which is they claim can

be used in jet fighters… if you push the military into decarbonising they'll stay the same size but there will be no renewable energy there for anything else as far as I can see. I mean, I decided to make a calculation to how many… what size megawatt wind farm would be sufficient to keep a F35 in the air and it was quite a large one just for one hour… The other thing is bio… the thought of bio-fuels being used for tanks is so insane I can't believe anyone suggested it, less food and more fuel for tanks I mean it's … I think it will do anything to keep the whole show on the road, actually (UK019).

I think it's [decarbonising is] just green washing – what are they gonna do to make a situation better – when they're gonna have electric jets or…? It's absurd for them to say that in the first place because, in the meantime, they're constantly expanding operations … What we'd like to see is for them to cut down operations – that's what needs to happen. What really needs to happen is they need to cut the Pentagon budget (US006).

So, [ANONYMISED defence company] announced, I don't know some time in the last year, that they wanna be carbon neutral by 2050. Now, if you look into the details on that, there are none and never will be. But they say that they wanna be carbon neutral by 2050. That was followed by an announcement for some type of alternative jet fuel that is I guess is better for the environment but it's probably just more greenwashing (US012).

Several interviewees spoke about the rather superficial and low-key changes their companies were making compared to the scale of what was necessary, as US015 discusses here:

Jet fuel is one of the worst contributors to greenhouse gases and we make gas turbine engines and I know that, on the commercial side, they are developing greener fuels but, to my knowledge, we're not seeing it in the defence side right now …Also, the resources that go into manufacturing - the raw materials that we use - are very carbon intensive. It's all forged metals …It doesn't feel great, there's a lot of irony in the fact that I ride an electric bike to work to go and make jet engines …The company, they put solar panels and stuff in the parking lot but none of that is going to offset what we're dumping (US015).

Many of those interviewed did not think adequate change, in terms of transitioning to sustainability, was occurring or that it was occurring quite slowly in the defence sector (e.g. UK002; UK005). Some of the workers articulated that they felt or suspected that decarbonisation, diversification and Just Transition were not high priorities for the sector, as discussed here:

…my projects touch on that [decarbonisation] but there's certainly not an emphasis on it. The emphasis is more on, you know, how do we make cash flow or how much money are we saving versus, you know, it's more seen as a bonus than an actual goal. But, certainly, we need to do that because …I think it's important for all sectors of our society to do that and, especially where you have government sectors, where it's much more of just a choice to do that as opposed to maybe the private sector where you actually do have to do some sort of work in balancing budgets and things like this where, with the public sector, I mean, you know, just pass a bill and do the thing (US010).

The only means of recycling we have is cardboard, we haven't got any facilities to recycle … We haven't got the facilities to recycle glass or plastic or tin cans, like you would have a can of drink. They are not provided. It has been asked about before but it's not something that our overseer would consider. There's definitely the waste, like hand towels in the toilets for instance, they just go into general waste. There is no composting facility. There are things that are there, simple things that could be put into place and they're just not (UK005).

I suspect there are people who don't take this [decarbonisation] as seriously as I personally do. What influence they have, I think, it's difficult for me to say but while there is a continued debate about this, although the debate I think is becoming more of a fringe debate, all that will do is it will slow the allocation of resources and priorities. It will slow the approvals, labyrinthine approval spaces and, yeah, it will have an impact, if that's the case (UK027).

However, several made the point that attitudes to decarbonisation had shifted significantly within the sector so that now it is taken more seriously:

I think the pure notion of sustainability in defence to a lot of people would have been laughed at … We're only just in the transition stage. We are nowhere near where we need to be. We are very early days. We are still in the influencing stage of it. I think what is being done at the top is very, very good. I think they're doing…having read the kind of roadmap that they've currently got, they're targeting the right things, they're pushing hard, they're not actually taking it that easy. They have recognised where the big problems are but they're also doing it, as I say, it's not frontline. They're doing it in a place where they can safely do it and I just hope that doesn't stop (UK006).

We were constantly fighting to get sustainability up from the bottom of the stack and trying to get it higher and higher in the priorities, you know, so, whereas, what I'm doing now sustainability is, you know, obviously the system has to work, has to do its job but there is less emphasis on price, more emphasis on it being the right solution environmentally (UK006).

I'm very much aware of that [decarbonisation] and involved in keeping up with the technologies of decarbonisation. [Before] That never, never, ever came up in the military, never. No. In fact, the closest I ever got was, I like gardening and I would ask my commanding officer if I could create a garden at the barracks, and they would laugh at me…You would never hear anyone take consideration of carbon, decarbonisation or anything like that (US019).

I'll be honest and say that, probably, in the time that I've been there it's got more credibility and it's got more prominence. I very much remember when I started, and I started in that teaching aspect, we were very much classed as "oh, you were the green tree huggers", etc., etc., and I think there's been a lot of having to break down those barriers and show that we're not, I was going to say, necessarily, especially in the MoD, that pink fluffy kind of environmentalist, but actually we are quite grounded in science and the benefits and that's been a lot of hard work breaking down some of those preconceptions and barriers (UK011).

So, I am seeing these changes in a positive way as far as helping with the environment. So I do see that it's going in the right direction in places. The military was not focused on that at all before it was, you know, "fight, fight, fight, do what we've got to do"… and now I'm starting to see where that pressure is coming in for them to start focussing on global warming …(US016).

Some of the workers felt that defence would necessarily be slow in this transition because of the culture of the government defence departments and myriad other special considerations, as described here:

I think anyone who works in government can get a little bit frustrated by the bureaucracy. It is a very slooooow beast. It's like a super tanker, it's very difficult to move, and I think that's the challenge that we've got, frustratingly (UK007).

There is a real drive from the top to do as much as we can but that is constantly measured against what we have to deliver against defence outputs. That's always going to be the case. I think defence is going to be the lame duck when it comes to this sprint towards net zero. …We just can't do it at the same rate as other industries because of the types of considerations that we have to have… sometimes it can be glacially slow when it comes to attitude changes. It's such a large organisation and we are dealing an awful lot of time with legacy pieces of equipment (UK010).

AGENTS OF CHANGE

The interviewees saw change regarding diversification, decarbonisation and Just Transition as being the responsibility of, and being initiated and drive by, a variety of agents including the national government, the public, defence companies, unions and defence sector workers. Some of the interviewees argued for the need for a more structural analysis of the climate crisis which focused less on individuals and more on the companies and the economic system that drives high emissions. For example, US025 said:

I would love to see more responsibility being upheld by the corporation community, versus placing it on individuals to change, because the biggest polluters in that aspect have always been corporations that have always been able to get away with it because they have the money and means to do so… I do think that the corporation community needs to own up to their bad behaviours and start to make their own changes as well (US025).

Sometimes, pressure came from the supply chain. For example, UK001 explained, 'There is a concern flowed down from our customer, or customers, that environmental issues are important to them'. He referred to, both companies that purchase from their company, urging more sustainable products and processes, as well as government procurement departments. Similarly, US007 remarked,

…the DoD concept, we contract with people to make things. We don't make anything. That's where you can make some influence – in those kind of things. Working with the contractors, because the contractors are the ones who bring the product forward and say, "Hey, we think this is a good idea for your DoD – we think this is a good weapon for you and look what it can do for the environment also". So, those are the people that really provide the influence (US007).

The defence sector workers we interviewed also discussed the relative merits of change being initiated in a top down, rather than a bottom-up way. For example, UK002, UK007 and UK006 commented:

> *With all of this resistance that we seem to be getting, unless there's actually some top-down push I think – as well as bottom-up push – but definitely we need the support from the leadership (UK002).*

> *….they won't change unless there's a reason to change. Either there needs to be an incentive or there needs to be a change that necessitates them doing something. They need to be pushed into it (UK007).*

> *…I think the message has to come down from above but we have to also ensure that, obviously, there is that passion for it in the supply chain. And I believe it will be there, but it has to be unlocked and they [defence procurers] have to not be afraid to suggest it (UK006).*

Workers did not spontaneously mention the unions as driving forward these changes in most cases. Some had tried to propose motions regarding decarbonisation within their workplace union branch but this had been difficult in branches with low union membership (e.g. UK002) or contentious issues regarding jobs (e.g. UK020; US011). In particular, a few of those interviewed found that their unions had not backed them about particular environmental issues where their proposals were seen to conflict with the necessity to retain jobs, as union activists discuss here:

> *…on two occasions at party conferences, I put a motion up to say that [ANONYMISED union], should stop backing the remaking of Trident, but because [ANONYMISED] has a massive work base membership at [ANONYMISED], they had the power to veto my proposals, because, say they have got like 1500 or a thousand workers, maybe more in [ANONYMISED]…and I have only got a few bus drivers behind me and then they can get all the other people. So, on two occasions, they poo-poo'd the resolution for [ANONYMISED union] to stop backing the replacement of Trident and their thing is ''it's all jobs, you look for jobs''. To me, jobs are less valuable than a world that's not on the brink of nuclear destruction every few years … because we are charged to look after members jobs, that comes first before any sort of higher aspiration of green and the planet so to speak (UK020).*

> *…in the union, we did get the state of [ANONYMISED] in 2014 to establish a commission on the future of manufacturing in [ANONYMISED] which was an attempt to introduce the concept of diversification among, especially, the sub-contractors of [ANONYMISED] so they weren't reliant on defence contracts, but we didn't get the money that we needed to do anything meaningful. Then, along the way, the [ANONYMISED] union, which had the principled idea that we should be making socially useful things, all of a sudden they switched and they began promoting star wars and other weapon systems because the union was so desperate for members. We had lost so many members … we were a big industrial union, and our only national industrial plan is to make weapons, so the union took the position, well let's make more of them (UK011).*

Conversely, some of the interviewees felt the unions were dominated by groups that did not support defence, as US014 discusses here:

> *… I don't want to say far left wing but people with a very liberal agenda, which is fine, I consider myself a pretty liberal person, but a lot of times we're in conflict with teachers unions, and some of the other unions that go after why we are spending all this money on defence, and we're not spending on education or other social issues (US014).*

US014 also went on to discuss how, as a union leader, he needed to prioritise jobs as that was his role, as he explains:

> *On the plus, as the president of this local [trade union branch], as I've said from the beginning, I would certainly not condone anybody destroying the environment to keep their job, but my top priority is trying to make sure that we have work in jobs in the United States, and especially for my local. So, I don't make a lot of judgments on abortion, I don't make a lot of judgments on gun control, I don't make a lot of judgments on anything other than, what can you do to keep the people I represent in work? That's my job, and to be anything other than that, it would really be a disservice to the people that are paying my salary. Believe me, some of my own members try to argue with me about, "well, why we giving political money to a senator, or a representative, who was against, or is for, gun control?" I don't care if he's for or against gun control, he supports defence spending. That's your job. You can't worry about guns, you can't worry about abortion, you can't worry about anything if you can't put food on your table and a roof over your head. So, that's what I care about first and foremost (US014).*

A variety of agents were seen to be creating, or responsible for, the transformation to sustainability, then. However numerous factors were perceived to be supporting or undermining their plans and actions as the next sections discuss.

