The Hague Centre for Strategic Studies

Building Europe's alternative fuels industry for military resilience

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EU flag and Three military fighter jets flying in formation across clear sky during air show

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Executive summary

The war in the Middle East in early 2026 created the biggest oil supply disruption in history and highlighted Europe's fuel vulnerability.[1] The closure of the Strait of Hormuz and attacks on oil infrastructure across the region have had significant consequences for oil prices and supply security globally. About half of the European Union's (EU) jet fuel imports come from the Middle East. Jet fuel is not just used by commercial aviation – it is also the principal NATO military fuel. To ensure military readiness, import dependency should be reduced and balanced with increased domestic production.

The expected decline in fossil fuel imports and refining infrastructure as a result of net-zero goals has yet to be matched by any comparable surge in alternative fuel production. Given the interdependence of civilian with military fuel infrastructure, fuel readiness will be affected by the energy transition. European armed forces will have to reassess fuel security in the coming decades and ensure that they derive strategic benefits from the energy transition. If integrated into defence supply chains, alternative fuels can significantly increase resilience, even amidst global commodity crises.

Alternative fuels blended with jet fuel and diesel are the most relevant short-term options for European defence. This includes sustainable aviation fuels produced from hydroprocessed esters and fatty acids (HEFA SAF); renewable diesel produced from hydrotreated vegetable oil (HVO); and synthetic fuels (e-SAF and e-diesel). These fuels can be inserted into the existing military supply chain with no engine or infrastructure alterations, supporting a gradual integration into the military fuel mix. In the short term, HEFA SAF and HVO offer the most immediate opportunities given their existing production scale. In the longer term, synthetic fuels provide a scalable and strategically autonomous pathway, less dependent on feedstock imports.

The main obstacle to military adoption is the scale of the alternative fuel market. Although the four fuels assessed are suitable for blending, production capacity remains limited and unevenly distributed. Military uptake depends on three interrelated factors: coherent policy frameworks across European NATO members, economic instruments that support industrial scale-up and harmonised military standards to safeguard interoperability.

Stable civilian regulations are essential for industry scaleup but will not guarantee sufficient supply to meet defence needs. The expansion of alternative fuels is driven primarily by civilian climate and energy policy, namely ReFuelEU Aviation and the Third Renewable Energy Directive. Yet existing civilian trajectories alone are unlikely to generate sufficiently rapid capacity expansion, interoperability, and geographically distributed supply along key military nodes. Announced projects of SAF and e-SAF in the EU would create enough supply to cover less than 0,012% of military aviation fuel demand during conflict, while HVO could replace 0,05% of military diesel demand. Since alternative fuels will primarily be used by civilian users, there is no guarantee that during conflict they will be repurposed for military consumption. Moreover, the amounts are too low to bring about a meaningful difference to fuel readiness. If armed forces rely only on civilian market growth, they risk becoming residual consumers without guaranteed access during periods of disruption or heightened demand.

1 International Energy Agency, *Oil Market Report* (2026), https://www.iea.org/reports/oil-market-report-march-2026.

Armed forces could use alternative fuels for a targeted readiness boost or to strengthen cross-domain readiness, though there are clear trade-offs in the short-term. Faster and wider adoption offers greater supply chain diversification and stronger strategic autonomy, but it involves higher costs and may face standardisation and interoperability challenges in the short-term. A phased approach starting with targeted military consumption at strategic nodes and followed by adoption across air, land and maritime domains, would be the most beneficial. It would preserve readiness and interoperability while allowing armed forces to develop smart planning that accounts for long-term resilience.

To ensure that European military fuel readiness is strengthened and evolves in tune with civilian fuel market developments, this paper makes three recommendations for policymakers in European NATO member states.

1. **Develop a consolidated civil-military strategy on alternative fuel scaleup to ensure coherence in policy, planning and investment decisions.** European fuel infrastructure is largely civilian-owned and regulated, while military demand remains small and episodic. The likelihood of a fuel demand shock due to military escalation in Europe may be relatively low, but its potential impact would be disastrous. Without structured civil-military coordination, fuel production plans may become incoherent and undermine fuel readiness for defence. A consolidated strategy should focus on information sharing, joint demand assessments for civilian and military users, infrastructure planning and the identification of investment gaps that could be filled through governmental support. This effort can be led by national governments and coordinated by the European Commission and NATO.

2. **Recognize alternative fuel plants as dual-use assets and commit funding accordingly.** The progressive adoption of fuel blends can support military readiness only if governments, both national and at the EU and NATO level, take a proactive approach to supporting this industry by generating demand signals and reducing investment risk. Specifically, national Ministries of Defence can choose among financing options: (a) paying a reservation fee to alternative fuel producers, helping them maintain minimum production levels over time and prioritising access in times of need; (b) securing long-term offtake agreements, creating a strong demand signal for industry to produce adequate amounts of alternative fuels; and (c) acquiring a stake in or full ownership of an alternative fuel plant, firmly placing fuel security within the control of the military. The 1.5% infrastructure-related defence spending pledges by NATO Allies by 2025 offers a potential instrument for this purpose. Alternatively, the 35% earmarked Climate & Environment spending of the upcoming EU Multiannual Financial Framework (MFF) could be used for scaling up alternative fuel production.

3. **Establish benchmarks for minimum domestic production of alternative fuels for defence.** The 2026 oil disruption in the Middle East showed that fuel availability is not only a question of overall supply, but also of control, prioritisation and geographic concentration. If European armed forces are to rely more heavily on alternative fuels, governments avoid repeating their mistakes and becoming overly reliant on foreign energy suppliers. It is essential to ensure access to a minimum level of production and technological capacity within Europe. This involves production capacity for alternative fuels, whether HEFA SAF, HVO, e-SAF, e-diesel, or others outside of this paper's scope like waste-to-fuels, as well as their feedstocks and inputs.

1. Introduction

European countries are operating in a tense security environment. Ever since the invasion of Ukraine in 2022, European governments and the European Union (EU) have been taking steps towards strengthening military readiness. The growing uncertainty of American military support in the case of a military escalation in Europe has created momentum to act. This is reflected in greater defence investments, with NATO Allies pledging to spend 3.5% of GDP on defence and 1.5% on defence-related infrastructure by 2035.[2] Within the EU, the Readiness 2030 initiative aims to strengthen military capabilities and mobilise €800 billion in defence expenditures.[3]

Armed forces will have to redefine fuel readiness for the next decades to ensure they draw strategic benefits from the energy transition.

Fuel readiness should be an integral part of new defence investments, especially after the 2026 Middle East disruption highlighted the strategic risks of Europe's fuel import dependence. With about 25% of world seaborne trade transiting through the Strait of Hormuz, the closure of this key maritime chokepoint led to massive prices increased and imminent supply shortages.[4] While strategic oil reserves held by International Energy Agency members can dampen the effect in the short term, a military-induced demand shock would be impossible to match without massive impacts on civilian consumption.

Since the European military and civilian fuel systems are closely interconnected, including supply, distribution and storage, the ongoing energy transition impacts military fuel supply chains. As of 2026, military operations run predominantly on fossil fuels.[5] Military systems such as aircraft, tanks and frigates require large amounts of jet fuel, diesel, or other hydrocarbons. Considering the median age of main equipment items in most Western militaries, dependency on liquid fuels will remain for at least the next 20 years. The shrinking fossil fuel import and refining infrastructure has not been met by an increase in alternative fuels. Armed forces will have to redefine fuel readiness for the next decades to ensure they draw strategic benefits from the energy transition.

Blends of fossil and alternative fuels emerge as an attractive option for European armed forces to implement by 2030. Alternative, 'drop in' fuels, within this paper's scope comprising advanced sustainable aviation fuel (SAF), renewable diesel (HVO) and synthetic fuels (e-SAF and e-diesel), can be blended with fossil fuels without modification to infrastructure or military engines.[6] For civilian use, the ratio of fossil-alternative fuels in the blend is determined by certification schemes, such as those from the American Society for Testing and Materials (ASTM).[7] While NATO military blending targets have not yet been developed, some armed

2 NATO, 'Defence Expenditures and NATO's 5% Commitment', NATO, 18 December 2025, https://www.nato.int/en/what-we-do/introduction-to-nato/defence-expenditures-and-natos-5-commitment.

