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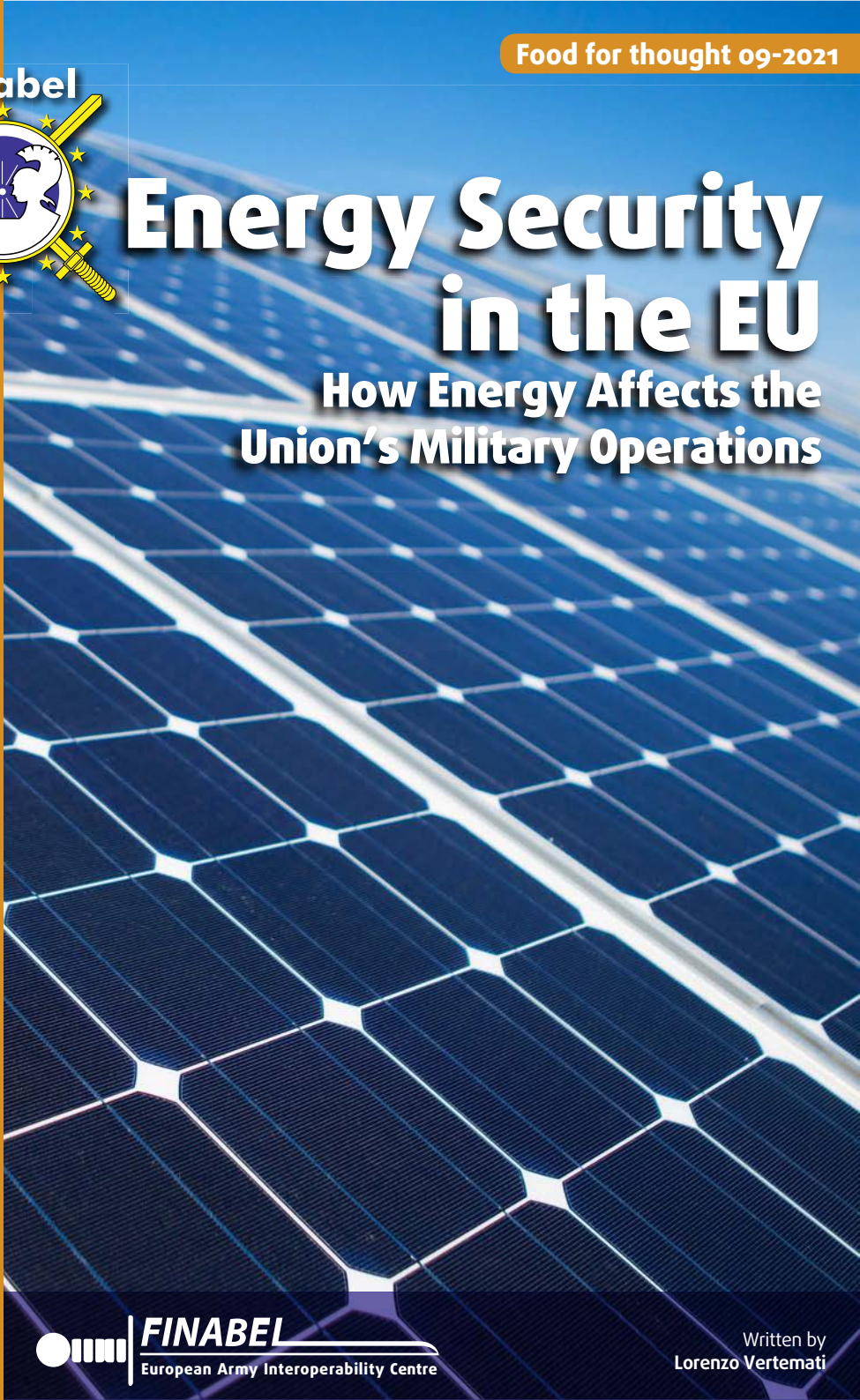
Energy Security in the EU

How Energy Affects the Union's Military Operations



AN EXPERTISE FORUM CONTRIBUTING TO EUROPEAN ARMIES INTEROPERABILITY SINCE 1953

FINABEL
European Army Interoperability Centre

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This Food for Thought paper is a document that gives an initial reflection on the theme. The content is not reflecting the positions of the member states but consists of elements that can initiate and feed the discussions and analyses in the domain of the theme. All our studies are available on www.finabel.org

DIRECTOR'S EDITORIAL

In 2014, the European 'Energy Security Strategy' emphasised the importance of stable and abundant energy supplies for the EU's security. This statement represented the culmination of a learning process leading European lawmakers and the public to accept energy as a key factor in the strategic defence of the continent. Today, the union has come to full terms with energy's centrality in modern societies and their infrastructures, economies, and environments.

The armed forces also depend on energy considerations for their mission delivery. Any kind of operation requires some form of energy to enjoy mission assurance and battlefield advantage. The EU's leadership position in the energy field allows it to channel resources and capital into the most urgent and innovative research and technologies for security and defence. The union's interests have recently expanded into resources' (e.g. alternative fuels) and installations' (e.g. micro- and mini-grids) efficiency, environmental impact (e.g. renewables).

This paper aims to portray the European energy security strategy following a decade of heavy legislation both by national and supranational institutions, and the increased awareness concerning the EU's energy vulnerability following the outbreak of conflict in certain key regions such as North Africa and the Middle East, the Caucasus, and Eastern Europe. Therefore, it was necessary to outline the European energy security strategy in relation to international geopolitical, legal, economic, and environmental developments.

We trust that this study will provide some basic understanding of the concepts of energy security, a grasp of the legal measures adopted by the EU in this field, and the overall geopolitical context. The study, moreover, highlights the obstacles hindering the achievement of an energy-efficient European defence industry. Should they be overcome, armed forces throughout the continent would enjoy reduced costs, increased troop security, political leverage, environmental protection, and a number of operational advantages.

Mario Blokken
Director PSec

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INTRODUCTION

Reliable energy sources are vital for the proper functioning of today's societies, powering transport and the supply networks that deliver us the products we rely on. As Europe witnessed many times in the past few decades, energy supply disruptions can cripple modern economies and raise prices. Moreover, such situations have a worldwide impact since major energy sources are traded internationally. In this context, the impact of attacks on energy sources conducted by militant groups, terrorists, or pirates is enhanced. Thus, energy security is defined by the International Energy Agency (IEA) as "reliable, affordable access to all fuels and energy sources".[1] Similarly, the 2014 European 'Energy Security Strategy' emphasises the importance of stable and abundant energy supplies for the EU's prosperity and security. It requires that prices be reasonable without negatively affecting production, consumption, or inflation.[2]

Energy considerations have also been essential for the armed forces' mission delivery. Energy enables operations and allows the military to enjoy mission assurance and a decisive battlefield advantage. Thus, 'Security' is achieved by powering major weapons systems and communication infrastructure at the desired performance, range, and readiness level. However, given in-theatre energy resupply's vulnerabilities, security is also derived from the minimisation of vehicles and forward locations' energy requirements. Reduction and diversification of fuel use could lower energy costs and benefit military investments and overall functionality. In the U.S., the Department of Defence (DoD) further divides 'military energy' into 1. 'facility energy', which is consumed at fixed installations by non-tactical vehicles and 2. 'operational energy', which is consumed during training, transport, and the sustainment of military forces and weapons platforms during operations. Today, both these types of energy are in high demand in relation to the growing defence capabilities worldwide.[3]

1. IEA (2019) 'Energy security: Ensuring the uninterrupted availability of energy sources at an affordable price', [online] Available at: https://www.iea.org/areas-of-work/ensuring-energy-security

2. Quaker Council for European Affairs. 2010. "Military Responses to Energy Security Problems: What Role for Common Security and Defence Policy?" http://www.qcea.org/wp-content/uploads/2011/04/rprt-militesponses-en-nov-2010.pdf ; European Commission. 2014. "European Energy Security Strategy." Brussels, COM (2014) 330 final, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0330&from=DE ; and Cornell, P.E. 2009. "Energy and the Three Levels of National Security: Differentiating Energy Concerns Within a National Security Context." Connections, Vol. 8(4): 63-80. https://www.jstor.org/stable/pdf/26326186.pdf?refreqid=excelsior%3A113bad5afe67c6747950cda7c1d9dbbf