DRIVERS OF CHANGE

The main drivers of change were seen to be defence sector security concerns, the climate crisis itself and public pressure. For many of the workers interviewed, climate change was seen to bring wide-ranging risks in terms of defence including undermining military assets, destabilizing societies and triggering civil conflict. Workers, therefore, identified a great deal of interest in transitioning to sustainability within the defence sector for improving its operational capacity, public image, independence and resilience, as the following comments highlight:

> *I think there's a lot more to it than just environmental benefits with decarbonisation. There is an increase in resilience of our supply chain if we can…wean ourselves off reliance on fossil fuels because we don't have a natural supply of fossil fuels… If we can operate on green hydrogen, on wind energy related stuff, we've got plenty of those, and we're not importing them and we're not subject to fluctuations and not subject to not being able to get hold of those materials and relying on other people…If you're not reliant on shipping things in, just basic things like water, like energy, fuel supplies, all those kind of things that you need to get into your frontline or into your operating bases, if you can actually be more independent of those, then there's a massive - and that for me is one of the key things about sustainability (UK006).*

…ultimately if you've got an electric vehicle driving around on the battlefield it's quiet, so you haven't got a big thumping 26 litre V12 engine pushing you around creating lots of smoke and noise, so that you gain the tactical advantage (UK016).

I think, by being forward thinking and trying to be at the leading edge of what we do, has its benefits in that we're taken more seriously in our operations. If you look at a Russian aircraft carrier and they're just smoking diesel out … they don't get taken as seriously as if they'd have had a more cutting edge, a less polluting and less carbon emitting vehicle than we operate with. But, on the global scale, I think we would have more punch in what we say so I think that is probably one of the greatest benefits… that forward thinking is better, to be ahead of the curve. If that's where the world's going, I'd rather us be at the front of it than behind (UK008).

While increased costs were seen to be a barrier to decarbonisation, many of the interviewees believed that costs would be reduced by decarbonisation so that this would also be a driver (e.g. UK001; UK002; UK006). It was also considered by some that the defence sector could be an advanced sector in the field of sustainability, since it has often led the development of new technologies (e.g. UK002) and some aspects of the sector could be quite responsive to need as it is used to being reactive and deploying new technology as quickly as possible (e.g UK004).

Another of the main drivers for decarbonisation was seen to be the climate crisis and other environmental harms. All the workers interviewed said they were concerned about climate change and other environmental issues and were trying to make corresponding changes in their personal and work lives (e.g. UK014; UK018; US003; US013), as expressed in the following comments:

I suppose it developed over the years as the awareness has been raised within the press and the media and you can quote all the standard phrases, if you like, 'there is no planet B' and stuff like that. So, I do what I can to try and mitigate that in my home life and if I can do that while I'm here at work then I will be trying that as well …in the office, we just generally try to be as frugal as we can be with resources, like paper where you're printing stuff off, you're using paper, you're using ink, electricity and all the rest of it. So, unless we absolutely necessarily have to, and sometimes it is a necessity to print off large documents, we don't (UK016).

I've always had a bit of a passion for the environment and basically using resources efficiently. I really don't like to see resources being wasted or used in an unsustainable way. I like to see things used that can be recycled and sustainable so that we're not having to destroy more than we actually need to (UK002).

I know people say "oh, we've suddenly woken up to this crisis". No, we haven't. We've known about it for about 30 years. It was in high school text-books… and in a way we've left it a little bit late, a lot late, to start doing anything about it and made it much more difficult for ourselves now to change course. We're going to do it but it's going to be painful now (UK007).

I think we can all help here. Just something as small as recycling which isn't done. Start small and just get bigger. .. I just think that everyone needs to think about what they are disposing of… I think probably we need to go back a few decades and

make the most of what we've got around us before we consider bringing in something new (UK005).

I have been what you might call a tree hugger since the early 80's, late 70's… and I have been banging on about climate change since the 80's and the front of my head is flattened with banging my head against a brick wall, basically, but people are beginning to listen now (UK020).

…the survival of the human race is at stake, the stakes could not be higher. …Here in Oregon, wildfires are the worst there's ever been. We just had the worst ever tornados through our Midwest …Climate change is upon us. It's here. It's getting worse (US003).

…we were actually just in Alaska and went to see the glaciers because I wanted to see them before they all melt into the ocean and that sea rise is going to - it's changing fishing industries; it's changing the quality of the food that we can get; and it's changing the lives of the people that it impacts (US013).

Many of the workers considered that greater public pressure could be a driver for transitioning the defence sector to sustainability (e.g. UK016: UK017). For example, UK017 said:

The key to this, in my opinion, is not governments, it's not countries, it's people's attitudes and manufacturers. People won't buy from a company if they employ six-year-old children to make footballs in Bangladesh and they're getting paid 10 pence a day. They won't do it. People are generally good and generally - and that's the power of change that can be implemented. If you're asking countries, governments and multi-nationals to do it and to come in and do that change they won't because all they're interested in is the bottom line. But people can do that and in carbon reduction programmes that's where the change needs to be made (UK017).

Several interviewees made the point that more could be made of developing links between environmental organisations and defence workers, though this was now building. For example, US012 and US017 explained,

I have very good friends that are in the environmentalist movement and we have noticed that some green groups will … without talking to us, say some really stupid shit that they end up regretting. … if we're not in the same room with them and having those conversations and have those relationships, then it's gonna create a wedge that doesn't need to be there. …unions can also, can use their, kind of, political influence to ask sharper questions about you know, our trade policies and that sort of thing (US012).

I've seen in 10, 15 years a movement towards collaboration between labour and the environmental movement that initially was non-existent (US017).

Thinking back to diversification campaigns in 1990s United States, US005 said,

…during this whole process, you know I was asked to speak at so many different events and I connected with so many different local and national organisations… A lot of peace organisations and environmental groups and so they were just really behind everything and pushing and one of the things was that it was so unusual for them to see somebody out of the defence industry that was promoting a lot of the same things that they had been promoting… I mean defence workers and the unions were pretty much never involved with the peace organisations and the environmental groups (US005).

However, it was felt that there was not enough knowledge among the public about the environmental harm associated with defence (US003; US004) and, therefore, 'not enough noise out there to convince the governments at the present time to clamp down on the military' (US003). Some of those interviewed considered that there needed to be more public awareness of the issue.

The workers also discussed the importance of Public Relations and Corporate Social Responsibility for the defence sector and how this could be an additional driver to decarbonisation. They stressed the importance of 'being seen to be doing the right thing' (e.g. UK011; UK017). It was expected that the public would put pressure on the shareholders, as discussed here:

I think the majority of the major original equipment manufacturers – the likes of Rolls-Royce, Boeing, BAE Systems – their shareholders expect companies to decarbonise and aim for net zero wherever possible because the majority of the large defence companies are publicly owned by pension funds and small investors. The expectation of the general populous now is that there is a green agenda and if you own shares in these companies you expect them to be participating in that green agenda (UK001).

A few felt that the Covid-19 pandemic had even created a push towards arms conversion as values and priorities were reassessed (e.g. US004). It was felt that this, combined with recent military events, such as the withdrawal from Afghanistan and '… the fact that billions of dollars were spent to no good point' (US004) may have increased the interest in military conversion issues among the public.

CHALLENGES TO BE OVERCOME

The main themes regarding challenges to overcome were seen to be technical factors, human factors and political-economic factors.

The interviewees pinpointed numerous technical difficulties that would need to be overcome in order to decarbonise defence, including the following:

Yes, moving to simulation is great for the air training part of it but, for the live part of it, where you have to fly, then you know, jet engines are really, really carbon inefficient, the amount of fuel that you burn per hour is astronomical in a large aircraft. … With a battery, battery technology itself, the amount of energy you can get into a battery is finite. …I think if we could forward alternative fuels, then that's probably gonna be more efficient…so if you can produce engines that are able to be powered and get their energy from hydrogen rather than a battery, then yeah it would be more advantageous…. The negative effect is that you don't get the same level of training from simulation and you don't get what's generally termed as the 'random effect' (UK013).

Some of the workers interviewed discussed the lack of appropriate infrastructure and long equipment life cycles, whereby fossil-fuel-powered equipment that is being used now or coming into service will still need to be in use in 2050:

> *…it's not just a matter of getting electric vehicles, for example. The whole of the electric vehicle infrastructure to charge these vehicles has not yet been created really in the United States. I mean it exists in a kind of skeletal patchwork fashion and it certainly does not exist in other countries, as yet, where all these [United States Military bases are]. So, I think that there's just a lot of really [sigh] - there are really practical barriers (US004).*

> *Again, an awful lot of the infrastructure that we've had, we've got is aging. We are not opening new sites, we are limping through [with] the ones we've got. The opportunities to really make positive changes would be if new sites are built that the approach taken should be to make it as green as possible. I don't think that it's going to be possible to decarbonise some of these old sites that were built in the early 1900's. All the money that we've got is to stop them crumbling away to dust. It needs a top-down approach and it needs somebody to actively manage it. At the minute, I think an awful lot of it is lip service (UK010).*

The interviewees also mentioned new problems that could be created through changing technologies, particularly regarding creating other environmental issues and new global conflicts, as US026 and UK010 discuss here:

> *… especially when companies like [ANONYMISED defence company] will say we've got to focus on nuclear which is a renewable to an extent and we're focusing on cleaner gas products, cleaner gas this and gas that, which is a turn off for some people who think …they are not truly looking to be green; they are just looking to use their carbon credits essentially to get away with still manufacturing what they are used to (US026)*

> *It shouldn't come as any surprise we fought conflicts over commodities …and resources. As the desire for a different resource emerges, it wouldn't surprise me if we see conflicts stemming based on land that's more viable, or water, or any other desired commodity. It doesn't have to be conventional fossil fuels or any other material if something rises in value enough it can spark conflicts. It's just where that conflict emerges, moving forwards (UK010).*

The interviewees frequently mentioned the need to prioritise operational capacity in the endeavour to decarbonise and utilise the appropriate technology, as these interviewees highlight:

> *…the defence sector will always prioritise, essentially, lethality … or bang for buck, over anything else. They will spend a huge amount of money to get that outcome and so decarbonisation is – they're not gonna go out of their way to spend more money to make it happen because it may reduce the effectiveness of their weapon systems, ultimately. If there was a way that decarbonisation was kind of, what's the word I'm looking for, concurrent with achieving a more capable weapon system then they would do it but if there's no explicit motivation, then, no (UK022).*

> *If the option is to deliver a full capability that has an environmental impact or a degraded capability with zero environmental impact, the end user is always going*

to select full capability. That's what they want. The ideal state would be delivering full capability with zero environmental impact but often that becomes prohibitively expensive (UK010).

I am a hundred percent in understanding that we cannot sacrifice the in-use effectiveness of our defence.... We put people at risk through using sub-standard materials. But we have to do everything we can and if one of those areas is in the actual manufacture, the production, the end of life and everywhere else and the non-frontline activities, then absolutely. We should be over-achieving in those areas to make up for the deficit in the frontline operations (UK006).

