



EU ARMED FORCES AT THE CROSSROADS:

How to strategically integrate the green
approach into European defence

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Summary

Now that Europe has recovered from the Russian attempts at fossil fuelled extortion, the current situation in the Red Sea is once again showing how fragile international fossil fuel supply chains are.

After the Iranian-backed Houthi rebels attacked a Norwegian-flagged oil tanker and other ships, oil giants such as BP suspended transit to Europe until further notice or rerouted the tankers via the Horn of Africa. Every military is at a standstill without the constant supply of climate-damaging fossil fuels. But that doesn't have to be the case.

Powerful armed forces that provide a credible deterrent are often regarded as inherently incompatible with a 'green' approach to defence. Yet, the recent surge in European defence spending requires an urgent green reframing to avoid reverting to the same fossil fuel dependencies as before the war in Ukraine and creating new energy-based and climate risks.

Green defence is an interdisciplinary, comprehensive and forward-looking notion of integrated military effectiveness that goes far beyond civilian green efforts, while improving or maintaining combat power.

The EU has made considerable progress in recent years. A Joint Communication to the European Parliament and the Council on the topic, of June 2023, proposes many far-sighted measures and policies. Nevertheless, some important points are unclearly formulated, underdeveloped or missing from the current agenda.

Taking a holistic and long-term view, this Policy Brief shows that there is no alternative to greening defence in EU Member States. It recommends a cluster of policies on strategic, interconnected research and development to support the entirety of the EU's current approaches. The future of EU defence is at a crossroads right now and we shouldn't miss the potential for disruptive change!



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Major tasks for the future of EU defence

The second winter in the horrific war currently raging in Europe is already upon us. The eyes of policymakers have focused on buying new military hardware as quickly as possible to transform the EU's external border into a credible red line. Rightly so; however, questions remain. Will the expensive equipment also be able to protect us against threats beyond the end of the war? Should the EU practise joint defence procurement in a way that also promotes and integrates innovative green technologies and production processes? The current wave of investment creates great opportunities for the armed forces of EU Member States, but also **pitfalls when planning solely accounts for the near future.**

We should heed the lessons of Russia's invasion. The EU was startled by the realisation that energy-based economic interdependence did not deter, but rather encouraged, conflict with Russia. This made the EU's energy self-sufficiency a priority.

Armed forces are not exempt from this pressure; they too could become more resilient by switching to locally produced renewable energy and fuels. **Resilience in armed forces is essential**, as it ensures credible deterrence and the fulfilment of any armed force's core mission: to provide reliable security even in unpredictable situations and rapidly changing environments. This truth also applies to a world heavily impacted by climate change. The objectives of mitigation and adaptation in defence are therefore not only compatible but also inherently interconnected.

In 2019, the emissions of **armed forces in EU Member States** totalled almost as much as the emissions of **Latvia, Estonia and Lithuania** combined. Furthermore, military emissions are reported voluntarily to the United Nations Framework Convention on Climate Change (UNFCCC), with few countries publishing or collecting comprehensive data on such emissions. The **military emissions gap** in the UNFCCC reports is believed to be huge – with some estimates of up to **5.5% of global greenhouse gas (GHG) emissions** for the world's armed forces, excluding direct and indirect emissions associated with warfare itself. Only now do the EU and NATO want to close this significant gap and find out exactly how much their respective defence sectors actually emit. Attention must also be paid to including the entire supply chain of the military-industrial complex.

If European defence procurement takes a wrong turn now, we will largely remain dependent on fossil fuels for military projects for decades to come, even when alternative technologies and systems are long available on the civilian market.

Sustainable, low-carbon technologies also have tactical and financial advantages in the long term. Although alternatives such as e-fuels or second-generation biofuels can be used by non-modified fossil engines, the necessary accompanying infrastructure is absent. Furthermore, in the military context, civilian innovations must usually be further adapted or developed before they can be implemented. Consequently, there is no way around green-by-design equipment and far-reaching strategy transformations in the military.

Many of these aspects can also be found in the EU's new publications. But what prevents a tangible **revolution towards green defence** is a lack of political coordination and central guidance of the many actors involved.

At present, the EU's approaches to green defence remain disjointed and do not **take advantage of low-hanging fruit**, such as thermal insulation and solar power for barracks and off-the-shelf electric cars in the armed forces' fleet. Instead of one after the other, long-term projects must be tackled simultaneously.

Armed forces need to be prepared to respond to climate change-induced conflicts and disasters without exacerbating them. So, when talking about transformative technologies for new hardware in the defence sector, it is also important to remember that **tomorrow's military will not only have to be low-carbon, but will also have to help with increasingly frequent and severe environmental disasters.**

What is green defence and why is it important now?

