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Research and innovation for long-term resilience

Independent Expert Report

Research and innovation for long-term resilience: Towards a place-based, innovation-driven strategy for Europe's security and competitiveness

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Research and innovation for long-term resilience

Towards a place-based, innovation-driven strategy for Europe's security and competitiveness

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INTRODUCTION

Europe faces multiple threats to its security, its access to essential goods and critical materials, and its strategic autonomy. At the same time, Europe is the fastest warming continent on the planet, with extremely damaging and costly implications in terms of climate-related shocks, heat stress, drought, wildfires and rising tensions. The EU is confronted with major constraints in its capacity to respond to all these challenges, especially given the EC's limited fiscal powers. The EU has multiple goals, most notably to achieve greater economic security while also enhancing its competitiveness and completing its net-zero transition.

In his 2024 report, Mario Draghi proposed that the way to overcome conflicts and trade-offs between these objectives is to align policies and increase investment, but further investment has not materialised at the scale he recommended. This paper focuses on how to achieve policy alignment through a strategy based on linking security with innovation across a range of policies, and by leveraging dual-use and place-based investments that serve both security and competitiveness objectives. Draghi's principal recommendations were to invest in innovation, accelerate decarbonisation to support growth and strengthen economic security. His latest assessment of progress over the past year (Draghi 2025) is that the EU is failing to match the speed of change, and business fears that governments have failed to recognize the gravity of the moment. He argues that a new scale and intensity are needed, focusing resources where the impact is greatest.

What the Draghi report ignored is that both innovation and industrial policies have a European and a place-based dynamic. It is not just that innovation is contextual in terms of place. European transformation to achieve sustainable and resilient prosperity is and will continue to be inherently place-based as has been argued extensively in previous reports by the FASE pool of experts[1]. This is an important feature, especially when the transformations most urgently needed have to do with sustainable economic development, climate resilience and social cohesion. Europe needs innovation and industrial policies that are fit for purpose to direct and accelerate place-based change dynamics. A place-based EU R&I policy would enable Europe to bridge innovation divides, deliver sustainability, create local jobs and empower regional ecosystems and communities. Such a policy would also enable Europe to achieve systemic change outcomes necessary to achieve any of these elements. In the context of place - own city or region - people understand intuitively that things are connected and interdependent and therefore understand why and how to change systems.

Security too has an essential place-based dimension. Today, the border regions in the Northern and Eastern parts of the EU face existential threats as highlighted in Commission President Ursula Von der Leyen's 2025 State of the Union speech (EC, 2025b). The need to upgrade critical infrastructure across the EU is becoming an essential element in ensuring overall European security.

In other words, the call for EU-level scale in the Draghi report must be complemented by bottom-up creativity and empowerment. The EU needs a paradigm shift in how to conceptualise and concretise competitiveness and security. New EU policy can no longer afford to be context-blind, nor can it be heavy on strategy but light on implementation; to ensure its effectiveness, it must connect with bottom-up initiatives and ecosystems. Such a comprehensive approach would not only increase value for money; it would also ensure delivery and buy-in of EU policy. This, in turn, would reduce the risk of further fuelling discontent and polarisation, which is currently endangering the entire European project.

[1] See amongst others McCann, P. and Soete, L. (2020) and Schwaag Serger, S., Soete, L. and J. Stierna (2023)

Finally, from a fiscal and financial perspective, there is an urgent need to focus not only the resources where the impact is greatest but also to coordinate public spending needs across localities, regions and countries to achieve both security and competitiveness objectives. Nearly all EU Member State governments are struggling with major fiscal constraints, and those that are part of the NATO alliance have committed themselves to meet defence spending targets of 3.5% of GDP by 2035. This is a major challenge, but it offers also an opportunity to scale up research and innovation that has not only defence uses but also wider applications that will enhance the competitiveness of European firms. Furthermore, the additional 1.5% of GDP investment committed to security-related infrastructural investment provides new opportunities to strengthen infrastructure across the EU, thus benefiting also place-based growth and development.