3. Samaras, C., W.J. Nuttall, and M. Bazilian. 2019. "Energy and the Military: Convergence of Security, Economic, and Environmental Decision-Making." Energy Strategy Reviews, Vol. 26, https://doi.org/10.1016/j.esr.2019.100409 ; Cornell 2009; Office of the Deputy Under Secretary of Defence. 2011. "Department of Defence Annual Energy Management Report". https://www.acq.osd.mil/eie/Downloads/IE/FY%202011%20AEMR.pdf ; and Legal Information Institute. 2011. "10 U.S. Code 2924 - Definitions." https://www.law.cornell.edu/uscode/text/10/2924

From a geopolitical perspective, the major actor crowding EU policymakers' minds is Russia, as the EU imports around 30% of its oil and 40% of its gas from there.[4] This dependence, however, is not distributed evenly. Certain member states (MS) import almost all their energy from Russia, especially in Eastern Europe, while others are exporters themselves.[5]

Arguably, Russia was the sling that catapulted energy security to the top of the EU agenda. In January 2006, on the very day it took over the presidency of a G8 that was supposed to focus on energy security, Russia halted natural gas deliveries to Ukraine. Since European markets were supplied by pipelines running through the country, several MS suffered significant disruptions. Already in the 1970s, NATO allies feared European overdependence on Russian energy supplies, and the Ukrainian incident opened NATO's eyes to Europe's geopolitical vulnerabilities. Similar incidents concerning Ukraine followed in 2009 and 2014. In the latter instance, prior to the invasion of Crimea, Russia raised gas prices before cutting off supplies altogether.[6]

Under Putin's leadership, the Kremlin has pursued economic and political gains by leveraging the EU's dependence on Russian energy. Gazprom keeps investing in acquiring Europe's strategic energy assets, locking it in a dependence cycle and fostering corruption at home. After deciding to rid its nuclear energy mix in 2011, Germany has become fully dependent on Russian natural gas imported through the Nord Stream pipelines. Europe's efforts to foster ideals such as good governance, market transparency, and democracy are continuously undermined. Finally, Russia's UN Security Council (UNSC) position has trapped the West in a policy of non-action while allowing Putin to get away with his illiberal actions. For the Kremlin, energy is weaponised. It is used to undermine Western unity and institutions and, ultimately, achieve state capture in former Soviet states. Given their relative political inexperience and heavy dependence on Russian energy, the latter are particularly vulnerable to such manipulations. In the 1990s, the USSR used oil and gas exports to the Baltics as a weapon to curb their aspirations for independence.[7]

Today, Russia employs a divide-and-rule strategy whereby MS with large buying power like Germany, France, and Italy can obtain discounts and guarantees, while smaller ones pay full price. The Commission is the body assigned to investigate and fine abusers while seeking remedies. It is aided by the EU's market-based approach and transparency, which

4. IEA (2019) 'Energy security: Ensuring the uninterrupted availability of energy sources at an affordable price', [online] Available at: https://www.iea.org/areas-of-work/ensuring-energy-security

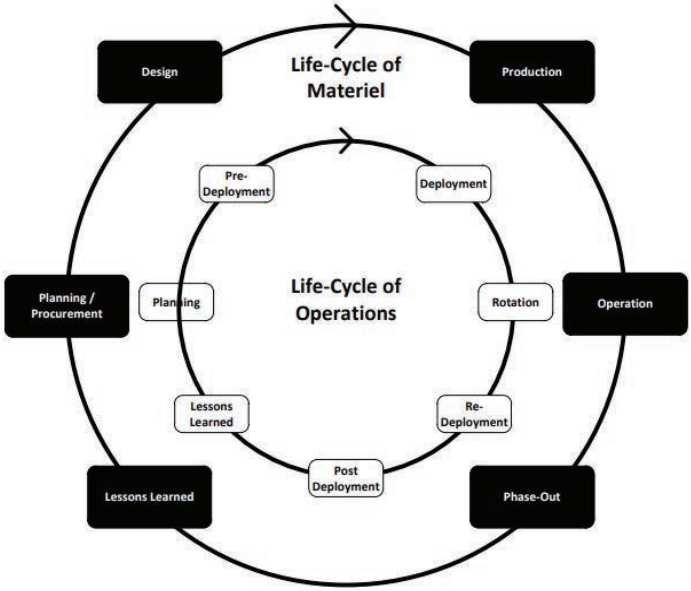
5. European Commission and EU Secretary-General/High Representative. 2006. "An External Policy to Serve Europe's Energy Interests." https://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/reports/90082.pdf ; and Baran, Z. 2007. "EU Energy Security: Time to End Russian Leverage." Washington Quarterly, Vol. 30(4): 131-144. DOI: 10.1162/wash.2007.30.4.131

6. Baran 2007; Deni, J.R. 2013. "Energy Self-Sufficient Military Installations: Rewards and Obstacles." NATO Energy Security Center of Excellency, No. 2, https://enseccoe.org/data/public/uploads/2017/02/esoh-201302.pdf ; Collins, G. 2017. "Russia's Use of the 'Energy Weapon'in Europe." Baker Institute for Public Policy, https://www.bakerinstitute.org/media/files/files/ac785a2b/BI-Brief-071817-CES_Russia1.pdf ; and Zeniewski, P. 2019. "A Long-Term View of Natural Gas Security in the European Union." International Energy Agency, https://www.iea.org/commentaries/a-long-term-view-of-natural-gas-security-in-the-european-union

7. Baran 2007; Bartuška, V., P. Lang, and A. Nosko. 2019. "The Geopolitics of Energy Security in Europe." Carnegie Europe. https://carnegieeurope.eu/2019/11/28/geopolitics-of-energy-security-in-europe-pub-80423 ; Conley, H.A., et al. 2016. "The Kremlin Playbook: Understanding Russian Influence in Central and Eastern Europe." Center for Strategic and International Studies, ISBN# 978-1-4422-7958-2 https://www.csis.org/analysis/kremlin-playbook ; Collins 2017; and Zaniewski 2019.

helps curtail certain MS's exceptionalism, implement market rules, and helps smaller MS battle corruption.[8]

However, the Kremlin has problems of its own. The absence of market stimuli is causing its energy industry to be inefficient, raising consumer costs and decreasing productivity. It is also increasingly unregulated, allowing companies like Gazprom to act outside of the commercial framework. Finally, energy resources' exports are used to fund domestic programmes, as the lack of diversification in its economy has led the Russian government to become dependent on energy sales, all in the context of volatile prices. While it is true that Europe depends upon Russian pipelines for gas, the Kremlin itself depends on Central Asian countries such as Turkmenistan to provide for its domestic energy consumption. Russia also has an issue of demand dependence. Despite attempts at the development of LNG production and the construction of the 'Power of Siberia' pipeline to China in 2019, the country still relies almost entirely on EU purchases of its oil and gas to obtain revenue.[9]



Source: https://data.consilium.europa.eu/doc/document/ST-13758-2012-INIT/en/pdf

Life cycles of operations and materiel, 2021

EEAS. 2012. "European Union Military Concept on Environmental Protection and Energy Efficiency for EU-Led Military Operations." Council of the European Union, 13758/12, LIMITE CSDP/PSDC549 COSDP762, EEAS 01574/12

8. Bartuška, Lang, and Nosko, 2019.

9. Baran 2007; Bartuška, Lang, and Nosko 2019; CNA Analysis & Solutions. 2009. "Powering America's Defense: Energy and the Risks to National Security." https://www.cna.org/cna_files/pdf/MAB_2-FINAL.pdf ; Collins 2017; DPA International. 2019. "Russia Opens Power of Siberia Natural Gas Pipeline to China." https://www.dpa-international.com/topic/russia-opens-power-siberia-natural-gas-pipeline-china-urn%3Anewsml%3Adpa.com%3A20090101%3A191202-99-971804 ; Russell, M. 2018. "Seven Economic Challenges for Russia: Breaking Out of Stagnation?" European Parliamentary Research Service, DOI:10.2861/227260 https://www.europarl.europa.eu/RegData/etudes/IDAN/2018/625138/EPRS_IDA(2018)625138_EN.pdf ; and Russell, M. 2020. "Energy Security in the EU's External Policy." European Parliamentary Research Service, DOI:10.2861/10775 https://www.europarl.europa.eu/cmsdata/210517/EPRS_IDA(2020)649334_EN.pdf

Still, the EU must diversify its energy sources and supply routes to give regional exporters and European consumers greater choice. Energy sources of interest in this regard are Central Asia and the Caucasus.[10]

Despite the importance of Russian gas in the European energy security discourse, one single resource might, arguably, carry even more global weight. Oil has been the major energy source in the West since WW1, awarding importance to previously ignored regions of the world.[11]

The main example is the Middle East. The US have been particularly active in the militarisation of oil security in the region, and EU MS have participated, in one way or another, in the two interventions in Iraq in 1991 and 2003. Even today, France boasts expeditionary capabilities suited to missions protecting oil supplies. These expeditions have not always delivered as they should have though. Another state break-up, like Libya's after NATO's removal of the unifying dictator Qaddafi and his handouts, might substantially diminish energy exports. US-Iran tensions have recently raised fears of military conflict. One-fifth of the world's oil supplies passes through the Strait of Hormuz, located between Iran and Oman. Any clash might raise crude oil prices significantly, as occurred in 2020 when the US assassinated top Iranian general Qassem Suleimani.