The climate-security nexus

The global community has consistently **missed the mark on reducing emissions** to limit a global temperature rise to 1.5°C by the end of the century. This makes it reasonable to expect that climate change will only intensify.

As this occurs, new (violent) conflicts will emerge while extant conflicts will be amplified due to intensified competition over precious and basic resources and large-scale migration. **Water** in particular plays a decisive role here. Environmental disasters such as **droughts** or weather patterns like the **current El Niño** have an impact on regional security. Through disrupted supply chains, regional extreme weather events further affect other parts of the world.

These disruptions, which are already being observed in regions such as [Sub-Saharan Africa](#), demonstrate the climate-security nexus: the mutual amplification and influence of climate change and conflict-based insecurity. Violent conflicts often deprive affected actors of the [opportunity to prepare for and recover from climate shocks](#). Even so, the relationship between climate change and conflict continues to be hotly debated in academic discourse and is generally considered to be non-linear, complex and thus very difficult to predict.

Meanwhile, national efforts to reduce GHGs are often undermined by warfare itself. Overall, this can lead to self-reinforcing cycles that are difficult to break out of. The climate-security nexus was discussed in depth at an Environment & Development Resource Centre [event in 2019](#), which included representatives from the EU and NATO. It concluded that a warmer world will have a large impact on military operations, mission planning and equipment.

Climate change and the associated global warming are often understood as linear, when in reality we are entering uncharted territory with potentially catastrophic effects for humans, animals and the environment. Thus, any efforts to reduce emissions, which should have been seriously addressed decades ago, must always be combined with intensive mitigation and adaptation efforts for cross-sectoral resilience. The EU is already working on [climate change mitigation](#) and in 2021 the European Commission adopted a new [strategy on adaptation to climate change](#). The EU's definitions of the two mechanisms should be used more widely in EU green defence efforts. We have seen this increasingly over the past year.

Introducing green defence

Inevitably, the militaries of many states will become involved in climate-induced and amplified conflict management. Yet, there is a conundrum. In the same states, the military is usually one of the largest single emitters directed by government. The basic operations of armed forces inherently contribute to climate insecurity through the energy- and resource-intensive production and maintenance of military hardware and the environmental degradation that follows deployments and wars. Simultaneously, as made clear by Russia's invasion, dependence on fossil fuel imports can become a national security threat.

In response, EU Member States have allocated **EUR 200 billion** to revitalising and upgrading their militaries. However, if these **investments occur without applying green defence principles**, EU Member States will have to **spend more money in the future**.

Consequently, the concept of **green defence** becomes relevant: **maintaining or upgrading military hardware operationality and conduct while lowering the overall climate impact**. A reduction of the climate impacts is achieved by, for example, limiting carbon footprints and environmental degradation. While in military circles some resist greening due to fears of reduced operational effectiveness, the concept of green defence places effectiveness first, searching for synergies between innovative green technologies and security goals. In turn, a green military will add to adaptation efforts through the development and integration of new technologies and policies in preparation for responses to impending disasters.

Just because we live in a world of fossil path dependencies does not mean that modern 'green technologies' in the defence sector cannot deliver substantial strategic and tactical advantages. Choosing between a fossil and a renewable path is scientifically an illusion. Even if the global community had achieved its climate goals, most environmental systems would continue to suffer before a slow regeneration can begin. Moreover, current climate projections do not account for cascading effects, leading to an underestimation of the speed and intensity of actual climate change.

The push and pull mechanisms of green defence

The importance of green defence stems from push factors such as the closing window to effectively counter climate change. There are also economic, political, strategic and tactical pull factors.

Moving away from fossil fuels makes us less dependent on unreliable energy suppliers. This is possible through electricity, but also by **blending second-generation biofuel** with conventional vehicle or aviation fuel. Wind and solar energy in the field, as well as **mobile hydrogen-synthesis containers**, reduce the vulnerability and logistical demands of fuel supply, while saving costs. Modern and intelligent microgrids can operate field camps flexibly and efficiently. All the while, the **maintenance, staff and costs of electric motors** and drones are much lower than for conventional jet and combustion engines. Tactically, **hybrid vehicles and tanks** in electric mode are quieter, have a lower heat signature, have better traction in difficult terrain and can be driven underwater, as an electric motor does not need to intake air.