I think, whilst we're not at war, we can make some clever decisions and transitions to decarbonise. I think, when we do go to war, there's a bit of a compromise between capability and environmental impact. Mission criticality comes into its own and that may take precedent over any environmental decisions.... If you're in a mission critical scenario then you probably don't have the luxury of choosing and spending and using the more, sort of, sustainable fuels, you kind of have to put up with whatever is available at the time depending on where you are in the world (UK018).

A few of those interviewed were concerned that diversification of the sector, in terms of using civil components or companies, would not be workable because defence has its own standards and these cannot be compromised, as discussed here:

...we are inclined in our industry to understand that we're not making cars, we're not making toaster ovens, we're not making washing machines. The products we make people's lives depend on, they have to work every time they're used, every time they're used, no exceptions, no excuses, no "it was left in a warehouse for five years, it was in the Antarctic, it was in the Sahara Desert"; it has to work no matter what. So the quality of what we produce is very, very good, but it comes at a very high cost ... So, at least my experience of [ANONYMISED defence company], it's hard to make that transition to, "well, it's a toaster oven, so if it doesn't work they can bring it back and get another one". Well, you can't bring it back and get another patriot missile. If it doesn't fire when it's supposed to fire, people are going to die. So it's a different mentality in the industry (US014).

Their defence and commercial are not the same. One is basically, you're working at ... speed and, when you're working in defence, it's more you're pushing quality a lot harder. Their emphasis is on quality - making sure that it's right. Making sure that you're not putting soldiers' lives in danger. With commercial, I would say that management's focus is on ''We have planes on the ground, there's customers waiting for them, and we need to get this out right now'' (US023).

Some of those we interviewed located the barriers mostly in terms of human feelings, thinking and behaviour either as the key limiting factors or as associated factors. In particular, some of the workers pinpointed the barriers to decarbonisation, diversification and Just Transition as being related to problematic attitudes, sometimes of particular groups, as in the following statements:

Unfortunately, there tends to be a lot of – when someone does have an idea [for decarbonisation] that they do want to implement – there does tend to be a lot of

back feed because they like to stay in their own, "well, this is what we've always done, so we don't really want to change". That's what I don't tend to like about it... I mean, even when we say things like, "we need to use less paper and why are we shredding all of these documents? Why are we printing off if we're just going to shred them anyway when we've got secure, online, easy collaborating software we can use to share documents without ever taking them offline?" But then I get certain staff saying, "I prefer to work with paper" (UK002).

I think there's a lot of older members of the forces and defence that it was never something they were exposed to as a child or a young person. They are very much, you know, "our time on earth is nearly done, there's nothing much we can do, we can't affect it", etc., etc.... But I think the younger people coming through, they've grown up with being exposed and understanding in the media about ozone depletion, deforestation, local sourcing of resources, so I think that there is a bit of a generational change happening as well (UK011).

Although most interviewees saw these attitudes and habits as changeable, 'human nature' was also a concept that was raised by a number of the interviewees to explain why it would be difficult or impossible to decarbonise or diversify because,

...unfortunately, since man started using fire we've been, er, I won't say destroying the planet but were making it not a very nice place to live, but the culture we have, especially with the throwaway society culture, has really impacted it massively and, like I say, defence is no different from any other sector ...I mean, these things are designed for one purpose and one purpose only and, I hate to go back to it, it's to kill. That's it. It's to win on a battlefield and it's to reduce your casualties and inflict more on them. That's it. That's the bottom line and it's been the way since the Romans that invented spears...There is scope and operation for everybody to – I won't say have what they want – but to live a decent life but we're flawed, and that's at the heart of our soul and, as that flaw remains, you're going to have to have a [military based] power balance because the moment you drop it is the moment somebody else will actually step in (UK017).

Some things can't be helped, human beings we do like to wreck the planet. It seems to be in our nature (UK005).

Some of the interviewees touched on the identities of defence workers and their human need to belong as perhaps standing in the way of transitioning the sector, as in the following comments:

I toured [ANONYMISED defence company], and people there are extremely proud of that product which they fully know is the most technically complicated and advanced manufacturing product ever made, even more than a rocket. So, they had that pride and by telling them that they're making weapons of war really, you know, insulting them, isn't really the way to go at this. But, beyond the pride, they have pride in their skill and they all want to make good things. So, I think if you said to folks, "we're just not going to make this stuff, we're going to make this other stuff", I don't think there's any problem with that all. I think people would be happy with that. It becomes more complicated when you go to defence workers and you say, "well we're going to cut out these weapons because we need more nurses and teachers and we need more highways" or something, because we're not nurses and

teachers or construction workers, so people need to keep the thing that's relevant to what we do. At the end of one meeting, I remember a guy saying, "just tell us what you need, we can make anything", so I think that's it (US011).

I thought that, all the industries I've been in, I've changed into somebody who thinks within the industry and not outside it. It's very easy to do that, I think. You become one of one of a team that goes "well, this is what we do" and, if you if you speak out against it, you're sort of out, really…it's like coming out, actually … saying war is wrong and yet you're a soldier, how come you're not loyal to the regimental loyalty, which many people continue the whole of their life until they die, you know, basically (UK019).

I would say the majority of the union membership were against doing conversion stuff and, looking back, using the word 'conversion' was a big mistake because people think that you're getting rid of something and moving onto something else and for somebody that's been in a career like that their entire lives, it's threatening to them (US005).

I don't think there would ever be a problem in the MoD with training people and upskilling them into a different role and supporting them into that. I think it's really down to whether somebody really believes in the environmental and decarbonisation agenda and whether they are open enough to moving from their current job and current role into a different one. Yeah. I don't think it's the ability to learn the skills, I think it's the way they've always done it, they're losing something they've always done and they're not fully bought into what they're being asked to do (UK011).

I think I'm a bit of an exception among my colleagues and I feel uncomfortable working in the defence industry. A lot of them don't. A lot of them feel very proud to work in the defence industry and so getting them to shift is something else (UK022).

… there's a sort of soldier worship we have in this country I think where, you know, people die in combat and the combat's the reason for when everything else cannot be questioned because people have died … and so it makes it very difficult to criticise the military when it's all bound up in this enormous sort of pride (UK019).

Those workers who did not necessarily identify as defence workers, found the idea of doing different kinds of work less problematic, as US012 discusses here:

I don't really consider myself part of the defence sector. I consider myself a machinist, and a [ANONYMISED union] person and a [ANONYMISED company] worker. We wanna make anything in our plant. What I care about is that folks, my neighbours and my community have good union jobs and I don't care if we're making widgets for any company. It could be anybody as long as we're making them and we're union, I'm happy. So we'll make the [ANONYMISED], we'll make windmills, we'll make whatever you want and I think that it is essentially crucial for the future of the plant that we do a diversified portfolio (US012).

The workers that we interviewed generally expressed a great deal of job satisfaction, primarily as a result of enjoying working with their colleagues (e.g. US012); feeling they are making a difference

(e.g. UK007); having a degree of autonomy (e.g. UK009); variety in the job (e.g. UK010); interacting with a range of people (e.g. UK010); opportunities for learning (UK008); enjoying meeting people (e.g. UK014); using their skills (US025); making a worthwhile contribution in terms of supporting the defence of the country (UK008); and pay, conditions and job security (US015). They also felt very responsible about the work they do, as US014 explains:

> *you have to be producing top quality. Again, you can't have a missile fired at somebody who's trying to kill you, and you're in an F16, or F17 and it doesn't fire. If it doesn't fire, there's no second chance, you're dead. So, people's lives depend on the work that defence contractors do … I would hate to think in my 40+ years at [ANONYMISED defence company] that, because of something I didn't pay attention to, that some service man or woman lost their life. If I worked at [ANONYMISED defence company] making toaster ovens, I probably wouldn't feel the same way. I would be like, "well, so what, they could go back and get another one" (US014).*

Some said this high level of job satisfaction would be a barrier to transition as civil jobs, including 'green jobs', tend not to be as good in these respects as US015 discusses here:

> *I think that's part of the hesitation in transitioning, because these jobs are so good and secure and they pay well and especially the ones that are protected through collective bargaining. I mean, this is a job for life and, in the civilian sector … it's impossible to find anything like that. So I think that's the major stumbling block towards a transition, in my experience. Most of the people who work in these types of fields, one of the major motivating factors is just it's such a good job and why would I want to go and work for a [ANONYMISED electric car manufacturer] or somebody else who beats the shit out of their workers and I could get fired at any moment? Why would I want to leave for that? Even if I would rather be doing something that there is more of a public good involved, people aren't as selfless as they would need to be to just walk away from this (US015).*

In addition, as mentioned earlier, some workers emphasised how environmental regulatory improvements had sometimes led to job losses as their work was outsourced to companies, or offshored to countries, where such restrictions did not apply. US020 stated, for example,

> *I worked with a lot of chemicals and, on any given day, you could come into work and then all of a sudden this chemical was gone – an adhesive, maybe, that we were using – and, "What happened to it?", "Oh, that caused cancer. They got rid of it". Well, slowly, over time, they just started sending this work out to, I feel, instead of dealing with the environmental issue, just, "We're not going to use that in our company but we'll send it to another place that's going to do work for us. They can use it. We're okay with that because it's not us" (US020).*

Such associations between environmental policy and loss of jobs could easily create negative attitudes towards, and a distrust of, measures towards transitioning to sustainability.

Attitudes, knowledge and habits are underpinned by 'culture'. The culture of the organisation can include aspects of tradition, the written and unwritten rules and the norms and expectations. All these aspects were discussed by our interviewees as potential barriers to change. Interviewees spoke about a lack of environmental targets beyond legal obligations, such as ISO 14001. Sometimes they were unsure of whether there were decarbonisation targets (e.g. UK001).

'Tradition' was also frequently raised as a barrier to change. The usual ways of working sometimes clashed with the decarbonisation statements and goals of the organisation because they did not fit with other values of the organisation. For example, UK002 described how management demands for onsite working undermined low carbon aspirations because employees continued to have to drive in to the workplace. Interviewees frequently described contradictions between what they were asked to do for sustainability and what they were required to do to comply with 'the usual ways of working', as in this comment:

> *I mean, for example – and probably relevant to this discussion – is that we're trying to be a paperless office or at least that's the direction from the top level to say that we should be using less and less paper. When trying to implement that, the request is, "this needs to be printed off, that needs to be printed off, the other thing needs to be printed off" (UK002).*

Various aspects of the culture of the defence sector were highlighted by interviewees as being a barrier to transitioning to sustainability, including their reliance on the fossil fuel sector (e.g. UK004); lack of prior transparency and accountability in terms of carbon emissions (e.g. UK020); militarised mindsets (e.g. UK020); prioritisation of defence considerations; and unquestioning compliance, as commented on here:

> *… the standards for how the defence infrastructure has always operated, you know it's quite an ingrained system … in terms of use of energy from fossil derived fuels and not necessarily, until now, having a real reason to focus on sustainability has meant that it's perhaps on the back foot in comparison to some other industries like civil transportation, for example (UK004).*

> *A lot of people there are rightly driven to want to just provide the best for the boots on the ground and the people who are trying to save people in the world and putting themselves in dangerous positions, but we also need … let's say we send a flotilla of ships across the world as a publicity exercise. Would we do that if we really looked at the carbon involved in doing that and pollution involved in it? Maybe we would question it a little bit more if there was a culture more akin to looking after the environment (UK008).*

> *…a lot of them [the UK military] they become a bit - brainwashed is not the right term - but they become institutionalised. If you have been 22 years in the army, being told what to do morning, noon and night for 22 years, when you come out you… are actually institutionalised and you think that's the best thing that's ever happened to you and it's almost like de-programming from a cult that needs to take place and a lot of these guys that have done a lot of years in the army, they feel proud and they don't ask questions (UK020).*

A few of those interviewed also mentioned the 'culture of secrecy' within the defence sector and the regulations surrounding that (e.g. International Traffic in Arms Regulations (ITAR) and International Property Rights (IPR)) as possibly hampering the transition to sustainability, as in the following excerpts:

> *[I think the main barriers to diversification might be] Secrecy - the Official Secrets Act. The technology only gets shared for two reasons, first reason being somebody has leaked it and second reason being we have developed something else that's*

better…. and do you really wanna give the Chinese everything because they have already stolen most of it anyway and they have already moved their technical advantage forward. Everybody is a little bit scared at the moment of the way they are advancing, so do you wanna diversify and allow everything out into the civilian sector? It's a difficult thing (UK013).

