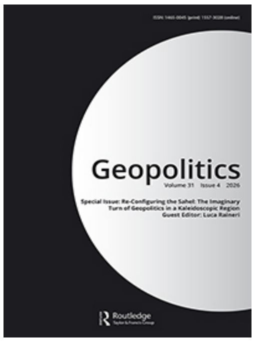

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RESEARCH ARTICLE

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A Comprehensive Framework for the Relationship Between Organized Violence and Climate Change

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ABSTRACT

While extensive research examines how climate hazards influence violence, less attention has been paid to the relationship between violence and the production of anthropogenic climate change that creates these hazards. This article analyzes this relationship through three channels. First, organisations that maintain the capacity for violence – such as militaries, defence industries, and their supply chains – generate substantial emissions, concentrated in hard-to-abate sectors. Second, violence influences climate change mitigation through opposing effects: security concerns drive competitive green industrial policies while hindering international cooperation, as illustrated by the Russian invasion of Ukraine and Sino-American tensions. Third, mitigation policies themselves can create new risks of violence, particularly in fossil fuel-dependent states facing rapid transitions. Integrating these insights into a pre-existing analysis of the self-reinforcing dynamics between violence and climate vulnerability creates a comprehensive framework for understanding violence's relationship to climate change.

Introduction

It is well known that climate hazards (e.g., droughts, floods, extreme weather events) can increase the risk of organised violence (IPCC 2023; Koubi 2019; Nagano and Sekiyama 2023; Suleymanov 2024; von Uexkull and Buhaug 2021; Xie et al. 2024). While this part of the climate–violence relationship is well documented, the effects of violence on the production of climate change remain under-explored. For example, the deteriorating international security conditions – driven by wars in Ukraine and the Middle East (Belo and Rodríguez 2023; Krieg 2024), rising risks of Great Power conflict (Bulletin of the Atomic Scientists 2024), and the Trump administration's attempts to

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renegotiate U.S. relationships with Russia and NATO (Sanger 2025) – are reshaping countries' decarbonisation efforts. Meanwhile, increased military spending and arms production (SIPRI 2024) are expanding emissions-intensive sectors at a time when scenarios for meeting Paris Agreement targets already require unprecedented reductions in industrial emissions (Olhoff et al. 2024; Rogelj et al. 2023). Thus, alongside our understanding of the relationship between climate hazards and violence, it is necessary to understand the relationship between violence and the production of anthropogenic climate change.

Violence in this article refers to organised physical violence, which encompasses commonly recognised forms of violence such as invasions, civil wars, or mass killings carried out by formally or informally organised groups (Galtung 1969; Högbladh 2024). Limiting the analysis to organised violence, and then focusing primarily on state violence, is useful when examining the relationship between violence, GHG emissions, and climate change mitigations dynamics. While domestic violence and small-scale criminality may influence emissions politics, violence carried out by organised groups plays a more central role in the political economy of climate change because organised violence connects directly to state power and the energy, industrial, transport, and food systems that emit GHG. Furthermore, the analysis extends beyond violent events themselves to encompass the military sector that produces and maintains the capacity for violence, as well as the potential for future violence. This expanded conceptualisation enables a more comprehensive examination of how violence relates to GHG emissions and efforts to reduce them.

This analysis examines three distinct aspects of this complex relationship: direct greenhouse gas emissions from both combat operations and the military sector that produces capacity for violence; violence's influence on climate policy development and implementation; and how climate change mitigation strategies can affect the risk of violence. These findings are combined with the framework from Buhaug and von Uexkull (2021), which shows how armed conflict creates significant negative societal impacts, increasing climate vulnerability and future conflict risk in a self-reinforcing 'vicious circle'. By endogenizing the production of anthropogenic climate change that drives these hazards, this article extends their framework to create a comprehensive model for understanding the relationship between violence and climate change.

Previous research on climate change and violence has primarily examined violence as an outcome of climate hazards (Burke et al. 2024; Stechemesser et al. 2021; von Uexkull and Buhaug 2021). Within this approach, scholars investigated if, when, and how climate-related hazards shape conflict patterns (Cappelli et al. 2023; Hastings and Ubilava 2025; Ide 2023; Mack et al. 2022; Maconga 2023; Michelini et al. 2023; Schleussner et al. 2016; Suleymanov 2024). Even critical scholarship remains focused on this unidirectional relationship between climate-hazards and conflict outcomes, either empirically contesting causal links between climate hazards and specific conflicts (Selby et al. 2017; Verhoeven 2011), or theoretically critiquing how securitising climate change depoliticises its structural causes and leads to problematic policy responses (Daoust and Selby 2023; Hartmann 2014; Selby and Hoffmann 2014). Based on this research, there is now scholarly agreement – supported by expert elicitation (Mach et al. 2019), IPCC assessments (IPCC 2023), and broader research syntheses (Beaumont and de Coning 2022) – that climate–conflict relationships are highly contextual, mediated by social conditions, and inherently complex. However, this focus on violence as an outcome overlooks its crucial role in shaping the production of climate change itself.

While recent scholarship has begun to broaden its focus (Gilmore and Buhaug 2021), few works have systematically analysed violence's role in shaping climate change mitigation overall. Furthermore, when mitigation is discussed, it is often disconnected from the broader climate-conflict literature which focuses primarily on climate hazards. Perhaps, the closest work to this article comes from Vogler (2024), who examines military-environment interactions through four lenses: environmental destruction, Anthropocene geopolitics, impact alleviation, and climate policy obstruction. While both this work and Vogler's connect multiple ways climate change and violence intersect, their analytical purposes differ. Vogler documents and categorises how military institutions interact with environmental challenges, whereas this article analyzes how violence, as a broader social phenomenon, shapes and is shaped by the political economy of climate change mitigation across society. For example, where Vogler's discussion of Anthropocene geopolitics centres on Arctic militarisation because this is where militaries play the largest role, this paper instead examines how the broader risk of violence shapes climate policy through economic policy, industrial strategy, and international cooperation.

By integrating different aspects of the relationship between organised violence and climate change production, each component of the framework contributes uniquely to the existing scholarship. For example, the discussion of how violence drives GHG emissions (Section 2.2) advances the literature by connecting research on military emissions and spending with broader climate change mitigation scholarship. While previous studies have focused on measuring military emissions (Crawford 2022; Parkinson and Cottrell 2022), highlighting accountability gaps (Rajaeifar et al. 2022; Vuong, Nguyen, and La 2024), or documenting military–environmental interactions (Vogler 2024), this article synthesises these research streams to analyse how military emissions fit within broader decarbonisation goals.

This synthesis reveals three key insights about military emissions and climate goals. First, the central challenge is not their current share of total emissions, but their concentration in hard-to-abate industries, meaning they will likely constitute a large portion of residual emissions. Second, conflict-related emissions currently stem primarily from military bureaucracies and their aligned industries preparing for or deterring future wars, rather than from active conflicts themselves. Third, the increasing risk of Great Power conflicts exacerbates emissions by shifting military spending towards equipment purchases, which are relatively emissions-intensive. Collectively, these findings demonstrate that the military sector's combination of high emissions intensity, decarbonisation challenges, and continued growth means achieving Paris Agreement goals will require both accelerated decarbonisation in non-military sectors and significant structural changes to defence industries.

Furthermore, Section 2.3's discussion of how violence shapes climate change mitigation politics contributes to both the climate change mitigation literature and the emerging literature on climate–violence relationships by demonstrating that ongoing warfare and military competition are driving the creation of competitive, securitised green industrial policies, which in turn influence national mitigation strategies. This process has largely involved countries and blocs responding to energy security risks as well as to green industrial policies undertaken by other nations. Although some research has examined this dynamic for specific countries or regional blocs, primarily focusing on energy security (e.g., Zabanova 2024), these insights have not been systematically integrated into the broader climate-violence literature, leaving the international dimension underexplored. In contrast to studies that focus solely on how violence hampers mitigation efforts (Block et al. 2025), this analysis recognises that concerns about violence can also accelerate certain forms of climate change mitigation. Rather than simply affecting the amount or speed of climate policies, violence may play a more significant role in shaping the type of climate mitigation that occurs.

Additionally, Section 2.4 contributes to the climate-violence literature by connecting research on resource dependency and austerity with the energy transition. While the future remains uncertain, accelerating the energy transition presents significant fiscal risks to fossil fuel-dependent countries, which may prove destabilising. However, these risks are somewhat offset by the fact that fossil fuel exports have not historically provided a sustainable path to prosperity for many of the same countries most vulnerable to the transition.

Beyond examining individual components of the framework, integrating these literatures with broader research on climate hazards and conflict reveals important interconnections and allows for comparison of relative effect magnitudes. The framework illuminates several key feedback mechanisms that demonstrate the complex relationships between violence, emissions, and climate change. First, military activities create a direct link between emissions and the capacity for violence. The military contributes significantly to global emissions (Belcher et al. 2020), far exceeding its contribution to GDP and making it more emissions intensive than most civilian economic activities. Thus, increased military activities therefore likely drive higher total emissions, intensifying climate change and generating more severe future climate hazards (IPCC 2023). This process feeds into the vicious cycles identified by Buhaug and von Uexkull (2021), where violence increases climate vulnerability, which – combined with intensified hazards – elevates future violence risk. However, this effect likely remains modest given that military emissions constitute a small fraction of total global emissions, the multi-decade lag between emissions and realised hazards, and the limited role climate hazards play in conflict dynamics.

The second connection – where climate mitigation policies influence violence levels and thus help alleviate or reinforce the vicious circles associated with climate hazards, climate vulnerability, and violence – likely carries greater significance, though the overall global effect could go in either direction. While the overall impact of global climate mitigation efforts on violence remains uncertain, the energy transition process will likely play a important role in each country's trajectory – either increasing or decreasing the likelihood of conflict, depending on local circumstances. Countries dependent on fossil fuel exports face significant political and economic disruption as global demand shifts away from their primary revenue sources, while nations that supply critical minerals for renewable energy technologies may experience different pressures from increased extraction demands. Many countries in both groups have recent histories of organised violence, and how successfully each adapts to these transition-related changes will be a crucial determinant of their individual violence trajectories in the coming decades. This dynamic will then influence the feedback loops where violence levels affect climate vulnerability and future conflict risk, creating a complex web of positive and negative interactions that suggests the relationship is better characterised as a process of ambiguous change rather than a self-reinforcing negative cycle.

Finally, combining research on violence's role in climate change with studies of climate hazard impacts reveals a significant imbalance in both research priorities and policy attention. Existing research has focused heavily on understanding conflict risks from climate hazards, while much less attention has been given to conflict risks from climate policies or to understanding how violence affects climate action itself. This imbalance becomes clear when examining these different research areas together. Since the relationship between violence and climate action is at least as important as the relationship between climate hazards and conflict, the current research focus appears incomplete. This represents an important opportunity for researchers and policymakers to invest more in understanding how violence affects the energy transition. Such research is especially urgent because both climate action and conflict prevention are critical challenges in the coming decades.

This article proceeds as follows. Section 2 introduces the framework, showing how violence relates to climate change. Section 2.1 lays out the existing framework by Buhaug and von Uexkull (2021), Sections 2.2, 2.3, and 2.4 examine specific ways that violence relates to the production of anthropogenic climate change. Section 3 synthesises these relationships to evaluate potential feedback loops in climate–violence interactions. Section 4 draws out the implications of these findings for climate policy. Section 5 concludes and points towards future research.