EU investments in green military technology in synergy with civilian sustainable components and infrastructure, which are becoming cheaper, could help **retain and promote key technologies within the EU** in a future-proof manner. Existing and upcoming regulations constraining fossil fuels and civil market research have already taken off. If the armed forces of EU Member States turn a blind eye to reality and, despite the climate catastrophe and the Russian war of aggression, once again commit themselves to fossil path dependencies, they will be left behind economically, politically and militarily.

It would be too far-fetched to call our recommendations a plan for a **'green wartime economy'**, but we argue that a centrally managed and strategically led European defence industry is well suited to meeting the challenges of climate change and aggression from unfriendly states simultaneously. Compared with the US, the European defence industry is of course much less integrated, jointly regulated or coordinated. It is also strongly guided by national interests, which in practice leads to a number of problems.

But the American model shows the innovative power that well-funded and guided **cooperation between civilian and military research** can have by centralising strategic long-term planning and de-centralising research and development. Current American projects for green defence include the production of **fuel from algae**, the testing of **hydrogen-electric vehicles**, a **planned hybrid tank generation**, **AI-supported microgrids** and much more.

These bold advances, which promise to increase combat effectiveness while reducing dependencies and emissions, are often absent or lack political backing and funding in Europe. It is not just in the case of green defence that the US has repeatedly and successfully used public spending for research, which then drives economies of scale and lowers costs for the civilian economy in the medium term. In the European landscape for military innovation, there is also a less symbiotic relationship between civilian and military research, as the defence industry mostly follows civilian innovations and not vice versa.

The EU and the road to green defence

Based on the 2019 **European Green Deal**, Europe is striving to be the first climate-neutral continent by 2050. During the 2022 Madrid summit, NATO introduced a similar net-zero emissions goal, also for 2050. In line with these two goals, the EU has expressed the responsibilities of the European External Action Service (EEAS) and European Defence Agency (EDA) in integrating **'green' approaches**.

Further initiatives and instruments already exist within the EU framework that are important for a comprehensive approach to green defence. These include the [European Defence Fund](#), the [EU Defence Innovation Scheme](#) and [Permanent Structured Cooperation](#) (PESCO).

Especially notable is the [European Defence Industry Reinforcement through Common Procurement Act](#) (EDIRPA), put forward by the European Commission in July 2022 in light of Russia's invasion. Within EDIRPA, an emergency instrument is being introduced that allows for joint military acquisitions in the range of EUR 500 million.

While EDIRPA demonstrates the EU's awareness of the extant gaps in its defence industry, it unfortunately overlooks the fact that we are also in a climatic crisis, even if the sense of emergency is not as palpable as the threat posed by hostile neighbours. Looking at the long timeframes embedded within military developments and procurements, today's investments and decisions for or against fossil technologies will lock us into path dependencies for many decades.

In June 2023, the European Commission published a landmark [Joint Communication](#) that takes a closer look at the climate and security nexus as a response to the Council of Europe's [approved conclusions on climate and energy and diplomacy](#) of March 2023. The Joint Communication is peppered with concrete calls for action. It includes four chapters, covering support for climate and environment-oriented planning, decision-making and implementation; EU foreign policy; climate-resilient security and defence; and international cooperation.

The Joint Communication sets the appropriate tone and contains a clear call for action: 'The EU needs to better integrate the climate, peace and security nexus into the EU's external policy, including Common Security and Defence Policy (CSDP) and international cooperation and partnerships.' The direction of the Joint Communication towards greater engagement with the climate and security nexus at the EU level is welcome.

Although implementation and integration of the action items of the Joint Communication remain to be seen, a number of new projects are proposed that would have a fundamental impact on the future of green defence in the EU.

Of particular note are a new EU climate security and defence training platform under the aegis of the European Security and Defence College, an EU climate and defence network of experts from Member State defence ministries, and a climate and defence support mechanism between relevant Commission services, the EEAS and the EDA. This mechanism is to be launched in the form of a proposed EU-led Competence Centre on Climate Change, Security and Defence.

An important step towards more strategic research is the EDA's **Overarching Strategic Research Agenda**. A major component of it are the 15 **Capability Technology groups** (CapTechs). CapTech number 14, on **Energy and Environment**, focuses on operational energy, energy efficiency and climate change, and the environmental impact of military activities.

In addition, there is also increasing and meaningful **cooperation between the EU and NATO** in green defence, which is an inevitable necessity. However, two big intergovernmental organisations, NATO and the EU, are now influencing the same national military structures, aiming for the mostly same goals. NATO is generally more advanced in its sustainable endeavours than the EU, which leads to uneven starting points. Therefore, particular care must be taken to ensure that work is not duplicated, that national armed forces and their bureaucracies are not obstructed by too many differing requirements from the EU and NATO and that future EU green defence projects are better harmonised with the USA, being an important NATO, but not EU, stakeholder.