3 European Commission, 'White Paper for European Defence and the ReArm Europe Plan/Readiness 2030', Text, European Commission - European Commission, 19 March 2025, https://ec.europa.eu/commission/presscorner/detail/en/ip_25_793.

4 International Energy Agency, *Oil Market Report*.

5 European Union Instiute for Security Studies, "'The Lifeblood of the Military: The Energy Transition and Operational Capacity | European Union Institute for Security Studies', 25 June 2025, https://www.iss.europa.eu/publications/briefs/lifeblood-military-energy-transition-and-operational-capacity.

6 Waste-to-fuel technology is not in the scope of this paper due to the relatively early stages of the industry, but could be a promising option in the long-term.

7 SkyNRG, 'Sustainable Aviation Fuel Certification and ASTM International: What Is It & Why Does It Matter?', *SkyNRG*, 26 January 2023, https://skynrg.com/sustainable-aviation-fuel-certification-and-astm-international-what-is-it-why-does-it-matter/.

forces are testing different options, and SAF blends have been authorised for transport through the Central Europe Pipeline System (CEPS), the largest military fuel infrastructure network in Europe.[8]

Increasing alternative fuel blends could bring benefits for armed forces. They have the same performance properties as conventional fuels and can increase fuel availability, one of the most important factors in military fuel readiness. They also strengthen the autonomy of the fuel supply chain when alternative fuels are domestically produced. Finally, they give armed forces the flexibility to switch between fossil and alternative fuels and their blends, ensuring resilience during the energy transition. Drop-in fuels, therefore, bring notable opportunities for European militaries.

While the alternative fuel market is developing, fuel availability for the military is not guaranteed. Current production volumes are insufficient for widespread use in either the civilian or military sectors. Although technologically mature, the growth of the alternative fuels sector in Europe is hampered by regulatory and economic uncertainty.[9]

This paper explores how alternative fuel adoption and development by European militaries could benefit fuel readiness by 2050. It follows as the third part in a series of reports by The Hague Centre for Strategic Studies released in 2025, 'Securing European Military Fuels in a Tense Security Environment: Supply, Distribution and Storage' and 'European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics', both of which deal with fuel logistics in the military.[10]

The paper is organised as follows. Section two discusses fuel blending options for the military, including the suitability of drop-in fuels to support these military requirements and fuel needs in different security contexts. Section three explores pathways of adoption that could benefit European armed forces, followed by conclusions and recommendations in section four.

While the alternative fuel market is developing, fuel availability for the military is not guaranteed.

8 European Union Aviation Safety Agency, 'Sustainable Aviation Fuels', EASA, 2024, https://www.easa.europa.eu/en/domains/environment/eaer/sustainable-aviation-fuels.

9 T&E, "'Europe Risks Losing Its Early E-Fuels Lead for Aviation, Study Warns', T&E, 20 January 2026, https://www.transportenvironment.org/articles/europe-risks-losing-its-early-e-fuels-lead-for-aviation-study-warns.

10 Ron Stoop and Irina Patrahau, *Securing European Military Fuels in a Tense Security Environment: Supply, Distribution and Storage* (2025), https://hcss.nl/wp-content/uploads/2025/04/Securing-European-Military-Fuels-in-a-Tense-Security-Environment-HCSS-2025-v2.pdf; 'European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics', *HCSS*, n.d., accessed 19 January 2026, https://hcss.nl/report/european-military-fuel-readiness-the-role-of-alternative-fuels-in-military-logistics/.

2. Transforming military fuel readiness

This section introduces military fuel readiness, outlines the need to adapt to developments in the civilian sector and discusses how alternative fuel blends could support this transformation for European defence.

Military fuels

Fuel security is essential to defence readiness. According to the EU's Defence Readiness Roadmap, "*achieving full defence readiness means that Member States' Armed Forces can anticipate, prepare for and be able to respond to any defence-related crisis, including high intensity warfare. It requires well-equipped and resourced armed forces that are coherent and interoperable, adequate training and a doctrine for the use of military force*".[11] As such, fuel readiness refers to the assured availability, quality and logistical flow of fuel, ensuring military forces can meet performance requirements for assigned missions.

The main military fuels are jet fuel for air operations and various diesel variants for land and maritime operations (see Table 1). According to NATO's Single Fuel Concept (SFC), both air and land-based systems should be able to run on jet fuel in combat, to simplify logistics and ensure interoperability.[12]

11 European Commission, *Preserving Peace - Defence Readiness Roadmap 2030* (2025), https://defence-industry-space.ec.europa.eu/eu-defence-industry/readiness-roadmap-2030_en.

12 'The Reality of the Single-Fuel Concept', accessed 22 December 2025, https://www.globalsecurity.org/military/library/report/2005/050300-concept.htm.

Table 1. Main conventional military fuels and alternatives with no changes to engines or infrastructure

Military domain	Main conventional fuel	Primary application(s)	Fuel alternatives with no engine modification	
Air	Jet fuel (F-34)	Aviation, land vehicles, some generators under the Single Fuel Policy.[13] It contains both icing inhibitor (S-1745) and lubricity improving (S-1747) additives.	Blend of F-34 jet fuel and SAF	Blend of F-34 jet fuel and e-SAF
Land	Jet fuel (F-34)		Blend of F-34 jet fuel and SAF	Blend of F-34 jet fuel and e-SAF
	Diesel (F-54 & F-63)	F-54: Land vehicles (compression ignition engines), some marine use. Inter-changeable with commercial diesel.[14] F-63: Land vehicles in very cold climates. Contains the additive S-1750, which enhances lubricity and ignition performance.[15]	Blend of F-54 or F-63 diesel and renewable diesel	Blend of F-54 or F-63 diesel and e-diesel
Maritime	Marine diesel (F-75 & F-76)	F-75: Compression ignition engines, naval gas turbines and ships' boilers for steam raising.[16] Has a low pour point.[17] F-76: Primary naval fuel. Ships, naval vessels, shipboard generators.[18] Contains lubricity improver additive (R655) and antioxidant additive (AO-37).[19]	Blend of F-75 or F-76 marine diesel and renewable diesel	Blend of F-75 or F-76 marine diesel and e-diesel
	High flash point jet fuel (F-44)	Naval aviation / carrier-based aircraft with a higher flash point than F-34/F-44, making it suitable for shipborne operations with high fire risk. Contains additives S-1745 and S-1747.[20]	Blend of F-44 jet fuel and SAF	Blend of F-44 jet fuel and e-SAF

Blending drop-in alternative fuels with conventional fossil fuels would strengthen military readiness in the energy transition, enhancing fuel security and flexibility. Drop-in fuels can be inserted directly into existing storage and distribution infrastructure and used without altering it. Blends of fossil and alternative fuels also support autonomy in a time of considerable geopolitical and supply chain uncertainty where Europe is particularly vulnerable due to its large fossil fuel import volumes.[21] Its high import dependence and limited supplier base limit policy options in times of war. Adding a new type of supply in the form of drop-in fuels can increase the resilience of the military. Moreover, these fuels can be produced domestically or regionally, shortening supply chains and increasing European fuel autonomy.

13 Standards Council of Canada, 'Aviation Turbine Fuel (Military Grades F-34, F-37 and F-44) | Standards Council of Canada', 9 July 2024, https://scc-ccn.ca/standards/notices-of-intent/canadian-general-standards-board-cgsb/aviation-turbine-fuel-military-2.

14 *NATO Logistics Handbook* (NATO, 2012), 101–2, https://www.nato.int/docu/logi-en/logistics_hndbk_2012-en.pdf..