If the supply chain is good at making widgets, then we can use those widgets for civil and military applications. You'd expect the underlying principles wouldn't be too different. I think the challenge is that military tends to be, or defence can be, more heavily regulated which creates, again, a sort of resource drain to navigate the regulations and therefore less ability to spend resource on civil applications. And I think the likes of IPR and ITAR, laws and regulations around what information can be communicated away from a defence realm and what can be reused for civil applications. I think those are probably the key elements which needs to be navigated by various companies (UK018).

A barrier to change that was very commonly mentioned by interviewees was the cost of decarbonising and bringing about a Just Transition. Interviewees regularly mentioned the cost implications in implementing both, as these interviewees described:

…it's all very well setting out these aspirations, it's practically what are you going to do about it and have you put the funds aside to do so because it's costly? So, for example, on the defence estate we've got 50,000 homes. Well, you need to be putting heat exchanges in those, etc. Well, that's a lot of money (UK007).

I think that, whatever the Pentagon is saying about electric vehicles and solar power for certain military bases or installations, the obvious physical fact remains that the vast array of jets, helicopters, warships, tanks, you know, huge fleets of just regular cars and trucks, all of that runs on petroleum, and will for the foreseeable future. It's going to be an extremely expensive endeavour to convert even a fraction of that to electric vehicles (US004).

There was some uncertainty regarding whether adequate funds would be made available for greening the defence sector as, for example, expressed here:

We have to demand a better solution and, unfortunately, people aren't prepared to pay for it. We absolutely have to be prepared to pay for the more sustainable option. That might be the downside that it's more expensive but we have to be prepared to do that. We cannot sacrifice environment for cost (UK006).

… sustainability doesn't come cheap, you have to change processes, you have to change systems, you have to change platforms. If you look at … air combat or land systems or marine transport, changing to … alternative fuels would be a massive expense and there is already a drive for reducing the costs of delivering platforms within the defence sector … so I think having the financial backing within the defence sector to really make a difference in sustainability will be a challenge. Budgets would have to increase significantly … (UK004).

In order to go greener, they would have to invest a whole lot of their money into that whole transition. Companies don't really have an interest in moving in that

direction just because that's gonna be money taken away from stockholders – away from CEOs – people that are running those businesses (US022).

Workers highlighted that difficult business decisions would have to be made about whether the costs of changes to production would be carried by the customer and whether initial outlays would be recuperated:

Now, it all comes down to the motivators in terms of the key people behind it and how they want to progress with that, whether it's the financial side of installing this renewable system or whether the driver is reduced CO_2. So some of these projects, yeah, economically the pay backs can be perceived as long but if you take into consideration the CO_2 you've saved, what's the key driver for the guys making these decisions going forward? That's the biggest, I think, obstacle to get over (UK024).

The cost is always going to be another element of this. You could have the best system in the world that has zero carbon footprint but if it costs five times as much as the other one, then they'll buy the other one. That's the unfortunate truth of it… (UK010).

Some of the workers felt that the costs of decarbonisation and just transition could not be met because of long term lack of investment in the defence sector, for example, as in the following excerpt:

… And one of the real problems with much of the military estate, specifically when it comes to facilities, is that we've had a concession of repair and fail. So, money will be available once it's failed but not before. And what that has resulted in is a whole estate which has been allowed to run down to a point, but almost everything could possibly fail at any minute (UK023).

Some felt that the defence industry options were constrained by economic imperatives, including vested interests and perverse incentives within the system:

… defence is easy money for companies and doing anything else is risk … it comes down to the money thing and the incentives. So if the country and the government wants the defence industry to diversify, there needs to be incentives that minimise the risk for them to do that so, whether that's funding support, whatever, that needs to be there and I guess then on the other side we need to make defence funding less attractive or more strict because the defence industry, from my point of view, is essentially a magic money tree. There is always money available no matter what you do and so…they almost need to be made less dependent on that to make them do other things (UK022).

I remember one meeting we had with one of the Vice-Presidents of [ANONYMISED], which was a big organisation, a big workforce in Southern California at one point and this Vice-President was the head of technology for the entire corporation. We got into a discussion about the potential to convert some of their technologies to commercial applications, similar to what was done with the auto-seat type of stuff. And he said oh yes, there's a lot of potential there. He said we've written up 600 or 700 patented technologies that were developed for the defence sector that could have some application to commercial and potentially,

like, some green areas and things. And so, you know, he was saying – well we were asking has any work been done to take that forward … and he said "no". And he said the main reason was because "we made 50 or 60 million dollars a year on patent infringements and if I try to do anything in that area, my legal department would be outraged"… And so that was like, wow, that was an eye-opener (US005).

…defence work is essentially state run. It's a state run industry and the majority of the funding is through the taxpayer. So, for the defence industry to branch out, you'd probably have to have an equal amount of investment from state governments to justify it. …the private sector is so focused on short term reward that they're not really going to be interested in putting in the type of investment it would take to transition entire sectors into something out of the defence industry. …they don't care where their money comes from as long as they make their money. So, if they can see the same type of profit margin through renewable energy then maybe they will invest as much in that as they have in aviation in the past, but the problem is with defence work it's kind of like a blank cheque (US015).

Some of those interviewed discussed the profit motive as a barrier for change, as in the following excerpts:

UK is notoriously a conservative country. It's just been that way ever since. I don't remember a period when it was actually overtly less conservative, shall I say. That basically means that they want more of a free-market criteria, but this free market tends to support pro-big business …This is why I don't think it's going to be very easy [to decarbonise] … (UK002).

…and just recently I read that arms companies have had the biggest profit ever and it's something horrendous like 500 billion pounds profit, not just turnover, but profit. It's massive, massive profits, so, until such time as money doesnae talk, it's [diversification is] gonna struggle here (UK020).

There's, undeniably, there is a vested interest within the defence sector to sell defence equipment, that's what it is there for. I don't think it's necessarily sinister… there is a gap in the market and people want these things and they are more than happy to sell as any other business is (UK010).

…it's a very lucrative business for a start. I mean, I think when you have a permanent arms industry that has to make lots of money and sell arms then you're going to have a dynamic to fight wars (UK019).

… there's people who live off war and war based industries and you would have to overcome that barrier …If you can convince them, I think, that they could make as much money in another field, that would be the barrier that would have to be broken (US013).

I think it's short-term thinking by business, that they're not planning strategically like that. They're spending more time worried about stock buy backs and compensation levels for their executives and return on investment to stockholders than they are about the long-term vision of what are we going to be doing in the 2080s? …Yes. I think that's the main problem (US017).

I think that there's just so much money, and I think it all just boils right down to that. There's just so much money in the defence side –My sense is that people who do a lot of defence work really don't wanna get into the greening of the economy – the profit margins aren't as good as defence manufacturing. There's a lot of competition in that area – I think that's one of the barriers. It would be tough for business to make substantial money on some of these things that are being built offshore, so that's one barrier…it's the premium on shareholder value that just drives every decision in corporate America, including the defence industry (US024).

Some of the interviewees connected these vested interests to power, associated lobbying, and consequent inadequate legal and regulatory back up, as illustrated by the following comments:

Well, the major barrier is this, for Trident, the only reason they have got it - they can't use it because if they used it, you would be talking the annihilation of civilisation - the only reason they have got it is to keep a seat at the top table of the Security Council at the UN and it's a political thing. It's no' really a defence weapon, it's a macho thing. Britain is still the imperial power or it thinks it is … Their obsession with sabre rattling and being the world's policemen and challenging Russia and China to a duel, basically, they are no' gonna stop their macho posturing to decarbonise. That's part of the problem (UK020).

I always revert back to lobbyists because they're the ones controlling our politicians. If we can somehow take the money out of the voting system in the States, then we'll take the power away from lobbyists. …We're under the guise of a lot of propaganda, unfortunately. That's really the only first step that I can think of, rearranging the voting system in order to make it more just and more authentic towards the voices of the people that are taking part in it. That would be it. I can say we should change the machinery; we can change this and that, but if the lobbyists are still there to control the policy, they [the government] realistically won't do it (US019).

The military is one of the, sort of, exempt, keep your hands off, as far as giving any rules to the military goes and that should not be … [ANONYMISED names of defence companies], they contribute heavily to political campaigns, putting in politicians that favour their views which is generally money into power and there's where the decision-making lies as to what the military does …many of our politicians are, frankly, sort of in the pay of defence contractors, big companies so they're not interested in doing anything that would impair their profits (US003).

Where someone may go "this is a carbon free product", it very, very much depends on what they define as carbon free. …what they say and what the definition mean are very different to perhaps the reality that you perceive it to be (UK010).

If we didn't have this extensive lobbying system that they call it – it's a bribery system, actually – the lobbyists… spending millions and billions of dollars on lobbying congress to pass these rules, regulations, and laws that benefit them. They write the so-called 'environmental laws' – they're all written by these company lobbyists that bribe congressmen and members of Congress to pass these pieces of legislation…. They donate to the parties, and also to the congressmen and senators themselves, and a lot of times they don't have to reveal those sources

of where that money comes from, so there's a lot of dark money involved. There's so many ways of covering up what the sources are, or just hiding it, and they do their bidding (US006).

When you've got all these folks wanting to lobby for their companies that's probably, I think, the main reason why we keep doing it [producing so many weapons]. It's not really logical to keep doing stuff like that but, when a company is lobbying that has that much power, that's what I think the problem is going to be is how we can get around that, so I don't know. Logically, it should but I don't know how you're going to crack that nut (US008).

As a result of these political and economic constraints, some of the interviewees were not convinced that the decarbonisation strategies and discourses of the government departments and companies were genuine, as illustrated in the following comment:

… I think companies will use a lot of PR over the coming years and decades to show that they're decarbonising and having a Just Transition and all that good stuff. I don't think that will actually be happening behind the scenes and I think particularly the defence industry will have to be dragged screaming and kicking to make it happen (UK022).

