## Global Arms Production and Climate Change: Evaluating the Environmental Consequences of the Defense Industry

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### Abstract

*The global defense industry, a colossal economic and political entity, is a significant yet often overlooked contributor to climate change. This article critically evaluates the environmental consequences of arms production and military operations, from carbon emissions and resource depletion to toxic waste and ecosystem degradation. By applying an analytical framework grounded in structural violence and ecological politics, the study dissects the systemic factors that enable the defense sector's environmental unaccountability. It reveals that the industry's massive carbon footprint, comparable to major industrial nations, is driven by a cycle of resource consumption and is largely shielded from international climate regulation. The paper argues for a fundamental reframing of security paradigms to integrate environmental accountability into defense strategies, thereby disrupting a self-perpetuating feedback loop where climate instability fuels militarization, which in turn exacerbates environmental degradation.*

*Keywords: Defense Industry, Arms Production, Climate Change, Environmental Impact, Carbon Emissions, Sustainability*

### Introduction

Arms production is an essential component of national security strategies across the globe, yet its substantial environmental footprint is frequently neglected in climate discourse. The defense industry not only perpetuates geopolitical instability but also intensifies global warming through high-energy consumption, toxic waste, and greenhouse gas (GHG) emissions (Liu et al., 2025). The pursuit of "national security" through traditional militaristic means has created a critical, yet overlooked, environmental threat. The sheer scale of the global arms trade, which reached a record $2.7 trillion in 2024, reveals a powerful economic and political entity that operates with a high degree of insulation from the same market and regulatory pressures that govern civilian industries (SIPRI, 2025).

This article critically evaluates the environmental consequences of global arms production and military activities. Recent research indicates that military emissions alone account for a significant percentage of the world's total carbon output, rivaling large industrial sectors. Unlike civilian industries, the defense sector operates under a veil of secrecy and prioritizes tactical advantage over environmental sustainability, a stance that is enabled by national security rhetoric (International Scientists Coalition, 2025). This paper will dissect the multifaceted environmental burdens of the defense industry, exploring how systemic, policy, and geopolitical factors obscure and perpetuate this impact. The central thesis is that the industry's significant environmental footprint, driven by a cycle of resource consumption, high emissions, and regulatory

opacity, is a critical and under-addressed challenge to global climate mitigation, necessitating a reframing of security paradigms. The analysis will provide a theoretical framework to link militarism and climate change, followed by an examination of empirical data and a discussion of potential pathways to harmonize defense imperatives with climate resilience.

## Theoretical Framework: Intersecting Militarism, Security, and Ecological Politics

A comprehensive understanding of the defense industry's environmental impact requires a theoretical framework that connects security studies with ecological politics. The concepts of structural violence, ecological politics, and "carbon militarism" provide a foundational lens for this analysis, illuminating how militarism and environmental degradation are inextricably intertwined.

### Structural Violence and the Security Paradigm

The concept of structural violence, provides a foundational perspective for this analysis. Structural violence manifests through institutional practices that prioritize power and security over social and ecological well-being (Galtung, 1969). This perspective helps to explain how the defense industry perpetuates environmental harm by prioritizing arms production and military readiness at the expense of climate stability. It is not about direct conflict, but about how the very structure of the military-industrial complex and its associated policies harm individuals and the environment by siphoning resources away from social and ecological well-being, thereby creating an ethical and moral issue beyond a simple technical one.