15 *NATO Logistics Handbook*, 102.

16 NATO, "'NATO Logistics Handbook: Chapter 15: Fuels, Oils, Lubricants and Petroleum Handling Equipment', October 1997, https://www.nato.int/docu/logi-en/1997/lo-1511.htm.

17 *NATO Logistics Handbook*. NATO Logistics Handbook (NATO, 2012).

18 *NATO Logistics Handbook*, 102.

19 Environmental Protection Agency, Chemicals of Potential Concern (COPCs) Recommendations Fuel Additives Red Hill Bulk Fuel Storage Fuel Facility (2016), https://www.epa.gov/sites/default/files/2016-07/documents/red_hill_navy_fuel_additives_list.pdf.

20 Standards Council of Canada, 'Aviation Turbine Fuel (Military Grades F-34, F-37 and F-44) | Standards Council of Canada'.

21 Chris Rosslowe, "'Shockproof: How Electrification Can Strengthen EU Energy Security', *Ember*, n.d., accessed 20 January 2026, https://ember-energy.org/latest-insights/shockproof-how-electrification-can-strengthen-eu-energy-security.

Alternative fuel producers must meet regulatory standards that ensure that, when their product is blended with its traditional counterpart at the maximum prescribed blend, the final product meets the same standards as the fossil fuel type. Military standards most often build on civilian standards such as those from the ASTM (American Society of Testing and Materials) or the EN (European standards).[22] NATO Standardization Agreement (STANAG) documents coordinate the development and evolution of NATO standards on concepts, doctrines and procedures for all the NATO allies.[23] It is through these documents that military standards are set for the qualities of different fuels used by NATO militaries, but they also set out common fuel doctrines, meaning they could theoretically mandate specific fuel blends, including alternative fuels. NATO interoperability requirements for drop-in fuels are currently underdeveloped.[24]

Blending drop-in alternative fuels with conventional fossil fuels would strengthen military readiness in the energy transition, enhancing fuel security and flexibility.

Four types of alternative fuels are attractive for military fuel blends: sustainable aviation fuels (SAF) produced from hydroprocessed esters and fatty acids (HEFA); renewable diesel produced from hydrotreated vegetable oil; and two types of synthetic fuels (e-fuels), e-SAF and e-diesel (see Table 1).[25] These are drop-in fuels that can be blended into conventionally used fossil fuels and necessary additives, with no modification to infrastructure or military engines.

HEFA SAF and renewable diesel are the most mature in Europe, even though they account for only small shares of total fuel consumption. Nevertheless, both HEFA SAF and HVO are unlikely to fulfil sustainable fuel needs in Europe, mainly due to feedstock availability issues. Both are primarily produced from used cooking oil (UCO). The amount of UCO and animal waste globally is finite.[26] The EU and the UK combined already use eight times more UCO than they collect domestically, and four times more than their maximum collection potential.[27] This domestic insufficiency highlights issues with the global scaling of this industry, in addition to a notable import dependency, primarily from China, and difficulties in monitoring which imported UCOs fulfil European sustainability requirements.[28]

Synthetic fuels, or e-fuels, are made by combining green hydrogen and a carbon source.[29] Two major production pathways are under development. The first is based on e-methanol as a precursor, and has not been certified for consumption yet, and the second is based on synthetic gas using Fischer-Tropsch processes.[30] From these precursors, both e-SAF and

22 Irina Patrahau et al., *European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics* (The Hague Centre for Strategic Studies, 2025), 8. Irina Patrahau, Ron Stoop, and Thomas Jansen, *European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics* (The Hague Centre for Strategic Studies, 2025), 8.

23 NATO, "'Standardization', NATO, 14 October 2022, https://www.nato.int/en/what-we-do/deterrence-and-defence/standardization.

24 "'Energy Transition: How NATO Can Get It Right', *Council on Geostrategy*, n.d., accessed 6 February 2026, https://www.geostrategy.org.uk/britains-world/energy-transition-how-nato-can-get-it-right/.

25 Patrahau et al., *European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics*. Irina Patrahau, Ron Stoop, and Thomas Jansen, European Military Fuel Readiness: The Role of Alternative Fuels in Military Logistics (The Hague Centre for Strategic Studies, 2025).

26 'Is the Biofuel Industry Approaching a Feedstock Crunch? – Analysis', IEA, 6 December 2022, https://www.iea.org/reports/is-the-biofuel-industry-approaching-a-feedstock-crunch.

27 T&E, *UCO (Unknown Cooking Oil): High Hopes on Limited and Suspicious Materials* (2024), https://www.transportenvironment.org/articles/uco-unknown-cooking-oil-high-hopes-on-limited-and-suspicious-materials.

28 T&E, *UCO (Unknown Cooking Oil)*.

29 'What Are eFuels? - eFuel Alliance', accessed 4 February 2026, https://www.efuel-alliance.eu/efuels/what-are-efuels.

30 Irina Patrahau and Ron Stoop, *Making E-SAF Land: Opportunities for the Netherlands in the Synthetic Aviation Fuel Sector* (The Hague Centre for Strategic Studies, 2025), https://hcss.nl/report/making-e-saf-land/.

e-diesel can be produced in the final step of the process.[31] Synthetic fuels can be wholly produced in Europe, starting from green hydrogen and captured carbon, all the way to the final product. While electricity costs and the insufficient scale of the green hydrogen and carbon markets pose challenges in the short term, synthetic fuels are theoretically more scalable and could be geopolitically advantageous compared to 'traditional' SAF or HVO, which rely on limited and imported waste streams.[32]

Considering NATO's Single Fuel Concept, which relies on F-34 jet fuel, HEFA SAF and/or e-SAF blends into F-34 would be logical entry points for fuel blends for the military. This would maximise fuel availability and interoperability in times of conflict. In the short term, HEFA SAF and HVO fuel blends offer opportunities for adoption, given the existing scale of these industries in Europe and globally and their greater maturity than e-fuels. In the longer term, synthetic fuels would be a more promising solution, as they provide a sustainable scaling pathway that could be independent of global imports.

Scaling alternative fuels for defence

As of 2026, EU civilian frameworks – the Renewable Energy Directive III (RED III) and ReFuelEU Aviation – are the main drivers of the alternative fuel industry scale-up.[33] RED III requires progressively increasing sustainable fuel blends starting in 2030, as well as penalties for fuel suppliers that breach these mandates.[34] ReFuelEU Aviation mandated that at least 2% of all aviation fuel supplied to EU airports be SAF by 2025. This target was fulfilled. The blending obligations will progressively increase to 70% by 2050.[35] Within this mandate, e-SAF needs to account for at least 1.2% of the total aviation fuel mix by 2030, increasing to 35% in 2050 as part of the broader switch to alternative aviation fuels. Figure 1 shows the increasing aviation fuel blending targets as mandated by ReFuelEU.

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31 Alba Soler et al., *E-Fuels: A Techno- Economic Assessment of European Domestic Production and Imports towards 2050* (Concawe, 2022), 11, https://www.concawe.eu/wp-content/uploads/Rpt_22-17.pdf.