Violence, Power, and Climate Change

This section presents an integrated framework that captures the relationships between organised violence and climate change. As Figure 1 shows, the framework builds on Buhaug and von Uexkull (2021)'s analysis of vicious circles, where organised violence increases conditions of social vulnerability to climate hazards, which also raises the risk of further climate-induced violence. This article extends their framework by examining how organised violence influences the production of anthropogenic climate change through two channels:

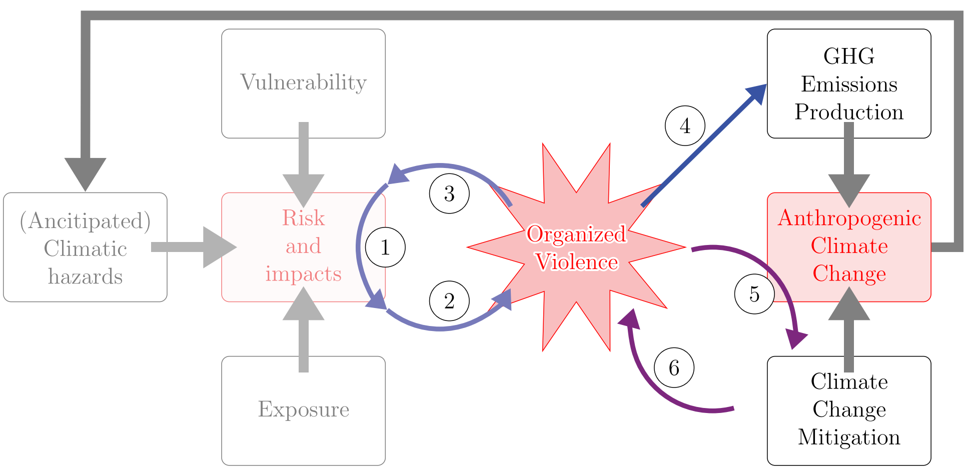

Figure 1. Climate change and violence framework. Notes: Conceptual framework integrating violence into climate change dynamics. Shown in semi-transparent blue, relationships 1 – 3 represent the established relationships from Buhaug and von Uexkull (2021):① vulnerability shapes risks and impacts from climatic hazards, ② climate-related impacts shape armed conflict risk, and ③ armed conflict shapes vulnerability to future climatic hazards. Climate hazards has been changed to anticipated climate hazards to properly incorporate climate adaptation (see Section 2.1.1). This framework adds three pathways – shown in purple – that relate violence to the production of anthropogenic climate change: ④ greenhouse gas (GHG) emissions from both the active use of violence (e.g., combat operations) and the maintenance of violent capabilities (e.g., military forces and defence industries) (see Section 2.2), ⑤ influence of violence on climate change mitigation policies (see Section 2.3), and ⑥ how climate change mitigation affects patterns of violence (see Section 2.4). These pathways then affect the climate system through total GHG emissions, potentially intensifying future climate hazards (see Section 3).

direct effects on GHG emissions and impacts on climate change mitigation efforts. Additionally, mitigation policies themselves can affect patterns of violence. The result is a comprehensive framework explaining the relationship between violence and climate change that includes endogenous production of GHG emissions.

This analysis focuses on organised violence rather than armed conflict because organised violence encompasses a broader range of actions, including one-sided violence where there is no engagement between opposing armed forces. For example, armed groups can target civilian populations, increasing their vulnerability to climate hazards (Ahmed et al. 2021), or police can use violence to suppress climate protesters (Gulliver et al. 2023; Hadjimatheou 2023). Since armed conflict represents a subset of organised violence, the relationships described by Buhaug and von Uexkull (2021) remain valid while allowing this analysis to capture a more comprehensive range of violence–climate interactions.

This framework focuses exclusively on anthropogenic climate change, which is divided into two parts: the production of climate change and the effects of climate change. This distinction mirrors that of the IPCC, where climate change mitigation and emissions are addressed in separate reports from climate impacts, adaptation, and vulnerability. This separation is useful because the relationship between climate hazards and conflict is qualitatively different from the relationship between military-industrial complexes and the energy transition. However, considering these two aspects of climate change together allows for a framework that endogenizes emissions and thus covers the whole process of climate change from its production to its effects, shows connections between the two halves, and allows us to compare the magnitudes of different aspects of the climate–violence relationship.

This framework is comprehensive in the sense that it maps how organised violence connects to every stage of climate change – from emissions production to climate hazards – identifying specific channels and providing key examples of each. However, it is not an exhaustive list of the ways that climate change and violence interact. Since fossil fuels are embedded throughout modern life and violence shapes politics in countless ways, such a list probably could not exist. Instead, this paper outlines the main channels through which these myriad interactions can be categorised and highlights examples with the greatest potential to help us understand the magnitude and direction of each effect.

This approach explains the paper's geographic and thematic focus. While all militaries and armed groups produce emissions, the examples in this article concentrate on large industrial regions because these areas generate most global emissions and maintain the world's largest militaries and military-industrial complexes. For similar reasons, the analysis emphasises how great power conflict reshapes climate mitigation – these countries form the core of global capitalism and produce most emissions, making their actions critical to decarbonisation pathways. By contrast, smaller states feature more prominently in discussions of how climate change mitigation affects violence, since these countries – with less diversified economies and limited fiscal capacity – are likely more vulnerable to political and economic disruption from a successful global energy transition than larger, more economically diverse nations.

Vicious Circles: Climate Hazards, Climate Vulnerability, & Violence

As Figure 1 illustrates, the relationship between climate hazards and conflict draws from Buhaug and von Uexkull (2021)'s analysis of vicious circles, which operates as a three-step process: (1) violence increases conditions of social vulnerability to climate hazards, (2) which raises the risk of further climate-induced violence, (3) which then further increases social vulnerability. There is near-universal agreement that social vulnerabilities such as poverty, political exclusion, and inequality increase susceptibility to climate hazards (e.g. Otto et al. (2017) and Cardona et al. (2012)). Similarly, scholars widely acknowledge that violence exacerbates these same forms of social vulnerability (e.g. Martin-Shields and Stojetz (2019), Bruück, d'Errico, and Pietrelli (2019), Crane et al. (2017), and R. P. Smith (2014)).

The central debate concerns whether, when, and to what extent climate hazards causally increase violence. While earlier scholarship was characterised by sharp disagreements between those reporting large, generalised causal impacts of climate variation on various forms of violence (Burke, Hsiang, and Miguel 2015), those arguing that no such effects could be detected (Buhaug et al. 2014), and those contending that such claims were methodologically or politically problematic (Selby 2014), recent years have witnessed notable convergence. A 2019 expert elicitation involving the most prominent authors from previous disputes found that climate change was less important than political, economic, and demographic factors in driving conflict risks (Mach et al. 2019). Climate change emerged as the most uncertain factor and was projected to remain so unless global warming reaches 4°C above pre-industrial levels.

Subsequent research, along with the latest IPCC report (IPCC 2023), reflects this growing consensus that climate impacts can increase conflict risk, but only under specific conditions. These conditions typically align with the same socioeconomic and political vulnerabilities that make communities susceptible to climate change – particularly when climate hazards change the strategic calculations of actors who are already involved in some form of conflict (Hastings and Ubilava 2025; Ide 2023). This consensus now includes both researchers who initially provided highly pessimistic estimates and have since revised their findings based on new evidence (Burke et al. 2024), as well as critics of the original debate who argued it relied too heavily on Malthusian assumptions, promoted inaccurate narratives about specific conflicts, or removed violence from its political context (Selby, Daoust, and Hoffmann 2022).

Incorporating Climate Adaptation

While not addressed separately in the original article, climate adaptation can be incorporated into the framework from Buhaug and von Uexkull (2021) largely through the lens of vulnerability to climate hazards. Violence undermines the social, economic, and institutional foundations necessary for effective climate adaptation, as ongoing conflicts disrupt the health, transport, education, and food systems that must be strengthened to address climate hazards (Sitati et al. 2021). This creates a particularly destructive dynamic – as violence-induced socioeconomic vulnerability makes communities more exposed to climate risks and thus more dependent on adaptation measures, the same violence systematically erodes their capacity to implement these necessary adaptations. This dynamic fits directly within the original framework, as climate adaptation becomes one component of how violence leads to social vulnerability, which in turn leads to vulnerability to climate hazards.

Adaptation initiatives – particularly top-down interventions – can also become sources of violent conflict and increased vulnerability (Nadiruzzaman, Juürgen Scheffran, and Stefanie 2022). Such outcomes depend heavily on local contexts. For example, the Duterte administration used authoritarian tactics and extrajudicial violence to implement water and climate-resilience projects (W. Smith 2022). However, political violence in the Philippines extends far beyond climate adaptation policy, making this 'violent adaptation' essentially an extension of pre-existing authoritarian practices into climate adaptation projects. When implemented effectively with attention to equity and local contexts, adaptation measures can reduce violence risks when climate hazards strike (Gatti, Baylis, and Crost 2021). The key insight is that climate adaptation's potential for violence – like the climate impacts it aims to address – depends largely on the same underlying socioeconomic and political conditions that shape a society's vulnerability to climate change.

These dynamics create a vicious cycle akin to that described by Buhaug et al. Violence increases social vulnerability to climate change by degrading socioeconomic, political, and environmental conditions. This degradation then increases vulnerability to climate hazards by reducing the effectiveness of climate adaptation efforts. At the same time, these weakened socioeconomic conditions make it more likely that climate adaptation projects will themselves trigger violence. This occurs because adaptation's violence risks depend heavily on underlying socioeconomic and political conditions – the same conditions that determine vulnerability to climate change. To capture this dual relationship with both actual hazards and anticipatory responses (i.e., adaptation), the original framework has been modified to reference '(anticipated) climate hazards'.

Violence and GHG Emissions

Many forms of organised violence can contribute to GHG emissions. For example, ISIS was found to be running its own small defence production networks (Ismay, Gibbons-Neff, and Chivers 2017) and armed groups in the Niger Delta often cause oil spills (Ebiede 2022; Omoogun, Olayemi, and Ogungbade 2021). However, the vast majority of emissions come from the formal military sector due to its larger scale and sophistication. For comparison, the U.S. military alone is estimated to have more emissions from operations than the entire national emissions of most developing countries where non-state armed groups are located (Belcher et al. 2020).

Military activities are a significant source of emissions, though precise quantification remains challenging since they are excluded from the Paris Climate Agreement reporting requirements and report their emissions on a purely voluntary basis (Birch and Van Bergen 2022; Rajaeifar et al. 2022). A recent, conservative estimate suggests that militaries' global 'carbon bootprints' comprise 5.5% of total emissions when including defence production (Parkinson and Cottrell 2022). Other estimates suggest direct military emissions alone account for 1–5%, with up to three times this number when including defence production and supply chains (Rajaeifar et al. 2022).

These figures exclude emissions from active combat operations, which are difficult to systematically count. The limited available evidence suggests that combat can be emissions intensive. Emissions from conflict in Ukraine during the first 18 months after the Russian full-scale invasion were estimated to total around 77 $MtCO_2$-eq (Bun et al. 2024). A large part of these emissions come from the destruction of carbon sinks during conflict. For example, the Kuwaiti oil fires during the first Gulf War were estimated to cause 1.8 $MtCO_2$ emissions per day (Hobbs and Radke 1992). Michaelowa et al. (2022) suggest that the U.S'.s destruction of Vietnamese tropical forest and mangroves in southern Vietnam using chemical 'Agent Orange', may have caused 300 $MtCO_2$.

Given that 2023 global emissions were around 57 $GtCO_2$-eq, these impacts are not sufficient to significantly change emission trajectories. For example, the estimates from Bun et al. (2024) imply annual emissions from the Ukraine war amount to around 0.1% of the global total. Even the largest estimate of combat emissions, from the US global war on terror, found the total GHG emissions from 2001 to 2017 to be 1.2 $GtCO_2$-eq (Crawford 2022). This amounts to around 2% of a single year's global emissions over a 20-year period. Furthermore, while rebuilding can be emissions intensive, only a very small fraction of the world's construction activity comes from rebuilding war-torn cities, so it contributes only a small fraction to global emissions.

At present, most military emissions come from the military sectors maintaining the capacity for violence and not active combat. One key reason for this is that the military-sector spending tends to concentrate in industrialised nations such as the U.S. and China (SIPRI 2024), whereas actual combat tends to occur in places with very few emissions. The combined emissions from the nine countries that UCDP listed as having an ongoing war with more than 1000 combat deaths in 2023 was only 1.22 Gt CO_2-eq.[1]

Organized Violence and Macroeconomic Change

Another way that violence can affect emissions is by changing the macroeconomic situation of countries in conflict, which then impacts overall emissions. There are several contrasting ways this can happen. First, war can lead to suppressed consumption. For example, the Syrian civil war drastically reduced emissions in the first phase of the war due to economic contraction and massive population displacement (Wang et al. 2023). A similar trend occurred in Libya, where emissions plummeted in 2011 during the First Libyan Civil War, recovered briefly, then declined again starting in 2014 with the Second Libyan Civil War and have remained significantly below their 2013 peak (IEA 2025). This is part of a broader trend whereby increased geopolitical risks reduce economic growth as well as emissions-intensive activities such as tourism and oil production (Chiu 2025; Zhang et al. 2024). Crucially, this has both short-term and long-term effects, as warfare can significantly reduce prospects for long-term growth (Petrova et al. 2023).