The strategy presented in this short paper aims to achieve greater security and competitiveness over the longer term, not only to meet immediate threats to peace and prosperity in Europe – such as strategic autonomy and resilience following trade disruption, US disengagement from climate action, Russia's aggression in Ukraine and China's drive for export-led growth – but also long term challenges – such as climate impacts, declining biodiversity and a changing industrial geography. As already indicated above, Europe is not only the fastest warming continent on the planet but also suffering from major biodiversity loss and soil degradation, and critical capacity issues with water, heat and pollution[2]. Furthermore, the European continent is also poor in resources and human capacity, given its rapidly ageing population. The resources and materials needed for the transition to sustainable and resilient infrastructure are largely not available in Europe unless a major pivot takes place in terms of resource recovery and circularity. Food and water systems are largely (70-80%) unprotected and at risk[3]. Half a century of international security dependency on the US has suddenly evaporated and the current geopolitical situation has put rising emissions into an acceleration which will have even more costly implications.

Two questions are central: What approach to defence and security is the most appropriate, given the much broader risk and resilience context that the EU is facing? And how is this reflected in Europe's future R&I policy? In particular, how can the current civilian R&I system contribute to security and resilience while absorbing at the same time the additional investment in defence R&I?

In other words, the challenge today is to design public spending for several policy objectives at the same time[4] connecting defence, sustainability and technological competitiveness in a longer-term perspective that integrates the three pillars set out in the 2023 European Economic Security Strategy: promote, protect and partner. To promote innovation in the most cost-effective ways, the EU needs new R&I policies that encourage dual use technologies and investment, create security in the supply of critical goods, services and resources and incorporate resource efficiency and circularity as long-term comparative strengths of European firms. To protect the EU from both hostile powers and climate impacts, investment should go into upgrading infrastructure systems across Europe that are designed for resilience so that they are less vulnerable to extreme weather and to sabotage. To partner with other countries for systemic resilience, R&D programmes can play a beneficial role. We

[2] See the EEA's SOER 2025 (European Environment Agency State of the Environment Report 2025) published on September 29-30 2025, https://www.eea.europa.eu/en/europes-environment-2025/toolkit/europes-environment-2025-preview-and-main-findings/@@download/file

[3] See Insurance and Risk Management Tools for Agriculture in the EU, https://www.fi-compass.eu/library/market-analysis/insurance-and-risk-management-tools-agriculture-eu

[4] See also ESIR's recent Policy Pressure Points report: European Commission: Directorate-General for Research and Innovation, *Policy pressure points*, Publications Office of the European Union, 2025, https://data.europa.eu/doi/10.2777/6668715

also set out place-based measures that take into account the geographical and cultural context of innovation, revitalise and upgrade manufacturing, and create a clearer division between EU-led fundamental research, and national and regional innovation support.

As a concrete example of partnership, this paper has been produced by both members of the ESIR high-level expert group providing evidence-based policy advice to the EC's Directorate-General for Research and Innovation (DG RTD) and members of the FASE (Fair And Sustainable Economy) panel of experts of the Joint Research Centre of the EC.

1. DESIGNING FOR SECURITY AND COMPETITIVENESS: ACTIVATING DUAL-USE RESEARCH AND INNOVATION INVESTMENT

The EU has adopted a strict distinction between exclusively civil and exclusively defence activities. Until recently, the public funding at EU level, through framework programmes, was limited to civilian R&I. Defence and military R&I was the hallmark of the national policies of the member states often coordinated within the NATO alliance. In 2017, a three year Preparatory Action on Defence Research (PADR)[5] was launched which led to the creation in 2021 of the European Defence Fund (EDF) with a total budget of €7.3 billion, approximately €1 billion annually financing cross-border R&D projects within the EU and associated countries, like Norway[6]. National defence policies need now to be complemented with EU policies such as the EDF focussing both on stepping up investments in defence and security and on opening up European R&I activities to possible military and civilian uses.