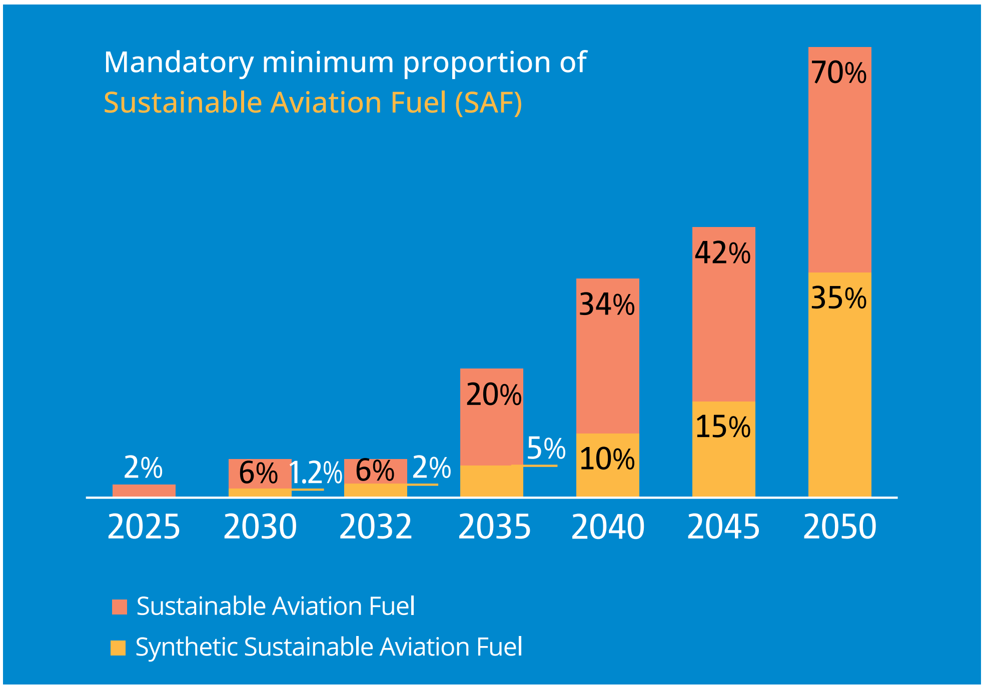
32 September 2025, 'Global Feedstock Assessment for SAF Production', accessed 24 December 2025, https://www.iata.org/en/publications/economics/reports/global-feedstock-assessment-for-saf-production/.

33 SkyNRG and ICF, *2025 SAF Market Outlook* (2025), 27, https://skynrg.com/safmo25/.

34 European Parliament and Council of the European Union, 'Directive 2023/2413 - Renewable Energy Directive', Official Journal of the European Union, 2023, https://eur-lex.europa.eu/eli/dir/2023/2413/oj/eng.

35 'Regulation (EU) 2023/2405 of the European Parliament and of the Council of 18 October 2023 on Ensuring a Level Playing Field for Sustainable Air Transport (ReFuelEU Aviation)', 2023, https://eur-lex.europa.eu/eli/reg/2023/2405/oj/eng.

Figure 1. ReFuelEU Aviation fuel blending targets for fuel suppliers.
Figure from the European Union Aviation Safety Agency, 2025.[36]



For aviation, HEFA SAF remains by far the most dominant pathway. About 80% of SAF used in the EU and UK is made via the HEFA method.[37] In 2025, fuels delivered to EU airports included a 2% SAF blend, in line with the ReFuelEU Aviation mandate. Although revised downward from earlier projections, the expected EU SAF capacity in 2030 stands at 3.5 Mt/year with an additional 0.3Mt in the UK.[38] This means that the ReFuelEU mandated targets can be met, as these require 2.8Mt.[39]

While there are no existing plants for producing e-SAF at a scale of over 10,000 tons per year, there has been a massive increase in announced projects in the EU since 2024 (see Figure 2).[40] This makes the EU the region with the most e-fuel plants worldwide. This includes both large-scale plants and modular facilities, planned specifically for military use by Rheinmetall.[41]

If all 40 large-scale projects materialise in Europe, the e-SAF production capacity could reach 3 million tons per year, equivalent to 5% of the civilian aviation sector's demand in Europe.[42] This would be higher than the ReFuelEU targets in 2030, 2032 and 2035.

[36] European Union Aviation Safety Agency, *European Aviation Environmental Report 2025* (2025), https://www.easa.europa.eu/en/domains/environment/eaer.

[37] T&E, *UCO (Unknown Cooking Oil)*.

[38] SkyNRG and ICF, *2025 SAF Market Outlook*.

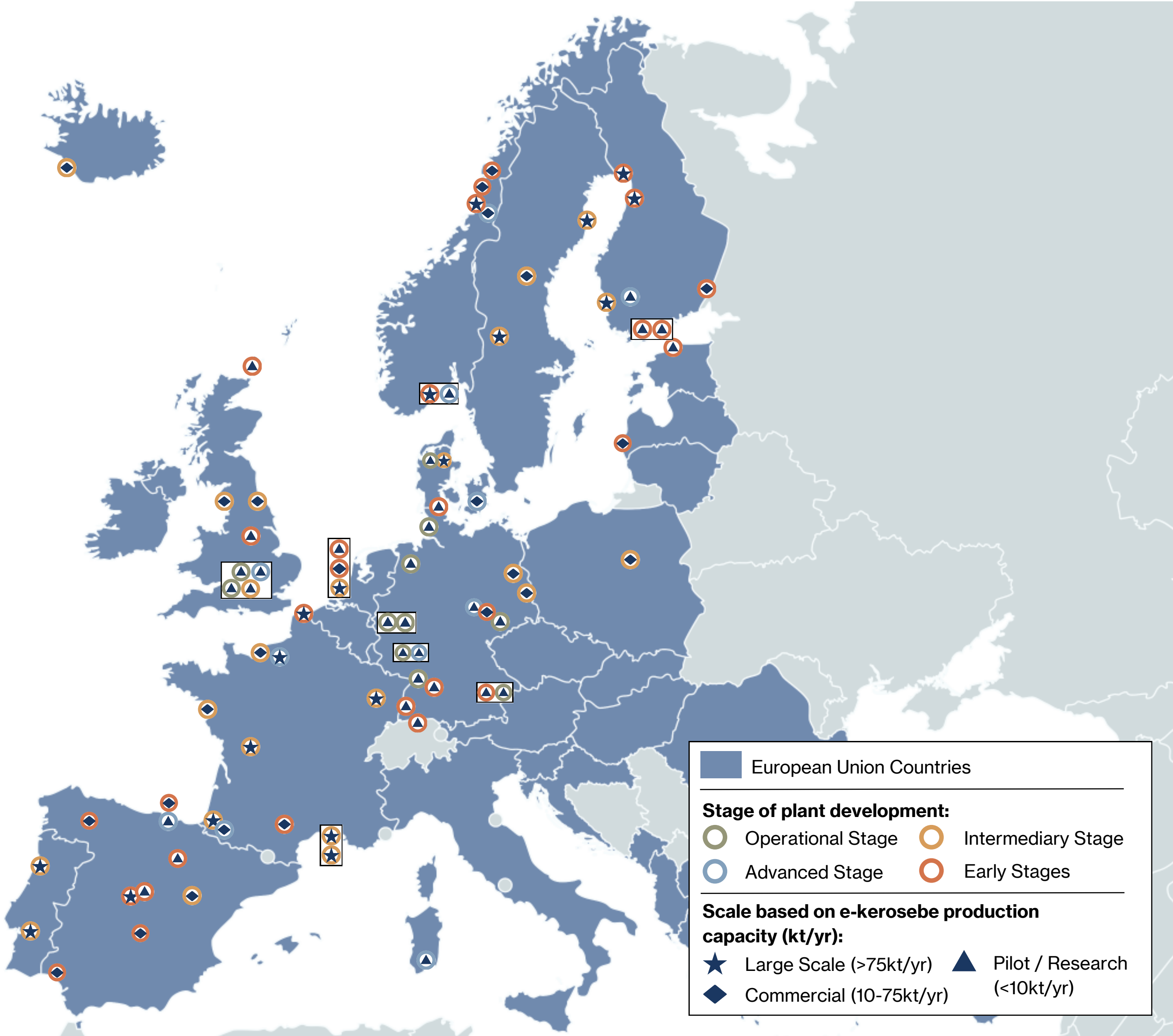
[39] European Commission, 'ReFuelEU Aviation', accessed 4 February 2026, https://transport.ec.europa.eu/transport-modes/air/environment/refueleu-aviation_en.

[40] Camille Mutrelle et al., *The E-SAF Market: Europe's Head Start and the Road Ahead* (T&E, 2025).

