Bio-based Industries Consortium

Dual-use and the Bio-based Industries: A Strategic Opportunity for Europe

A drone frame made from lignin extracted at a Finnish paper mill. A military uniform woven from hemp grown in France. A battery electrode made from wheat straw from Poland. A defence vehicle that is lighter than ever, because its dashboard, door panels and bumpers are made from bio-based polypropylene. This is not science fiction. These are innovation pathways that already exist today, partially scaled up, technically mature enough to accelerate, and strategically relevant at a time when Europe is urgently rethinking its defence posture and industrial sovereignty.

The concept that links them is dual use: technology and materials that have both civilian and military applications. For the bio-based industries, dual use is not a deviation from its mission. It is an extension, that opens up new markets, attracts new funding and accelerates the innovation cycle that makes bio-based solutions competitive. This report, commissioned by the Bio-based Industries Consortium (BIC), explains why.

1. What is Dual-use?

The dual-use concept is far from new: GPS, the internet, and composite materials all originated in defence programmes before transforming everyday life. What is new is the speed and urgency with which dual-use is being adopted as a cornerstone of European industrial and innovation policy.

For decades, Europe maintained a strict institutional separation between civilian research and military applications. Public funding was directed exclusively at civilian projects; banks and asset managers often excluded defence-related companies from sustainable investment portfolios. This is now changing, rapidly and fundamentally.

The turning point came with a confluence of geopolitical shocks: Russia's invasion of Ukraine, war in the Middle East leading to

worldwide energy supply disruptions, and the uncertainty about US commitment to NATO. There is a growing recognition that Europe's dependence on external suppliers for energy, raw materials and manufactured goods, represents a structural vulnerability. **European Commission President Ursula von der Leyen captured the mood in June 2025** when she told the NATO Summit Defence Industry Forum in The Hague:

> Many critical components of 21st-century defence are dual-use (…). Our defence industry needs seamless access to the high end of these vital technologies.

An independent expert report commissioned by the European Commission (**ESIR, June 2025**) called for a 'dual-use by design' approach as 'a vital pillar for ensuring Europe's security, competitiveness and prosperity', arguing that the persistent separation between civilian and military R&I is leading to 'a loss of competitive advantages in emerging technologies'.

Why it matters?

Dual-use matters for several interconnected reasons. First, it maximises the return on public and private R&D investment by allowing innovations to serve multiple markets simultaneously.

Second, it accelerates the path from laboratory to market, because defence demand can act as a launching customer, providing certainty of uptake and funding that commercial civilian markets rarely offer at early stages.

Third, and crucially for Europe, it strengthens strategic autonomy by reducing dependence on imports of critical materials and technologies.

The regulatory dimension is real and important. **EU Regulation 2021/821** governs the export of dual-use goods and technologies, defining them as items that can be used for both civilian and military purposes, including materials, software and technology. These export controls exist for legitimate security reasons. But they are increasingly recognised as one part of a much larger picture: the deliberate integration of dual-use thinking into European research, innovation and procurement policy.

2.

The EU and NATO Context

A policy revolution in progress

The EU is also undergoing a fundamental shift in its approach to defence and dual-use research. For forty years, the EU's Framework Programme for research and innovation was exclusively civilian in scope. That era is ending.

In July 2025, Ekaterina Zaharieva, the EU Commissioner responsible for research and innovation, confirmed that Horizon Europe's successor, the **Framework Programme 10**, would be '**open to dual-use by default**.' The European Commission is proposing to nearly double the Horizon budget to €175 billion, with a new pillar dedicated to resilience, security and defence. As Zaharieva put it:

> The division between civil and defence applications is very often artificial, and we cannot miss out on the potential of research and innovation to make Europeans safer.

Ekaterina Zaharieva, EU Commissioner for Startups, Research and Innovation

The **European Defence Industry Programme (EDIP)**, adopted in October 2025, allocates €1.5 billion to strengthening Europe's defence technological and industrial base. Ukraine has been invited to join the European Defence Fund, reflecting the strategic significance of its battle-tested innovation ecosystem.