Following the summit in The Hague, the European NATO countries have committed themselves to invest by 2035, alongside 3.5% of GDP on purely military expenditures, an additional 1.5% of GDP annually on security-related expenditure such as protecting critical infrastructure, defending networks, ensuring civil preparedness and resilience, unlocking innovation and strengthening the country's defence industrial base. While this offers significant additional financial opportunities for funding dual-use R&I, it raises also major challenges to the governance of R&I in the EU: an area of shared parallel responsibility between member states and the Commission. This holds for both breakthrough science and for more radical, disruptive innovation. With respect to dual use, this calls for a new more integrated R&I policy framework addressing on the one hand the dramatic fragmentation of publicly funded research in Europe (as highlighted by Draghi and Heitor) and on the other hand, more risk-oriented innovation policy approaches as popularised in the US with respect to dual use through its Defense Advanced Research Projects Agency (DARPA).

Connecting defence and sustainability for Europe's future resilience

Such investments in dual use technology and innovation can trigger productivity gains as innovative solutions which find fruitful applications not only in the military domain but also in the civilian one, and vice versa (ESIR 2025). Many converging technologies, such as AI, robotics and biotech, are foundational and susceptible to multiple uses, and if deployed at scale can contribute to economic efficiency and competitiveness, strategic autonomy and economic security. In many ways, it is today no longer feasible to draw a strict line between civil and defence-related research. Although the EU's framework programmes for research and innovation have formally excluded research for defence purposes, today's technologies - from AI to biotechnology - are inherently multi-use. The same algorithm used to optimise energy consumption can also be applied to guide drones for military purposes. The next EU Framework Programme must therefore be based on a clear and balanced approach that safeguards both scientific openness and security. By combining risk assessment, accountability and ethical guidelines, it can create a framework where innovation and security go hand in hand. That would also strengthen coordination with the European Defence Fund, bolster the Union's resilience and preparedness, and promote cooperation with other research stakeholders in this area.

[5] PADR funded 18 research projects selected following calls for proposals in the years 2017 to 2019 involving a total amount of some €92 million, including €2 million from associated member country Norway.

[6] See https://defence-industry-space.ec.europa.eu/european-defence-fund-over-eu1-billion-drive-next-generation-defence-technologies-and-innovation-2025-01-30_en

At the same time, many converging technologies such as AI, robotics, and biotechnology can also drive sustainability, for example, by improving resource efficiency, enabling cleaner production, and supporting the low-carbon transition. This would show that dual-use innovation contributes not only to security but also aligns with Europe's environmental and climate objectives, thereby reinforcing the goal of sustainable competitiveness.

Recommendations

- **Identify areas in Horizon Europe and the future Framework Programme, in which dual use R&I should be incentivised**. Promoting dual use R&I entails cooperation with industry, and this in turn may require clear intellectual property rules and a lower level of openness to non-EU partners than other areas of the EU R&I framework programmes, such as the ERC.
- **Map dual use technologies and capabilities in Europe, with corresponding civilian use cases**. This requires economic geography and complexity mapping, based on Europe's current technological specialisation. This can lead to better prioritisation of investments that can generate productivity and competitiveness benefits for both military and civilian uses. Envisage an ongoing review process to ensure the mapping exercise reflects emerging technology developments.
- **Facilitate early identification of dual use potential and effective management** including integration in the initial research design (incentives: educational programs on dual-use research, security precautions, ethics, risks and barriers).
- **Place a premium on dual use applicability of innovation** by offering additional financial incentives to projects that are able to demonstrate relevance in both the civilian and defence sectors.
- **Consider imposing conditionalities on dual use R&I, in line with the industry 5.0 approach.** Industry 5.0 conditionalities can promote greener production models, circular economy principles, and reduced environmental footprints**.** This can ensure that budget earmarked for defence can generate beneficial human-centric, resilient and sustainable approaches to industrial transformation, fostering sustainable industrial transformation that helps to strengthen the connection between security, resilience, and long-term environmental objectives.
- **Invest across the board in much higher literacy in risks.** Alongside cyber-security also in risks associated with climate, water, food, social tipping points, which would therefore inform purpose and imperative for dual use.
- **Enhance strategic planning and regulatory reform**. Embed dual-use considerations into EU R&I programmes and national innovation strategies (e.g. fit-for-purpose regulatory frameworks, setting R&I investment targets for critical technologies, and better coordination across funding programmes).
- **Promote capacity building**. Training researchers in dual-use assessment and exploitation; placing a stronger emphasis on cybersecurity aligned with existing civilian standards; accelerating procurement cycles; providing funding (e.g. grants, tax incentives) and a testing environment (e.g. sandboxes).
- **Monitor and evaluate**. Introduce mechanisms that allow for tracking the return on research and innovation investments from dual-use pathways to plan future investments.