### Ecological Politics and the Climate-Conflict Feedback Loop

Ecological politics theory further emphasizes the inseparability of environmental and security issues. The defense sector's resource-intensive nature and emissions exacerbate climate vulnerabilities, thereby intensifying conflicts over scarce resources such as water and arable land. The relationship between militarism and environmental degradation is not merely a one-way street, but a complex and dangerous feedback loop. Climate-induced environmental scarcity can lead to increased competition and conflict over resources, which in turn drives increased militarization to secure those resources. This increased militarization, however, amplifies greenhouse gas emissions and resource depletion, thereby accelerating climate change and completing a self-perpetuating, non-linear cycle of instability. The security solutions of today become the environmental problems of tomorrow, intensifying the very security threats they were meant to address. The concept of "carbon militarism" further conceptualizes defense activities as major contributors to carbon emissions, necessitating a reframing of security paradigms to incorporate ecological sustainability (Saunders, 2018). This analytical lens moves beyond a general critique to specifically name the phenomenon of defense activities being a major contributor to carbon emissions. This provides the specific vocabulary needed to integrate the theoretical framework with the empirical data presented later in this paper. This framework guides the analytical evaluation of defense-related environmental impacts, highlighting the need for integrated climate-security strategies that transcend traditional, militaristic notions of security.

### The Environmental Consequences of the Defense Industry

The environmental footprint of the global defense industry is multifaceted, encompassing direct carbon emissions, resource depletion, the generation of

toxic waste, and extensive land use. The scale of these impacts is significant but has historically been obscured by a lack of transparency and regulatory oversight (Vogler, 2024).

**Carbon Emissions and Energy Consumption**

Military activities are profoundly energy-intensive, involving the manufacturing, maintenance, and deployment of a vast array of equipment such as tanks, aircraft, and naval vessels. The sheer scale of this energy consumption makes the defense sector a formidable, and often uncounted, source of greenhouse gas emissions. Recent estimates indicate that global military emissions may constitute 5.5% of worldwide carbon dioxide emissions. The data suggests that if the world's militaries were a single nation, they would collectively rank as the fourth-highest carbon emitter, a figure comparable to the carbon output of some of the world's largest industrial sectors.

The sources of these emissions are diverse and span the entire life-cycle of military hardware. The manufacturing processes for arms production are notoriously fossil fuel-powered, involving the production of heavy metals and other energy-intensive materials that contribute significantly to atmospheric pollution (Security in Context, 2025). Once deployed, the operational activities of a military force are a major source of emissions. For example, aviation fuel use in military aircraft is among the largest single sources of defense-based greenhouse gases, with jet engines burning high quantities of fossil fuels during training, transport, and combat operations (Stop Fuelling War, 2025). The U.S. military's use of jet fuel alone accounts for 55% of its total energy consumption (At the U., 2023). The logistics and supply chains that support a global military presence-from troop transport to supply convoys-are also massive contributors to the carbon footprint (Scientists for Global Responsibility, 2022).

The quantitative data on defense emissions underscore the significant yet under acknowledged role of the arms industry in the climate crisis. For instance, the U.S. military, the largest global emitter among militaries, releases approximately 59 million metric tons of CO2 annually, a figure that exceeds the emissions of some entire countries like Portugal or Sweden. This figure, however, may be conservative, as many allied nations and private contractors also contribute substantial emissions, which are often not included in national reporting. The lack of standardized, mandatory reporting creates a fundamental data gap, making accurate assessments virtually impossible and hindering effective policy. To fully grasp the scope of the problem, the environmental footprint must be assessed across the entire defense supply chain, from the mining of strategic minerals to the factories producing weapons systems. The table below illustrates the scale of this problem by synthesizing available data on the emissions of major militaries and their contractors.

**Table 1: Estimated Annual Carbon Emissions of Major National Militaries and Arms Manufacturers (2020-2024)**

| Entity | Estimated Annual CO2 Emissions (Millions of Metric Tons) | Primary Sources |
|---|---|---|
| U.S. Military | 59.0 | Operational fuel use, infrastructure, logistics |
| China's Military | ~50.0 (est.) | Naval, air, and ground forces, manufacturing |
| Russia's Military | ~30.0 (est.) | Operational activities, a legacy of Soviet infrastructure |
| U.S. Defense Contractors | ~10.0-15.0 (est.) | Manufacturing, supply chain logistics |
| NATO Militaries (Excl. U.S.) | ~45.0 (est.) | Joint operations, training, logistics |

Note: Emissions data for militaries and defense contractors are often not publicly disclosed and are derived from various estimates by independent research organizations and think tanks. Figures are approximate.