Some of the interviewees were concerned that greening the military would be a way of the military increasing its government investment and that this would not be a good use of these funds:

One of the things I'm concerned about with the Department of Defence's approach is that this will lead to them just asking for more money in addition to the huge amounts that they're already getting… So, the Secretary of Defence, Lloyd Austin has called the climate crisis an existential threat, which it certainly is, and the military also uses this term of threat multiplier …congressmen, or congress members, I should say, and senators often push for military spending just to get the money rolling into their districts rather than any actual need as identified even by the Pentagon (US004).

OVERCOMING BARRIERS

While the interviews discussed a number of barriers to decarbonisation, diversification and Just Transition with regard to the defence sector, they also offered a number of solutions. For example, with regard to problematic attitudes, suggestions included incentives, contractual requirements, regulations and policies, including the following:

So there's the organisation I work for but there's also the suppliers that we use who need to transition as well. So we need to - our organisation needs to - try and embed it in some contractual requirements and, sort of, technological requirements in new procurements to ensure that our supply chains are also decarbonising and being more sustainable (UK018).

There's people in the business who are more savvy than others, especially at the sort of middle management level so you have pockets of knowledge and ways of working and understandings which are not consistent through the business. So I think it needs to be led more from, and pushed through from, a corporate and a high level (UK008).

There probably needs to be some policy changes – it's probably not gonna happen just through goodwill. It needs to be pushed in the right direction … I guess, the thing is, there has to be a huge amount of master planning done now to make sure that everything that we do is all heading in the right direction [so that] we don't do things now – spend money, even, now – that, actually, when you look back in 20 years' time, you go, "No, we shouldn't have done that". We need to make sure that everything we do is right (UK030).

Regulation and incentives. I'm certainly of the view that things won't happen unless you make people do them. So, it comes down to what I've said before - it needs to be a money side thing from the MoD or whoever else and maybe a taxation thing and perhaps, particularly for the Just Transition regulation, to make sure that you can't, for example, get rid of people because you've changed your business sectors or you must retrain people or whatever (UK022).

I think what would make a difference is if Congress, or different countries around the world… the ones that control the purse strings, made it a requirement that a certain percentage of the money that's spent [on defence] has some [requirement to develop] some of these greener technologies to move away from fossil fuels. … if they put a priority and said, "In order to get this amount of money to build these jets, a certain amount of this money is gonna have to go towards developing something green and, if you don't do that, then you're not gonna get these contracts anymore – we're gonna find somebody that will" (US022).

In relation to the cost barriers, many of those interviewed discussed the need for government incentives (e.g. UK010). Some of the interviewees also expressed ideas about how to be more cost-efficient or re-allocating resources so the funds for decarbonisation could be found. For example, interviewees said:

… there are things that we could do in order to save money in the short-term to put towards an investment in the future… A lot of defence is currently contracted out. We don't actually do a lot of stuff ourselves. These big manufacturing companies create exorbitant cost half the time. We tend not to invest in the smaller companies… provided that the contracts can, to an extent, be split up and the work divided, then it's very much more feasible that costs can come down and we're not spending lots of money to companies that are overvaluing their services …There is an awful lot we can do with minimal investment and, actually, it would incur long-term savings for the defence sector. For example, solar panels - the facilities that I work in don't have a single solar panel on them, whatsoever (UK002).

We just need to reallocate our budget. Instead of investing in the same technology from [ANONYMISED] – or whoever you want to name in terms of the equipment we're using – we need to allocate it towards renewable resources, possibly even turning down our engagements in conflicts around the world (US019).

A number of the workers interviewed also stressed the important of organising together through the union as a way of ensuring a Just Transition, as US015 emphasises in this comment:

I just really want to stress that organised labour, I think, is the most powerful tool when it comes to shifting economies and industries and even politics. And so, in

some ways, it's easy to be very pessimistic about the last several years but one thing that I am really optimistic about is just how angry workers are right now and how much more power they seem to have than they ever had before. My hope is just that they keep that because that's what's going to decarbonise and transition the defence sector, is the people that are doing the work (US015).

The need to engage the workers in finding solutions was emphasised by many of the interviewees as US024 discusses here:

I think we have to be at the table. I'm very proud of my [trade union] members – we innovate – an engineer comes out with something and we improve it because we're the ones with hands-on [experience]…Where I used to work at [ANONYMISED defence company], they used to have this suggestion programme and you'd actually get bucks for refining a process – you'd get a piece of the pie – and you'd be surprised how many people would participate in that. You didn't get the whole profit margin, but you got a good chunk… Those are all incentives and you felt part of the team – you know what I mean? I think that's how you do it – right now, workers feel like they're just robots that go in and punch in every day – do their eight hours – leave – "They don't want my ideas – they don't want my insight – they just want my work"…(US024).

The interviewees also often discussed the need to have adequate discourses that workers can engage with. For example, US011 said,

Well, I don't think it's easy and we've seen in the [ANONYMISED] union we've got a big problem because we're big on white male workers, we've got a lot of them … we've got a lot of Trump supporters in our ranks at the moment …. I think, if you keep at a positive message - when I talk to people about climate change, I always emphasise our kids and their kids and future generations because I think it's the only way to make sure that you feel fully the imperative … What I've found, when I go and talk to groups of workers, there is some scepticism sometimes but really they're just wondering what can be done about it [climate change]. People are actually really worried and they know their kids are really worried, so they really just want somebody to say "we can deal with this" (US011).

The workers interviewed also stressed the importance of good leadership and taking a step-by-step approach, as in the following comment:

…it's going to be having groups of leaders within the industry that can drive creative problem solving and figuring out how to get over each hurdle one at a time and continue moving processes forward, technologies forward, because we're either going forward or going backwards. So, you know, some people run into a problem and they throw their hands up in the air and they say "I don't know how to do this" and they shut down. We can't do that - we have to keep pushing forward. You know the old adage of "How do you eat an elephant? - One bite at a time". You have to break it down into small sub-problems, work out each issue and get over each hurdle so that we can continue moving forward (US001).

Having different approaches to foreign policy, based on human security within the context of the climate and environmental crises was also mentioned as an important way forward, as US019 discusses here:

> *There are drawbacks in wars. Let's end wars. Let's stop selling weapons, especially machinery that requires fossil fuels. …Let's reallocate that budget towards renewable and sustainable ways of living and I guess more ethical. I'm a very young person. I'm only 28. …Coming to terms of the reality that I'm born into and now having a son – and you're aware of where we could have been and that we had the technology to live in a different existence – it's kind of depressing. It's hard to swallow. We could do better (US019).*

However, others felt that having a strong defence set up would be the best way to achieve human security, allowing for diplomatic goals to be achieved as US023 argues –

> *…I don't think that there can be diplomacy without weapons. For example, if North Korea didn't have an atomic bomb the US wouldn't have diplomacy with them, they just wouldn't care about them. You know what, you don't have a bomb, I don't really have to bother with you, but the fact that they have an atomic bomb is where the US has to be at the table with them and has to be diplomatic with them so, even though a county can choose to not use weapons, you have to have defence…You have to have a form of defending yourself or else you have no say in diplomacy (US023).*

Therefore, the workers interviewed discussed a range of barriers and ways of overcoming them in the transition to sustainability. They also frequently proposed inclusion in the decision-making process as a way of overcoming those barriers, as outlined in the next section.

INCLUSION

Almost all of those interviewed expressed an interest in being consulted on plans for decarbonisation, diversification and/or Just Transition to a greater or lesser extent. While some wanted to be closely involved in helping to develop and write these strategies (e.g. UK009; UK013; US001; US021); a number said they did not want to have this level of involvement because they did not have the confidence (e.g. UK008); did not feel they had enough knowledge or expertise (UK008); did not have enough time (e.g. UK022) or capacity (e.g. UK022); and that it might not help them achieve what they need to focus on to reach their career goals (e.g. UK008). Yet, overall, there was strong enthusiasm for some involvement in developing the plans.

Even so, inclusion in developing these strategies, policies or programmes was extremely rare among those interviewed. A few had been consulted on decarbonisation, particularly if they were at a management level or where working on sustainability was part of their job remit. For example, UK016 and US016 said,

> *…what the company are doing is they're looking at this and they're, because they've obviously made the pledge to, the go-green pledge or whatever you like to call it, to reduce the carbon footprint of the company, so we get notification of that and they ask us how we think we can help so there is a representative on site that deals with that…. So, yes, as far as decarbonisation is concerned [we are able to have a say], most definitely (UK016).*

We do have a forum that we can go into that's global … and we're all putting in our opinions about everything and we have discussed …how can we help the environment. Our CEO is very open, very liberal, he's open to anything that's going to assist as far as making his employees feel comfortable, as well as giving back to the community and helping our environment… So, yes, I have been asked to weigh-in on things like that (US016).

However, the majority of workers interviewed had not been consulted on decarbonisation and were uncertain about if there were any plans or policies on this in their company or union (e.g. UK017; UK005; UK027; US019). For example, interviewees said:

No. Unfortunately not. I've raised it. We go to work with the current guidelines and letters of the law which dictates what we should and shouldn't do. Very, very, very stringent in that respect… But nobody ever comes up and says "well, you don't have a quality circle or box to tick on carbon reduction". Maybe you should because sometimes the best solutions to a problem come from the people who actually work on the ground or don't work in that environment at all because they're looking at it from new eyes and they're not biased against it but, as a general rule of thumb, it's hardly ever mentioned (UK017).

As far as I know, specifically on decarbonisation, no. Are there systems in the Ministry of Defence to get the views of families and individuals? Yes, because there are lots of continuous attitude surveys. Do they have questions about decarbonisation? I don't know, but they could (UK027).

Only one of the interviewees had been consulted on diversification (UK029) and just a few on Just Transition by their company or union. For example, US001 said,

[Just Transition] that's the one part of this conversation that, you know, while it makes perfect sense to me, that's not something I've seen or heard of anyone really talking about in the media or within the industry of how are we transitioning. Most of the folk I work with were talking about the technologies and what's enabling technologies we develop that will support next generation aircraft or whatever else. So probably [we need to be] just getting the word out more and having more candid conversations around how are we going to plan and this kind of Just Transition for those that will be affected (US001).

Some highlighted that these topics may be difficult to talk about at all, even currently:

I think it's largely taken for granted that the majority of us support moving to more sustainable ways of working. No-one's ever asked specifically about decarbonisation or Just Transition or diversifying defence. In fact, I think that diversifying defence is pretty much a taboo subject within defence simply because it puts us all out of a job (UK002).

…in the civil service as well as the military, if you don't want to upset your boss, because your boss is God and has the ability to make or break a career, so that means that people don't tend to push their passions quite so much (UK011).

Several of the workers interviewed had tried to make proposals, or seen others do so, that were not taken up. They were given the impression that such ideas were a distraction from their main job.