Address European public research fragmentation

As the European R&I system grew and became consolidated in different treaties providing a strong legal base for its management at European level, it could not prevent the European economy to become caught in a mid-tech trap with its productivity growth now lagging behind that of both the US and China.

Apart from the gap in private R&D funding with the US and China, it is **the fragmentation of European public R&D funding** which is striking[7]. As Draghi (2024) noticed: *"In the US, the vast majority of public R&D spending comes from the federal budget. In the EU, it largely comes from the budgets of the 27 Member States, complemented by a smaller amount of EU-level resources"*. However, the call made in the Draghi, and subsequent Heitor (2024) report for a doubling in the public funds devoted to R&D at EU-level, does not address this fragmentation situation. There is today an urgent need to address directly the European fragmentation of public research funding, starting with the funding of fundamental research and groundbreaking science. With discussions having started on the next Framework Programme, it is also a good timing.

Europe's greatest chance of managing a stable transition and a successful prosperous transition state able to stay cohesive through ongoing shocks will be through pooling and leveraging its collective intelligence, ingenuity and capability. Europe cannot afford fragmentation. However, the solutions need to be multi-dimensional, distributed, decentralised to ensure resilience. This combination requires transnational and multilocal policies across the board.

Recommendations

- **Following the subsidiarity principle, where decisions are made at the most appropriate level, fundamental research should become organised in a transnational, e.g. a European setting, not a national one**. Doing so, the EU should take on responsibility for remaining the global gatekeeper for independent research, including science for policy research, adhering to principles of open science and fair principles, guaranteeing independence in research in a global context of increasing political control over academic research[8].
- **At a more practical level, the excellence Pillar I of the Horizon Europe Framework Programme should become known as the *European Research Fund* (ERF).** It would now include, apart from EU funding through the current Horizon Europe Pillar 1 budget, on a voluntary basis[9] also all member states' public funding on (fundamental) research. The principle of excellence should be coupled with a new mechanism to support those Member States whose scientific performance lags behind but who are willing and determined to make necessary efforts to close the gap. Such a new targeted mechanism - the inclusive excellence initiative - could reward reform efforts, capacity development, and collaborative initiatives that strengthen research quality and integration into European networks. In doing so, the EU would uphold the principle of excellence while also fostering

[7] See also Steeman, J.-T., Peiffer-Smadja, O. and Ravet, J. (2025).

[8] See the Trump administration's attempts at influencing US universities research, the debate on vaccination, the reduction in environmental and climate data collection, the attack on measures supporting 'diversity and inclusion', the withdrawal from the Paris agreement on climate change, etc.

[9] One could also think of applying some "juste retour" principle to ensure that each member state gets back in approved research contracts/grants what it has contributed to the ERF in terms of public funding. While the basic principles governing research are broadly similar amongst EU countries, the advantages of allocating research funds at the EU level will reduce administrative costs and public research fragmentation.

convergence and inclusiveness, ensuring that excellence becomes a shared European asset rather than a source of persistent disparity among Member States.

- **Individual member states' public research budgets becoming part of the ERF will now be excluded from the regular EC semester assessments of member states' fiscal deficits**. With the transfer of responsibility to the EC level, these national research budgets, given their long-term impact nature, are now becoming exempted from any individual member states' SGP fiscal deficit 3% criterion[10]. That would make the European Research Fund larger than US public R&D funding.

Creating dynamic conditions for dual use innovation

Recent announcements and official documents of the European Commission have already opened the door to broader dual use R&I funding, in particular by the EIC but also under the new EU International Digital Strategy. That said, the EU defence expenditure remains decoupled from broader R&I strategies, which results in a fragmented ecosystem in which potential cross-sectoral benefits remain underexploited. Making the most of dual use R&I requires adequate mapping, streamlining and re-design of the EU framework programmes, the EU's regional structural funds, better coordination with defence and security spending (e.g. the European Defence Fund), and rules that are conducive to fruitful public-private cooperation.