However, this effect is somewhat offset by the fact that the rebuilding process after a conflict can involve a significant amount of emissions. A preliminary study on the first 120 days of the Gaza war found that emissions embodied in the pre- and post-war construction of Gaza's built environment were 100 times greater than those from the fighting itself. Similarly, Michaelowa et al. (2022) estimate that emissions from rebuilding the 50,000 buildings destroyed during the Syrian Civil War in Aleppo and Homs alone would involve 11–19 $MtCO_2$-eq, which represents between a quarter and half of the 41 $MtCO_2$-eq that Syria emitted in total in 2023 (Crippa et al. 2024). So, over the medium term, much of the emission reductions from reduced consumption may be offset unless the reduction is permanent and rebuilding does not occur.

Violence also slows or prevents investments in decoupling economic growth from GHG emissions. While renewable energies are sometimes adopted in conflict-affect areas as a response to energy-poverty (Matallah, Zerigui, and Matallah 2024), overall war has negative effects on overall investment in clean energy and emissions intensive activities may become more prominent (Yang et al. 2022). In the Syrian case, after the initial phase of the war, energy and emissions intensity of economic activity significantly increased and eventually offset the reductions from population loss and impoverishment (Wang et al. 2023).

However, as with the emissions from actual combat, the relevance of the macroeconomic changes from war on overall emissions is severely limited by the fact that the majority of the world's conflicts occur outside the regions that produce most of the world's emissions. Ongoing warfare may have large effects on the emissions trajectories of South Sudan and Myanmar, but this is of limited importance for global GHG emissions because these countries represent a small share of global emissions and are not projected to become major emitters by 2050.

This would likely change if larger, more industrialised countries became involved in the conflict. In the past, when industrialised states were fully mobilised for war – especially when that war occurred outside their borders, and thus no industrial facilities or infrastructure were destroyed – the emissions intensity of the economy increased (Pirani 2018). Indeed, at present, the Russian economy seems to have pivoted towards heavier industries and military production (Astrov et al. 2024). So conflicts involving Japan, Germany, or Canada would likely have different dynamics than what we see in most current conflicts. However, nowadays, this is not the case, and so this article focuses on emissions produced by militaries because they are currently more important for global emissions trajectories.

Military Sector is Emissions Intensive

The military sector's emissions intensity – its emissions relative to its economic output – significantly exceeds that of the broader economy (Parkinson and Cottrell 2022; SIPRI 2024). While military expenditure accounts for 2.3% of global GDP, conservative estimates place military emissions at 5.5% of the global total, making the sector more than twice as emissions intensive as the average economic activity. This stems from the sector's heavy reliance on emissions-intensive activities like industrial manufacturing and aviation (Crawford 2022, 2022; Parkinson and Cottrell 2022).

Recent geopolitical developments and international tensions are slowing or potentially reversing reductions in military emissions intensity across the globe. Though some military technologies are becoming more energy efficient (USD A&S 2023), militaries are becoming more capital intensive overall (Jorgenson et al. 2023) as they modernise their forces. This shift is particularly evident in the growing risks of conventional warfare, which is driving a transformation in military spending patterns away from personnel costs and towards weapons and equipment production that rely on emissions-intensive heavy industry.

This shift towards more equipment and capital-intensive activities is evident across major military powers. In Europe, the Ukraine war has prompted increased investments in military equipment and heavy industry (Becker, Seth Benson, and Malesky 2024), with the European Defense Agency reporting a 19% annual increase in equipment spending for 2023 and projecting a 50% increase in 2024 (EDA 2024). China shows similar patterns: while its military remains relatively personnel-heavy, military equipment spending increased by 10.2% annually between 2000 and 2021, outpacing both GDP growth (8.6%) and overall military spending growth (5.7%) (Robertson 2024). In Russia, the recent investment boom has concentrated in resource-intensive manufacturing and construction, particularly in military industrial regions and areas near Ukraine (Simola 2024), indicating significant investments in defence-related heavy industries. These trends suggest that military expenditures are increasingly directing resources towards emissions-intensive industrial activities, potentially offsetting efficiency improvements.

Military Emissions are Hard to Abate

Beyond being emissions intensive, military emissions are hard to abate because they are concentrated in aviation and heavy industry, sectors that are difficult to directly electrify and thus prospects for full decarbonisation remain limited and expensive. Aviation represents 70% of the United States Department of Defence's energy consumption (Crawford 2022). It also plays a significant role in European defence emissions (Parkinson 2021). Aviation poses particular challenges for decarbonisation – recent analysis shows no clear pathway to zero-emissions flight (Kallbekken and Victor 2022). Sustainable aviation fuel offers one potential solution, but faces significant cost and production barriers.

Furthermore, military decarbonisation plans demonstrate the technical challenges of fully decarbonising military operations and their supply chains. Official plans to reduce emissions have two main focuses: switching to clean electricity and investing in new equipment. The documents make clear that these technological improvements will not achieve decarbonisation by 2050. For example, the U.S. Department of Defence's 2023 emissions reduction plan (USD A&S 2023) proposes measures like increasing aircraft efficiency, purchasing electric vehicles, and shifting buildings to green power, but contains no firm GHG emissions targets. The UK's 2021 Climate Change and Sustainability Strategic Approach includes a net-zero goal, but relies on the same technology-first strategy (Findlay 2022) and openly acknowledges a lack of a clear path to achieve full decarbonisation.

Furthermore, military technology cycles span decades (GAO 2024), making sufficiently rapid technological development, implementation, and diffusion unlikely by 2050. For example, the United States Air Force plans to use sustainable fuels for only half of its needs (Poland 2021) by mid-century. Additionally, a recent military analysis by Adams (2022) that even if electrified military forces could be built and deployed, conventional military units will still outperform them in 2050. These force-preparedness constraints, combined with limited technological options, suggest no clear path to military decarbonisation. As Crawford (2022) suggests, the difficulty of reducing military emissions through technological changes may mean that, in the short term, significantly reducing military emissions is only possible with reduced military activity.

Military Spending is Increasing

Global military expenditure is rising sharply, outpacing broader economic growth. SIPRI reported a 6% increase in real global military expenditure in 2023, compared to global GDP growth of 2.7% (SIPRI 2024; World Bank and World Bank 2025). This trend is particularly pronounced in regions facing heightened security threats. In Europe, the Russian invasion of Ukraine and U.S. pressure to meet NATO defence commitments have led 22 EU member states to increase defence spending, with 11 states – particularly those bordering Russia and Belarus – raising spending by more than 10% to meet NATO's 2% GDP target (SIPRI 2024; Dorn 2024; EDA 2024; World Bank and World Bank 2025). Similar dynamics are evident in East Asia, where China's 6% defence spending increase prompted Japan to raise its defence budget by 11% (SIPRI 2024). This global shift towards increased military expenditure poses challenges for meeting Paris Agreement climate targets, as it directs a growing share of resources towards a sector characterised by both high emissions intensity and significant technological barriers to decarbonisation.

Effects of Violence on Climate Change Mitigation

Securitized Green Industrial Policies

War, and the preparation for war, are likely the largest way that violence shapes climate mitigation efforts (Buhaug et al. 2023). This dynamic is exemplified by China's renewable energy revolution. Many of the technological advancements that are currently driving the global energy transition – such as the drastic fall in solar and wind production costs and rapid advances in battery technology – were developed primarily in China (Hemmelder et al. 2025; Jackson, Lewis, and Zhang 2021; Maka and Alabid 2022). However, while decarbonisation is a goal in China, it was not a top priority in the 2010's when renewable energy and direct electrification technologies were being scaled up. Instead, energy security considerations, driven in part by fears of American military pressure, played a much larger role in motivating these investments. China's energy landscape is characterised by what experts describe as 'more coal, less gas, and lack of oil' (Zhu and Wang 2020), making it strategically vulnerable (Yuan, Zhao, and Umair 2023). While China has abundant coal reserves, its limited oil resources create dependence on Middle Eastern suppliers – many of whom are militarily aligned with the U.S.—and on vulnerable maritime shipping lanes to coastal ports. Consequently, China's massive investments in renewable energy and electric vehicles were primarily motivated by export growth and energy security considerations rather than environmental concerns (Boyd and Ufimtseva 2021). The Chinese government's extensive investment in green technology thus represented a strategic response to reduce dependence on foreign oil and mitigate the risk of American blockades (Xie 2021).

The success of China's security-driven green technology strategy has, in turn, triggered a competitive response from the United States. As China's economic and military power grew, fears emerged in America about the economic and security implications of increased Chinese power. These geopolitical anxieties merged with domestic discontent about free trade policies to produce a marked shift towards industrial policy at both rhetorical and policy levels, beginning with the first Trump administration and continuing through the Biden administration. A coalition driven by protectionist interests and concerns about a potential military conflict with China pushed for large-scale industrial policies targeting 'strategic' sectors, including semiconductors, clean technology manufacturing, and green energy. This security-focused approach has specifically prioritised domestic manufacturing capacity for electric vehicles and renewable energy technologies, reflecting concerns about supply chain vulnerabilities and technological dependence on a potential adversary (Li and Zhao 2023). Given that many of the technologies and material inputs needed for the energy transition are concentrated in China, this represents a significant shift in American climate policy.

The second way violence came to shape American climate policy was the Russian invasion of Ukraine. Senator Joe Manchin, who held the decisive vote as Chairman of the Senate Energy Committee, cited Russia's weaponisation of energy supplies against American allies as a key reason for supporting the Inflation Reduction Act (IRA) (Roger 2024). Responding to this concern about energy security, the IRA channels massive investments towards subsidising green energy, and green hydrogen in particular. The uncapped nature of the spending in the bill means that the act could invest more than $1 trillion in green energy (Aldy 2025). The idea is to use publicly subsidised green energy production as a means to simultaneously accelerate power-sector decarbonisation and reduce the impacts of war related shocks from foreign supply chains, thereby reducing the dependency on geopolitical rivals to maintain cheap, reliable energy flows. This demonstrates how war, and its effects, both enabled and shaped the passage of America's most significant climate legislation, as concerns about energy security driven by the Russian invasion of Ukraine aligned with climate action objectives (Bang 2024). The enduring focus on energy security has helped protect the IRA's core energy production provisions, even as other aspects of the legislation – such as methane emissions taxes – remain more politically vulnerable (Shah 2025).

The intersection of security concerns and climate policy has produced mixed results for the American energy transition. On the one hand, fears about technological dependence on China combined with the shock of Russian energy manipulation created a broad enough coalition to pass unprecedented climate legislation. This has unlocked massive public investment in critical technologies like electric vehicles, hydrogen, and batteries (Bistline et al. 2023). However, China's global leadership in clean energy manufacturing, particularly in solar panels (Yuan, Farina, and Anctil 2024), means that American efforts to domestically produce solar panels or source them from allied countries could increase costs and potentially slow the overall energy transition (Helveston, He, and Davidson 2022). This tension illustrates how security-driven climate policies, while politically feasible, may not always optimise for the fastest or most cost-effective decarbonisation pathways.