UK011, for example, spoke of a colleague who had done research into reusable plastics but there was no interest in the workplace for taking that forward and said that there were no formal systems for bringing these ideas forward. Others said,

> *I make suggestions routinely. Not just because it's decarbonisation but because it would actually save us money. Things like getting solar panels, it's an expensive upfront cost but it would yield a lot of dividends very quickly, especially with the amount of roof space that we have and spare ground space. We would put solar panels right there that no-one ever uses, so very minimal cost in the grand scheme of things. Does anyone listen? No, not really. They tend to complain that "we don't actually have enough capital upfront", even though there are plenty of grants available from the local councils and main government are trying to encourage this kind of thing (UK002).*

> *Do they listen to me? I think, not always in terms of my work. Yeah, I think, I think most of the time! I have wanted to progress…a green initiative… I wanted to enter us into a competition about it, to try and progress it a bit more but I don't think they were interested. We have a task to do and we have to achieve that task (UK009).*

Workers said that inclusion was important in order for the workforce to feel part of the process and, therefore, less resistant to the accompanying change. They also felt that they had a strong contribution to make in terms of knowing the reality of implementing policies on the ground, as UK011 and UK003 describe here:

> *So, I would say yeah, I'd love to be involved in it [developing these strategies] because I think I would like to bring a bit more realism from having the implementation side to say "okay, I understand where the aspiration is but actually if we make it a little bit more targeted in here we can …pick off the low hanging fruit and we can actually achieve some very good things here while we're still working on some of the other longer term areas that would be difficult to bring on board" (UK011).*

> *….those responsible for the decarbonisation of the department, as all departments are meant to be doing, actually are committed and are actually able to bring people along with them and they're only going to do that by actually involving them. Rather than doing things to them they should be actually involving them so that they actually feel part of that process as opposed to being affected by it…(UK003).*

The point was also made that efforts need to be made to include particular disadvantaged and marginalised social groups in these debates to achieve a Just Transition, as US017 discusses here:

> *I believe that the kind of democracy that we need, that will reflect the true will of all of America, you know, we have to fight racism. We have to eliminate the exclusion of so many people who then don't participate, because they don't matter. Why would they participate? So, I think it's about eliminating white supremacy, building democracy, building the institutions of democracy, and then we can get good public policy, like Just Transition (US017).*

A number of interviewees that were involved in the union felt that they needed to increase the power of the unions, work collectively, and be willing to use collective action in order to have influence on their companies and workplace.

For example, US012 stated:

> *With the company the only influence we have is the same influence we have for everything else which is kick rocks unless you can really make us feel pain (US012).*

Several of the interviewees highlighted the importance of workplace democracy for achieving a Just Transition, and how the discourses and values embedded in this concept could, in turn, push forward such democratic workplaces. UK017, for example, argued,

> *If we built the …infrastructure that would be required to move this [Just Transition] policy forward, it will at the same time create the political infrastructure that will promote workers' democracy on the job. So, I think they go together (UK017).*

Problems were also highlighted with having influence in decisions beyond the workplace, such as in the unions and in society, as exemplified in these excerpts:

> *…the money these guys are on are probably three times, four times the average, because they are skilled workers, skilled electricians, skilled engineers etc, so they are on mega bucks, so they are not wanting that gravy train to run out. So I think it's a bit self-interest, but …the defence guys were sympathetic to my motions, propositions to change the policy, but sympathy does not get things changed, because they were towing the party line… and if the Executive makes a decision to continue supporting Trident, my proposal was against the Executive, so the Executive says to the delegates that this is against the Executive, so it's a bit sort of Soviet in a way, that you going against the party line so to speak by voting against the Executive (UK020).*

> *…this sort of movement, it feels very weak because the power base is so skewed towards large companies so…you know, the arms fairs are absolutely paranoic about anybody entering it whose not on their side so to speak. I mean, I'm an ex-serviceman and normally that would be easy to apply and have a ticket. I've been refused every time 'cause they've noticed that I might say something …So I think these … breaching these, you know, closed rooms, closed minds and closed industries is very important but how to, how to, engage with them (UK019).*

Overall, then the workers expressed a desire to be involved in conversations about decarbonisation, diversification and Just Transition, but were mostly excluded or felt their influence was minimal unless supported by organisational or company leaders.

FOCUS GROUPS

INTERNATIONAL EXPERT DIALOGUE

This group spanned participants from defence companies, national government, academics, NGOs and trade unionists (see Appendix 3 for a list of members of this focus group). The key debates in the group were the extent of the defence sector's negative impact on the environment; the size of the sector and levels of employment; the value of diversification in relation to decarbonisation and Just Transition; the meaning and use of the term Just Transition; and barriers to a Just Transition of the defence sector

Regarding the defence sector's environmental impact, several expert members questioned the assumption that defence is more carbon intensive than other sectors. It was generally agreed,

however, that this debate might be a distraction as all industrial sectors would need to reduce their emissions to meet net zero targets. The size of the sector was also contentious, with some considering that it was a large employer, and others that it was too difficult to calculate, having unclear boundaries.

Unsurprisingly, given its make-up, the group was divided on the question of whether diversification was necessary in order to reduce the environmental impact of the defence sector. Those who were opposed to diversification argued that changing to civil production would not reduce GHG emissions significantly since civil was no less harmful. They also expressed their belief that defence is fundamentally necessary for national security and, therefore, the wellbeing of humanity. This means, they argued, that it cannot be safely reduced. For example, [ANONYMISED], Business Development Manager in Energy Transition at [ANONYMISED international defence company], while recognising that there is merit in diversification in the sense of having a mix of product and working styles, argued that:

> *I think this is a bit of a … philosophical assumption or starting point that defence is more carbon intensive than other sectors. I think perhaps just parking that for a moment and just taking a much wider view of sustainability which is sustaining a way of life that's built upon democracy, safety, freedom of speech etcetera. … I think it's really important that we remember that defence is about defending our way our life and we can't achieve what we want to … if, actually, we're not able to maintain, as democratic nations, where we have freedom of speech. For me that's what defence is about. Defence, not attack.*

Those who supported diversification raised the concern that there would not be enough funds to deal with climate change if society continues to invest so highly in military products. It was suggested that companies may be interested in diversifying their product line so as to be part of the climate solution not only by reducing their own emissions, but also by producing equipment that will help with decarbonization across the economy as a whole. Several of those that supported diversification argued that a shift in industrial policy was required, particularly in the US, where, it was claimed, a military-industrial policy dominated. It was argued that this needed to shift to an industrial policy that focused on the national security threat of climate change. For example, Sam Perlo-Freeman, Research Coordinator at Campaign Against the Arms Trade stated:

> *I believe that a large part of military spending in, not just the UK or the US, but in a lot of major countries, is not actually contributing to our real security needs; that it's not simply about defending democracy from attack. Too much of it is about making, or being prepared to make, military interventions as an attempt to solve political problems which have usually turned out disastrously over the last 20 years. …I think that the world would be a lot better off in less investment in military means of addressing such problems. Also, a lot of defence production … is not for defending themselves but for export. Our biggest customer is Saudi Arabia. Arms exported to Saudi Arabia are definitely not about defending democracy. I don't think the strongest advocates of defence exports would claim that Saudi Arabia is a democracy and given the use of them at the moment in Yemen, it's pretty horrific what the consequences of that are.*

The point was also made that defence was linked to colonialism. Erik Kojola, Just Transition researcher at Texas Christian University, particularly highlighted the Just Transition issues for

defence in terms of the extraction of resources, testing of weapons, and uranium being mined on indigenous lands with attendant health risks.

The question of resource constraints was also discussed, with some arguing that, if there was less spent on the military, there could be more spent on addressing the climate crisis. However, the point was made that it is not always a zero-sum total amount of spending. Yet, seeing security through a military lens was considered to crowd out other ways of thinking about security, particularly recognising the climate crisis as probably the most important security threat for all of humanity. Sam Mason, Policy Officer at the PCS union, for example, put forward this position in the following comment:

> *… if we consider the investments that are going into the defence sector side, broadly into nuclear weapons and Trident renewal, for example, and what is the basis for real human security, which is dealing with the climate challenge, which we've got such a short time frame now to really make progress …if you look at the Integrated Strategic Review and how Boris Johnson has positioned global Britain in the world and it's very much an imperialist and colonialist position that it's going to be back with greater investments in the defence sector and in arms and militarisation. The biggest increase in the defence budget for 70 years. Increase in nuclear war heads. I think that's a threat for all of us, and that's a threat for global security as well.*

Most of the group agreed that decarbonisation and the wider environmental and social aspects of Just Transition would require government incentivisation and regulation. Focussing on the measures that could take place, [ANONYMISED], Business Development Manager at [ANONYMISED, international defence company] stated that,

> *…in the UK, certainly, the client for all defence programmes is the Government, so you can put commercial requirements for commercial constraints in place to – not just to incentivise but to mandate that the industry decarbonise. You can also put commercial constraints in place to dictate the extent to which they can subcontract and the environmental measures and the scrutiny that they need …[along] their supply chains. You can put whatever measures in place …and they can be solidified in that contract.*

The importance of ensuring good accounting and monitoring of the defence sector as the basis for this was also emphasised, so that there could be checks against standards. For example, [ANONYMISED], Chief Technologist at [ANONYMISED international defence company] argued,

> *…you need processes that allow us to metricate that and to measure it so that, when you think about supply chains that can have thousands of companies in the supply chain, how do we measure and compare like for like so that we're at a coherent set of standards? I think that needs thinking about as well and, at the moment, it feels as though that metrication and regulation are some of the challenges that I think we need to get our heads around.*

With regard to Just Transition, the interviews carried out for this project indicated that workers were not included in dialogues about decarbonisation, diversification or Just Transition. Therefore, this expert group were asked about why they thought this might be. Several in the group said that

some companies and organisations might avoid using the specific term, although would address the issues that it embodies (for example, Brendan Donegan, International Climate Finance Just Transition Lead, UK Government Dept Business, Enterprise and Industrial Strategy). One of the expert focus group members said that this was not a conversation that is currently taking place because job losses are not foreseen as a result of decarbonisation, as [ANONYMISED], Business Development Manager at [ANONYMISED, international defence company] comments here:

> *…certainly, the part of the defence sector that I work in, I don't think we'd have those sorts of discussions because I don't think that we would see that decarbonisation would lead to job loss. It would just be that we would be working on different projects. …I think we would just expect the sorts of project, the sorts of equipment and technologies that we're working on, to change over time and to some extent, our skill sets would evolve, but it would be an evolution rather than a mass job loss.*

However, [ANONYMISED], Chief Technologist at [ANONYMISED international defence company], explained that their company did have a process for engaging workers around decarbonisation:

> *…we have an engagement process with the workforce around ideas for net zero and decarbonisation from small scale things, recycling, right the way up to large scale electric products …through to new ways of doing things in the defence environment, that would be low carbon footprint. We're certainly actively engaging the workforces … everybody's on this agenda and everyone's embracing it. It's a real attractor for the next generation coming through in terms of jobs and skills and it's certainly galvanised the workforce because it's the right thing to do. We see it as very positive.*

Even so, setting this in the broader context of workers in the UK, Anna Markova, Policy Lead on Industry and Climate Change at the Trade Union Congress (TUC), described the results of polling carried out by the TUC last year (TUC, 2022). Two in three of the workers polled (65%) said it is important that their employer is actively helping to tackle climate change. But only one in three (33%) said that their employer has put measures in place in the workplace to help tackle climate change. Only one in eight of those surveyed had been consulted by their employer or had a chance to voice their ideas about decarbonisation. Anna remarked that, despite this, workers have come up with their own plans when the employer was reluctant to engage with the topic. She gave an example of recent action at Rolls Royce where union representatives across three UK sites, together with local environmental and community activists, developed their own transition plans for sustainable and green manufacturing, and lifted threats of closure (see also Minio-Paluello, 2021).