[41] Mutrelle et al., *The E-SAF Market: Europe's Head Start and the Road Ahead*; 'E-Fuels – Giga PtX', Rheinmetall, accessed 3 November 2025, https://www.rheinmetall.com/en/products/e-fuels/giga-ptx.

[42] 'Spotlight on E-SAF', T&E, accessed 23 December 2025, https://www.transportenvironment.org/topics/planes/saf-observatory/spotlight-on-e-kerosene.

Figure 2. Map showcasing location of e-SAF projects in Europe. Data from T&E[43]



Nonetheless, the outlook for meeting civilian targets for all four alternative fuels post-2030 remains uncertain. For HEFA SAF, capacity buildout has slowed down in recent years as projects are paused or shelved altogether, showing that voluntary demand (meaning above the mandated levels) remains low.[44] This is due to a variety of factors, including regulatory uncertainty, high production costs caused by electricity prices and a lack of general competitiveness of the industry.[45] The temporary oversupply of HEFA SAF at the end of 2024 further weakened the business case for new projects and may cause further slowdowns in the

43 T&E, 'Spotlight on E-SAF'.

44 'SAF Production Growth Rate Is Slowing Down, Essential to Correct Course Ahead of e-SAF Mandates', accessed 6 February 2026, https://www.iata.org/en/pressroom/2025-releases/2025-12-09-04/.

45 Cecilie Skov Johansen et al., 'Exploring the Potential for Cost-Competitive e-SAF in European Aviation towards 2050', *Energy Reports* 15 (June 2026): 109018, https://doi.org/10.1016/j.egyr.2025.109018.

development of new projects.[46] More recently, both BP and Shell pulled out of projects in Rotterdam, with Shell even cancelling a billion-euro project it had already started.[47]

Moreover, the ReFuelEU framework is up for review by the European Commission in 2027.[48] The emerging e-SAF industry could be vulnerable to industry pressure to weaken or delay SAF targets.[49] The EU is currently revising several long-term regulations it had previously set, such as the internal combustion engine car ban by 2035 and the dilution of the corporate reporting obligations under the CSDDD framework.[50] These rollbacks might create additional uncertainty about the future of ReFuelEU and therefore e-fuel production, as producers could fear investing in plants while e-SAF usage mandates will be pushed back in time, leaving them with a potentially unproductive asset.

The successful adoption of alternative fuel blends by European militaries is not a given and necessitates a proactive approach by armed forces.

Apart from aviation fuels, including SAF and e-SAF, the EU has not set clear blending targets for renewable diesel or e-diesel. These are derived from RED III and national implementations. The road transportation sector, a key user of the two diesel alternatives, has been progressively increasing its consumption, but it is unclear what its long-term prospects are. Biodiesel (including HVO and the FAME biodiesel variant) accounted for 7.2% of diesel consumption in the EU in 2022.[51] Renewable Diesel (HVO), like SAF, is commercially available. Estimates of current HVO production capacity range from 3.5 mt to 5.3 mt per year.[52] The expectation is that EU demand for HVO could reach 16 mt by 2030, with a production capacity of about 8-10 mt.[53]

There has, however, also been a slowdown of HVO project developments in the EU. In 2025, major projects were cancelled or delayed, wiping out over 2 million tons of potential production capacity per year.[54] E-diesel faces similar challenges in scaling up as e-SAF, given that their production processes are closely interrelated.

46 Diana Dimitrova et al., *Sustainable Aviation Fuels Need a Faster Takeoff* (Boston Consulting Group, 2025), https://www.bcg.com/publications/2025/sustainable-aviation-fuels-need-a-faster-takeoff.

47 Polly Martin, 'Shell Exits EU-Backed, Green Hydrogen-Based Aviation Fuel Project', Hydrogeninsight.Com, 9 July 2024, https://www.hydrogeninsight.com/transport/shell-exits-eu-backed-green-hydrogen-based-aviation-fuel-project/2-1-1674752. 'BP Abandons Plans to Build Rotterdam Biofuels Plant | Reuters', accessed 6 February 2026, https://www.reuters.com/sustainability/climate-energy/bp-abandons-plans-build-rotterdam-biofuels-plant-2025-09-22/.

48 'ReFuelEU Aviation', *Carbon Gap - Policy Tracker*, n.d., accessed 14 January 2026, https://tracker.carbongap.org/policy/refueleu-aviation/.

49 Mutrelle et al., *The E-SAF Market: Europe's Head Start and the Road Ahead*.

50 'EU Drops 2035 Combustion Engine Ban as Global EV Shift Faces Reset | Reuters', accessed 22 December 2025, https://www.reuters.com/business/autos-transportation/eu-relent-combustion-engines-ban-after-auto-industry-pressure-2025-12-16/; Jangoulun Singsit, 'EU Parliament, Member States Reach Deal on Diluted Due Diligence Law', *Just Style*, 9 December 2025, https://www.just-style.com/news/omnibus-european-parliament-sustainability-package/.

51 *Trends of Bioenergy in the Member Countries of IEA Bioenergy: Country Reports – 2024 Update | Bioenergy*, n.d., accessed 4 February 2026, https://www.ieabioenergy.com/blog/publications/trends-of-bioenergy-in-the-member-countries-of-iea-bioenergy-country-reports-2024-update/.

52 Khalid, 'COMMODITIES 2025: European Renewable Diesel Market Bullish on Regulatory Support and Rising Demand', S&P Global Energy, 31 December 2024, https://www.spglobal.com/energy/en/news-research/latest-news/agriculture/123124-commodities-2025-european-renewable-diesel-market-bullish-on-regulatory-support-and-rising-demand; 'Europe: HVO 100 Available in Eight European Countries', SGS, 30 August 2021, https://inspire.sgs.com/content/100102941/europe-pure-hvo-available-in-nine-european-countries; 'HVO Fuel Explained', *Oilfast*, 8 August 2025, https://oilfast.co.uk/hvo-fuel-explained/.

53 'Fastmarkets Launches European Hydrotreated Vegetable Oil (HVO) FOB Amsterdam, Rotterdam, Antwerp Outright and Premium Prices: Pricing Notice', *Fastmarkets*, 30 April 2026, https://www.fastmarkets.com/insights/fastmarkets-launches-european-hydrotreated-vegetable-oil-hvo-fob-amsterdam-rotterdam-antwerp-outright-and-premium-prices-pricing-notice/.

54 'HVO and SAF prices: why such increase of price?', *Greenea*, 20 November 2025, https://www.greenea.com/publication/hvo-and-saf-prices-why-such-increase-of-price/.

Even though alternative fuel blends could offer militaries increased strategic autonomy and fuel flexibility in the next decades, none of the four fuels considered have reached a sufficient level of maturity to provide these functions as of 2026. The successful adoption of alternative fuel blends by European militaries is not a given and necessitates a proactive approach by armed forces. They will have to consider how to support the industry's emergence, what steps are needed and how the relationship with the civilian sector should be structured.

Military fuel needs

Fuel use in the military is heavily dependent on the security environment. In peacetime, fuel is used in routine activities at military home bases and during training and exercises. In times of heightened security tensions, military fuel consumption increases from an average of 5-8% of civilian use in peace time up to 150%, depending on the country's proximity to the contested area. This is due to extended exercises, military buildup or even troop deployment in the event of a full-scale war. Military consumption also includes the temporary or semi-permanent establishment of forward operating bases near the battlefield, supporting deployed forces with command and control, logistics and sustainment.

Military needs are thus significantly higher than the capacity of announced projects of alternative fuels.