European climate policy has also been shaped, albeit in slightly different ways, both by war and by the securitised industrial policies of other countries. The Russian invasion of Ukraine clearly demonstrates this. When Russian gas supplies were cut off in 2022, the EU responded with its REPowerEU initiative, aiming to end Russian fossil fuel dependence by 2030 (de Jong 2024; Giuli and Oberthuür 2023). This crisis produced mixed effects on the EU's energy transition. On one hand, it accelerated decarbonisation through voluntary gas demand reduction of 15%, increased the 2030 renewable energy target from 32% to 42.5%, and reduced overall energy consumption. On the other hand, the EU's search for alternative fossil fuel suppliers, including Azerbaijan, Qatar, and the United Arab Emirates, created new fossil fuel dependencies (Donaghy, Amadeo, and Préaux 2023; Falkner 2023; Tocci 2023).[2]

Europe now finds itself caught between these competing powers (Germann 2023; Schneider 2023). As both superpowers invest heavily in their industrial rivalry, Europe has been forced to adopt more aggressive industrial policies to remain competitive. This shift is evident in two key areas: the transition from emissions trading-based climate strategies towards a Green New Deal approach (Oberthür and Ingmar 2023), and the development of a European industrial strategy to ensure domestic clean hydrogen production capacity (Zabanova 2024).

The intensifying security tensions between China, Europe, and the United States have also created new opportunities for developing countries to advance their energy transition goals. The Just Energy Transition Plan for Indonesia illustrates this dynamic, providing $20 billion in financing for Indonesia's clean energy initiatives. While questions remain about the adequacy of funding and its distribution to vulnerable populations (Chotimah 2023), the package clearly serves a broader geopolitical purpose: strengthening Indonesia's strategic alignment with the United States, Japan, and the EU (Marciel 2023).

Geopolitical competition, with a clear focus on military confrontation, is reshaping climate policy approaches worldwide. China's energy security concerns catalysed massive investments in green energy, electric vehicles, and other clean technologies over the past decade (Zhu and Wang 2020). Combined with the Russian invasion of Ukraine, this spurred both the United States and EU to develop competing industrial policies (Bang 2024; Schneider 2023). While driven by strategic rivalry, this competition has had positive spillover effects: the resulting scale of investment and innovation has significantly reduced wind and solar costs, making clean energy more accessible to developing nations (Yuan, Farina, and Anctil 2024).

Climate Negotiations

While Great Power competition can effectively mobilise domestic resources for the energy transition, it often undermines crucial international climate negotiations. This dynamic is clearly illustrated by China's suspension of bilateral climate talks with the United States following the U.S. House Speaker's visit to Taiwan (Lau 2022). Only after a large-scale effort to stabilise the relationship and reduce the risk of conflict – in early 2023 the U.S. shot down a Chinese surveillance balloon and senior military officials were openly discussing the prospect of war (Horton 2023) – could climate talks resume (Gupta 2024; Moritsugu 2023). Moreover, the resulting shift towards competitive industrial policies, where nations build separate manufacturing bases for green technologies, has fragmented global efforts (Miller 2022). This fragmentation reduces opportunities for coordinated technology development and impedes the technological diffusion that could accelerate the global energy transition.

The Russian invasion of Ukraine reveals an even more severe case of Great Power conflict reducing the possibility for climate cooperation. Coordination on climate policy between Russia and Western countries in the foreseeable future is significantly reduced because the war has badly damaged relations between the two parties (Javeline et al. 2024; Overland 2022).

The pausing of meaningful Arctic council cooperation after the 2022 invasion of Ukraine provides an example of this. In 2022, Russia held the rotating presidency of the Arctic council, and the other members cut off scientific cooperation (Dyck 2024). While the Arctic council does not primarily govern mitigation issues, this led the Russians to withhold vital climate data and held up any attempts to coordinate on addressing the impacts of climate change (Paukkunen and Black 2024). Furthermore, the war seems to have led to an increase in militarisation of the arctic (Limon and Gürdal Limon 2024).

International sanctions and conflict can rapidly unravel years of climate cooperation progress. Reduced international cooperation not only prevents future agreements from being reached but can undermine ongoing cooperation efforts already achieved. According to Shugurov (2023), Russia demonstrates this dynamic: both its climate science and clean energy development have historically relied on EU technology and expertise, particularly in research. Following Russia's full-scale invasion of Ukraine, sanctions and the suspension of scientific cooperation led to the cancellation of major EU Horizon projects and reduced data collection efforts. The Russian Academy of Science reports significant reductions in domestic capacity to reduce GHG emissions. Even viewing these claims cautiously, the impact of sanctions on Russian emissions reduction capabilities is likely substantial, given the country's dependence on foreign technology for both fossil fuel sector modernisation and green technology development (Shugurov 2023).

This illustrates a broader challenge to global climate action. International scientific cooperation and institutions like the IPCC have been instrumental in advancing decarbonisation goals, shaping policy, and mobilising public support (Beck and Mahony 2018). A successful global energy transition relies upon on international technological transfers and proliferation to achieve decarbonisation across various sectors (see e.g., O¨hman, Emrah, and Frauke (2022)). However, increasing technology restrictions, economic sanctions (Syropoulos et al. 2024; Yalcin et al. 2024), and security-driven industrial policies threaten to impede both technological diffusion and scientific collaboration necessary to address climate change.

Finally, violent conflict can divert resources away from international climate cooperation. At COP29 in Baku, developed countries agreed to a $300 billion annual target in climate financing. While short of the $1 trillion sought by developing countries, this represented a major increase over previous commitments (U.N. News 2024). However, several months later, the U.S. withdrew from the Paris Climate Agreement and drastically reduced American development cooperation (Daly and Borenstein 2025; Mednick, Mcmakin, and Pronzcuk 2025). Although these actions were not directly tied to violence, they occurred as part of President Trump's 'America First' agenda, which simultaneously reduced American participation in military alliances and international institutions. This withdrawal prompted European NATO members to significantly increase their military spending goals, with some funds being directly redirected from previously committed international climate financing (Daly and Borenstein 2025; Taylor 2025). Consequently, both the ongoing Russian invasion and internal NATO disputes about addressing it have contributed to failures in mobilising resources to meet agreed-upon climate funding targets. This situation further undermines the credibility of COP negotiations as a venue for meaningful climate diplomacy and diminishes developing countries' ability to influence the global climate agenda.

Effects of Climate Change Mitigation on Violence

Climate mitigation policies can shape patterns of violence through multiple channels. Gilmore and Buhaug (2021) identify four primary pathways through which rapid decarbonisation could cause conflict: reduced economic growth, loss of income or livelihood, increased food and energy prices, and land use conflicts. These risks arise from the large-scale economic transformations needed to meet the 1.5°C temperature target. In some cases, these risks of violence arise from specific climate change mitigation strategies that represent just one pathway among many to achieving decarbonisation. For instance, REDD+ and carbon offset programs have been associated with resource enclosure and displacement-related violence (Cavanagh and Benjaminsen 2014; Svarstad and Benjaminsen 2017). In other cases, projects that are necessary for the energy transition, such as building out renewable energy infrastructure, are carried out violently. For example, Cavanagh and Benjaminsen (2014) and Kumar (2024) found numerous cases of state-sanctioned violence being used against indigenous communities during the construction of Indian hydropower facilities.

Among the most significant risks is the impact on fossil fuel-dependent states. A recent United Nations Development Program (UNDP) report identified 40 fossil fuel-dependent countries, of which 31 were low- or middle-income nations (Jensen 2024). In these countries, fossil fuel rents comprise, on average, 14.3% of GDP, 38.6% of government revenue, and 61.2% of exports. This high dependence on fossil fuel revenues makes these states particularly vulnerable to the energy transition, as declining demand could trigger severe fiscal contractions (Jensen 2024).

These fiscal pressures have important implications, as fiscal austerity can increase conflict risk. Hartzell, Hoddie, and Bauer (2010) found that IMF structural adjustment programs involving fiscal austerity increased civil war risk, while Aguirre (2016) demonstrated that countercyclical fiscal policies during resource revenue shocks reduced conflict risk. These findings suggest that managing the fiscal transition away from fossil fuels will be crucial for maintaining stability in dependent states.

Yet, fossil fuel dependence itself has often contributed to violence. Ross (2015) reviews the resource curse literature and finds general agreement that oil wealth increases the risks of civil wars in low and middle-income countries. However, this effect appears limited to onshore oil production and is strongest in relatively poor, ethnic minority regions. This pattern suggests that oil wealth both empowers potential rebels and increases the challenge for states to facilitate a peaceful division of national resources.

Furthermore, Ashford (2022) provides systematic evidence that petrostates are also more likely to engage in interstate warfare. This tendency towards conflict stems from the increased capacity to purchase weapons afforded by oil wealth (Ali 2020; Soubrier 2020; V´ezina 2021), while simultaneously reducing leaders' incentives to engage in international cooperation or pursue constrained foreign policies (Ross and Voeten 2016). Thus, while the energy transition poses significant near-term risks to fossil fuel-dependent states, the long-term reduction in fossil fuel dependence may ultimately decrease the likelihood of violence in these countries.

Climate change mitigation can also affect patterns of violence in places where the scaling of renewable energy production, battery storage, electric vehicles, and other technologies critical to making an energy transition possible makes their extractive industries more, not less, valuable. This dynamic is particularly evident in the critical minerals required for clean energy technologies, such as rare earth metals. When these minerals are mined in contexts where the power of surrounding communities and the workers who mine them is weak, they can become sites of violence – a dynamic often called 'green extractivism' (Bruna 2022; Post and Le Billon 2024). Furthermore, the wealth and geopolitical leverage that these minerals bring to those who control them can affect patterns of violence in ways that are somewhat similar in form, if not in scale, to fossil fuels.

For example, control over the rents from mines has served as an important part – although not the root cause (Chaffetz 2021) – of conflict in the eastern parts of the Democratic Republic of Congo (Burgis 2015; Stearns 2012). Moreover, both the Congolese and Ukrainian presidents have tried, with limited success, to trade access to their countries' energy transition-critical minerals for security guarantees from the United States (see Baranowski, Jabkowski, and Kammen (2025) and Christien and Tshimbombu (2025) for discussions of each case) – a deal that is, at least on the surface, similar to the arrangement that Gulf Cooperation Council (GCC) states have with the U.S.

Geopolitics plays a crucial role in distributing the risks of violence associated with mining minerals essential for an energy transition. Rare earth minerals exemplify this dynamic as key sites of green extractivism. While not geologically scarce (Haskin and Frey 1966), their concentrated production in China (Fan, Omura, and Roca 2023; Park, Tracy, and Ewing 2023) and essential role in renewable energy technologies and electric vehicles has made them strategically vital for decarbonisation efforts. This has generated pressure for other countries to secure supplies from allied nations through 'friendshoring' strategies. However, rare earth mining and processing causes significant environmental damage, which contributed to the decline of the U.S. rare earth industry (Goldman 2014). While friendshoring can involve increased production in wealthy countries (Vivoda and Matthews 2024), securing critical mineral supply chains often means shifting ecological costs onto poorer nations in service of wealthier countries' security objectives (Post and Le Billon 2024). This combination of geographic concentration and growing clean energy demand can drive violent resource extraction practices as states compete to diversify supply chains while reducing emissions (Meehan, Sadan, and Seng Lawn 2025; Walter, Deniau, and Herrera Vargas 2024; Post and Le Billon 2024).

Feedback Loops?

When we combine violence's contribution to climate change with the feedback loops described by Buhaug and von Uexkull (2021), we get the integrated framework shown in Figure 1. This comprehensive view reveals a potentially self-reinforcing cycle. Violence increases greenhouse gas emissions (④), which accumulate in the atmosphere and intensify climate hazards (IPCC 2023). These stronger climate hazards, combined with exposure and violence-induced vulnerability (①, ②, and ③), can then increase the risk of further violence. This creates a feedback loop where violence and climate change may reinforce each other over time.

The strength of this feedback loop is moderated by two key factors. First, there is a significant delay between current emissions and future climate impacts, meaning that this feedback mechanism operates over decades rather than the faster time scales of the armed conflict and climate vulnerability cycles. Second, the most recent IPCC report indicates a crucial distinction in how climate shapes different forms of violence: climate hazards primarily drive intrastate conflicts, while it is interstate military competition that generates significant emissions (IPCC 2023). While intrastate and interstate conflicts are interconnected – through military framing of climate as a 'threat multiplier' requiring future interventions (Center for Naval Analysis 2007; Hendrix et al. 2023) and through the potential for civil wars to escalate into regional tensions or proxy wars (Bellamy 2023) – both the temporal lag and this typological distinction suggest the self-reinforcing dynamic may be weaker than initially apparent.