The TUC representative also made the point that workers can have an expanded view of JT, beyond a 'jobs focus'. Workers not only focus on their own jobs, but sometimes take into consideration the wider issues pertaining to their work. The case of the AUKUS deal was discussed, a trilateral security pact between Australia, the United Kingdom and the United States. This was announced in 2021, where the US and the UK will help Australia to acquire nuclear-powered submarines and cooperate on cyber capabilities and artificial intelligence, among other programmes. The Maritime Union of Australia was totally opposed to the deal even though they could gain out of it in terms of jobs. They were opposed because they did not agree that is where public investment should be going. Finally, the point was made by the union members of the expert group that a great challenge for Just Transition is the drive to reduce the costs of manufacturing, even for renewables, so that

companies need to compete to become the cheapest supplier and, therefore, move jobs internationally to reduce the costs of labour, minimising the chances of a Just Transition.

INTERNATIONAL TRADE UNION DIALOGUE

See Appendix 4 for a list of members of this focus group. The points made in this group reflected those made by the individual workers in the interviews. In particular it was noted that there are worker concerns regarding (1) pay, which is usually better in the defence sector than in the 'green' sector or other manufacturing work; (2) attachment to jobs, with workers being very proud of helping with the defence of the country (although they would be proud of carrying out any work that was skilled, interesting and of social value); (3) the intense quality assurance requirements for special products built for the military, as opposed to civil (4) asking workers to take on trust that they will get a good job at the end of the process.

Many of these points are captured in this excerpt from John Harrity, a representative from Labor for Sustainability, who said,

> *The pay is usually better in the defence sector because it's more highly skilled work and it has its own cycle to it. We …build for commercial and for military aviation and, if the mix is too heavy one way or the other, if military goes down, then all of a sudden you're having all sorts of layoffs or vice versa. …I guess the members take a certain pride in helping with the defence of the country but, on the other hand, I think they just want to build good products. We did a workshop on conversion at one of our locals and we said that maybe they won't be building the same stuff and one of the members said, "Well, we can build anything. Just ask us what you need and we can do it"… I think the main challenge comes down to that people don't really want to take a big hit in terms of their wages and benefits and their future security.*

Comments included that, if you reduce the amount of arms spending, you will reduce the industries impact on the environment but that would not make as much impact as seeking to move investment and work or jobs in the arms industry into producing decent climate friendly jobs. This might include transferring people from the defence industry into developing and building pro-climate technologies and other environmental jobs, including clean ups. The ITUC representatives made the point that, with decarbonisation, there would be reduced global conflict, since oil has been a major source of military conflict. This would, in turn, automatically drive diversification as there would be less need for defence operations.

The group went on to discuss the difficultly in deciding what constitutes the defence sector and that pay can also be low in the defence sector, depending on the worker's job role – not all are engineers, some are cleaners or have other less well-paid jobs. Some emphasised the need for a strong overall national industrial policy and a plan for economic development so that the workers are not transitioning from making jet engines to toasters. It was also felt that much more transparency was necessary for understanding the climate impact of this sector. It is very difficult to regulate without transparency.

One of the key drivers for decarbonisation and a Just Transition was seen to be the international agreements. As Bert De Wel, Climate Policy Officer for the International Trade Union Confederation stated:

> *The drivers are the international agreements that are signed between governments - the Paris Agreement; the infrastructure that's set up after the Paris Agreement, with nationally determined contributions - these are the national climate plans where the governments committed to the ratchet mechanism and step up their ambition every five years. That's the main driver. In the Paris Agreement, governments committed to Just Transition and made a direct link with decent work and quality jobs … after the last COP in Glasgow, most governments became aware that they have to pick this up …*

A key message from the group was that investment is needed and social dialogue is important. Unions need to make sure that their members are involved in Just Transition plans and coming up with those plans. Training and upskilling are crucial so that workers can continue to have quality jobs (e.g. Rick Graham, Researcher, Aerospace, Engineering and Manufacturing, Unite the Union). For example, participants said:

> *Unions need to make sure that their members are involved in those Just Transition plans, in coming up with those plans …if you give the job [of making these plans] to the workers to do, they will not come up with crap jobs as an alternative because they have an absolute incentive not to (Owen Tudor, Deputy General Secretary International Trade Union Confederation).*

> *So I think these are some things we have to do as trade unions, but we have to do a lot of work within our own memberships as well. PCS has a very long track record on this agenda but, as I like to say to colleagues, we have to be careful we don't live in our own bubbles with this. If we went out to our whole membership tomorrow, I wonder how many would know what our policies are and the various campaigns we're supporting. …it's about getting our reps and the rank and file having these discussions (Sam Mason, Policy Officer, PCS Union).*

> *I think, in terms of the private [defence] sector and decarbonisation, the first requirement is much more transparency. Till this moment, the climate impact of this sector is pretty much unknown. They continue to be under the radar. How are you going to regulate, stimulate, deal with this sector if they avoid being transparent? … That would be the first thing. The second thing …climate policy is, in a sense, industrial policy and we need everybody on the table to discuss this. Then it's a question of budgets and fiscal policies and tax policies to pay for the investments that are needed, that are linked to your industrial policies and this [defence] sector has to pay up for this too because there are huge profits there. The fourth factor is a level playing field because there is always this race to the bottom, delocalisation, this threat, and you have to close the back doors in order to make industrial policy effective and not just shift the impact to other regions (Bert De Wel, Climate Policy Officer for the International Trade Union Confederation).*

Referring to the Lucas Plan for diversification in the 1970s, Owen Tudor, went on to discuss the importance of workplace democracy, in general, stating,

> *…from a union perspective, one of the other lessons of Lucas, obviously, is that it was actually somewhat about workers' control as well. I mean, the movement that it came out of, the movement that it generated, is about giving workers generally more of a say over what goes on with the work that they deliver. ….we're [trade unions are] often characterised as an organisation which simply monitors the price, or negotiates over, the price of handing over our labour, whereas all of the traditions of working class apprenticeships and things like that in skilled jobs was that you were actually not just giving over some labour and skill …for which you wanted to be decently rewarded, you actually wanted to have a role in determining what was done with that labour and those skills.*

The group also talked about how the term 'Just Transition' is not always used as there can be preconceptions about it. It was suggested that it might be more useful to talk about the concept of human rights and that environmental social movements tend to forget that labour rights are human rights. The point was made during the discussion that many in the environmental movement do not understand social dialogue and the need for collective bargaining and why it is important.

The importance of the global supply chain, offshoring and lack of protective government policies were important issues for this group. Just Transition was not chiming well with some workers, as they could see that jobs are being lost, as Adam Kaszynski, Local 201 leader of the Industrial Division of the Communications Workers of America (IUE-CWA) discussed, stating:

> *…this [defence products] is, basically, the last stuff that we're making around here. Because of NAFTA, because of free trade and because of the lack of US industrial policy, we're lucky to have anything left. So the idea that we can go ahead and transition and be making something else when everything is going out the door for the past 30 years does not sit well with manufacturing workers. I mean, we know it's a lie. So, I think that trade agreements have to be addressed.*

The ITUC representatives discussed how they have been working at making sure that global supply chains are run in a way which doesn't undermine workers' basic rights. They pointed to the need for legislative controls over how corporations run their supply chains and the need for them to be compliant with ILO standards. They are working to ensure that corporations which are commissioning along supply chains take responsibility for the labour standards and treatment of workers in those supply chains. It was argued that the global supply chain is intentionally created to limit the responsibility of the employer. It can disguise that they are in an employment relationship with the consequences that there are greater risks to the employee. Unions are trying to re-establish that employer responsibility for the consequences of production. They are insisting on creating transparency throughout the supply chain and ensuring there are formalized relations. That is translating into mandatory due diligence as a way of insisting that companies do take responsibility across their supply chain and do risk assessments, mapping not only security risks but also the conditions of workers.

DISCUSSION AND CONCLUSION

Compared to many other sectors, the global defence sector appears to be at an earlier stage in transitioning to sustainability. With the requirement to prioritise safety, reliability, and performance, and in a context where it has not been expected to be as transparent as other sectors, it has, perhaps, not been as ready to consider environmental issues until relatively recently. In addition, some of its infrastructure and operations may be more difficult to decarbonise than in many other sectors. Furthermore, because R&D and deployment cycles can span decades, it may be a long time before changes will be seen. However, in the face of public concern and increased pressure from investors and customers, this situation is now rapidly changing. Environmental issues, particularly climate change, are now becoming increasingly important considerations for government defence departments and defence companies. The views of workers in this sector are important for understanding how to make the necessary transition to sustainability in an effective and fair way.

The study indicates the range of opinion and attention to nuance and complexity among an occupationally and geographically diverse group of defence sector workers in the US and UK. Although it is a small study and we cannot generalise from the sample, the project provides insights into the thinking of these workers on decarbonisation, diversification and Just Transition in relation to the defence sector. Overall, their ideas reflect many of the debates in the literature and wider society around the meaning and implications of these concepts.

With regard to the question of how Just Transition is being understood, defined and contested by workers in the defence sector, there were a range of views. Overall, though most had not heard of the term before, when it was explained to them, most of the interviewees were supportive. However, there were concerns about how new sustainable jobs would be presented to workers, their perceived equivalency and the retraining programmes on offer. There were a range of interpretations and positions on Just Transition, from 'job focused' to 'environment focused' to 'society focused'. This impacted on the policies that the interview participants were prepared to support. Some of those interviewed considered Just Transition primarily in terms of specific policies designed to reduce environmental impact without reducing overall military production. Others included reducing defence production and operations and replacing with green jobs or other civil, humanitarian or socially useful jobs in their idea of Just Transition.

With regard to decarbonisation, most of the workers interviewed understood this term in advance of the study and all were in support, despite many reservations about how it might be carried out. Change was predominately seen in technical terms, though there was also recognition of the cultural, behavioural, political and economic contexts that would also need to transform.

There was very little knowledge of the term 'diversification' among those interviewed in advance of taking part in the study. Once explained, there were different positions on the value of limiting this process solely to widening the products developed by the defence sector versus reducing defence sector operations and using the funds for other purposes. There was a minority view, but strongly held, that there needs to be more emphasis on 'human security', as opposed to 'national security'. In particular, it was argued that the climate crisis threatened to create an enormous number of problems that human and financial resources will be needed for. There was an equally strongly held view among some participants that the defence sector is absolutely necessary for the protection of citizens and the prevention of attacks from foreign powers. Some felt there was an inherent human nature that drives conflict such that showing power through weaponry would always be necessary. These participants strongly endorsed the social value of the defence sector.