In November 2025, the European Parliament and Council reached agreement on a '**defence mini-omnibus**', opening the **European Innovation Council (EIC) Accelerator** to dual-use projects for the first time, and allowing equity investments in defence technologies under the **Strategic Technologies for Europe Platform (STEP)**. An additional €210 million was unlocked for the EIC Fund.

NATO: the science dimension

NATO's **Science for Peace and Security (SPS) Programme** offers funding for collaborative research between NATO member states and partner countries addressing emerging security challenges.

The **SPS 2026-1 Call for Proposals** explicitly lists biotechnologies among its key priorities, including biosensors for CBRN (Chemical, Biological, Radiological, and Nuclear threats) detection and environmental monitoring, and biomanufacturing of critical materials for use in logistically challenging environments. This is a direct signal that NATO sees industrial biotechnology as relevant to collective security.

NATO has also established dedicated innovation funds and mechanisms, including the **NATO Innovation Fund** and the **Defence Innovation Accelerator for the North Atlantic (DIANA)**, designed to connect alliance needs with emerging technology companies. These represent concrete funding opportunities for bio-based companies whose technologies have dual-use potential.

Meanwhile, the war in Ukraine has demonstrated the value of agile, distributed manufacturing. Ukrainian defence innovators have shown that prototypes can reach the frontline within 24 hours. The broader lesson for Europe is that the speed, resilience and localisation of manufacturing capacity -precisely the characteristics that biomanufacturing can offer- have direct strategic value.

3.

The Role of BIC and the Bio-based Industries

The Bio-based Industries Consortium (BIC) represents the private sector in a public-private partnership with the European Commission through the Circular Bio-based Europe Joint Undertaking (CBE JU). Its members develop products and processes that replace fossil-based materials with renewable, bio-based alternatives, across materials, chemicals, textiles, energy storage and more.

BIC's engagement with dual-use has emerged from the same geopolitical pressures that are reshaping European policy. Dirk Carrez, BIC's Executive Director, explained the evolution: "The first phase was Made in Europe, reducing dependence on external suppliers of energy, fertilisers and raw materials. The second phase, accelerated by Trump's re-election and questions about NATO commitments, is dual-use: recognising that the technologies BIC members develop can also contribute to European defence capability and resilience."

Dirk Carrez, fromer BIC Executive Director

We don't want to lose this opportunity if companies are willing to do this. Each company must decide for itself whether it wishes to participate, but they should know that extra funds for innovation are flowing toward dual-use, and that new applications developed for military purposes have historically generated innovative applications in everyday life as well.

For BIC, 'defence, space and dual-use' is a topic that Europe cannot neglect to address, given the current security environment and the need for European resilience. If dual-use engagement enables the switch from fossil to bio-based chemicals and materials, technology knowledge transfer must be ensured in both directions.

BIC argues that the upcoming EU public procurement rules should consider dual-use applications of bio-based materials in defence procurement. Specific examples include bio-based lightweight materials for drones and space applications, bio-based textiles (man-made fibres from cellulose) for military clothing and protective gear, and bio-based products for energy infrastructure, such as lignin applications for battery storage.

In December 2025, BIC hosted a webinar on dual use in collaboration with **VCG.AI**, a Stuttgart-based bio-based intelligence platform. The webinar created awareness on the opportunities presented by dual-use markets.

Examples from the Bio-based Industries

VCG.AI, commissioned by BIC, conducted a detailed analysis of four bio-based material categories with clear dual-use potential. These examples are deliberately illustrative, not exhaustive. The aim is to demonstrate the logic of dual-use by design in concrete terms.

Bio-based Polypropylene for vehicles

Europe holds 44-51% of global bio-based PP consumption and 45% of production capacity, positioning the continent to lead this transition. The starch-to-ethanol-to-polypropylene value chain is commercially mature; what is needed is the policy signal and market certainty to scale.