EU green defence: Projects and policies

The **EU's climate change and defence roadmap** specifies that Member States can and should contribute to EU climate policy by planning and implementing CSDP into civilian and military missions with an awareness of the climate-security nexus. Most notably, the EEAS highlights that the climate-security nexus encourages responses in three interconnected areas of action:

- (1) the operational dimension**
- (2) capability development**
- (3) multilateralism and partnerships.**

These areas constitute 'an integral part of the EU's overall effort to address climate change under the European Green Deal', as reiterated in the Strategic Compass. The Joint Communication provides an overview of what has been achieved or planned in each area of action.

Most progress can be found in **capability development**, with the allocation of monetary resources as well as emphasis on key technologies and circular economy models in PESCO, the European Defence Fund and EDA. The work programme of the European Defence Fund has **allocated EUR 133 million** to support the development of energy resilience and environmental-transition defence products and technologies. As goals, it spotlights the use of **hydrogen as a fuel, electrical energy storage for military bases, and alternative propulsion for air combat systems**.

The European Commission also plans to support projects for environmentally sustainable, dual-use transport infrastructure that facilitate military mobility through the **Connecting Europe Facility**. This was then reinforced by the **action plan on military mobility**.

Concurrently, the EU recognises the importance of collaboration and partnerships between key stakeholders, and strives to coordinate the various groups and fora in the EDA for increased resilience and operational efficiency. Specifically, the EDA is planning an 'incubation forum' on the **circular economy in European defence** to address issues of waste management, component tracing, water management, the safe use of chemicals and resource inputs. These efforts involve repair, maintenance, reuse, refurbishment and recycling. The EDA also aims to set up a **platform to assist national ministries of defence to reduce energy consumption and to increase energy efficiency**.

So far so good, but...

Overall, the **existing measures sound promising** as they provide a good basis for a comprehensive approach to green defence. Further steps are needed, however, to build genuine security:

- ▶ The EU insufficiently addresses two important gaps. First is the **gap between the EU's strategies and their actual implementation by the responsible bodies in the EU Member States**. Second is the **gap between current efforts and those identified by climate science**. Planning is still too short term, while climate change projections and complex, interoperable defence projects require long-term planning horizons.
 - With the recent Joint Communication, an attempt was finally made to bring together the rather disjointed efforts, policies and initiatives into one document.

But further effort is needed to better link the now numerous EU green defence projects with one another and to establish a single strategic management body, which is committed to **realistically incorporating the 2050 net-zero target into all planning processes**. Such a bundling could take place in the Competence Centre on Climate Change, Security and Defence proposed in the Joint Communication. However, it must be clear from the outset that the Competence Centre will not become a new parallel institution alongside the EEAS, the EDA and other institutions that make proposals on green defence, such as the European Union Institute for Security Studies. Rather, the key competences will have to be effectively concentrated in such a Competence Centre.

It often takes more than 20 years from the initiation of a new technological idea to its (infrastructural) introduction in the armed forces. If we retain our defence capacity, this will mean at least another 20 years of fossil-fuelled military technology. In practice, based on lifetime economics, it will probably be 40 more years of fossil military technology in the EU, as the hardware ordered with present defence budgets is fossil.

This means that even if the EU's armed forces make the quantum leap to renewables in the next few years, the first large-scale renewable projects will not find their way into the armed forces until around 2045 and fossil technologies will still be in use after 2060. That runs **contrary to the EU and NATO targets of net-zero by 2050**.

This short calculation should make clear that concrete, joint plans must be worked out in the EU and NATO on how to approach the **green transition in an interoperable manner** so as to not completely abandon or fail the net-zero goal by 2050. To tackle big issues like security and climate change in Europe, we urgently need to address more projects jointly – especially since military interoperability can only be ensured if all EU countries join the green revolution.

- The Joint Communication leaves open the question of how the EU's green defence strategy will interact with national implementation and stakeholder cooperation.

The Joint Communication also addresses the second gap only vaguely, although our rough calculation is actually a strong argument in favour of more investment in greener military hardware. This overlaps with the objectives of the Joint Communication. We must remain realistic and recognise that it is almost impossible to get European armed forces to net-zero by 2050 with today's financial resources and political will.

- ▶ Civilian technology and research are not being integrated into military practices because of **fossil path dependencies, fears of reduced efficiency or political backlash and a lack of centralised coordination**.
 - There is ample low-hanging fruit, on the one hand, and disruptive and expensive large-scale projects on the other that have the potential to change the entire logistics and structure of armed forces. The latter include, for example, hydrogen-powered ships, second-generation aircraft biofuels from EU sources, microgrids with renewable energy sources and multinational compatibility, and electric hybrid heavy-duty vehicles.