Nevertheless, the most important player in the oil game remains Saudi Arabia. Despite supplying only 7% of the EU's needs in 2017, it is the world's largest oil exporter and second largest producer. Accounting for 13% of global oil production in 2018, it is also the most influential member of the Petroleum Exporting Countries (OPEC), controlling 42% of global oil production. OPEC has been used by its members as a political weapon and financial tap in many instances. Together with the OPEC+ (including Russia and Kazakhstan), it continues to limit production and raise prices at will. The Saudi's geopolitical stance *vis-a-vis* the EU, however, is not as strong as Russia's. Oil generates three quarters of the Kingdom's exports and, given the level of global oil markets integration, it could never embargo the EU without affecting global supply.

On the other hand, countries like Sudan have made billions exporting oil to China despite a lack of Western investment following the Darfur genocide. The giant's huge demand for energy provides a lifeline for many smaller nations with weaker human rights records. The Middle East has also seen many non-state actors posing a threat to energy security. Al-Qaeda has based its global oil strategy on inflicting economic pain, but more tech-savvy elements (e.g. hackers) might implement cyber-attacks on critical energy infrastructure.[12]

In the past twenty years, Africa has emerged as a leader among global energy markets. Operation Atalanta, the EU's first naval mission, was launched in 2008 in Somalia. Two of the

10. Baran 2007.
11. Cornell 2009.
12. Quaker Council for European Affairs 2010; Bartuška, Lang, and Nosko 2019; U.S. Energy Information Administration. 2019. "The Strait of Hormuz Is the World's Most Important Oil Transit Chokepoint." https://www.eia.gov/todayinenergy/detail.php?id=39932 ; Russell 2020; Cohen, A. 2018. "OPEC Is Dead, Long Live OPEC+." Forbes, https://www.forbes.com/sites/arielcohen/2018/06/29/opec-is-dead-long-live-opec/?sh=2f19b9db2217 ; BP. 2019. "BP Statistical Review of World Energy." https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf#page=32 ; International Trade Center. 2015. "Trade Map." https://www.trademap.org/Product_SelCountry_TS.aspx?nvpm=1%7c124%7c%7c%7c%7cTOTAL%7c%7c%7c2%7c1%7c1%7c1%7c2%7c1%7c1%7c1%7c%7c1 ; Barnes-Dacey, J. 2019. "The End of the Post-Khashoggi Era? Europe's Collapsing Unity on Saudi Arabia." European Council on Foreign Relations, https://ecfr.eu/article/commentary_the_end_of_the_post_khashoggi_era_europes_collapsing_unity_on_sa/ ; European Commission, Directorate General for Trade. 2021. "European Union, Trade in Goods With Saudi Arabia." https://webgate.ec.europa.eu/isdb_results/factsheets/country/details_saudi-arabia_en.pdf ; CNA 2009; Cornell 2009; and Deni 2013.

mission's three primary goals were: 1. protect vulnerable shipping in the Gulf of Aden and the Indian Ocean and 2. deter pirates and stop them from carrying out attacks. Among the most vulnerable cargo shipped off, the Somali coast was crude oil. 11% of the world's supplies passed through the area, and pirates' hijackings increased transportation costs through ransom payments, rising insurance premiums, and delayed deliveries. The operation followed the Commission's recognition of the seas' crucial role in transporting fossil fuels in the 2007 'Maritime Strategy'. Pirates were beginning to launch strikes in the Gulf of Guinea during the same period. Militias like the Movement for the Emancipation of the Niger Delta (MEND) conducted attacks on offshore oil installations, shut down oil facilities' production, and kidnapped foreign oil workers. They are driven by poverty, environmental degradation, and state repression. They have created an 'economy of conflict' whereby illicit oil trade, kidnapping, and ransoms provide a living for many unemployed young Nigerians. They are unable to fish or farm because the oil industry has ruined rivers and agricultural lands. Attempts at peaceful reconciliation have been met with violence by both military and civilian rulers with Western oil companies' complicity.[13]

Another highly demanded energy source from the area is Niger's uranium. In Europe, uranium is necessary to power the nuclear industry. Still, mining this radioactive metal has caused health problems to people and livestock in the north of the country, especially the Touaregs. They make up the majority of the Niger Movement for Justice (MNJ), which led violent campaigns against the government in the early 1990s and between 2007 and 2009. They attacked the Nigerian military and uranium mining facilities and kidnapped foreign mine workers. Uranium leaks into the water, soil, and air adjacent to mines. The MNJ demands a fairer share of the profits from Niger's uranium industry.[14]

In the North, Algeria is the final transit state for the Trans-Saharan Gas Pipeline (TSGP) that has supplied gas to Europe for many years. Islamist forces first attacked its energy infrastructure during the 1991-2002 Civil War, and again by Al-Qaeda in the Islamic Maghreb (AQIM) in 2006 and 2007. Although pipelines can be repaired quickly, frequent attacks still reduce production.[15]

As an energy security practice, the EU should transfer new energy technologies to oil-importing countries, especially in Africa. The revenue gained from the domestic replacement could be spent on the improvement of living standards. Replacement, not abandonment of fossil fuels, is the key to force major importers like India and China on the alternative energy path and reduce prices and consumption. However, the EU should also be wary of the effects such a move could have on fossil fuels producers. Some will see social unrest, political crises, and even state failure. The latter is particularly dangerous for the threat of migration and terrorism.[16]

13. Quaker Council for European Affairs 2010; EU NAVFOR Somalia. 2021. "Mission." https://eunavfor.eu/mission/ ; U.N. Security Council. 2008. "Resolution 1816 (2008)." United Nations Digital Library, https://digitallibrary.un.org/record/627953 ; European Commission. 2007. "An Integrated Maritime Policy for the European Union." Brussels, COM(2007) 575 final, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF ; and Ikelegbe, A. 2005. "The Economy of Conflict in the Oil Rich Niger Delta Region of NIgeria." Nordic Journal of African Studies, Vol. 14(2): 208-234. http://www.njas.helsinki.fi/pdf-files/vol14num2/ikelegbe.pdf
14. Quaker Council for European Affairs 2010; and News Wires. 2010. "Greenpeace Slams Areva Over Radioactive Contamination." France24, Africa, https://www.france24.com/en/20100329-greenpeace-slams-areva-over-radioactive-contamination
15. Quaker Council for European Affairs 2010; and Eurasia Review. 2010. "Examining North Africa Terrorist Threat to Energy Infrastructure." https://www.eurasiareview.com/02022010-examining-north-africa-terrorist-threat-to-energy-infrastructure/
16. Bartuška, Lang, and Nosko 2019.