Polypropylene (PP) is one of the world's most widely used plastics, with demand projected to rise from 70 million tonnes today to 111 million tonnes by 2035. It makes up approximately 3% of a vehicle's total weight but accounts for 20% of all its plastic components: interior trims, door panels, dashboards, bumpers and protective housings.

Bio-based polypropylene (BB-PP), produced from feedstocks including starch-rich crops, lignocellulosic biomass and waste oils, offers the same functional properties as its fossil counterpart while reducing supply-chain dependence on petro-inputs.

For defence vehicles - designed for troop transport, patrol and special operations - bio-based lightweight innovation can reduce total vehicle mass (improving air and sea transportability), lower maintenance energy costs, and diversify material sources for supply assurance. European players such as Borealis already offer renewable PP grades from waste-oil feedstocks via the Neste RE pathway, with performance equivalent to fossil PP. Kia and Hyundai have demonstrated market adoption in civilian vehicles.

Bio-based Carbon Fibre for drones and lightweight structures

Carbon fibre can constitute up to 32% of a drone's frame and is a critical material across aerospace, armoured vehicles, naval vessels and submarines.

The global carbon fibre market reached $4.82 billion in 2025 and is projected to double to 403,000 tonnes by 2030. The bio-based segment, growing at 6% CAGR, remains small but is gaining strategic traction.

Lignin, the by-product of Europe's pulp and paper industry, is a credible domestic feedstock for bio-based carbon fibre precursors. Europe's pulp and paper sector produces lignin in industrial volumes (TRL 9 for extraction); the bottleneck lies in converting lignin to spinnable precursors (TRL 4-5). Airbus has already flight-tested a bio-fibre nose panel on its H145 PioneerLab helicopter (May 2024), demonstrating stiffness and strength on a par with conventional parts. The strategic opportunity is to activate the full value chain, from European lignin sources through to aerospace and defence integration.

Natural fibres for textiles and uniforms

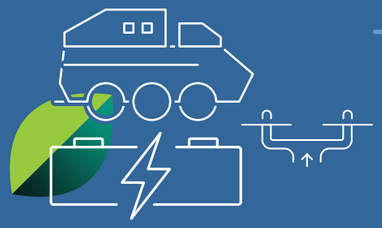
Natural fibres can potentially constitute 90% of a complete military uniform. Defence applications demand abrasion resistance, flame protection, breathability, thermal control and reduced radar signature. These same performance properties are valued in civilian performance apparel, workwear and protective equipment, creating natural dual-use synergies.

Europe is the world's largest textile importer, using 4.8 million tonnes of fibres and yarns annually: 58% synthetic, 42% non-synthetic. The opportunity lies in scaling EU-grown natural fibres including flax, hemp, wool, nettle and miscanthus.

France already leads hemp cultivation, though production remains geographically concentrated. Technologies from cultivation through to fabric manufacturing are commercially mature (TRL 9); the bottleneck is scaling cultivation across Member States.

A growing number of bio-based products developed for the civil market are now of such high quality that they would also meet the standards set by the defence sector. For instance, Bostik (Arkema) has developed a partially bio-based, fluorine-free breathable membrane from castor oil for textile lamination. It is waterproof, flexible even in cold conditions, and compatible with conventional lamination processes.

Although intended for civilian applications, these properties mean it could easily meet the performance requirements of the defence textile market.



Lignin-based electrodes for energy storage

Europe's battery manufacturing expansion is creating growing demand for electrode carbons, currently dominated by imported fossil-based graphite and carbon black. Lignin-derived hard-carbon anodes represent a credible domestic alternative.

Battery-grade lignin-derived carbon materials are projected to grow from $237.9 million to $585.2 million by 2032 (12% CAGR), riding the broader lithium-ion battery market expansion from $41.1 billion to $116.6 billion by 2030.