Breaking down fuel use, the share of fuel used in air operations ranges from 70% to 90% of total fuel use in combat, depending on the stage of the war and the nature of the operation.[55] This share increases in air-intensive phases such as major air campaigns or rapid air-heavy interventions that aim to disrupt the adversary at the outset of a campaign. The share decreases when operations are more focused on sustainment using ground forces. Land operations also use significant amounts of fuel, mainly from ground vehicles and base electricity generators.[56]

During full-scale conflict, assuming the military consumption of aviation fuel (jet fuel and SAF) to equal 60-70% of civilian peacetime consumption across EU countries, this would amount to approximately 78.500-91.500 tonnes/day.[57] For road fuel (diesel and HVO), a more modest increase to 8-10% of civilian peacetime consumption would translate into about 42.000-53.000 tonnes/day.[58]

Military needs are thus significantly higher than the capacity of announced projects of alternative fuels. If EU SAF capacity reaches 3,5 mt/year by 2030 (9,56 ton/day), it could fulfil about 0,012% of daily military demand. In the optimistic scenario whereby e-SAF capacity could reach 3 mt/year (8,2 ton/day), this would account for an even smaller percentage of military consumption. If HVO capacity reaches 8 mt/year (21,9 ton/day), the percentage of military consumption it fulfils could be higher, reaching 0,05%.

Nonetheless, alternative fuels will primarily be used by civilian users. There is no guarantee that during conflict they will be repurposed for military consumption. Even if they were, the current amounts are too low to bring a meaningful difference to fuel readiness. To ensure availability for armed forces, a more proactive approach is necessary, as discussed below.

55 Neta Crawford, 'Pentagon Fuel Use, Climate Change, and the Costs of War', Brown University, 19 November 2019, https://costsofwar.watson.brown.edu/paper/pentagon-fuel-use-climate-change-and-costs-war.; and 'NATO Pipeline System Conference, 2025', October 2025., https://nps-conference.org.

56 "'Strategy Charts Path to Fuel-Efficient Forward Operating Base', Army.Mil, 26 October 2015, https://www.army.mil/article/157524/strategy_charts_path_to_fuel_efficient_forward_operating_base.

57 Calculations based on Eurostat consumption data from 2024.

58 Calculations based on Eurostat consumption data from 2024.

3. Pathways of military adoption of alternative fuels

Apart from sustainability, scalability and the civilian market outlook of alternative fuels, the military adoption of drop-in fuels also depends on the goals that the defence sector seeks to achieve. To illustrate possible options, three adoption pathways are explored below: *Continuity*, *Targeted readiness boost* and *Cross-domain readiness strategy*. The three pathways can be seen as an evolutionary path, whereby the 2026 trends and developments transform into targeted military adoption and, finally, in a comprehensive cross-domain strategy. The pathways have clear trade-offs. Pathways two and three offer greater supply chain diversification and stronger strategic autonomy than pathway one. At the same time, they involve higher costs and may face standardisation and interoperability challenges in the short-term. The pathways, the improvements they bring to military readiness and necessary conditions for their adoption are summarised in Table 2 and detailed in the paragraphs below.

Table 2. Summary of pathways of adoption

	Pathway 1: Continuity	Pathway 2: Targeted readiness boost	Pathway 3: Cross-domain readiness strategy
Alternative fuel use by armed forces	Ad-hoc consumption of HEFA SAF and HVO in NATO countries where civilian supply already exists and via CEPS	Ad-hoc consumption is complemented by adoption at strategic nodes in the air domain, including both HEFA SAF and e-SAF	Operationally embedded consumption coordinated by NATO, integrated into planning assumptions across domains, from trainings to sustained operations and deployment support, including high-tempo high-disruption contexts
Improvements to military readiness	Learning-by-doing and becoming more familiar with the fuel by having military staff that handles it Improvements to supply security at military bases that use alternative fuels	Improvements to supply security and storage and distribution infrastructure for a limited number of strategic locations across Europe Enhanced cross-border operational frameworks for interoperability under 'coalition of the willing'	More robust and autonomous supply chain, due to diversified fuel types and production locations, including in Europe Fully integrated operational frameworks for interoperability across NATO Allies
Conditions for adoption	**Political** Continuation of existing policy framework **Economic** Continuation of existing industrial development trends **Technical** Continuation of uncertain timeline of technical adoption and certification	**Political** Support by a 'coalition of the willing' for developing a cross-border policy framework to integrate alternative fuels in defence planning **Economic** Possible financial support for fuel projects, and expansion of storage and distribution infrastructure around strategic military airbases **Technical** Military certification advancements with added benefits for the civilian sector	**Political** Full support for and integration of alternative fuels in defence planning coordinated by NATO, and developed and implemented by national governments **Economic** Offtake agreements, financing, co-development, defence-owned plants around military bases in the air, land and maritime domains **Technical** Full integration into NATO fuel standards

Pathway 1: Continuity

Description

The first pathway mirrors the reality of 2026. The military adoption of drop-in fuels is shaped by civilian market developments and ad-hoc military consumption rather than by a dedicated defence strategy. In the absence of an enabling policy framework coordinated between the EU and European NATO members, adoption strongly depends on national policies and domestic ambitions in this field. To avoid weakening interoperability, militaries limit the use of alternative fuels to routine activities rather than deploying them in cross-border operations. This is taking place in a fragmented way, starting with 'fast mover' countries and states connected to CEPS.

As the military consumption in this pathway is an add-on to civilian markets, the first countries that might try adopting alternative fuels for defence will be those in proximity to civilian production plants. In this pathway, the speed of adoption differs significantly between countries, and so does the type of consumption. Some, like the UK, Sweden, the Netherlands and France, have been proactively testing alternative fuel blends in their aircraft.[59] Military tankers and helicopters have been successfully tested with 100% alternative fuels, although official standards have not yet been developed. Fighter jets, both F-16 and F-35, have been tested with blends under 50%.

Military consumption in 2026 extends to HVO. The Dutch Ministry of Defence signed a four-year agreement with VARO, who will supply a diesel blend consisting of 70% fossil fuel and 30% HVO.[60] The UK Royal Air Force successfully tested HVO in Mechanical Transport Squadrons, Mobile Catering Squadrons and an Expeditionary Logistics Squadron.[61]

These governments will likely be first movers in adopting drop-in fuel blends, whereas Central and Eastern European states that have little or no experience or plans with alternative fuels are more likely to become followers. Because of this, fuel procurement is fragmented and short-term, relying on ad-hoc purchases and limited framework agreements with suppliers.

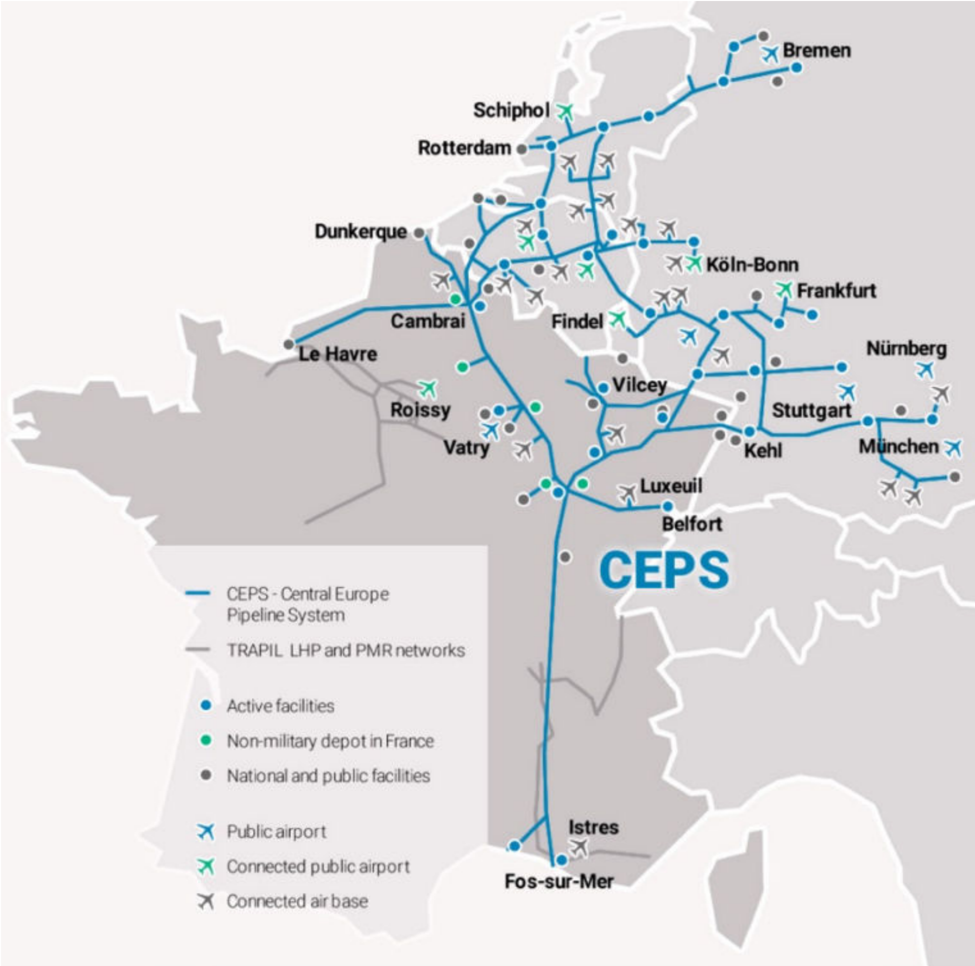
Moreover, the CEPS pipeline network has already authorised the transportation of SAF, and this is expected to continue. Deliveries of HEFA SAF-jet fuel blends are made to both military and civilian airports in Germany, the Netherlands, Belgium, France and Luxembourg (see Figure 3). Within this system, fuel suppliers and purchasers trade conventional jet fuel and SAF blends that are physically transported through the CEPS infrastructure.