While the EU has already established a credible reputation in energy security despite its lack of competence on this specific matter, NATO has lacked the legal means to follow suit. Although absent in the North Atlantic Charter, energy security was integrated into the alliance's agenda following the 2012 Chicago Summit. MS decided to develop partnership activities, improve the military's energy efficiency, and establish the NATO Energy Security Centre of Excellence. Based in Lithuania, the latter provides strategic analysis and research, and develops doctrines, standards, procedures, workshops, training, and exercises.[17]

NATO's institutional energy security was maintained for years through its Cold War-era pipeline system, which ensured petroleum supply and distribution. After an energy security workshop in London in 2004, the Bush administration was the first to prioritise the issue at meetings in 2006. The 2006 Riga and 2008 Bucharest Summits established possible collective responses to energy security issues and priority areas. In 2007, NATO Maritime Groups including EU members (Germany, France, the Netherlands, Portugal, Denmark, and Spain) provided training for naval officers. They conducted 'presence operations' in oil-rich West Africa and Somalia. Pirates were identified, along with interstate warfare, insurgent groups, and terrorists, as a threat to energy infrastructure in the 2008 NATO Parliamentary Assembly report. The alliance launched Operation Allied Provider to counter piracy in Somalia, which evolved into Operation Allied Protector and Operation Ocean Shield in 2009. The three missions were useful in protecting UN programmes, detaining, defending against, disrupting piracy, and training regional governments.[18]

More than 60 NATO Allied Publications address energy, and especially fuel standardisation. Fewer are concerned with energy and power generation and supply security, and these are very technical.[19]

Today, the major issue for NATO's armed forces concerning energy security is the dependency on fuels into theatre to sustain deployed camps. Reducing consumption can reduce the vulnerability of supplies and deployed forces, increase autonomy, reduce casualties, and ensure interoperability with partners. Reducing fuel dependency can also provide financial benefits and increase operational resiliency by freeing assets and infrastructure. Vulnerabilities of fuel logistics have been relevant since WW1 and have changed little. In 2011, the supply line providing the International Security Assistance Force (ISAF) with the daily 6.8 million litres of fuel it required was attacked in Pakistan. Twenty-four soldiers were killed, and the supply line had to be shifted to the North on a difficult path

17. Lunytė, J., and J. Urbanavičius. 2014. "Energy Security in the NATO Framework." NATO Energy Security Center of Excellency, https://www.enseccoe.org/data/public/uploads/2017/02/esoh_no_7.pdf ; and Samaras, Nuttall, and Bazilian 2019, 5.
18. Quaker Council for European Affairs 2010; NATO. 2017. "NATO Pipeline System." Topics, https://www.nato.int/cps/en/natohq/topics_56600.htm ; and Volman, D. 2009. "China, India, Russia, and the United States: The Scramble for African Oil and the Militarization of the Continent." The Nordic Africa Institute, Globalisation, Trade and Regional Integration, ISBN 978-91-7106-658-9, http://nai.diva-portal.org/smash/get/diva2:272960/FULLTEXT01.pdf
19. Lunytė, J., and J. Urbanavičius. 2014.

originating in Latvia, 5,000 km away. NATO has suggested involving short-term maritime escort operations during energy-supply missions to protect oil rigs, terminals, refineries, and storages to respond to such supply disruptions. A more long-term multinational maritime task force should instead deter attacks against critical energy assets like tankers. In more extreme situations, NATO might organise quick reaction forces to protect chokepoints. MS are also collaborating on smart energy solutions to reduce fossil fuels consumption in the military and environmental damage. The US Air Force and Navy, for example, are experimenting with biofuel mixes containing liquid fuels.[20]

Away from the front, the potentials of energy and cost savings given by efficiency and renewable energy have been explored in military installations. The imperative of maintaining power independence in forward operating bases has created a demand for innovative systems. More efficient microgrids for electrical power distribution combine smart IT, enhanced IT security, and environmental benefits to ease fuel supply to generators and reduce fossil fuels needs.[21]

Apart from the up-front budgetary challenge, other constraints impede energy self-sufficiency. The main alternative power source at US military facilities is geothermal and requires specific geologic conditions or vast solar arrays, which need consistent sun exposure and substantial excess land. Smaller, densely populated European countries might lack these.[22]

EU ENERGY POLICY

The first project kickstarting European integration and establishing the common customs union, the 'European Coal and Steel Community', was born in 1951. At the centre of the community were the two materials essential for both warfare and reconstruction. The establishment of the European Atomic Energy Community (EURATOM) in 1957 confirmed the centrality of energy in the European project. Progress lacked until the 1990s, with only a few regulations concerned with energy making it into the EU agenda. The 1980 Council Regulation 2618/80, for example, contributed to improving energy security in underdeveloped regions of Greece and Italy using alternative energy sources and new technologies for hydro-electrical power generation. Similar collaborative work in the defence community started in the 1990s through bottom-up approaches revolving around R&T. The Western European Armament Group (WEAG) and the Common European Priority Areas (CEPA) were the forums of choice. Efforts back then focused on

20. Cassolato, S., et al. 2014. "Operational Energy: A Multi-Faceted Government Approach." NATO Energy Security Center of Excellency, https://www.enseccoe.org/data/public/uploads/2017/02/esoh_no_7.pdf ; amaras, Nuttall, and Bazilian 2019; Shea, J. 2006. "Energy Security: NATO's Potential Role." NATO Review, https://www.nato.int/docu/review/2006/issue3/english/special1.html ; Tracy, R. 2012. "Senate Again Backs Pentagon's Green-Energy Plans." The Wall Street Journal, https://www.wsj.com/articles/SB10001424127887323751104578149423431835586 ; and NATO. 2012. "NATO Seminar Highlights Smart Energy Projects." News, https://www.nato.int/cps/en/SID-69477654-8333BFE2/natolive/news_84927.htm
21. Samaras, Nuttall, and Bazilian 2019.
22. Deni 2013, 6.

all-electric vehicles that could improve energy efficiency by better distributing to all consumers. MS oil dependence, however, largely hindered energy policy cooperation during this period.[23]

The European Commission then published the 'Green Paper' in 2002, which defined energy security from supply and demand sides. The latter included elements of energy efficiency and savings, renewables, competition, prevention from leakages, and protection of new technologies. In its 2003 'European Security Strategy' (ESS), the EU acknowledged its dependence on imported fossil fuels, which causes difficulties with supply and vulnerability to price shocks, especially for oil and gas. The lack of alternative means of distribution make gas particularly susceptible. Still, it causes much lower CO2 emissions than other fossil fuels. Despite unchanged consumption levels in the past decades, the EU's declining resources have resulted in a rise in import dependency. One of the alternatives, nuclear energy, has also been criticised, being dismissed as too risky and expensive to be sustainable by the Greens. To remedy these vulnerabilities, force projection and the increased flexibility and mobility of the armed forces were identified as valid security approaches.[24]

The establishment of the EDA in 2004 kickstarted work in the areas of fuel cells through joint R&D efforts to consolidate military requirements and attempts at a joint roadmap. In 2006, the European Parliament adopted a resolution on the security of energy supply, with coordination and collaboration being highlighted as key aspects. One year later, following the Commission's publication of the 'An Energy Policy for Europe' strategy and the 'Internal Energy Market Package', European energy policy started integrating. 2007 also marked the first time EU policymakers endorsed an EU 'Energy Action Plan'. The plan laid out the three major challenges to the EU's energy policy: sustainability, security of supply, and competitiveness. These remain at the core of the common energy policy today. Other areas of research were the internal market for gas and electricity, internal energy policies, and energy technologies. Despite all this work on energy security, only individual elements were addressed.[25]

Only in 2009 did energy formally become an area of EU competence after signing the Lisbon Treaty. Article 194 states that energy policy should primarily aim to ensure the security of energy supply. Article 12 instead focused on the functioning of the energy market. To achieve it, it called for the security of the energy supply, the promotion of energy efficiency and saving, the development of new and renewable energy sources, and the promotion of energy networks. The first point, the most innovative one at the time, is still a preserve of MS. With energy mixes, foreign energy policy, and the exploitation of energy resources in the hands of MSs, there is little that the EU could do to directly affect the security of energy supplies. Still, the European Court of Justice has categorised the safeguarding of energy supplies during existential crises as an issue of public interest and security (C-503/99 Com-

23. Langsdorf, S. 2011. "EU Energy Policy: From the ECSC to the Energy Roadmap 2050." Green European Foundation. http://archive.gef.eu/uploads/media/History_of_EU_energy_policy.pdf ; Lunytė and Urbanavičius, 2014; and EDA. "European Framework Cooperation for Security and Defence Research." EDA Factsheet, http://www.europarl.europa.eu/meetdocs/2009_2014/documents/sede/dv/sede301109factsheetefcsecuritydefence_/sede301109factsheetefcsecurity defence_en.pdf

24. Quaker Council for European Affairs 2010; Council of the European Union. 2009. "European Security Strategy: A Secure Europe in a Better World." Brussels, ISBN 978-92-824-2421-6, https://www.consilium.europa.eu/media/30823/qc7809568enc.pdf ; Langsdorf 2011; and Lunytė and Urbanavičius, 2014.