For defence, lignin-based energy storage can deliver lighter and more thermally stable power systems, improving mobility and sustainment of electronics and equipment, and lowering environmental impact in mobile deployments. Should the defence sector choose to pursue lignin-based energy storage, there is already a European company with the technology that could help to achieve this.

Stora Enso's Lignode® programme, converting lignin from cellulose fibre production into renewable hard carbon, has operated an anode pilot line since 2021.

Europe could potentially scale to 300,000+ tonnes per year of carbon anode powder through standardised 20,000-tonne manufacturing units.

Bolstering production and the supply of raw materials within Europe involves more than just developing new materials from European bio-based feedstocks; it also includes investment in the development of alternative materials that are less reliant on rare minerals, as well as the recycling of critical materials. European companies such as Umicore and Solvay are working on this already. In La Rochelle, France, Solvay operates a rare earth refining facility that, if fully scaled, could support approximately 30% of the permanent magnets needed in Europe for electric vehicles and wind turbines.

The principle is the same as in the bio-based world: reducing import dependence through local processing capacity, whether the feedstock is biomass or end-of-life electronics.

4.

Open science, closed borders

The dual-use dimension of research raises governance challenges that go beyond funding and markets. The Stockholm International Peace Research Institute (SIPRI) warns that the boundaries between civilian and military technology are fading ever more rapidly. As a result, research undertaken with entirely legitimate scientific intent can generate knowledge or techniques that pose a potential threat to public health, safety or security. In the context of industrial biotechnology, biosecurity risks offer a clear example: the use of biotechnology to engineer dangerous microbial strains via DNA techniques.

The principle that research should be 'as open as possible, as closed as necessary' is easier to state than to implement. Dual-use requires research institutions, funders and policymakers to develop shared frameworks for assessing which areas of bio-based R&D carry elevated security risks, how international collaborations should be structured, and what IP protection mechanisms should apply.

Against this, collaboration with defence also brings considerable advantages. In civilian markets, a bio-based material typically faces tough competition from its fossil-based equivalent the moment its price is even a few per cent higher. Defence procurement is less purely cost-driven and more focused on performance and security of supply, which is precisely why it can provide the market signal needed to scale up bio-based production.

Long term responsibility

One advantage of using bio-based feedstocks is that production can take place locally, it's a resource we have in Europe. Furthermore, bio-based materials should not only be functional and scalable, but also safe for people and the environment, and suitable for reuse, recycling or controlled degradation.

In a dual-use context, this means that performance and strategic deployability can go hand in hand with long-term responsibility.

5.

Global Examples: EU, US and Beyond

The United States has been the clearest trailblazer in integrating biomanufacturing into national defence strategy. The US **Department of Defense's Distributed Bioindustrial Manufacturing Program (DBIMP)** has made 34 awards totalling $60 million, with scaling support up to $100 million, targeting domestic bioindustrial manufacturing capacity across applications including bio-based solvents and fuels, PFAS-free lubricants, nutritional supplements for military rations and chemical precursors. The public-private initiative **BioMADE** explicitly links biomanufacturing scale-up with both civilian and military relevance.

Other countries offer instructive models. Japan has demonstrated that **dual-use research systems are 'not incompatible with defensive-only or pacifist stances'**, and is actively scouting start-ups with dual-use potential. South Korea systematically scans civilian markets for solutions to military challenges. China operates a '**military-civilian fusion**' model that has proved highly effective – if controversial – in accelerating the transfer of civilian technology to defence applications and vice versa.

The Ukraine conflict has generated perhaps the most rapid defence innovation ecosystem ever seen. Ukrainian start-up Himera Tech, founded in 2022, now **sells its universal secure communication system to NATO countries and the US Air Force**. Prototypes reach the frontline within 24 hours of development.

Ukraine's **Brave1 defence innovation programme** has a portfolio of 1,500 companies, with 87% of grant recipients improving their technology readiness levels. These experiences are now being deliberately integrated into EU innovation policy through Ukraine's planned association to the European Defence Fund.