The European Defence Fund will need to be supplemented by a network of European innovation agencies modelled on the US DARPA, enabling security/defence radical innovations based on combined public-private joint venture partnerships, as Rainer Kattel and Josh Entsminger (2025) argue and discussed further below under section 3[11].

Recommendations

- **Strengthen and streamline the "investment journey" from general-purpose, convergent technologies and downstream (dual) uses**, by identifying opportunities and risks of downstream applications of technologies like AI, biotech, robotics and advanced IoT.
- **Work with local innovation "speedboats"**. Focusing on scaling-up, one should build on some of the smaller Member States and larger regions to test and further refine new innovative solutions, system-oriented products and services which are co-shaped by local citizens and stakeholders to optimise added value. Lessons could be learned from the EIT KICs which were set up to do this[12]. The Regional Innovation Scheme (RIS) that the KICs work with was designed to enable smaller MS and regions to test and learn. So, EU-funding should be provided for firms to scale-up, test and customise their new solutions in dialogue with local authorities and civil society. A comprehensive approach to innovation should link EU funding to place-based regulatory sandboxes, allowing the firms to fully test scale-up solutions locally[13].

[10] This was the proposal made by Commissioner Philippe Busquin at the Lisbon summit in 2000.

[11] See Kattel, R. and Entsminger, J. (2025).

[12] The Climate KIC for example launched Deep Demonstrations in 2019 and uses regulatory sandboxes in that context where one works with EU member states to enable systems innovation and acceleration of transformation.

[13] See amongst others Trippl, M., Soete, L., Kivimaa, P., Schwaag Serger, S., Koundouri, P. And Pontikakis, D. (2024).

- **Redesign a new border solidarity fund** through the re-allocation of the INTERREG programmes within the ERDF funding[14] to external border regions of the EU only. There are also sound economic arguments to make the case that today in the EU most cross border policy issues are primarily regulation-based, not issues to be solved through European subsidy funding. By contrast, external border collaboration is essential from a European security and solidarity perspective.

[14] Under the MFF 2021-2027 €10 billion is currently allocated to cross-border (Interreg A), trans-national (Interreg B), interregional (Interreg C) and outermost regions' cooperation (Interreg D).

2. DESIGNING FOR RESILIENCE AND SUSTAINABILITY: RESOURCE PRODUCTIVITY, INFRASTRUCTURE AND INTERNATIONAL PARTNERSHIPS

In light of the changing geopolitical order and the new nature of conflicts, the understanding of resilience and security must be expanded from relating only to defence when developing European R&D policy to include sustainability. Sustainability is a key pillar of resilience, as it enables systems to remain stable and adaptive over time. This change also aligns with EU priorities such as the Green Deal and the Competitiveness Compass, underscoring that lasting resilience depends on embedding alongside 'defence' security, sustainability into Europe's economic and innovation strategies. While resilience is about coping with crises, sustainability is about preventing crises and planning for the future. Together, they show a move from short-term reactions to long-term system building.

As pointed out in earlier ESIR policy briefs[15], enhancing resource efficiency, design of resilient infrastructure systems, and adjusting openness of R&D programs to the new world order all can increase the future resilience of European societies.

Resource efficiency and strategic autonomy: securing Europe's economic future and future resilience

For Europe, resource productivity and circularity are key issues that unite economic competitiveness, environmental protection, and security, and which has been highlighted by ESIR (2025b) as one out of ten European policy pressure points. In global trade and business, supply chains are subject to disruptions from trade wars, but also climate impacts such as extreme weather events and dwindling water supplies which all contribute to international tensions and conflicts. Limited resource availability means that traditional strategies focusing on supply diversification are no longer sufficient to ensure access to critical materials. Innovations that allow more efficient use of raw materials, that "innovate around" the need for scarce resources, as well as initiatives focusing on recycling, and the extension of product lifetimes are essential to achieving security.[16] Such resource productivity innovations require cooperation along the whole value chain, both by businesses and consumers.