25. Langsdorf 2011; Lunytė and Urbanavičius, 2014; and EDA.

mission v Belgium). Additionally, the court of the European Economic Area (EEA) has allowed restrictions in the movement of capital in cases of disruptions of energy supply (Case E-2/06).[26]

Currently, the Commission is working on the internal energy market to improve energy security and lower costs. Special focus is on key infrastructure projects like grids transporting renewables and smart grids to decentralise production and reduce costs. Other measures aimed at the creation of a functioning EU energy market include the liberalisation of electricity and gas, the assistance for MS in the creation of trans-European energy networks, the establishment of the EU Agency for the Cooperation of Energy Regulators, the investigation of Gazprom's dominant market position, and the study of a possible European energy community.[27]

European Defence R&T (EDRT) Development Strategy

The European Defence R&T (EDRT) Development Strategy is an ambitious guide for the different defence R&T stakeholders (MSs, industry, NATO, etc.) in their investments. It helps enhance cooperation between EU MS, but also between the defence and civil industries. This strategy was envisioned by the EDA and follows its brochure 'Your Guide to European Structural Funds for Dual-Use Technology Projects'. The EDA has since worked within the European Framework Cooperation (EFC) to ensure the complementarity of defence R&T investment for civilian security and space programmes. This relationship is the result of the uncertainty reflected in the decreasing defence budgets in Europe and of the need for increasing competitiveness on the global market.[28]

The synergy between defence and civil research can be achieved through cooperation with European small and medium enterprises (SMEs), which are engaged in a wide range of industries such as aeronautics, space, energy, etc. Their supply chains, providing goods and services to defence actors, can enhance innovation by stimulating new R&T dual-use projects. Cooperation with SMEs drives a strong, positive impact on MS's development at all levels and enables industrial competitiveness. Thanks to the EDRT, EU defence stakeholders can improve their effectiveness and capabilities through collaboration in various research projects focused on 22 key technologies. These, when delivered in time, can support military capabilities for short-, medium-, and long-term needs.[29]

The EDRT strategy is composed of three elements covering its planning and implementation phases. First, the 'ends' rely on a list of 22 technologies representing areas where R&T investment is required to improve European defence operational and industrial capabilities. An initial list of 'ends' represents an alignment of MS needs that will guide defence suppliers towards a more integrated European defence technology and industrial base (EDTIB). These 'ends' should be accomplished through collaborative R&T

26. Langsdorf 2011; and Lunytė and Urbanavičius, 2014.
27. Langsdorf 2011; Lunytė and Urbanavičius, 2014.
28. Meandzija, B. 2017. "European Defence Research and Technology Strategy: The Role in Improving European Competitiveness." University of Vienna, DOI:10.13140/RG.2.2.35059.68640 ; and European Defence Agency. 2009. "Info Hub, Latest News, EDA and Commission to work closely together on research." https://www.eda.europa.eu/info-hub/press-centre/latest-news/09-05-18/EDA_and_Commission_to_work_closely_together_on_research
29. Meandzija, 2017; and EDA. 2008. "A European Defence Research Technology Strategy." https://www.eda.europa.eu/docs/documents/edrt_strategy.pdf

projects balanced between capability-driven, scientific, and bottom-up initiatives. They help anticipate new threats and ensure operational superiority in science and technology. Particularly important is the appropriate use of funds and the attention given to disruptive and emerging technologies. Secondly, the 'means' are defined as objectives necessary for delivering the 'ends'. They are pursued through various forms of collaboration such as frameworks, mechanisms, processes, and structures, and have been grouped into different clusters depending on their area of impact: improving the integration of the defence technology and industrial base into the wider supply base; promoting the technological push, and improving the effectiveness of R&T collaboration. Finally, the 'ways' are a tool to help with the transition from the technological-strategic level to the practical level by bridging planning and implementation and indicating the connection between R&T activities and operational and industrial capabilities. Dubbed 'roadmaps' or 'action plans', they are concerned with identifying the appropriate 'means' to effectively accomplish the 'ends'. Strategic objectives from both areas are implemented to better apply R&T resources and reduce possible investment risks. Roadmaps highlight the pros and cons of each 'path', assisting the strategic level in the choice between different options and their posterior evaluation. Given its complexity, such road-mapping requires consensus on general objectives and decision-making processes, the care of experienced personnel, and a coherent and mature organisational framework.[30]

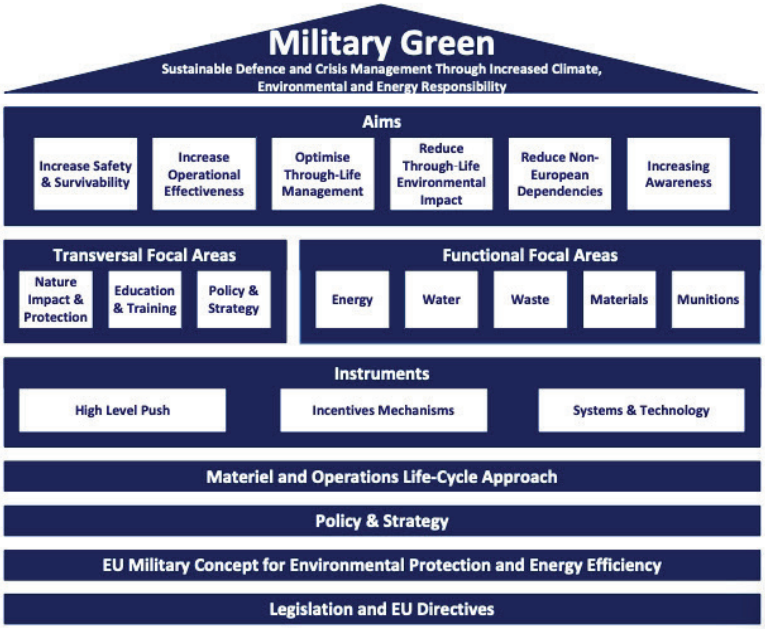
Additional means that will aid in improving the convergence of MS' defence investments are joint investment programmes, cooperation between European defence research centres, and the review of intellectual property rights conditions. The strategy can help improve European defence capabilities, especially when coupled with other programmes such as the 2008 'Capability Development Plan', the 2007 'EDTIB Strategy', and the 2008 'European Armament Cooperation Strategy'.[31]

Military Green

The 'Military Green' and the 'Go Green' initiatives were started in Europe following a push to increase self-sufficiency and reduce energy supply vulnerability within military bases. The former was created in 2012 by the EDA to bring stakeholders together to understand how the defence sector can help achieve the EU's energy and environmental goals, and define the concepts, principles, and responsibilities to meet the military's challenges. It is a strategic tool to mitigate the adverse effects on the climate while strengthening defence and crisis management capabilities, and to promote the development and implementation of novel sustainable technologies.[32]

Energy is essential for crisis management, the effectiveness and preparedness of operations, and conventional territorial defence. However, increasing efficiency and reducing consumption can cut costs, emissions, and

30. Meandzija 2017; and EDA.
31. EDA.
32. Keršiulis, V. 2013. "Strategy Options for Installation of Modern Energy Technology into Military Bases." NATO Energy Security Center of Excellency, No. 2, https://enseccoe.org/data/public/uploads/2017/02/esoh-201302.pdf ; and European Defence Matters. "Sustaining Europe's Armed Forces." https://eda.europa.eu/webzine/issue11/in-the-field/sustaining-europe-s-armed-forces



Source: https://eda.europa.eu/docs/default-source/documents/military-green-2013-report.pdf

An illustration of 'Military Green's comprehensive approach, 2013
EDA. "Military Green 2013: Climate, Environment, and Energy Security - From Strategy to Action."

dependency on foreign sources and improve effectiveness through enhanced mobility, endurance, and autonomy.[33]