Additionally, climate change mitigation efforts can either exacerbate or interrupt these feedback loops surrounding climate hazards, vulnerability, and violence. Mitigation policies may trigger violence if they create economic disruption or social tensions, thereby increasing social and climate vulnerability and raising the risk of future climate-related violence. Conversely, well-designed mitigation efforts may reduce violence and slow these vicious cycles. Since most high-conflict-risk regions are low and middle-income countries with limited emissions, climate mitigation will primarily affect them through global market dynamics that reshape their economic constraints and opportunities. How these countries navigate the changing commodity and energy markets – and the political economy surrounding them – will determine whether mitigation contributes to virtuous or vicious cycles.

Policy Implications

Investigating the relationship between violence and anthropogenic climate change reveals several critical implications for meeting the Paris Agreement goal. The first is that either the trend towards increased military activity will have to be reversed (Crawford 2022) or the growing emissions from military activities will require an even more ambitious transition in non-military sectors than currently planned. Military activities contribute 5.5% of the global emissions (Parkinson and Cottrell 2022), and the trajectory of these emissions poses a significant challenge. Based on their submitted strategies to the UNFCCC, Annex I countries (developed nations) must reduce emissions to just 18% of the current levels by 2050 to meet the Paris climate goals (Buck et al. 2023). Among the small subset of non-Annex I countries that included information on residual emissions in their submissions, the corresponding target is 34% (Smith, Vaughan, and Forster 2024). Since militaries lack viable plans for complete decarbonisation (Crawford 2022), these activities risk consuming a disproportionate share of allowable residual emissions. Furthermore, rising global tensions are driving military spending (SIPRI 2024), a trend not well accounted for in current decarbonisation scenarios. This is particularly concerning because military activities are concentrated in the transport and industry sectors, where emission reductions are projected to be far more limited compared to the power sector (Semieniuk et al. 2021).

The second implication for meeting global climate goals is that military spending is consuming an increasing share of government budgets at a time when significant investments are needed to achieve rapid decarbonisation and adaptation. According to SIPRI, global military expenditure rose by 6.8% in 2023 compared to 2022, with governments increasing the military's share of their budgets by 6.1% to accommodate this growth (SIPRI 2024). This fiscal pressure comes at a critical time for climate finance. The Climate Policy Initiative estimates that global mitigation spending must increase from current annual levels of $1.2 trillion to $10.4 trillion by the 2030s (Buchner et al. 2023). So even if rising military expenditure is not directly reducing current climate investments, it constrains governments' fiscal capacity to achieve the necessary massive increase in mitigation funding (Newell 2024).

Given that arms control negotiations are unlikely due to the Russian invasion of Ukraine and the 2026 expiration of major arms treaties (Albertson 2025), one solution to the challenges of increased military spending and production for emissions targets would be integrating allied defence industries to optimise efficiency and free up resources for clean energy investments. This solution is particularly available in Europe, where joint procurement and shared industrial strategy could limit military emissions as well as costs (Doré 2024). However, despite some European leaders' calls for greater integration in response to the Trump administration's unilateral approach to

Ukraine war negotiations (Madhani and Kinnard 2025; Weise, Kayali, and Sorgi 2025), economic protectionism, and sovereignty concerns have actually reduced pan-European cooperation in the past years (Anicetti 2024; Mombelli 2024).

A third implication is that while securitised green industrial policies can accelerate important parts of the energy transition, this tends to occur mainly in service of energy security, not decarbonisation. For example, Chinese energy security concerns have been successful in driving investment and technological innovation into renewable energy (Altenburg, Corrocher, and Malerba 2022). However, there remain serious challenges with trying to phase out coal (Steckel and Jakob 2021; Xu 2021). Similarly, the IRA in the U.S. aims at scaling up renewables while simultaneously setting oil production records (Herman 2024; Peterson 2024). While some suggest that making clean energy increasingly cost-competitive will naturally reduce fossil fuel use, historical evidence indicates that new energy sources have typically supplemented rather than replaced existing ones (Fressoz). Additionally, in sectors like agriculture, where fertiliser production without fossil fuels would require more land and energy resources (Rosa and Gabrielli 2023), energy security and decarbonisation objectives can face competing priorities. Therefore, while security considerations help advance certain crucial elements of the energy transition, there are limits to their contribution to full decarbonisation.

Discussion and Conclusions

This study advances our understanding of violence–climate relationships by developing an integrated framework that combines' Buhaug and von Uexkull (2021)'s vicious circles concept with an analysis of how violence shapes and is shaped by the production of anthropogenic climate change (see Figure 1). Previous research has primarily focused on examining violence as an outcome of climate hazards (IPCC 2023; Suleymanov 2024; Xie et al. 2024). Studies that address climate change mitigation have mostly analysed how specific mitigation projects affect conflict patterns (Cavanagh and Benjaminsen 2014) or focused on documenting military emissions to argue for reducing military activity (Crawford 2022). This framework makes a significant contribution by exploring the role of violence in the broader macro-level political and economic changes associated with mitigating climate change.

Three key findings emerge from this analysis. First, rising military expenditures, driven by increasing levels and risks of interstate violent conflict (Davies, Pettersson, and O¨berg 2023), makes achieving already ambitious emissions targets more challenging. Second, an increasingly violent geopolitical environment is driving climate change mitigation towards industrial policy-focused strategies that emphasise energy security, while simultaneously reducing opportunities for international climate cooperation. Third, climate change mitigation creates risks of violence through two pathways: directly through extractive projects required for renewable energy infrastructure, and indirectly by threatening to destabilise the political economies of states dependent on fossil fuel exports.

The framework presented in this paper is comprehensive in the sense that it creates typologies for how organised violence relates to both the production of climate change and the hazards it creates. Nevertheless, it is limited by the existing evidence, particularly with regard to military data (Rajaeifar et al. 2022). Additionally, I examine only some possible manifestations of the different effects discussed. For instance, my analysis of how climate change mitigation might increase or decrease violence focuses primarily on the energy transition. This omits how developments such as artificial meats, increased vegetarianism, and new fertilisers could trigger profound shifts in agriculture's political economy (e.g., Godfray et al. (2024)) – a sector central to many ongoing conflicts. While such analyses could fit within the channels discussed in this article, they remain unexplored here. This limitation may affect the assessment of the magnitudes presented, which will require updating as more evidence becomes available.

The framework itself does not rely on any strong assumptions from a particular school of international relations. Thus, Marxist, liberal, and feminist scholars of international relations can all engage with the core evidence presented. Nevertheless, scholars working in different traditions may take different implications from this research or see different pathways for future research arising from this framework. For example, liberal internationalists may be interested in exploring how increasing levels of violence reduce the space for international cooperation on climate change, Marxists may want to examine how violence and the security concerns of states alter the process of uneven and combined development through which the energy transition is playing out, and feminists may be interested in the ways that women's organisations play a role in ensuring that climate change mitigation policies do not lead to violence.

Finally, this paper sought to shift research focus towards examining the relationship between violence and the production of anthropogenic climate change. While extensive research addresses climate hazards' effects on conflict risk, empirical evidence suggests these impacts are relatively modest (IPCC 2023; Mach et al. 2019). However, the analysis presented here suggests violence plays a role in shaping the production of anthropogenic climate change that is at least as significant, if not more so. Consequently, there is a need for increased prioritisation of research examining violence's influence on climate change mitigation.

Notes

1. This list included Ukraine, Israel, Sudan, Burkina Faso, Somalia, Myanmar, Nigeria, Ethiopia, and Syria. The emissions figures come from Crippa et al. (2024), which only reports the combined emissions from Israel and Palestine as well as Sudan and South Sudan. Nevertheless, the order of magnitude is likely correct. Russian emissions are excluded from this because the majority of the fighting happened on the internationally recognised territory of Ukraine.
2. The geopolitical implications of these new energy relationships became evident in 2023, when Azerbaijan's position as a key European gas supplier likely influenced the timing of its actions in Nagorno-Karabakh (Zalewski 2023).

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In preparing this manuscript, I utilized Artificial Intelligence (AI) large language models (LLMs), including Claude Opus 3, Claude 3.5 Sonnet, Claude 3.5 Sonnet v2, Claude 3.5 Haiku, Claude 3.7 Sonnet from Anthropic, ChatGPT 3.5 and ChatGPT-4 from OpenAI, and Lumo from Proton. These tools served strictly as writing, coding, translation, and editorial assistants. All content, ideas, and analyses presented in this work are my own and were generated independently of these tools. Additionally, I did not use any LLMs to search for or synthesize existing research.

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References

Adams, C. 2022. Two shades of green: Can the British Army's warfighting division fight and win without fossil fuels in 2050. Technical report. Fort Leavenworth.

Aguirre, A. 2016. Fiscal policy and civil conflict in Africa. *Journal of African Economies* 25 (4):614–36. doi: 10.1093/jae/ejw004.

Ahmed, A., N. Saad Mohamed, E. Edwar Siddig, T. Algaily, S. Sulaiman, and Y. Ali. 2021. The impacts of climate change on displaced populations: A call for action. *The Journal of Climate Change and Health* 3:100057. doi: 10.1016/j.joclim.2021.100057.

Albertson, M. 2025. Life after new START: Navigating a new period of nuclear arms control. *Arms Control Today*.

Aldy, J. E. 2025. How big is the "biggest climate spending bill ever"? Key factors influencing the Inflation Reduction Act's clean energy impacts. *National Tax Journal*. doi: 10.1086/733762 .

Ali, H. E. 2020. Natural resource rents and military expenditures in the Middle East and North Africa: A long-run perspective. In Tan, Andrew T. H (Eds.), *Research handbook on the arms trade* (pp. 115–131). Cheltenham, UK: Edward Elgar Publishing. doi: 10.4337/9781789900996.00016.

Altenburg, T., N. Corrocher, and F. Malerba. 2022. China's leapfrogging in electromobility. A story of green transformation driving catch-up and competitive advantage. *Technological Forecasting & Social Change* 183:121914. doi: 10.1016/j.techfore.2022.121914.

Anicetti, J. 2024. EU arms collaboration, procurement, and offsets: the impact of the war in Ukraine. *Policy studies*. doi: 10.1080/01442872.2024.2324141.

Ashford, E. 2022. *Oil, the state, and war: the foreign policies of petrostates*. Washington D.C., USA: Georgetown University Press.

Astrov, V., A. Kochnev, V. Stamer, and F. Teti. 2024. The Russian economy amidst the war and sanctions. Technical report.

Bang, G. December, 2024. The U.S. Inflation Reduction Act: Climate policy as economic crisis response. *Environmental Politics* 1–22, December. Accessed February 13, 2025. doi: 10.1080/09644016.2024.2437886.

Baranowski, M., P. Jabkowski, and D. M. Kammen. 2025. From the Russian invasion of Ukraine to the battlefield of the future: The geopolitical fit for Ukraine's mineral wealth. *Energy Research and Social Science* 123:104043, 2025. doi: 10.1016/j.erss.2025.104043.

Beaumont, P., and C. de Coning. 2022. Coping with complexity: Toward epistemological pluralism in climate–conflict scholarship. *International Studies Review* 24 (4). doi: 10.1093/isr/viac055.

Beck, S., and M. Mahony. 2018. The IPCC and the new map of science and politics. *WIREs climate change. WIREs Climate Change* 9 (6). doi: 10.1002/wcc.547.

Becker, J., J. P. D. Seth Benson, and E. Malesky. 2024. Disaggregated defense spending: Introduction to data. *Journal of Peace Research*. doi: 10.1177/00223433231215785.

Belcher, O., P. Bigger, B. Neimark, and C. Kennelly. 2020. Hidden carbon costs of the "everywhere war": Logistics, geopolitical ecology, and the carbon boot-print of the US military. *Transactions of the Institute of British Geographers* 45 (1):65–80. doi: 10.1111/tran.12319.

Bellamy, A. J. 2023. Internationalized civil war. In Gruszczak, Artur, Kaempf, Sebastian (Eds.), *Routledge handbook of the future of warfare*, 1st ed (pp. 389-399). London: Routledge, July. Accessed March 3, 2025. doi: 10.4324/9781003299011-41.