**Resource Depletion, Land Use, and Biodiversity Degradation**

Beyond greenhouse gases, the defense sector's demand for raw materials leads to resource depletion and ecosystem disruption. The lifecycle of arms, from extraction to disposal, is environmentally burdensome. This includes not only the consumption of fossil fuels but also the intensive use of strategic metals, rare earth elements, and other materials crucial for modern military technology. The mining and processing of these materials have significant impacts on local ecosystems, leading to soil erosion, water contamination, and habitat loss (ISI Indonesia, 2024).

The defense sector requires vast expanses of land for bases, training ranges, and test sites. The United States Department of Defense, for example, is one of the largest landholders in the world. These large military bases and test ranges often result in habitat destruction and biodiversity loss. The constant disturbance from training activities, combined with the presence of pollutants and hazardous waste, can permanently alter landscapes and disrupt delicate ecosystems (Environment and Society Portal, 2025). While some scholars argue that the exclusion of human activity from military lands can create "de facto nature reserves" that provide sanctuary for species, others contend that this is a form of "green washing" that masks the severe environmental damage caused by military operations. This "khaki conservation" is often used as a rhetorical tool to justify military occupation of land and distract from documented environmental harms. The long-term ecological consequences of this extensive land use, from the destruction of forests and wetlands to the permanent alteration of landscapes, are profound and contribute to a broader pattern of environmental degradation.

**Toxic Contamination and Hazardous Waste**

The legacy of arms production and warfare is one of widespread toxic contamination. Munitions production involves toxic chemicals that can pollute water bodies and soils, with long-term consequences for surrounding communities and ecosystems (United Nations, 2025). The disposal of obsolete weapons and munitions creates hazardous waste, which is often inadequately managed (Nature, 2025). Explosive remnants of war (ERW) and unexploded

ordnance (UXO) can leach toxic substances like lead, mercury, and depleted uranium into the soil and groundwater for decades, posing a serious threat to human health for generations. For example, studies show that depleted uranium, a common component of military munitions, can migrate from soil into groundwater and the food chain over time (Health.mil, 2024). The cost of this environmental degradation has yet to be incorporated into defense accounting frameworks, representing a significant externalized cost to society and the planet (The Military and Climate Change, 2020).

A more recent but equally concerning issue is the widespread contamination of military bases with per- and polyfluoroalkyl substances (PFAS), known as "forever chemicals." These chemicals, used in firefighting foam, have contaminated the soil and water supplies at an estimated 80% of U.S. military bases. With at least 700 bases confirmed as sources of contamination, the issue has led to health problems among military personnel and surrounding civilian communities, with studies linking exposure to health issues like cancer and liver damage (National Injury Advocates, 2025). This contamination is a prime example of "toxic militarism," where military operations disproportionately affect vulnerable populations and ecosystems (ResearchGate, 2015).

## Policy Gaps and the Geopolitics of Environmental Inaction

The systemic reasons for the defense sector's lack of environmental accountability are rooted in policy gaps and the unique geopolitical position of the military-industrial complex. The opaque nature of military expenditures and activities limits regulatory oversight and public accountability on environmental impacts (Lamin Kamara, 2025). This opacity is enabled by national security rhetoric, which has historically sidelined environmental considerations, even as climate change poses a growing risk multiplier for global conflicts (United Nations, 2025).

## The Exemption from International Climate Agreements

A persistent policy gap exists because few international agreements explicitly regulate military emissions (SIPRI, 2017). Under the United Nations Framework Convention on Climate Change (UNFCCC), military emissions were granted an exemption, allowing nations to voluntarily report these figures, but without mandatory requirements. This exemption is a major structural reason for the problem, as it effectively removes a significant source of global carbon emissions from the most important international climate accountability framework (Scientists for Global Responsibility, 2022). The defense sector, unlike civilian industries, is not subject to the same emissions targets or regulatory pressures, a situation compounded by the complex web of private defense contractors who operate with even less public scrutiny (Security in Context, 2025).