To achieve these goals, the EDA revised the 'Military Green' initiative in 2013 as part of the Commission's Sustainable Energy Week. This updated version looks to develop roadmaps to deliver tangible results on civil-military synergies. Past operations proved the weakness of energy supply lines targeted by enemies during operations compromising operational effectiveness and causing loss of life. Reducing fossil fuel consumption can lower the number of casualties and free up resources to protect the fewer convoys. Moreover, it improves capabilities, cuts costs, and decreases emissions.[34]

To achieve these goals, 'Military Green' identified three essential instruments: to get high-level decision-makers to drive change, make greener solutions attractive for stakeholders, change behavioural patterns, and introduce novel technologies. Adopting a lifecycle approach enables good planning and significantly reduces the footprint in urgent-natured and long-term operations. Good planning takes into consideration both the threat (e.g. climate change, loss of biodi-

33. EDA. "Military Green: Energy and Environment at the European Defence Agency." doi: 10.2836/13547 https://eda.europa.eu/docs/default-source/news/military-green-leaflet.pdf ; and EDA. "Military Green 2013: Climate, Environment, and Energy Security - From Strategy to Action." https://eda.europa.eu/docs/default-source/documents/military-green-2013-report.pdf
34. EDA.

versity, etc.) and the context from which it originates.[35]

The EDA has also contracted the Fuel-D study to the Spanish company ISDEFE to fight logistic fuel dependency and provide a statistical picture of energy consumption during operations. The data is used to identify ways to reduce consumption and how this can benefit costs. Fuel-D has also shown the importance of novel and renewable energy technologies in the optimisation of camp designs. The alternative technologies addressed are solar, wind, and geothermal, with the latter showing especially good results in both urban and remote deployed operations.[36]

Finally, 'Military Green' is concerned with equipment's compatibility with different types of environmental conditions. Several standards exist at the national level, and MS share each other's experiences and feedback. Still, there is a lack of appropriate administrative arrangements between governments and industries concerning information-sharing means.[37]

EU Armed Forces Go Green

'Go Green' is a business model proposed by the EDA in 2012 and adopted by seven MS (Austria, Cyprus, Czech Republic, Germany, Greece, Luxembourg, and Romania) aiming to cut energy costs through the implementation of renewables. It pools access rights to rooftops and land in various military premises and offers them to the market for electricity production using photovoltaic technology. Alternative energy sources can meet the armed forces' growing energy needs in faster, cleaner, cheaper, and more sustainable ways. That is why the project has attracted €200-300 EUR millions in investments to improve CSDP capabilities and relieve pressure from national defence budgets.[38] The scope of the project is the analysis, preparation, implementation, maintenance, and operation of photovoltaic panel installations for renewable energy production in MS's military sites.[39]

Energy is essential for military operations and a force multiplier. Innovations in this field can support the activities of the armed forces. In the EU, armed forces manage about 200 million square metres of surface area, thus enjoying a unique opportunity to reduce consumption and deploy alternative energy sources. Despite the presence of several national initiatives doing just that, a sustainable, inclusive approach targeting the entirety of Europe is required. MS is also supported in the establishment and promotion of innovative concepts and collaboration in the areas of renewables production and energy efficiency. Gradually, it might help them reduce dependence on expensive and unstable energy sources and increase renewables' development.[40]

The final target of 'Go Green' is the military's production and use of renewables, which will be achieved by installing photovoltaic panels on national pilot sites. The large number of resources available to Europe's armed forces have not been exploited enough for energy production. More investments and incen-

35. EDA.
36. EDA.
37. EDA.
38. Keršiulis 2013; and EDA. "EU Armed Forces Go Green." Competitive dialogue, 12.ARM.CD.01, https://eda.europa.eu/docs/procurement/12-arm-cd-01_ts-technical-specifications.pdf
39. EDA.
40. EDA.

tives for both private and public investors can increase renewables' production and use. MS have thus employed 'Go Green' to pool resources under the EDA to establish a multinational photovoltaic business case. The handover of barrack roofs and lands will bring returns for both government and industry and improve conditions. The industry is encouraged to develop a common approach together with MS, who all benefit from the excess electricity being pumped into their public grids.[41]

EDA's Energy and Environment Working Group

Following the implementation of the 'Military Green' projects, the EDA established a dedicated Energy and Environment Working Group in 2014 with the aim to define the challenges to the military's strategic drivers using alternative energy sources.[42]

The first such challenge is the lack of energy data capture in the military at a European level. MS possess available data, but despite recent work on collection, analysis, and sharing (DCAS) activities, EDA's statistics are still mostly based on mere estimates. DCAS aims to collect non-sensitive, macro data on energy and fuel sources in the military from MS. Data is then used to weight the complexity of the challenge and assist MS in setting priority areas. Moreover, some of the programme's studies have also assessed the benefits of circular economies, and sustainable procurement to Europe's armed forces. Still, it doubles as a platform of collaboration for MS concerned with energy challenges in the defence sector.[43]

Another challenge is the low level of penetration of energy management systems (EnMS) in the European defence community. An EnMS training course was offered between 2016 and 2017 by the Working Group together with the EDA's Education, Training, and Exercises (ETE) unit to teach the systemic application of energy management based on the ISO 50001 standard at an operational level. Learning and mentoring classes helped MS apply EnMS principles to their armed forces.[44]

The EDA has analysed the benefits of new technologies for traditional power grids in deployed camps to counter the problem. Through the Smart Camp Technical Demonstrator Project, energy management equipment was installed in Mali at the European Training Mission (EUTM) in 2015, with three objectives. Firstly, to test the efficiency of various types of photovoltaic panels in specific climatic conditions and integrate renewables with battery storage during deployment. Secondly, to test 'demand management' technology and its impact on the locals, collect reliable data for analysis and sharing with MS, and develop planning support tools for CDSP operations. The British contractor BAE Systems recorded positive results with energy savings between 33% and 60% during tests, which could go up to 75% after some technical interventions. MS have also researched renewables and water and waste management technologies.[45]

The final challenge considered by the Work-

41. EDA.
42. European Defence Matters.
43. European Defence Matters.
44. European Defence Matters.
45. European Defence Matters.

The interrelationship between EP and force health protection, 2012
EEAS. 2012. "European Union Military Concept on Environmental Protection and Energy Efficiency for EU-Led Military Operations." Council of the European Union, 13758/12, LIMITE CSDP/PSDC549 COSDP762, EEAS 01574/12

Source: https://eda.europa.eu/docs/default-source/documents/military-green-2013-report.pdf

ing Group is the pressure on water management infrastructure caused by climate change and lack of funds. The military world has also been slow to acknowledge water cycle management, neglecting its installations. Six MS (Greece, Cyprus, Spain, Portugal, Ireland, and Italy) have participated in the 'Smart Blue Water Camps' (SBWC) project examining the defence sector's water management through the employment of standards of conservation, sustainability, and technological innovation. In the first phase of the project, the EDA has funded workshops to analyse water management technologies in MS's fixed military sites. In the second phase, it implemented the most suitable interventions identified.[46]

The Working Group has, since 2015, also hosted the Consultation Forum for Sustainable Energy in the Defence and Security Sector, a European Commission (DG Energy) initiative managed by the EDA. It has three objectives: to assess the best ways and means to implement EU energy legislation in the military and security sectors, stimulate sustainable energy projects in the defence sector, look for funds for these projects, and provide information regarding access to EU funding. To achieve these goals, it brings together experts from the defence and energy sectors to share best practices on energy management, efficiency, and the use of renewables in the military. Their work is carried out in three groups, each with a different focus. 'Energy Management' handles the Energy Efficiency Directive (EED), data collection and analysis, and EnMS. 'Energy Efficiency' focuses on certain articles of the 'Energy Efficiency' and 'Energy Performance in Buildings' directives such as renovation, heating and air conditioning inspections, technical building systems requirements, and buildings' energy technology and their applicability in the defence sector. Finally, 'Renewable Energy' is concerned with applying Renewable Energy Systems (RES) in military, national action plans, and technologies in areas as diverse as solar, wind, biomass, geothermal, hydro, fuel cells, and smart grids. The Consultation Forum's agenda later shifted towards protecting critical energy infrastructure (PCEI) and sharing expertise on protecting energy infrastructure against man-made and natural hazards. Its research helps