Belo, D., and F. Rodr´ıguez. 2023. The conflict in Ukraine and its global implications. *Canadian Foreign Policy Journal* 29 (3):235–48. doi: 10.1080/11926422.2023.2258227.

Birch, M., and L. Van Bergen. 2022. COP27 and the military–industrial complex: No more sidestepping the military emissions gap. *Medicine, Conflict and Survival*. 38 (4):261–65. doi: 10.1080/13623699.2022.2151076.

Bistline, J., G. Blanford, M. Brown, D. Burtraw, M. Domeshek, J. Farbes, A. Fawcett. 2023. Emissions and energy impacts of the inflation reduction act. *science*. doi: 10.1126/science.adg3781.

Block, K., L. Mengyu, J. G¨artner, and L. Manfred. 2025. Geopolitical conflict impedes climate change mitigation. *NPJ Climate Action*. doi: 10.1038/s44168-025-00224-7.

Boyd, R., and A. Ufimtseva. 2021. Facilitating peaceful rise: The increasing role of geopolitics and domestic legitimacy in China's energy policy. *Energy Policy* 158:112532. doi: 10.1016/j.enpol.2021.112532.

Brück, T., M. d'Errico, and R. Pietrelli. 2019. The effects of violent conflict on household resilience and food security: Evidence from the 2014 Gaza conflict. *World Development* 119:203–23. doi: 10.1016/j.worlddev.2018.05.008.

Bruna, N. 2022. A climate-smart world and the rise of green extractivism. *Journal of Peasant Studies* 49 (4):839–64. doi: 10.1080/03066150.2022.2070482.

Buchner, B., B. Naran, R. Padmanabhi, S. Stout, C. Strinati, D. Wignarajah, G. Miao, J. Connolly, and N. Marini. 2023. Global landscape of climate finance 2023. Technical report. Climate Policy Ini- tiative.

Buck, H. J., W. Carton, J. Friis Lund, and N. Markusson. 2023. Why residual emissions matter right now. *Nature Climate Change*. doi: 10.1038/s41558-022-01592-2.

Buhaug, H., T. A. Benjaminsen, E. A. Gilmore, and C. S. Hendrix. 2023. Climate-driven risks to peace over the 21st century. *Climate Risk Management* 39:100471. Accessed March 12, 2025. doi: 10.1016/j.crm.2022.100471.

Buhaug, H., N. Jonas, B. Thomas, T. Böhmelt, M. Br- Zoska, W. B. Joshua, C. Antonio, F. Hanne, G. Erik, P. G. Nils, et al. 2014. One effect to rule them all? A comment on climate and conflict. *Climatic Change* 127 (3–4):391–97. doi: 10.1007/s10584-014-1266-1.

Buhaug, H., and N. von Uexkull. 2021. Vicious circles: Violence, vulnerability, and climate change. *Annual Review of Environment and Resources* 46 (1):545–68, doi: 10.1146/annurev-environ-012220-014708.

Bulletin of the Atomic Scientists. 2024. *A moment of historic danger: it is still 90 seconds to midnight*. https://thebulletin.org/doomsday-clock/current-time/ .

Bun, R., G. Marland, T. Oda, L. See, E. Puliafito, Z. Niew Nahorski, M. Jonas. 2024. Tracking unaccounted greenhouse gas emissions due to the war in Ukraine since 2022. *Science of the Total Environment* 914:169879. doi: 10.1016/j.scitotenv.2024.169879.

Burgis, T. 2015. *The looting machine*. New York, USA: PublicAffiars.

Burke, M., J. Ferguson, S. Hsiang, and E. Miguel. 2024. New evidence on the economics of climate and conflict. In Ray, Debraj, Morelli, Massimo, Dube, Oeindrila, Sjostrom, Tomas (Eds.), Handbook of the economics of conflict (pp. 249-305). Netherlands: Elsevier Science. doi: 10.1016/bs.hoec.2024.10.008.

Burke, M., S. Hsiang, and E. Miguel. 2015. Climate and conflict. *Annual Review of Economics* 7 (1):577–617. doi: 10.1146/annurev-economics-080614-115430.

Cappelli, F., C. Conigliani, D. Consoli, V. Costantini, and E. Paglialunga. 2023. Climate change and armed conflicts in Africa: Temporal persistence, non-linear climate impact and geographical spillovers. *Economia Politica* 40 (2):517–60. doi: 10.1007/s40888-022-00271-x.

Cardona, O. D., M. K. Van Aalst, J. Birkmann, F. Maureen, M. G. Glenn, R. Perez, S. P. Roger, E. L. F. Schipper, T. S. Bach, H. D´ecamps, et al. 2012. Determinants of risk: Exposure and vulnerability. *Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Cavanagh, C., and T. A. Benjaminsen. 2014. Virtual nature, violent accumulation: The 'spectacular failure' of carbon offsetting at a Ugandan national park. *Geoforum* 56:55–65. doi: 10.1016/j.geoforum.2014.06.013.

Center for Naval Analysis. 2007. National security and the threat of climate change. Technical report.

Chaffetz, M. 2021. Disentangling conflict and minerals: How NGOs and lawmakers ought to rebrand their flawed narrative of eastern Congo. *Virginia Journal of International Law* 62:203–234.

Chiu, C.-N. 2025. The cost of war and peace: Evidence from the impact of Russia–Ukraine war on European tourism. *Current Issues in Tourism* 1–11. doi: 10.1080/13683500.2025.2472415.

Chotimah, H. C. 2023. Beyond the struggle of Indonesia for achieving a just energy transition partnership: An analysis from adaptive foreign policy theory. Proceedings of the 2nd International Conference on Democracy and Social Transformation, Semarang, Indonesia. Paris, France: Atlantis Press. doi: 10.2991/978-2-38476-174-616.

Christien, K. T., and T. N. Tshimbombu. 2025. A precarious pact: Scoping the risks of a U.S.-DRC minerals deal amidst instability and balkanization fears. *Open Journal of Business and Management* 13 (4):2769–81. doi: 10.4236/ojbm.2025.134147.

Crane, T. A., A. Delaney, P. A. Tamás, C. Sabrina, and E. Polly. 2017. A systematic review of local vulnerability to climate change in developing country agriculture. *WIREs Climate Change* 8 (4). doi: 10.1002/wcc.464.

Crawford, N. C. 2022. *The Pentagon, climate change, and war: Charting the rise and fall of US military emissions*. Cambridge, Massachusetts, USA: MIT Press.

Crippa, M., D. Guizzardi, F. Pagani, M. Banja, M. Muntean, E. Schaaf, F. Monforti- Ferrario. 2024. *Ghg emissions of all world countries*. Luxembourg: Publications Office of the European Union. doi: 10.2760/4002897.

Daly, M., and S. Borenstein. 2025. *Trump signs executive order directing US withdrawal from the Paris climate agreement — again*, paris-agreement-climate-change–788907bb89fe307a964-be757313cdfb0. https://apnews.com/article/trump-.

Daoust, G., and J. Selby. 2023. Understanding the politics of climate security policy discourse: The case of the Lake Chad Basin. *Geopolitics* 28 (3):1285–322. doi: 10.1080/14650045.2021.2014821.

Davies, S., T. Pettersson, and M. Öberg. 2023. Organized violence 1989– 2022, and the return of conflict between states. *Journal of Peace Research* 60 (4):691–708. doi: 10.1177/00223433231185169.

de Jong, M. 2024. Wind of change: The impact of REPowerEU policy reforms on gas security. *Policy studies*. doi: 10.1080/01442872.2024.2302442.

Donaghy, T., G. Amadeo, and C. Préaux. 2023. Who profits from war: How gas corporations capitalise on war in Ukraine gas industry and governments capitalise on Russia's invasion of Ukraine and lock Europe and the US into fossil fuels reliance. Technical report. Greenpeace.

Doré, A. 2024. Towards a European single defence market? *Future Europe Journal* 5: 2.

Dorn, F. 2024. Defence spending for Europe's security – how much is enough? *Intereconomics*. doi: 10.2478/ie-2024-0042.

Dyck, C. 2024. On thin ice: The Arctic Council's uncertain future. *Marine Policy*. 163:106060. doi: 10.1016/j.marpol.2024.106060.

Ebiede, T. M. 2022. How armed militancy transformed power relations in the oil communities of Nigeria's Niger Delta. *Review of African Political Economy* 49 (174). doi: 10.1080/03056244.2023.2185880.

EDA. 2024. Defense data 2023-2024. Technical report. European Defence Agency, December.

Falkner, R. 2023. Weaponised energy and climate change: Assessing Europe's response to the Ukraine war. *LSE Public Policy Review* 3 (1). doi: 10.31389/lseppr.78.

Fan, J. H., A. Omura, and E. Roca. 2023. Geopolitics and rare earth metals. *European Journal of Political Economy* 78:102356. doi: 10.1016/j.ejpoleco.2022.102356.

Findlay, A. 2022. Fighting climate change. *Nature Climate Change (July)* 12 (7):619–619. doi: 10.1038/s41558-022-01392-8.

Fressoz, J.-B. 2024. More and more and more: An all-consuming history of energy. London, UK: Penguin Random House.
Galtung, J. 1969. Violence, peace, and peace research. *Journal of Peace Research* 6 (3):167–91. doi: 10.1177/002234336900600301.
GAO. 2024. F-35 sustainment: Costs continue to rise while planned use and availability have decreased. Technical report. U.S. Government Accountability Office.
Gatti, N., K. Baylis, and B. Crost. 2021. Can irrigation infrastructure mitigate the effect of rainfall shocks on conflict? Evidence from Indonesia. *American Journal of Agricultural Economics* 103 (1):211–31. doi: 10.1002/ajae.12092.
Germann, J. 2023. Wrestling with unevenness: Sino-American rivalry, state strategy and the reformation of German capitalism. *Global Political Economy* 2 (1):77–97, 9. doi: 10.1332/WDGH8153.
Gilmore, E., and H. Buhaug. 2021. Climate mitigation policies and the potential pathways to conflict: Outlining a research agenda. *Wiley Interdisciplinary Reviews. Climate Change* 12 (5). doi: 10.1002/wcc.722.
Giuli, M., and S. Oberthür. 2023. Third time lucky? Reconciling EU climate and external energy policy during energy security crises. *Journal of European In- tegration* 45 (3):395–412. doi: 10.1080/07036337.2023.2190588.
Godfray, H., J. Charles, J. Poore, and H. Ritchie. 2024. Opportunities to produce food from substantially less land. *BMC Biology* 22 (1). doi: 10.1186/s12915-024-01936-8.
Goldman, J. A. 2014. The U.S. rare earth industry: Its growth and decline. *Journal of Policy History (April)* 26 (2):139–66. doi: 10.1017/S0898030614000013.
Gulliver, R. E., R. Banks, K. S. Fielding, and W. R. Louis. 2023. The criminalization of climate change protest. *Contention*. 10.3167/cont.2023.110103.
Gupta, S. 2024. Biden-Xi Woodside summit and the slow rehabilitation of US-PRC ties. *Comparative connections*.
Högbladh, S. 2024. *UCDP GED codebook version 24.1*.
Hadjimatheou, K. 2023. Surveillance, democracy, and protest in a time of climate crisis. In *The ethics of surveillance in times of emergency*, ed. K. Macnish and A. Henschke, 1st ed (pp. 132–149). Oxford, UK: Oxford University PressOxford, doi: 10.1093/oso/9780192864918.003.0009.
Hartmann, B. 2014. Converging on disaster: Climate security and the Malthusian anticipatory regime for Africa. *Geopolitics* 19 (4):757–83. doi: 10.1080/14650045.2013.847433.
Hartzell, C. A., M. Hoddie, and M. Bauer. 2010. Economic liberalization via IMF structural adjustment: Sowing the seeds of civil war? *International Organization*. doi: 10.1017/S0020818310000068.
Haskin, L. A., and F. A. Frey. 1966. Dispersed and not-so-rare earths: The relative abundances of these elements reflect the earth's geochemical evolution from primordial matter. Science, doi: 10.1126/science.152.3720.299.
Hastings, J., and D. Ubilava. March 18. 2025. Agricultural roots of social conflict in Southeast Asia. Journal of Peace Research. doi: 10.1177/00223433241305990.
Helveston, J. P., G. He, and M. R. Davidson. 2022. Quantifying the cost savings of global solar photovoltaic supply chains. *Nature* 612 (7938):83–87, doi: 10.1038/s41586-022-05316-6.
Hemmelder, A., T. Frank, L. Simon, L. Jens, J. Lars, and V. D. Stephan. 2025. The geostrategic race for leadership in future electric vehicle battery technologies. *Energy & Environmental Science* 18 (12):6117–30. doi: 10.1039/D5EE00301F.
Hendrix, C. S., V. Koubi, J. Selby, A. Siddiqi, and N. von Uexkull. 2023. Climate change and conflict *Nature Reviews Earth & Environment*. doi: 10.1038/s43017-022-00382-w.
Herman, K. S. 2024. Biden's climate agenda: The most ambitious ever, or overlooking key technological bottlenecks? *Sustainable Futures*. 7:100209, doi: 10.1016/j.sftr.2024.100209.