59 'Royal Netherlands Air Force Operating F-16 Fighting Falcons on 5% Biojet Blend', Bioenergy International, 16 January 2019, https://bioenergyinternational.com/royal-netherlands-air-force-operating-f-16-fighting-falcons-on-5-biojet-blend/; 'Norway Operates F-35s on Biofuel', Government.No, regjeringen.no, 15 January 2025, https://www.regjeringen.no/en/aktuelt/her-flyr-norske-f-35-pa-biodrivstoff/id3083703/; Swedish Armed Forces, 'Successful Tests with Fossil-Free Fuel', 2020, https://www.forsvarsmakten.se/en/news/2020/12/successful-tests-with-fossil-free-fuel/. 'Royal Air Force Completes World-First Sustainable Fuel Military Transporter Flight', GOV.UK, 2022, https:// www.gov.uk/government/news/royal-air-force-completes-world-first-sustainable-fuel-military-transporter-flight. Mark Huber, 'French Military NH90 Helicopter Flown On Sustainable Aviation Fuel', Aviation International News, 2023, https://www.ainonline.com/aviation-news/business-aviation/2023-02-10/french-military-nh90helicopter-flown-100-saf.

60 'VARO Enters Four-Year Partnership with Dutch Ministry of Defence to Deliver HVO30', VAROPreem, 2025, https://www.varopreem.com/en/news-and-media/articles/varo-enters-four-year-partnership-with-dutch-ministry-of-defence-to-deliver-hvo30/.

61 Chloe Williment, 'How Is The RAF Shifting to Renewable Fuel for Defence?', Sustainability Magazine, 12 June 2025, https://sustainabilitymag.com/articles/how-is-the-raf-shifting-to-renewable-fuel-for-defence.

Figure 3. CEPS Pipeline Network. Figure from European Union Aviation Safety Agency, 2025.[62]



Improvements to military readiness

As drop-in fuels are used on an ad-hoc basis rather than being structurally integrated into military planning, the readiness additions are limited in this pathway. There are gains in the expertise and experience of military personnel in handling the new fuel mix, but only in countries where the national government is already using some of the fuels. Security of supply at military bases in countries that use alternative fuels is strengthened, but cross-border sustainment is not affected as drop-in fuels are not used in operational environments.

Conditions for adoption

This pathway implies the continuation of existing political and economic developments in the civilian market, without direct, proactive military involvement. Notably, it requires that existing targets be maintained or even strengthened during the 2027 review of the ReFuelEU framework, and that announced projects be supported to achieve final a investment decision (FID) before 2030.

62 European Union Aviation Safety Agency, *European Aviation Environmental Report 2025.*

From a technical perspective, this pathway is based on the existing speed of development of civilian certification for alternative fuels. This includes a slow certification speed for higher than 50% blending possibilities in the final product. In turn, this can slow down the development of military standards, strengthening the idea that military adoption will only focus on exercises, training and routine consumption at a national level. Moreover, it includes issues around the certification of SAF for military use, which has only been done in a few countries, including via the CEPS pipeline.

Financing options of alternative fuels for European militaries

As the scalability of the industry is the main obstacle to military adoption of alternative fuels, Ministries of Defence and armed forces should consider (co-)financing options for alternative fuels in order to achieve a 'Targeted readiness boost' or 'Cross-domain readiness strategy'. Three options are described below.

1. Reservation/call option. European militaries could reserve a certain portion of fuel from civilian producers using a call option. This would allow the military to draw on supplies if necessary. Such a financing strategy would be cheaper initially, as there would be no obligation to purchase. The downside is that it does not provide a strong demand signal for civilian producers, potentially undermining the business case for scaling up alternative fuel production in Europe.

2. Long-term offtake agreement. European militaries could sign a long-term offtake agreement with civilian alternative fuel producers. This would give the military a guaranteed supply of alternative fuel. This supply would be guaranteed as it ensures that the producer can maintain operations for a longer time and potentially overcome competitiveness issues. However, this option is costlier upfront than just placing a reservation or a call option on alternative fuels.

3. Acquiring a stake or full ownership of an alternative fuel plant. European militaries could decide to acquire a stake in or fully develop their own alternative fuel plant. This would allow the military to retain more control over the ramp-up of alternative fuel production, increasing security of supply and ensuring prioritisation of military over civilian needs in times of conflict. The downside is that this would increase costs and would put more responsibility on the military for the success of the alternative fuel plant, which is not their core competency.

Pathway 2: Targeted readiness boost

Description

In this pathway, the military takes a more intentional, yet still cautious approach towards the adoption of drop-in fuels. Like the 'Continuity' pathway, it includes locations where HEFA SAF and HVO are available. As mentioned above, this can be done by any country that has a production plant within its borders or in close proximity, including Denmark, the UK and other Western and Northern European countries, and in connection with CEPS.

In addition, a 'Targeted readiness boost' focuses on strategic nodes in the air domain and expands towards both HEFA SAF and e-SAF blends. The air domain is prioritised over land and maritime domains in this pathway given the importance of aviation fuel under the Single Fuel Concept. The focus shifts from opportunistic and ad-hoc consumption based on proximity and supply, to strategic thinking around locations where the resilience of fuel supply is inadequate for military standards. This includes military bases in Central and Eastern Europe (CEE). With the addition of alternative fuels, these CEE bases also benefit from enhanced supply, storage and distribution infrastructure. This means that road and rail transport modalities start being used for alternative fuel blends where pipelines are not available.

Moreover, consumption in the defence sector is expanded from HEFA SAF blends to e-SAF, too. Ministries of Defence support early offtake from emerging large-scale and modular e-fuel plants, while maintaining flexibility in blending ratios. Military bases progressively enhance their capability to receive, test, store and distribute these fuels through upgraded quality assurance procedures, storage and handling infrastructure and harmonised documentation standards. This expansion remains concentrated at designated nodes, allowing armed forces to build operational familiarity with synthetic fuels and strengthen supply security without committing to defence-wide integration.

Improvements to military readiness

This pathway provides improvements to readiness for a limited number of strategic locations across Europe. Military fuel readiness is enhanced due to fuel supply diversification as additional suppliers for alternative fuels are contracted by the military, complementing fossil fuel providers. This also provides momentum for streamlining cross-border fuel procurement and transport, harmonising quality standards, certification processes and contracting procedures between NATO states. Moreover, storage infrastructure around critical nodes is expanded to support the uptake of alternative fuels.