46. European Defence Matters.

MS, including Denmark, Norway, and Switzerland, to show the importance of energy efficiency and find solutions to military energy management challenges.[47]

EU Military Concept on Environmental Protection and Energy Efficiency in Operations

The 2012 'EU Military Concept on Environment and Energy in Operations' was envisioned by the European Union External Action (EEAS) service to promote international action against environmental degradation and share its commitment to sustainable development. The document is concerned with the armed forces' impact on the civilian population, cultural property, and the environment. It lists three main reasons why it should be limited, namely to remain in compliance with international law, to gain public support at home and abroad, and to enable long-term reconstruction and development efforts. While resource scarcity and environmental damage lead to renewed conflict and instability, protection and preservation can foster lasting security and development.[48]

The concept highlights the interdependence between security and development, calling for improved coherence between civil and military instruments, capabilities, and policies. This link was first recognised in the 2008 ESS. Additionally, it covers the various tasks of environmental protection (EP), addresses energy efficiency and the use of renewables, and provides an overview of training, education, and capabilities development activities. It also considers health-related issues and the principles and best practices of UN, NATO, and preceding EU operations. EP tasks are categorised as follows: to prevent and reduce environmental damage, to conduct waste management, to achieve energy efficiency, to recover from negative environmental effects, and to protect EP installations and resources.[49]

The first task is particularly difficult to achieve, as a certain degree of environmental damage is always expected. Instead, containment and reduction elements are essential, such as reducing emissions and using pollutants and hazardous materials. While the second task is of less concern to armed forces, the third one is key. Energy-efficient operations can unburden the logistics supply chain during long and complex campaigns due to the military's reliance on fossil fuels and primary batteries. This dependency burdens the environment, constrains operational effectiveness, and leads to financial risks caused by the high fuel cost and price volatility. Personnel safety is also at risk during in-theatre convoy supply. Improvements in this field require organisational, technological, and behavioural enhancements. Technology can improve energy supply by introducing alternative technologies in the context of efficient storage and distribution architectures, and energy handling. The fourth task again does not concern the military as much. The last task, however, is essential. Food storages, drinking water installations, irrigation systems, energy facilities, and medical supplies must all be protected against counter-attacks and damage by one's forces,

47. European Defence Matters.
48. EEAS. 2012. "European Union Military Concept on Environmental Protection and Energy Efficiency for EU-Led Military Operations." Council of the European Union, 13758/12, LIMITE CSDP/PSDC549 COSDP762, EEAS 01574/12, https://data.consilium.europa.eu/doc/document/ST-13758-2012-INIT/en/pdf
49. EEAS 2012.

given their role in the survival of the civilian population in operations areas.[50]

Finally, the concept highlights several activities associated with EP and the armed forces. Firstly, the logistic chain is greatly affected by environmental damage as it requires additional transport for rectification and disposal. This need can be reduced through energy efficiency and the use of renewables. Secondly, reduced convoys lessen the risk to one's forces and increase operational efficiency. Thirdly, design requirements and incentives to contractors are key to support the choice of systems configuration. Finally, production of materials itself causes hazardous emissions and byproducts. Rewarding limitations to this negative aspect of energy consumption can reduce manufacturers' impact on the environment.[51]

European Energy Security Strategy

The 'European Energy Security Strategy' was published in 2014 by the Commission to promote the resilience of energy supplies from shocks and disruptions and reduce dependency on specific fuels suppliers and routes. In particular, the document identifies five points of concern: dependence on energy imports, especially of oil and natural gas; little energy security in disconnected regions like the Baltics and Eastern Europe; dependence from a single external supplier for gas (Russia) and electricity (Baltic states depend on a single external operator); high energy costs (~ €1 billion per day) and the large share of energy in imports; and energy demand growth and changes in supply and trade flows. To solve these issues, the strategy aims at improving cooperation and accountability among MS. This should help develop energy networks and coherent external policies, while simultaneously opening up markets. The strategy thus identified seven actions essential to strengthen Europe's resilience, reduce its energy import dependency, and help its transition to a competitive, low-carbon economy.[52]

In the short term, the Commission calls to

1. improve preparedness for disruptions to energy supplies, reinforce existing European emergency and solidarity mechanisms based on risk assessments to increase resilience, and engage with international partners and local stakeholders to develop new solidarity mechanisms for natural gas and its storage facilities,
2. invest in new infrastructure while adhering to the internal market and competition rules, especially for what concerns the South Stream project, and
3. cooperate with neighbours and partners, especially Ukraine and Moldova, to improve energy security and welcome any agreement in this respect.[53]

In the long term, the Commission wants Europe to

1. achieve a better, more integrated energy market through the join-up of existing energy islands and the enactment of the EU's 2030 interconnection target (15%),
2. diversify energy sources, suppliers, and routes to reduce external dependency on specific suppliers. (Points of focus here

50. EEAS 2012.
51. EEAS 2012.
52. European Commission 2014.
53. European Commission 2014.

are a reinforced partnership with Norway, the Southern Gas Corridor, and a new, Southern European gas hub.)

3. Prioritise energy security and the transition to a low-carbon economy to implement future EU financial instruments. They should also be guiding objectives for the interventions of EEAS' instruments such as the neighbourhood investment facilities and banks.
4. Better coordinate national energy policies through communication among MSs concerning their long-term energy policy strategies and intergovernmental agreements.
5. Finally, the Commission calls for unity in MS' foreign policies and its synergy with energy objectives.[54]

Energy Union

A key priority of the Juncker Commission, the 'Energy Union' (COM/2015/080) was published in February 2015 to give consumers in Europe secure, sustainable, competitive, and affordable energy.[55]

The Union focuses on five interconnected dimensions:

1. Diversifying the EU's energy sources and ensuring energy security through solidarity and cooperation between MS,
2. an integrated, internal energy market that, coupled with adequate infrastructure, technology, and policy, will secure energy supply,
3. improving energy efficiency to reduce imports dependency, lower emissions, and drive jobs and growth,
4. ratifying the 'Paris Agreement' and retaining leadership in the area of renewables, and
5. supporting research and innovation in low-carbon and clean technologies to drive the energy transition and improve competitiveness.[56]

In 2018 the 'Regulation on the governance of the energy union and climate action' (2018/1999) entered into force as part of the 'Clean energy for all Europeans' package. The regulation has identified several goals to help the EU reach its 2030 energy and climate targets and MSs to cooperate:

1. Ensuring the union's consistency with the Paris Agreement,
2. Stimulating cooperation between MS,
3. Promoting security for investors and fostering jobs, growth, and social cohesion,
4. Reducing administrative burdens by integrating and streamlining energy and climate planning and reporting requirements, and
5. Ensuring consistent reporting by MS under the 'UN Framework Convention on Climate Change' and the Paris Agreement.[57]

54. European Commission 2014.
55. European Commission. 2021. "Energy Union." Energy Strategy, https://ec.europa.eu/energy/topics/energy-strategy/energy-union_en#five-dimensions-of-the-energy-union
56. European Commission 2021.
57. European Commission 2021.

To assess energy security's overall impact on the armed forces, and *vice versa*, we identified four major potential benefits generated by increased energy efficiency at the defence level: operational advantages, reduced costs, increased troop security, and EP and political leverage.

Operational Advantages

Of the four points, this is the most important one. Operational energy is essential for everything from training and moving to maintenance during military operations. However, the more energy-intensive a force is, the riskier it becomes to move it at will, especially along supply lines in hostile territories. The bigger the fighting tooth, the longer and more complex the supply line. Today, military fuel depots and supply chains are often the first targets of operations, as NATO proved in Yugoslavia in 1999. Sometimes, countries might choose between force projection and physical, political, financial, and environmental risks. More fuel-efficient weapon systems and reduced logistic requirements might thus offset Anti-Access and Area Denial (A2/AD) efforts by adversaries.[58]

Another key area of work is military bases' reliance on electric energy sources provided by local grids and backup diesel generators in case of blackouts. Civilian grids are increasingly antiquated, suffering from lengthy power outages caused by overuse and severe weather patterns. Switching to such generators leads to increased costs, additional logistical fuel delivery tasks, and climate change. To change this, it is beneficial for the military to cooperate with developers and private investors in a public-private partnership (PPP) model. They could start joint projects to build renewable power plants on unused military lands. The energy product could then be sold to the military itself and local utilities and private consumers.