Hobbs, P. V., and L. F. Radke. 1992. Airborne studies of the smoke from the Kuwait oil fires *science*, May. Accessed March 20, 2025. doi: 10.1126/science.256.5059.987.

Horton, R. 2023. Offline: Why we must make peace with China. *Lancet*. doi: 10.1016/S0140-6736(23)00291-X.

Ide, T. 2023. *Catastrophes, confrontations, and constraints: how disasters shape the dynamics of armed conflicts*. Cambridge, Massachusetts, USA: MIT Press.

Libya. 2025. Accessed June 30, 2025. https://www.iea.org/countries/libya/emissions#what-are-the-main-sources-of-co2-emissions-in-libya.

IPCC. 2023. *Climate change 2022 – impacts, adaptation and vulnerability: working group II contribution to the sixth assessment report of the Intergovernmental Panel on Climate Change*, 1st ed. Cambridge University Press. doi: 10.1017/9781009325844.

Ismay, J., T. Gibbons-Neff, and C. J. Chivers. December., 2017. How ISIS produced its cruel arsenal on an industrial scale. *New York Times*.

Jackson, M. M., J. I. Lewis, and X. Zhang. 2021. A green expansion: China's role in the global deployment and transfer of solar photovoltaic technology. *Energy for Sustainable Development* 60:90–101, doi: 10.1016/j.esd.2020.12.006.

Javeline, D., R. Orttung, G. Robertson, R. Arnold, A. Barnes, L. Henry, E. Holland. 2024. Russia in a changing climate. *WIREs Climate Change*. doi: 10.1002/wcc.872.

Jensen, L. 2024. The economic and fiscal transition costs of global climate mitigation in fossil fuel export dependent economies. *Resources Policy* 96:105234, doi: 10.1016/j.resourpol.2024.105234.

Jorgenson, A. K., B. Clark, R. P. Thombs, J. Kentor, J. E. Givens, X. Huang, H. El Tinay, D. Auerbach, and M. C. Mahutga. 2023. Guns versus climate: How militarization amplifies the effect of economic growth on carbon emissions. *American Sociological Review (June)*. Accessed Febru- ary 10, 2025. 88 (3):418–53. doi: 10.1177/00031224231169790.

Kallbekken, S., and D. G. Victor. 2022. A cleaner future for flight — aviation needs a radical redesign. *Nature* 609 (7928):673–75, September. doi: 10.1038/d41586-022-02963-7.

Koubi, V. 2019. Climate change and conflict. *Annual Review of Political Science* 22 (1):343–60. doi: 10.1146/annurev-polisci-050317-070830.

Krieg, A. 2024. The war in Gaza, the decline of US leadership and the emergence of a networked regional order. *Mediterranean Politics* 30 (4):892–901, doi: 10.1080/13629395.2024.2358618.

Kumar, M. 2024. Violent transitions: Towards a political ecology of coal and hydropower in India. *Climate and Development (October)* 16 (9):751–61. doi: 10.1080/17565529.2023.2264259.

Lau, S. 2022. China suspends climate talks with US. POLITICO. https://www.politico.eu/article/china-suspends-climate-talks-with-us/.

Li, C., and X. Zhao. 2023. Renewable energy should not be the next semiconductor in US-China competition. Technical report.

Limon, O., and E. Gürdal Limon. 2024. The impact of the Ukraine war on Russian military capabilities in the Arctic. *Polar Geography*. 47 (3):157–78. doi: 10.1080/1088937X.2024.2399003.

Mach, K. J., C. M. Kraan, W. Neil Adger, H. Buhaug, M. Burke, J. D. Fearon, C. B. Field, C. S. Hendrix, J.-F. Maystadt, J. O'Loughlin, et al. 2019. Climate as a risk factor for armed conflict. *Nature* 571 (7764):193–97. doi: 10.1038/s41586-019-1300-6.

Mack, E. A., A. M. Richard, B. Erin, R. Amanda, Z. Andrew, C. Z. Leo, E. Liliana Gómez Fern ´andez, H. Jay, and M. H. Geoffrey. 2022. A systematic literature review of quantitative studies assessing the relationship between water and conflict on the African continent. *Sustainability* 14 (22):14912. doi: 10.3390/su142214912.

Maconga, C. W. 2023. Arid fiields where conflict grows: How drought drives extremist violence in Sub-Saharan Africa. *World Development Perspectives* 29:100472, doi: 10.1016/j.wdp.2022.100472.
Madhani, A., and M. Kinnard. February., 2025. *Ukraine and Europe worry about being sidelined as Trump pushes direct talks with Russia on war's end*. https://apnews.com/article/trump-ukraine-russia-war-putin-zelenskyy-europe-7940f9c5828fc46431928bc073170bc2.
Maka, A. O. M., and J. M. Alabid. 2022. Solar energy technology and its roles in sustainable development. *clean energy*. doi: 10.1093/ce/zkac023.
Marciel, S. August., 2023. The high stakes of Indonesia's $20 billion just energy transition partnership. *The Diplomat*. https://thediplomat.com/2023/08/the-high-stakes-of-indonesias-20-billion-just-energy-transition-partnership/.
Martin-Shields, C. P., and W. Stojetz. 2019. Food security and conflict: Empirical challenges and future opportunities for research and policy making on food security and conflict. *World Development* 119:150–64. doi: 10.1016/j.worlddev.2018.07.011.
Matallah, S., K. Zerigui, and A. Matallah. 2024. Renewable energy solutions to the lack of access to electricity in conflict-ridden countries: A case study of Yemen. *Energy* 296:131233, doi: 10.1016/j.energy.2024.131233.
Mednick, S., W. Mcmakin, and M. Pronzcuk. 2025. USAID cuts are already hitting countries around the world. Here are 20 projects that have closed. *assotiated press*.
Meehan, P., M. Sadan, and D. Seng Lawn. 2025. The Myanmar borderlands as a green energy transition 'sacrifice zone': A case study of rare earth mining in Kachin State. *Extractive Industries and Society* 22:101579. doi: 10.1016/j.exis.2024.101579.
Michaelowa, A., T. Koch, D. Charro, and C. Gameros. 2022. Military and conflict-related emissions: Kyoto to Glasgow and beyond. doi: 10.5167/UZH-230045.
Michelini, S., B. Šedová, J. Schewe, and K. Frieler. 2023. Extreme weather impacts do not improve conflict predictions in Africa. *Humanities and Social Sciences Communications*, pp.1996–1. doi: 10.1057/s41599-023-0.
Miller, C. 2022. *Chip war: the fight for the world's most critical technology*. US: Scribner.
Mombelli, S. 2024. Defense burden sharing and military cooperation in the EU27: A descriptive analysis (2002–2023). *Peace Economics Peace Science and Public Policy* 30 (4):423–53, doi: 10.1515/peps-2024-0050.
Moritsugu, K. November., 2023. *China and the US pledge to step up climate efforts ahead of Biden-Xi summit and UN meeting*, Accessed February 17, 2025. https://apnews.com/article/climate-china-us-apec-methane-5220b972f7d63cc58dbdbde4a166c9c8.
Nadiruzzaman, M., H. J. S. Jürgen Scheffran, and K. Stefanie. 2022. Conflict-sensitive climate change adaptation: A review. *Sustainability* 14 (13):8060. doi: 10.3390/su14138060.
Nagano, T., and T. Sekiyama. 2023. Review of vulnerability factors linking climate change and conflict. *Climate*. doi: 10.3390/cli11050104.
Newell, P. 2024. Towards a more transformative approach to climate finance. *Climate Policy*. doi: 10.1080/14693062.2024.2377730.
Öhman, A., K. Emrah, and U. Frauke. 2022. Enabling the transition to a fossil-free steel sector: The conditions for technology transfer for hydrogen-based steelmaking in Europe. *Energy Research & Social Science*. doi: 10.1016/j.erss.2021.102384.
Oberthür, S., and V. H. Ingmar. 2023. From emissions trading to the European green deal: The evolution of the climate policy mix and climate policy integration in the EU. *Journal of European Public Policy* 30 (3):445–68, March.
Olhoff, A., C. Bataille, J. Christensen, M. Den Elzen, T. Fransen, N. Grant, K. Blok. 2024. Emissions gap report 2024: No more hot air . . . please! With a massive gap between rhetoric and reality, countries draft new climate commitments. *United Nations Environment Programme*. doi: 10.59117/20.500.11822/46404.

Omoogun, A., T. E. Olayemi, and T. Ogungbade. 2021. Environmental pollution and its ecological consequences on the Niger Delta: A review of the literature. *African Journal of Environment and Natural Science Research*. doi: 10.52589/AJENSR-BJGGACSV.

Otto, I. M., D. Reckien, C. P. O. Reyer, R. Marcus, V. Le Masson, L. Jones, A. Norton, and O. Serdeczny. 2017. Social vulnerability to climate change: A review of concepts and evidence. *Regional Environ- Mental Change* 13–017–1105–9. doi: 10.1007/s101.

Overland, I. 2022. Russia's invasion of Ukraine: Consequences for global decarbonization. *Russian Analytical Digest*. doi: 10.3929/ethz-b-000550755.

Park, S., C. L. Tracy, and R. C. Ewing. 2023. Reimagining US rare earth production: Domestic failures and the decline of US rare earth production dominance – lessons learned and recommendations. *Resources Policy* 85:104022. doi: 10.1016/j.resourpol.2023.104022.

Parkinson, S February., 2021. Under the radar the carbon footprint of Europe's military sectors: A scoping study. Technical report. Conflict and Environment Observatory, February.

Parkinson, S., and L. Cottrell. 2022. Estimating the military's global greenhouse gas emissions. Technical Report. *Conflict and Environment Observatory*. 7:2025.

Paukkunen, S., and J. Black. 2024. Arctic cooperation with Russia: At what price?. International Affairs. doi: 10.1093/ia/iiae226.

Peterson, K. November., 2024. *U.S. crude oil production established a new record in August 2024*, Accessed February 14, 2025. https://www.eia.gov/todayinenergy/detail.php?id=63824.

Petrova, K., O. Gudlaug, H. Hegre, and A. G. Elisabeth. 2023. The 'conflict trap' reduces economic growth in the shared socioeconomic pathways. *Environmental Research Letters (February)* 18 (2):024028. doi: 10.1088/1748-9326/acb163.

Pirani Simon. 2018. *Burning up: a global history of fossil fuel consumption*. London, UK: Pluto Press.

Poland, C. 2021. The Air Force partners with twelve, proves it's possible to make jet fuel out of thin air. *Air Force Operational Energy*.

Post, E., and P. Le Billon. 2024. The 'green war': geopolitical metabolism and green extractivisms. *Geopolitics*, doi: 10.1080/14650045.2024.2385411.

Rajaeifar, M. A., O. Belcher, S. Parkinson, B. Neimark, D. Weir, K. Ashworth, R. Larbi, and O. Heidrich. 2022. Decarbonize the military — mandate emissions reporting. *Nature* 611 (7934):29–32, November. doi: 10.1038/d41586-022-03444-7.