The workers interviewed were clearly very concerned about climate change and other environmental issues. This might be expected from a self-selecting group of interviewees, so we cannot generalise that this might be the views of the workforce, as a whole. However, the study does suggest that even a very environmentally motivated group of defence sector workers are unaware of some of the discussions that related to their sector around diversification and Just Transition. It is also evident that some would not prioritise sustainability at any cost, putting operational adequacy above this. The workers did not tend to see transitioning to sustainability as a threat to their jobs although there were concerns about job losses in relation to other contemporary issues, such as automation and outsourcing. Some had uncomfortable feelings about working in defence because of the associated environmental and social harms and welcomed a transition to other kinds of production.

The experts and union leader dialogues debated whether defence is more carbon intensive than other sectors though agreed that this might be a distraction as all sectors would need to reduce their emissions to meet net zero targets. Those who supported diversification raised the concern that there would not be enough funds to deal with climate change if society continues to invest so highly in military products. They emphasised that defence was linked to colonialism, for example, in terms of the extraction of resources, testing of weapons and the US bases around the world. It was considered that reducing the use of oil could automatically drive diversification as there would be less need for defence operations.

Most of the 'expert' focus group agreed that decarbonisation and the wider Just Transition would require government incentivisation and regulation. Some argued that this would require greater accountability and monitoring of the defence sector as the basis for this, so that there can be checks against standards. Regarding the concept of Just Transition, it was proposed that some companies and organisations might avoid using the specific term, although would address the issues that it embraced. In some cases, it may be that this is not a conversation that is currently taking place because job losses are not foreseen to be a result of decarbonisation.

The trade union representatives said that there were worker concerns regarding levels of pay when transitioning jobs; dignity and respect for skills; quality assurance requirements for special products built for the military; and the process of change, where workers need to see that the transition will be just. They argued that it is evident that workers not only focus on their own jobs but also take into consideration the wider issues pertaining to their work. A key message from the trade union representatives was that investment is needed and social dialogue is important. Training is also crucial for upskilling and uptake of new jobs. It was also felt that working towards a Just Transition could build on and enhance greater workplace democracy.

The importance of the global supply chain, offshoring and lack of protective government policies were also important issues for the trade union dialogue group. Just Transition was not chiming well with some workers as they could see that jobs are being lost. Representatives discussed how they have been working at making sure that global supply chains are run in a way which doesn't undermine workers' basic rights. They are making sure to connect those in different countries and finding other ways to ensure that workers across the supply chain have a voice.

The project focused on a wide scope, including the question of diversification alongside the, more obvious, decarbonisation aspects of Just Transition. As discussed earlier, this was to enable a broader debate around a range of environmental issues and wider societal questions regarding not only how we should produce, but what we should produce. This seems to be necessary, given that we live on a planet with environmental limits and where, to date, decoupling environmental growth

from material footprint has seen limited success, even under very optimistic conditions (Hickel and Kallis, 2020; Vadén et al., 2020). While absolute decoupling of GDP from emissions can be achieved by replacing fossil fuels with renewable energy, this will not be done quickly enough to limit warming to 1.5°C if the economy continues to grow at the usual rates (Hickel, 2021b). While the defence sector is not unique in perhaps needing to consider scaling back production, just as it is not unique in needing to decarbonise, the social value of defence still needs to be part of the conversation. The workers interviewed clearly had different positions on this, some seeing the defence sector as vital for freedom, democracy and security, and others considering it to be socially and environmentally harmful. We cannot say how prevalent these views are in the workforce as a whole, but they may not be as marginal as might be assumed, given that they are evident even in this small sample, including among current defence sector workers.

The need for transparency, funding and regulation are key themes emerging from the workers' perspectives in this research. However, the question of inclusion is probably the strongest message from the study. These workers had important and profound insights into how this sector works and what is needed to help it to transition to sustainability. Yet, despite their evident interest in sustainability, unless it was part of their job, they had rarely been consulted on this and their attempts to contribute have often been ignored. There are many participatory structures that could be set up to facilitate this, including, for example, Workers on Boards (WOBs). Obviously, this would need to happen in a genuinely democratic way with accountability structures set up. O'Shea (2017) emphasises that WOBs should be members of a trade union, so that they are not just used as part of a public relations exercise. It is also important that they are listened to; that there is more than one worker on each board, so they can support each other; and that they are provided with adequate training and resources.

To the greatest extent possible, the workers own words have made up the bulk of this report because we wanted to show how intelligent, articulate, moral and caring these workers are. Not to make use of these qualities in developing sustainability policies seems wasteful and unwise. Just Transition policies and plans in the US and UK defence sector need to be developed with the full inclusion of these workers if they are to be appropriate and effective.

KEY RECOMMENDATIONS

Recommendations based on the worker interviews can only be tentative, given the small sample size of the participant cohort. However, putting this data in the context of the other aspects of the study, including the advisory committee inputs, literature review, document analysis, and focus group dialogues with relevant international experts and worker leaders, we can more confidently offer the following recommendations for consideration:

FOR COMPANIES:

- Set up structures and programmes so as to include workers at all levels in decarbonisation and diversification planning and implementation
- Create contractual clauses for companies along your global supply chain to comply with, or improve upon, US and UK environmental and employment standards
- Make your GHG emissions and other environmental impact data publicly available
- Work with suppliers to estimate upstream emissions and environmental impacts for each product and identify opportunities for switching to more environmentally benign inputs

- Understand the downstream emissions of customers for each of your products and solutions

FOR UNIONS:

- Create more opportunities for education and dialogue around decarbonization, diversification and Just Transition with rank-and-file defence workers
- Increase work on building solidarity with, and including the perspectives of, workers in Eastern Europe and the Global South who are supplying the defence sector
- Prioritise unionising the 'green' sector and improving job security and pay in this sector so that these jobs begin to become more attractive to workers
- Press for company forward planning, with consultation from rank-and-file workers, to ensure a Just Transition for their workforce

FOR GOVERNMENTS:

- Enact legislation to include defence sector greenhouse gas emissions in national carbon accounting
- Supply significant ring-fenced funding to enable the defence sector to decarbonise and address its other environmental issues, including the retraining of workers
- Create contractual obligations for private companies that supply the MoD/DoD to work to high environmental standards and reduced greenhouse gases
- Consider transitioning security policies and budget priorities to support a 'human security' approach, addressing the global and national poverty, inequality, health and environmental crises and investing in the jobs that would accompany this
- Set up a UK-wide Just Transition Commission, and US-wide equivalent, to ensure that workers' voice is central to guiding net zero and other environmental policies

FOR NGOS:

- Link up with trade unions on relevant shared interests around achieving a Just Transition
- Consider focussing on the defence sector as a possible contributor to the problems and solutions you are working on

FOR WORKERS:

- Propose decarbonisation, diversification and Just Transition education and dialogue in your company and union
- Demand greater consultation and inclusion in company decision-making on these topics

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APPENDICES

1. Demographic data for research participant

Sample by age category

Age	UK	US
18-30	3	3
31-50	12	11
51-66	11	10
67+	2	4
Not known	2	0
Total	30	28

Sample by ethnic grouping

Ethnic grouping	UK	US
White national	25	23
White international	2	1
BIPOC/BAME national	2	2
BIPOC/BAME international	0	2
Not known	1	0
Total	30	28

Sample by gender

Gender	UK	US
Male	25	22
Female	5	6
Non-binary	0	0
Other	0	0
Not known	0	0
Total	30	28

Sample by occupational level

Level	UK	US
Senior managerial	4	2
Managerial	9	3
Non-managerial	17	17
Not known	0	5
Total	30	28

Sample by sector

Main occupational area	UK	US
Civil service	12	0
Military service	3 (2 ex)	8 (6 ex)
Defence manufacturing	8	12
Defence other	7	7
Not known	0	1
Total	30	28

Sample by how accessed

	UK	US
Trade unions	11	9
Defence companies	8	1
Community groups	2	5
Online groups	1	1
Personal contacts	2	6
Snowball	6	6
Total	30	28

Sample by residential location

US cities and states	UK cities and counties
Boerne, Texas	Wiltshire
Portland, Oregon (3)	Rhondda Cynon Taf
Arizona	Dorset
Los Angeles (3)	Manchester (2)
East Hartford	Norfolk
Alabama (2)	Glasgow
New Mexico	Wiltshire (3)
California (3)	Hampshire (2)
Alabama	Merseyside
Connecticut (2)	Bristol (3)
Massachusetts (2)	Highlands
Dallas (2)	Somerset (2)
Indiana (2)	Essex
Currently outside US	North Somerset
Detroit	Suffolk
New York	London (2)
Seattle	Lincolnshire
Michigan	Warwick
	Birmingham
	Fife
	North Yorkshire

2. Recruitment text

Do you work, or have you worked, in the defence sector or for a company that supplies the defence sector? If so, we would like to interview you about your opinions on transitioning the defence sector (decarbonising and/or diversifying) to reduce carbon emissions. This is part of an international research project on sustainable transitions https://info.uwe.ac.uk/news/uwenews/news.aspx?id=4197

The interviews are confidential, everything is anonymised and you are not expected to breach any company confidentiality. You can be interviewed online or at a convenient public location. If you think you might be willing to be interviewed, please contact karen.bell@uwe.ac.uk, at your earliest convenience to find out more.

3. **Focus group 1 participants: International Expert Dialogue on Decarbonisation and Diversification of the Defence Sector – 17th January 2022**

Name	Position	Organisation
Samantha Mason	Policy Officer	Public and Commercial Services Union (PCS)
Sam Perlo-Freeman	Research Coordinator	Campaign Against the Arms Trade
Brendan Donegan	International Climate Dept. Just Transition Lead	UK Government Dept. Business Energy and Industrial Strategy
Anna Markova	Policy Lead on Industry and Climate Change	UK Trades Union Congress
ANONYMISED	Chief Technologist	ANONYMISED international defence company
Erik Kojola	Assistant Professor Sociology	Texas Christian University
ANONYMISED	Business Development Manager, Energy Transition	ANONYMISED international defence company
John Harrity	Board member	Labor for Sustainability
Miriam Pemberton	Associate Fellow	Institute for Policy Studies

4. **Focus group 2 participants: International Trade Union Dialogue on Just Transition of the Defence Sector – 20th January 2022**

Name	**Position**	**Organisation**
Samantha Mason	Policy Officer	Public and Commercial Services Union (PCS) - UK
Bert De Wel	Climate Policy Officer	ITUC
Jeroen Beirnaert	Peace and Disarmament Lead	ITUC
Rick Graham	Researcher - Aerospace & Shipbuilding; Engineering & Manufacturing	Unite Union - UK
John Harrity	Board member	Labor for Sustainability - US
Adam Kaszynski	Local 201 leader, Industrial Division of CWA, IUE-CWA	Communications Workers of America - US
Owen Tudor	Deputy General Secretary ITUC	ITUC
Larry Brown	President of the Washington State Labor Council	AFL-CIO - US