Moreover, these installations could provide a kind of testing ground to demonstrate energy-related technologies in a real world, integrated-buildings environment. Good military-civilian cooperation in this field would foster information-sharing, reduce the number of projects rejected by the military, and mitigate risks for conflict. Today, alternative energy sources instead of diesel can be employed during emergencies, but several requirements must be fulfilled. Micro-grids must be introduced to make bases fully self-sufficient through strict control over the overall electricity load. Such systems could generate power locally more flexibly, resistant, and cleaner than most other options. Micro-grids' independence could prove essential during emergency operations. Most renewables, however, are inconsistent and largely depend on location and weather conditions. Energy mixes can thus only reach reliability when balanced with other, more conventional energy sources.

Moreover, we must consider the difficulty of dealing with deployed military installations,

58. European Defence Matters; Cornell 2009; and Samaras, Nuttall, and Bazilian 2019.

which must fit all scenarios. Their mobility in operations causes them to encounter different climatic conditions, making selecting appropriate energy technologies difficult. Despite these problems and the huge budgetary requirements, mobile military installations can also take electrical power from a wide range of sources, depending on location and situation. Such an approach requires the interoperability of all military equipment, especially for land forces. The UK, for example, attempted to set common standards of land equipment interconnection through its Land Open System Architecture (LOSA). The PowerFOB project, the developer and tester behind the idea, supported LOSA's principles using intelligent power management in an open system design. Such technologies were able to deliver on LOSA's goals.[59]

Reduced Costs

Increased energy efficiency can also help reduce costs, which is especially important during periods of austerity and import dependency. A major cost burden is the consumption of fuel used to move other fuel. Diversifying energy supplies while increasing alternative energy sources in the overall energy mix can shield defence budgets from risks of future price instability. US military planners thus rely on in-theatre local markets, taking on cost fluctuations and security risks. EU armed forces rely on outsourced fuel supplies instead, resulting in questionable quality control and supply instability. High prices endanger fuel convoys and often reduce impact mission effectiveness. Fossil fuels, moreover, are not managed with the same care and resources of the equipment they power. Neglect costs money. The UK has recognised this and, since 2020, handles energy as a capability critical to operations.[60]

Concerning military installations, permanent defence establishments can be managed like any commercial property. Advantages and technologies are well-understood, and easily compared and selected. The behaviour of energy in such buildings can be modelled to inject confidence in investors. The technology they use is in continuous development and, despite significant up-front budgetary costs, is already proving effective in lowering prices. Apart from electricity, which is still largely dependent on location, transmission capabilities, and weather conditions, researchers have reduced prices for solar and wind power. Still, investment payoffs might often be difficult for self-sustainable military bases and assessment planning might be needed. Many of the cost-reducing initiatives run by the U.S. military might be out of reach for many EU MS. Their smaller sizes and budgets are unable to command the same market attention from technology entrepreneurs. Again, the PPP model could be used to leverage public and private competencies into the sharing of investments. Using the model, savings could result from sharing facilities and equipment through best value assessments and reductions of overhead costs. Both sides would additionally enjoy access to a wide pool of technical data. PowerFOB's holistic energy system offered fuel savings of around 30% for

59. Keršiulis 2013; Ölz, S., R. Sims, and N. Kirchner. 2007. "Contribution of Renewables to Energy Security." International Energy Agency, IEA Information Paper, https://iea.blob.core.windows.net/assets/682ee8e1-a423-4775-bed1-38bf4c18717f/so_contribution.pdf ; Deni 2013; and Barker, T. 2013. "How Relevant are Today's Energy Efficiency Technologies to Deployed Military Bases?" NATO Energy Security Center of Excellency, No. 2, https://enseccoe.org/data/public/uploads/2017/02/esoh-201302.pdf
60. European Defence Matters; Cornell 2009; and Barker 2013.

deployed bases. Finally, once self-sufficiency is achieved in a military installation, funds and resources can be retained or reallocated into current operations, modernisation, or other national security priorities.[61]

Increased Troop Security

Despite the attractiveness of the cost minimisation and economic efficiency provided by new, efficient technologies and practices, their acceptance by military personnel relies on soldiers' sense of isolation in forward operating bases. The extended, vulnerable supply chains on which they had to rely during asymmetric conflicts like Iraq and Afghanistan risked their lives and those of support workers. They would accept any approach to reduce the need for fuel resupply. Casualties tied to resupply, especially water and fuel, have historically accounted for 10-12% of total U.S. Army casualties. Energy-efficient systems could thus avoid unnecessary deaths. However, the sole use of alternatives could cause the loss of focus on the purpose of operations. Complex energy technologies can require considerable manpower and, even if efficient, might offer no operational benefit at all.[62]

Environmental Protection and Political Leverage

The 2016 'EU Global Strategy' cited climate change and energy insecurity as dangers to Europeans and their territory. Environmental stresses such as desertification, land degradation, and water and food scarcity exacerbate conflict and impact the locations of armed forces' future deployments. Additionally, hostile environments increase energy demand and costs, and trigger the need for new and advanced materials. Advanced operational technologies and strategies might thus increase military capabilities, competitive advantages, and combat lethality. These innovations could include reduced logistic requirements and costs, resilient and efficient off-grid power systems, and enterprise cost savings. Examples of energy and environmental efficiency include low-energy camps and self-sufficient operating bases. However, not all forms of renewables are suited for military use though. Wind turbines, for example, were shown to represent physical obstacles for air units and sometimes interfere with the Swedish Army's military radars.[63]

Finally, environmentally friendly armed forces can also pay off for MS on a political level. Defence and security energy savings can be accounted for against global CO2 emission reduction obligations, even if the military sector is not subject to them. Moreover, political leverage might be gained *vis-a-vis* foreign countries and organisations such as Saudi Arabia and OPEC and avoid blockades and embargoes.[64]

61. Barker 2013; Keršiulis 2013; ENF. 2013. "Small Chinese Solar Manufacturers Decimated in 2012." Solar News, https://www.enfsolar.com/news/1315/small-chinese-solar-manufacturers-decimated-in-2012 ; Deni 2013; and Renewable Energy World. 2007. "From 40.7 to 42.8 % Solar Cell Efficiency." Grid scale, https://www.renewableenergyworld.com/storage/from-40-7-to-42-8-solar-cell-efficiency-49483/

62. Samaras, Nuttall, and Bazilian 2019; U.S. Department of Defence. 2013. "Operational Energy by the Numbers." https://www.acq.osd.mil/eie/Downloads/OE/Operational%20Energy%20Numbers_09-30-13.pdf ; Eady, D.S., et al. 2009. "Sustain the Mission Project: Casualty Factors for Fuel and Water Resupply Convoys." Army Environmental Policy Institute, Final Technical Report. https://apps.dtic.mil/dtic/tr/fulltext/u2/b356341.pdf ; and Barker 2013.

63. European Defence Matters; Samaras, Nuttall, and Bazilian 2019; Keršiulis 2013; and Lindgren, F., B. Johansson, T. Malmlöf, and F. Lindvall. 2013. "Siting Conflicts Between Wind Power and Military Aviation: Problems and Potential Solutions." Land Use Policy, Vol. 34: 104-111. https://reader.elsevier.com/reader/sd/pii/S0264837713000355?token=E5686591ACB60C2409E59B0CFAFC513FEF6C34F7111C31E979DB8C164BC9B3BB4BB024F9DF0B1D23EE6FD9ACC51D6E29&originRegion=eu-west-1&originCreation=20210726150236

64. European Defence Matters; and Cornell 2009.

CONCLUSION

Energy is the centrepiece in modern societies' infrastructure. As we have seen, the loss of energy production and distribution capacity can have debilitating effects with the potential to ripple throughout society. Thus, the military applies concepts of both economic and environmental nature to its energy decision-making. In the defence domain, energy can be both an enabler of hard power and, via denial, to be a weapon of war. Throughout the past two decades, the EU has built a leadership position in energy supply and use. Recently, the union's interests have expanded to include resource efficiency and environmental impacts. Increased importance has also been awarded to installations' efficiency and the development of unconventional energy projects, especially concerning renewables. Finally, the EU is now researching the areas of micro- and mini-grids for installations and alternative fuels for major weapons systems such as ships and aircrafts.[65]

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