Robertson, P. E. 2024. The military rise of China: The real defence budget over two decades. *Defence and Peace Economics* 35 (7):809–25, October. Accessed February 14, 2025. doi: 10.1080/10242694.2024.2342043.

Rogelj, J., T. Fransen, M. G. J. Den Elzen, R. D. Lamboll, C. Schumer, T. Kuramochi, F. Hans, S. Mooldijk, and J. Portugal-Pereira. 2023. Credibility gap in net-zero climate targets leaves world at high risk. *Science* 380 (6649):1014–16, June. Accessed December 19, 2024. doi: 10.1126/science.adg6248.

Roger, S. 2024. Manchin pulls curtain back on battle for EV-boosting IRA. *Wards100*. July.

Rosa, L., and P. Gabrielli. 2023. Energy and food security implications of transitioning synthetic nitrogen fertilizers to net-zero emissions. *Environmental Research Letters* 18 (1):014008, January. Accessed February 20, 2025. doi: 10.1088/1748-9326/aca815.

Ross, M. L. 2015. What have we learned about the resource curse? *Annual Review of Political Science* 18 (1):239–59. doi: 10.1146/annurev-polisci-052213-040359.

Ross, M. L., and E. Voeten. 2016. Oil and international cooperation. *International Studies Quarterly*, March. Accessed March 19, 2025. doi: 10.1093/isq/sqv003.

Sanger, D. 2025. Europe's new reality: Trump may not quit NATO, but he's already undercutting it. *New York Times* (February). Accessed February 21, 2025.

Schleussner, C. F., J. F. Donges, R. V. Donner, and H. Joachim Schellnhuber. 2016. Armed-conflict risks enhanced by climate-related disasters in ethnically fractionalized countries. Proceedings of the National Academy of Sciences 113(33): 9216–9221. doi: 10.1073/pnas.1601611113.

Schneider, E. 2023. Germany's industrial strategy 2030, EU competition policy and the crisis of new constitutionalism. (Geo-)political economy of a contested paradigm shift. *New Political Economy*.

Selby, J. 2014. Positivist climate conflict research: A critique. *Geopolitics* 19 (4):829–56. doi: 10.1080/14650045.2014.964865.

Selby, J., G. Daoust, and C. Hoffmann. 2022. *Divided environments: an international political ecology of climate change, water and security*. Cambridge, UK: Cambridge University Press.

Selby, J., and C. Hoffmann. 2014. Rethinking climate change, conflict and security. *Geopolitics* 19 (4):747–56. doi: 10.1080/14650045.2014.964866.

Selby, J., S. D. Omar, C. Fr¨ohlich, and H. Mike. 2017. Climate change and the Syrian civil war revisited. *Political Geography* 60:232–44. doi: 10.1016/j.polgeo.2017.05.007.

Semieniuk, G., L. Taylor, A. Rezai, and D. K. Foley. 2021. Plausible energy demand patterns in a growing global economy with climate policy. *Nature Climate Change*. doi: 10.1038/s41558-020-00975-7.

Shah, S. February, 2025. *How Trump is trying to undo the inflation reduction act*, Accessed March 3, 2025. https://time.com/7262600/how-trump-is-trying-to-undo-the-inflation-reduction-act/.

Shugurov, M. 2023. International cooperation on climate research and green technologies in the face of sanctions: The case of Russia. *Green Finance*. 10.3934/GF.2023006.

Simola, H. 2024. Russia's wartime investment boom. Bofit policy brief. Bank of Finland.

SIPRI. April, 2024. Sipri military expenditure database.

Sitati, A., E. Joe, B. Pentz, C. Grayson, C. Jaime, E. Gilmore, E. Galappaththi. 2021. Climate change adaptation in conflict-affected countries: A systematic assessment of evidence. *Discover Sustainability* 2 (1). doi: 10.1007/s43621-021-00052-9.

Smith, H. B., N. E. Vaughan, and J. Forster. 2024. Residual emissions in long-term national climate strategies show limited climate ambition. *One Earth* 7 (5):867–84. doi: 10.1016/j.oneear.2024.04.009.

Smith, R. P. 2014. The economic costs of military conflict. *Journal of Peace Research* 51 (2):245–56, 2025. doi: 10.1177/0022343313496595.

Smith, W. 2022. Climates of control: Violent adaptation and climate change in the Philippines. *Political Geography*. 99. doi: 10.1016/j.polgeo.2022.102740.

Soubrier, E. 2020. The weaponized Gulf riyal politik(s) and shifting dynamics of the global arms trade. *The Economics of Peace and Security Journal (April)* 15 (1). doi: 10.15355/epsj.15.1.49.

Stearns, J. 2012. *Dancing in the glory of monsters: The collapse of the Congo and the Great War of Africa*. Public affairs.

Stechemesser, A., L. Wenz, M. Kotz, and A. Levermann. 2021. Strong increase of racist tweets outside of climate comfort zone in Europe. *Environmental Research Letters* 16 (11):114001. doi: 10.1088/1748-9326/ac28b3.

Steckel, J. C., and M. Jakob. 2021. The political economy of coal: Lessons learnt from 15 country case studies. *World Development Perspectives* 24:100368. doi: 10.1016/j.wdp.2021.100368.

Suleymanov, F. 2024. A review of the multifaceted relationship between drought dynamics and conflicts. *Hydrological Processes* 38 (9). doi: 10.1002/hyp.15262.

Svarstad, H., and T. A. Benjaminsen. 2017. Nothing succeeds like success narratives: A case of conservation and development in the time of REDD. *Journal of Eastern African Studies* 11 (3):482–505. doi: 10.1080/17531055.2017.1356622.

Syropoulos, C., G. Felbermayr, A. Kirilakha, E. Yalcin, and Y. V. Yotov. 2024. The global sanctions data base–release 3: COVID-19, Russia, and multilateral sanctions. *Review of International Economics*. 32 (1):12–48. doi: 10.1111/roie.12691.

Taylor, G. 2025. *EU shifts climate dollars to military spending as Trump upends U.S. foreign policy*, https://www.theenergymix.com/eu-shifts-climate-dollars-to-military-spending-as-trump-upends-u-s-foreign-policy/.

Tocci, N. 2023. Europe and Russia's invasion of Ukraine: Where does the EU stand? *LSE Public Policy Review* 3 (1). doi: 10.31389/lseppr.79.

U.N. News. November., 2024. *Cop29 climate talks end with $300 billion annual pledge, Guterres calls deal a 'base to build on'*, Accessed March 19, 2025. https://news.un.org/en/story/2024/11/1157416.

USD A&S. 2023. The Department of Defense plan to reduce greenhouse gas emissions. Technical report. Office of the Under Secretary of Defense for Acquisition and Sustainment. Accessed February 7, 2025.

V´ezina, P.-L. 2021. The oil nouveau-riche and arms imports. *Journal of African Economies* 30 (4):349–69, August. doi: 10.1093/jae/ejaa017.

Verhoeven, H. 2011. Climate change, conflict and development in Sudan: Global neo-Malthusian narratives and local power struggles. *Development & Change* 42 (3):679–707. doi: 10.1111/j.1467-7660.2011.01707.x.

Vivoda, V., and R. Matthews. 2024. "Friend-shoring" as a panacea to Western critical mineral supply chain vulnerabilities. *Mineral Economics* 37 (3):463–76, September. Ac August 7, 2025. doi: 10.1007/s13563-023-00402-1.

Vogler, A. 2024. On (in-)secure grounds: How military forces interact with global environmental change. *Journal of Global Security Studies* 9 (1). January. Accessed February 14, 2025. doi: 10.1093/jogss/ogad026.

von Uexkull, N., and H. Buhaug. 2021. Security implications of climate change: A decade of scientific progress. *Journal of Peace Research* 58 (1):3–17, January. doi: 10.1177/0022343320984210.

Vuong, Q.-H., M.-H. Nguyen, and V.-P. La. 2024. The overlooked contributors to climate and biodiversity crises: Military operations and wars. *En- Vironmental Management*. June. Accessed February 17, 2025. doi: 10.1007/s00267-024-01976-4.

Walter, M., Y. Deniau, and V. Herrera Vargas. 2024. The politics of 'green' extraction frontiers: Mapping metals and mineral mining conflicts related to the energy transition in the Americas. *Critical Sociology*. December. Accessed February 18, 2025. doi: 10.1177/08969205241305963.

Wang, Q., R. Li, S. Hu, and M. Su. 2023. Prolonged war reverses carbon emissions from an early decline to a late increase – evidence from Syria. *Journal of environmental management*, November. Accessed March 20, 2025.

Weise, Z., L. Kayali, and G. Sorgi. 2025. *Von der Leyen floats EU effort to finance missiles, ammunition and air defense*. Accessed March 3, 2025. https://www.politico.eu/article/ursula-von-der-leyen-eu-defense-finance-missiles-ammunition-air-defense/.

World Bank. 2025. *Global economic prospects, January 2025*. Global economic prospects. World Bank. Accessed February 10, 2025.

Xie, H. 2021. China's oil security in the context of energy revolution: Changes in risks and the hedging mechanism. *American Journal of Industrial and Business Management* 11 (9):984–1008. doi: 10.4236/ajibm.2021.119060.

Xie, X., H. Mengmeng, F. Ding, J. S. Tobias Ide, J.-F. Maystadt, Y. Qian. 2024. The impacts of climate change on violent conflict risk: A review of causal pathways. *Environmental Research Communications* 6 (11):112002, October. Accessed October 25, 2024. doi: 10.1088/2515-7620/ad8a21.

Xu, S. 2021. The paradox of the energy revolution in China: A socio-technical transition perspective. *Renewable and Sustainable Energy Reviews* 137:110469, March. Accessed June 30, 2025. doi: 10.1016/j.rser.2020.110469.

Yalcin, E., G. Felbermayr, H. Kariem, A. Kirilakha, K. Ohyun, C. Syropoulos, and Y. Yotov. 2024. The global sanctions data base - release 4: The heterogeneous effects of the sanctions on Russia. School of Economics Working Paper Series. LeBow College of Business, Drexel University, June.

Yang, Q.-C., M. Zheng, J.-S. Wang, and Y.-P. Wang. 2022. The shocks of armed conflict to renewable energy finance empirical evidence from cross-country data. *Energy Economics* 112:106109, August. Accessed August 7, 2025. doi: 10.1016/j.eneco.2022.106109.

Yuan, H., L. Zhao, and M. Umair. 2023. Crude oil security in a turbulent world: China's geopolitical dilemmas and opportunities. *The Extractive In- dustries and Society* 16:101334, December. Accessed June 30, 2025. doi: 10.1016/j.exis.2023.101334.

Yuan, L., A. Farina, and A. Anctil. 2024. How will manufacturing capacity additions in China and North America affect the carbon footprint of silicon photovoltaics? *Sustainable Production and Consumption* 49:236–48, September. Accessed December 23, 2024. doi: 10.1016/j.spc.2024.06.014.

Zabanova, Y. 2024. The EU in the global hydrogen race: Bringing together climate action, energy security, and industrial policy. In *The geopolitics of hydrogen*, ed. R. Quitzow and Y. Zabanova (pp. 15-47). Cham: Springer Nature Switzerland. Accessed February 13, 2025. doi: 10.1007/978-3-031-59515-8. 2.

Zalewski, N. 2023. "Azerbaijani natural gas: The European Union's dependency on natural gas from nations in conflict in Perspectives on the EU's eastern neigh- borhood. Proceedings of the Third Edition of the International Conference The European Union's External Relations and the Global Order (EUXGLOB), ed. V. Naumescu, R. Moldovan, and A. F. Caloianu, Cluj- Napoca.

Zhang, Q., Y. Hu, J. Jiao, and S. Wang. 2024. The impact of Russia– Ukraine war on crude oil prices: An EMC framework. *Humanities and Social Sciences Communications*. January. Accessed June 30, 2025. doi: 10.1057/s41599-023-02526-9.

Zhu, T., and L. Wang. 2020. *State energy transition*. Singapore: Springer Singapore. doi: 10.1007/978-981-32-9499-8.