Conditions for adoption

For this pathway to be achieved, political, economic and technical conditions for adoption shift. Reaching these conditions is time-intensive and will likely take place after 2030-2035. Political agreement is needed between a 'coalition of the willing' governments to ensure effective coordination. This implies that the military and the defence staff have successfully tested the adoption of alternative fuels in the air domain and have integrated it within the planning doctrine. Further agreements may be expanded to other countries that have integrated alternative fuels nationally.

Economically, the military will offer more concrete demand signals to industry by concluding offtake agreements with production plants that become dual-use, serving both civilian and defence customers. This can also include the possible financing of alternative fuel plants. To expand military consumption and CEPS deliveries from HEFA SAF and also include e-SAF blends, projects must be supported to materialise. As mentioned above, if all 40 announced large-scale e-SAF projects materialise, the available quantities will be higher than those mandated by the EU, leaving some room for limited adoption by national Ministries of Defence. Financing is a key issue. Estimates of $1-2 billion are required per power plant, part of which might have to be covered by Defence budgets.[63] Box 1 describes some options.

Technically, civilian certification schemes are supported by military procedures, with high potential for cross-fertilisation due to increased funding and human capital dedicated to accelerating approvals for production processes and increasing maximum blending targets. At the same time, NATO interoperability requirements start taking shape due to the adoption of alternative fuels at strategic nodes, but fall short of NATO-wide technical standards transformation.

Pathway 3: Cross-domain readiness strategy

Description

NATO and its member states develop and implement a defence-wide strategy for integrating alternative fuels in the military fuel mix based on aligning consumption and procurement timelines. Ministries of Defence translate alliance-level objectives into national implementation plans aligned with NATO logistics planning processes. This involves clear plans with milestones for blending alternative fuels with conventional ones, specifying indicative volume trajectories, locations, procurement strategies, and their impact on wartime sustainment.

Under this pathway, alternative fuels become operationally integrated across air, land, and maritime domains. Air forces incorporate certified sustainable aviation fuels into regular base supply; land forces integrate compatible alternatives into logistics fleets and training areas; naval forces coordinate port-based supply where infrastructure permits.

Improvements to military readiness

The military fuel supply chain becomes more robust and autonomous, as it enjoys a wider variety of suppliers and fuel types, which can be used without major modifications to fuel infrastructure and military systems. As the fuels are produced in Europe, the autonomy of fuel supply is also strengthened. Moreover, the integration is done holistically across military domains and in the different member states, ensuring that fuel logistics are optimised and streamlined.

63 T&E, 'Spotlight on E-SAF'.

Conditions for adoption

For this pathway to be achieved, political, economic and technical conditions are geared towards maximum adoption of alternative fuels. Reaching these conditions is time-intensive and will likely take place after 2040-2045.

Politically, this implies that the military and the defence staff integrate the adoption of alternative fuels within operational planning, in coordination with the other NATO Allies. To do so, Ministries of Defence will have to engage in data-sharing and joint planning around their fuel needs and procurement. This also requires enhanced civil-military coordination between armed forces and the fuel industry to ensure efficient logistics, up-to-date infrastructure and secure supplies.

Economically, the military will create significant additional demand and develop long-term offtake agreements with industry. Apart from this, co-investment and possibly even defence-owned alternative fuel plants could be beneficial to support widespread military adoption and ensure supply security. See Box 1 for details.

Technically, alternative fuels should be fully integrated in the NATO STANAG fuel standards and used across domains by all NATO Allies.

4. Conclusions and policy recommendations

Military fuel readiness is a high priority in the tense security environment that Europe is operating in. Military fuel policies must be developed to balance operational continuity and future resilience. As the energy transition progresses and alternative fuels scale up in the civilian sector, it is imperative that European armed forces explore the opportunities and choose a course of action that supports fuel readiness proactively. The paper leads to **three main conclusions:**

1. **The main obstacle to military adoption is the scale of the alternative fuel market.** Although the four fuels assessed are technologically mature and suitable for blending, production capacity remains limited and unevenly distributed. Military uptake depends on three interrelated factors: coherent policy frameworks across European NATO members, economic instruments that support industrial scale-up and harmonised military standards to safeguard interoperability.

2. **Stable civilian regulations are essential for industry scaleup but will not guarantee sufficient supply to meet defence needs.** The expansion of alternative fuels is driven primarily by civilian climate and energy policy, namely ReFuelEU Aviation and the Third Renewable Energy Directive. Yet existing civilian trajectories alone are unlikely to generate sufficiently rapid capacity expansion, interoperability, and geographically distributed supply along key military nodes. Announced projects of SAF and e-SAF would create enough supply to cover less than 20% of military jet fuel demand during conflict, while HVO could replace 23-29% of military diesel demand. Since alternative fuels will primarily be used by civilian users, there is no guarantee that during conflict they will be repurposed for military consumption. If armed forces rely only on civilian market growth, they risk becoming residual consumers without guaranteed access during periods of disruption or heightened demand.

3. **Armed forces could use alternative fuels for a targeted readiness boost or to strengthen cross-domain readiness, though there are clear trade-offs in the short-term.** Faster and wider adoption offers greater supply chain diversification and stronger strategic autonomy, but it involves higher costs and may face standardisation and interoperability challenges in the short-term. A phased approach starting with targeted military consumption at strategic nodes and followed by adoption across air, land and maritime domains, would be the most beneficial. It would preserve readiness and interoperability while allowing armed forces to develop smart planning that accounts for long-term resilience.

To ensure that European military fuel readiness is strengthened and evolves in tune with civilian fuel market developments, this paper makes three recommendations for policymakers in European NATO member states.

1. **Develop a consolidated civil-military strategy on alternative fuel scaleup to ensure coherence in policy, planning and investment decisions.** European fuel infrastructure is largely civilian-owned and regulated, while military demand remains small and episodic. The likelihood of a fuel demand shock due to military escalation in Europe may be relatively low, but its potential impact would be disastrous. Without structured civil-military coordination, fuel production plans may become incoherent and undermine fuel readiness for defence. A consolidated strategy should focus on information sharing, joint demand assessments for civilian and military users, infrastructure planning and the identification of investment gaps that could be filled through governmental support. This effort can be led by national governments and coordinated by the European Commission and NATO.

2. **Recognize alternative fuel plants as dual-use assets and commit funding accordingly.** The progressive adoption of fuel blends can support military readiness only if governments, both national and at the EU and NATO level, take a proactive approach to supporting this industry by generating demand signals and reducing investment risk. Specifically, national Ministries of Defence can choose among financing options: (a) paying a reservation fee to alternative fuel producers, helping them maintain minimum production levels over time and prioritising access in times of need; (b) securing long-term offtake agreements, creating a strong demand signal for industry to produce adequate amounts of alternative fuels; and (c) acquiring a stake in or full ownership of an alternative fuel plant, firmly placing fuel security within the control of the military. The 1.5% infrastructure-related defence spending pledges by NATO Allies by 2025 offers a potential instrument for this purpose. Alternatively, the 35% earmarked Climate & Environment spending of the upcoming EU Multiannual Financial Framework (MFF) could be used for scaling up alternative fuel production.

3. **Establish benchmarks for minimum domestic production of alternative fuels for defence.** The 2026 oil disruption in the Middle East showed that fuel availability is not only a question of overall supply, but also of control, prioritisation and geographic concentration. If European armed forces are to rely more heavily on alternative fuels, governments avoid repeating their mistakes and becoming overly reliant on foreign energy suppliers. It is essential to ensure access to a minimum level of production and technological capacity within Europe. This involves production capacity for alternative fuels, whether HEFA SAF, HVO, e-SAF, e-diesel, or others outside of this paper's scope like waste-to-fuels, as well as their feedstocks and inputs.

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