6.

BIC Recommendations: Play to your strengths

The bioeconomy and the bio-based industries are key economic sectors in Europe. Whilst the focus until now was on pure industrial applications, the strengthening of these sectors can help beyond. Biomanufacturing and the use of technologies (including biotechnology) must not be overlooked in the European dual-use debate. While policy attention often gravitates toward AI, semiconductors, cybersecurity and space, bio-based industries offer capabilities that are equally strategic, and often more immediately scalable. BIC recommends the following:

Include biomanufacturing explicitly in dual-use policy and procurement frameworks

The EU Bioeconomy Strategy (November 2025) creates the foundation; it must be actively linked to the Horizon Europe dual-use provisions, EDIP and NATO SPS priorities. Bio-based materials for defence procurement (lightweight composites for drones, cellulosic textiles for military clothing, bio-based polymers for vehicles, lignin-based energy storage) should be named explicitly in procurement guidance.

Pursue European sovereignty in bio-based feedstock and manufacturing

The strategic logic of dual-use is inseparable from supply-chain resilience. Investment in European biomass production, processing infrastructure and manufacturing capacity go hand in hand with a sustainable supply of biomass at competitive prices.

Ensure knowledge transfer flows in both directions

Defence-funded innovation can generate benefits for civilian markets, and civilian technological advances can be systematically assessed for defence applications. This knowledge transfer in both directions should be built into funding conditions and partnership agreements also for biomanufacturing.

Speed up decision-making processes

The competitive advantage of European science and industry must be kept, through faster permitting, close cooperation with industry and swift mobilisation of private and public funding. In the dual-use domain, where geopolitical and technological windows can close rapidly, Europe must develop the institutional agility to match its ambition.

7.

Conclusions

The rise of dual-use in European innovation policy represents a fundamental recalibration. Biomanufacturing and the use of technologies (including biotechnology) must be part of it. Europe possesses the scientific expertise, the industrial infrastructure and the renewable feedstock base to lead in bio-based dual-use materials. BIC can show this across four material families: bio-based polymers for vehicles; carbon fibres for drones and lightweight structures; natural fibres for textiles and uniforms; and lignin-based materials for energy storage.

The market intelligence and value chain analysis conducted by VCG.AI shows that these are not hypothetical futures: they are innovation pathways with identifiable technology readiness levels, feedstock geographies, patent landscapes and market players.

The pattern observed across all these areas is consistent: bio-based materials meet the performance requirements of both civil industries and defence applications. Europe has a window to accelerate scale-up, and secure strategic leadership in biomanufacturing before that window closes.

Twin objectives

Given today's political climate, there is a growing understanding of the bio-industry's potential to contribute to the transformation of the defence sector. The key is to recognise, as the United States, Japan, South Korea and even China already have, that civilian and military innovation are deeply interconnected, and that separating them artificially imposes costs that Europe can no longer afford.

Bio-based materials, developed with sustainability and strategic autonomy as twin objectives, can serve both civilians and soldiers, and in doing so, they can accelerate the innovation cycle that benefits all of society.

As Dominik Patzelt of VCG.AI put it at the BIC December 2025 webinar: "Europe has the science, the technology and the markets to be a leader in dual-use materials. The question is not whether this will happen, but whether it will happen consciously, strategically and in time."

The answer lies in the decisions made in the coming months, in Brussels and in national capitals, and in the boardrooms and laboratories of Europe's bio-based industries.

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This report was commissioned by the Bio-based Industries Consortium (BIC) and written by Pierre Gielen in March 2026. It draws on BIC's December 2025 webinar on dual-use innovation, the VCG.AI sector analysis commissioned by BIC, interviews with Dirk Carrez (BIC), Wageningen Food & Biobased Research, policy documents from the European Commission, NATO SPS programme documentation, the Munich Security Conference transcripts, and reporting by Science|Business and others.