The EU should play an **important role in bundling efforts** and guiding large-scale multi-stakeholder projects in particular, while incentivising Member States to pick the low-hanging fruit. This has to be a **parallel process, not a consecutive one**.

- In its latest Joint Communication on the subject, the EU has taken the right path and proposed that future operations and infrastructure involve 'lower costs [and] carbon footprints, while ensuring that operational effectiveness is maintained'. Nevertheless, the way to achieve this remains vague. The way in which civilian and military technology, research and development interact in the future will affect the success or failure of European green defence projects. We need a much deeper interaction between civilian and military research in the EU that is mutually beneficial, as is often the case in the US.

In Europe, as a result of the Russian war of aggression, there is now a certain recognition among educational institutions that research into defence is just as necessary as research into green technologies.

This is a good opportunity to link civilian and military research more fruitfully for both. It would also contribute to protecting and advancing European key technologies, as military developments are generally better protected against unauthorised access.

- In the area of sustainable military technologies, we must exchange research and technologies with the US, as it is the world leader. At the same time, the EU must realistically address the uncomfortable issue of what would happen if ties with the US were to weaken in the future. Thus, close cooperation with the US in furthering green defence must not lead to European capabilities for sovereign defence being neglected again. There must be an honest win-win relationship with the US. The Joint Communication does not address the future relationship with the US; even so, it is essential for our green defence.
- ▶ Currently, the **war in Ukraine and turbulence in the Middle East is shifting the focus away from sustainability efforts** in general and noticeably in the military.
 - This is fatal, because climate protection and the shift towards comprehensive green defence is not a bonus project for peacetime, which might just be put aside in the event of a crisis. If we adopt this mindset and don't consistently pursue our priorities, we will go from one crisis to the next. Instead, green defence is an integral part of a **long-term, credible deterrence and security** approach for the EU. This must be clearly communicated. Armed forces are only credible if they are effective, adapted to the changing operational environment and independent of potential hostile actors. Green defence makes all this possible.
 - As we have shown with the pull factors of green defence, it is a misconception that following green guidelines reduces the effectiveness or operational capability of armed forces. The opposite is the case, especially if one includes **systematic life-cycle assessments and long-term planning horizons**.

Good strategic foresight capability is essential for this. If policymakers aspire to make EU armed forces stronger, applying the lessons learned from Russia's invasion and preparing for future threats, green defence is the most promising path. This connection is briefly addressed in a paragraph of the latest Joint Communication, but not developed further into something we might call 'green deterrence'.

- ▶ Overall, the current EU strategy remains too vague in incorporating civil industry, does not mention some important state-of-the-art technologies and solutions, provides too few incentives to work towards a true green defence revolution and does not give enough practical guidance on how to do so. It is not fit to meet the net-zero goal by 2050. It is not fit to guarantee credible deterrence in a rapidly changing world.

Policy recommendations for an integrated green defence policy

If the EU wants to remain an actor with a credible deterrent capability in the long term, it must fully implement its planned approaches to green defence and go even further. This requires more strategic vision and cooperation, as well as the promotion of civil-military interaction. Here, the latest green technologies can be leveraged for both tactical and overall strategic advantage. We recommend integrating strategic long-term horizons, mindful of the 2050 goal, into all new policies and introducing or strengthening the following policies. Now is the time to seize the moment – while there is still strong support for increased defence spending and climate protection – to guarantee the long-term sustainability and security of the EU. Armed forces must adapt today to the world of tomorrow, emitting less while maintaining or improving their operational capabilities and thus their deterrence capacity:

**1**

Pick the low-hanging fruit in terms of enhancing and developing capabilities at the national level (insulating barracks, installing solar panels, electrifying non-tactical, vehicles, etc.). In parallel, initiate and coordinate the development of large multi-stakeholder capabilities at the multinational level (hybrid electric tanks, hydrogen ships, second-generation biofuels, green microgrids, etc.).

**2**

Establish civil-military partnerships with industry, as well as private and public research institutions. Create a civil-military exchange forum with members from said research institutions, industry, the military and policymakers. Pivot to long-term economic and political thinking, planning and calculation.

**3**

Provide funding for joint research projects and the civil-military transfer of civil research findings to military applications.

**4**

Strengthen the green defence relationship between the EU and the relevant national bodies of Member States, as well as NATO. Only together can we provide the necessary financial resources, know-how and production capacity to achieve such a major transformation. Involve the US in a win-win relationship.



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