## The Military-Industrial Complex and Strategic Greenwashing

The military-industrial complex is a powerful and symbiotic relationship between armed forces and the private defense industry that perpetuates a high-carbon status quo. The defense industry thrives on insecurity and perceptions of it, and climate change, as a "threat multiplier," offers new business opportunities in a world of increasing instability and conflict. This symbiotic relationship works to maintain high levels of defense spending and arms production, a cycle that is inherently resource-intensive and environmentally damaging. The lack of public data and the veil of national security make it difficult for civil society organizations and researchers to hold this powerful

sector accountable. The argument is that the pursuit of security through military means creates a self-perpetuating system that resists any and all attempts at climate mitigation or environmental regulation.

Despite these realities, some defense entities are beginning to recognize environmental responsibilities, investing in green technologies and sustainability initiatives (Euronews, 2024). However, these efforts are often nascent and focused on image management rather than systemic reduction of the environmental footprint. This dynamic is a form of greenwashing, where a military might adopt a high-profile biofuel program or install solar panels on a base to project an image of environmental stewardship, while the core mission of arms production remains inherently incompatible with true sustainability. The full life-cycle environmental cost of a single new F-35 fighter jet, for example, from its raw material extraction to its operational lifetime, is likely far greater than any savings from such a public-facing sustainability project. This highlights a fundamental contradiction between PR-friendly gestures and a systemic refusal to address the root causes of the environmental footprint.

**Analytical Discussion: Towards a Sustainable Security Paradigm**

The preceding analysis of defense emissions and environmental harms underscores the significant yet underacknowledged role of the arms industry in the climate crisis. The U.S. military's annual emissions of approximately 59 million metric tons of CO2 annually are not just a number; they represent a carbon output greater than that of Portugal or Sweden. The fact that this figure is likely conservative due to the exclusion of emissions from a vast network of defense contractors and allied nations indicates that the true environmental footprint of the military-industrial complex is far greater than publicly acknowledged. The environmental externalities of arms production-including land degradation, toxic pollution, and biodiversity loss-further exacerbate environmental insecurity and social injustice (Scientists for Global Responsibility, 2024).

The defense industry's perpetuation of conflict further impedes international cooperation on climate mitigation (United Nations, 2025). As climate change acts as a risk multiplier for conflicts over scarce resources, a militaristic response is a self-defeating strategy. True security in the 21st century requires global cooperation on climate mitigation and adaptation. However, the existence of a high-carbon, conflict-driven arms industry actively undermines this goal, creating a fundamental tension between traditional geopolitical power and the urgent need for a unified global response to the climate crisis. A genuine path to long-term security necessitates a fundamental reconceptualization of security paradigms to integrate ecological stewardship.

**Conclusion**

The global arms production industry exerts profound environmental consequences, contributing significantly to climate change and ecological degradation. This research affirms that the defense sector's carbon emissions, resource consumption, and waste generation are formidable obstacles to achieving global climate targets (Liu et al., 2025). The analysis has shown that these issues are not incidental but are deeply rooted in systemic policy gaps, geopolitical priorities, and a lack of transparency that has historically shielded the military-industrial complex from environmental accountability. Addressing this requires urgent integration of environmental accountability into defense policies, increased transparency, and international cooperation to regulate

military emissions. Future research should prioritize developing robust metrics for military environmental impact and exploring alternatives to militarization that align with sustainable security. This would involve a shift in national budgets from military spending to climate-resilient infrastructure and sustainable development, which would address the root causes of both conflict and environmental degradation. Achieving climate-resilient peace necessitates acknowledging and mitigating the environmental costs of arms production, thereby transforming security paradigms towards ecological stewardship. This transition is not only an environmental necessity but a critical component of a genuine, long-term global security strategy.

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