At the same time, many key strategic technologies (electric vehicles, drones, low-carbon energy provision, data centres) are on a strong growth path. Resource efficiency or material re-use is essential to reduce the amount of new, primary raw materials that would have to be imported. Europe has to diminish its dependency on resources, intermediate products and final products of which supply is dominated by countries who are likely to 'weaponize' such interdependencies[17]. This is an issue both with Rare Earths[18], but also many other materials. There are four major initiatives coming up where the Commission should embed an integrated strategy for both increasing security of supply and reducing demand through recovery of secondary materials: the "RESourceEU" that aims to diminish the EU's vulnerability to supply shocks; the Economic Security Doctrine, in which demand reduction should be a central plank; the forthcoming Advanced Materials Act and the Circular Economy Act due in 2026.

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[15] ESIR (2023) and ESIR (2024).

[16] See Grabbe, H. and Moffat, L. (2024).

[17] Farrell, H., & Newman, A. L. (2019). Weaponized Interdependence: How Global Economic Networks Shape State Coercion. International Security, 44(1), 42–79. https://doi.org/10.1162/isec_a_00351

[18] ERECON (2014) Strengthening the European rare earths supply chain: Challenges and policy options. Kooroshy, J., G. Tiess, A. Tukker, and A. Walton (eds.).

Recommendations

- **Incorporate resource efficiency criteria into Horizon Europe R&I funding calls**, where appropriate.
- **Set binding resource productivity targets**, incorporated into the forthcoming Circular Economy Action Plan, Competitiveness Compass, and Draghi report implementation, for major resource-intensive materials, such as steel, aluminium, and plastics.
- **Accelerate research on lifetime extension** and encourage projects which further develop new business models and new cooperative networks between traditional businesses, new enterprises, and civil society actors.
- **Invest in establishing alternative supply chains of critical technologies, while investing in innovation and circularity.** Europe needs to invest in innovation to substitute for and reduce the need for materials that it has to import, for example for batteries; permanent magnets, solar PV; data storage and servers; smartphones, tablets and laptops; and drones[19]. Research and investment could help to create supplementary value chains that are under the control of the EU and partner countries[20], that can engineer out critical materials required in such technologies and reduce the amount of materials needed through eco-design.

Design of resilient infrastructure systems within Europe

The EU Directive on critical entities[21] (EUR-Lex 2022) underscores the need to increase Europe's resilience with respect to all hazards, whether natural, accidental or intentional. Horizon Europe Cluster 5 on Climate, Energy and Mobility looks at fostering an energy transition, achieving a sustainable decarbonisation with minimum costs. From a resilience perspective, Europe's existing and future infrastructure is exposed to many forms of (hybrid) attacks as well as climate change impacts, including biodiversity loss and land degradation (e.g. deforestation) which is striking.

From a security perspective, the strategic decisions regarding future infrastructure systems, such as the level of centralisation and associated different needs for protection of the infrastructure, are key issues. Thus, future infrastructure research must consider both costs and security by design. Dual use research offers the potential to link the defence-related efforts to reduce vulnerabilities of infrastructure systems with civilian sustainability challenges. It enables more integrated research, which targets reduced vulnerabilities towards military threats and increased sustainability and climate resilience simultaneously[22]. In addition to extreme weather events, slow-onset problems such as water scarcity and desertification need to be integrated into resilience planning for infrastructure.

[19] Carrara, S., Alves Dias, P., Plazzotta, B., & Pavel, C. (2020). Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system. In JRC. Publications Office of the European Union. https://doi.org/10.2760/160859.

[20] See García-Herrero et al. (2023).

[21] Directive - 2022/2557 - EN - CER - EUR-Lex

[22] ESIR (2025)

Recommendations

- **Develop new generations of energy and other infrastructure systems models** which integrate costs and resilience as multi decision criteria for preferred options. This includes decentralised models that provide resilience for energy communities and citizens.
- **Include resilience targets in Energy system integration R&D** ensuring that novel system integration technologies and interconnected infrastructures contribute to the resilience of key sectors.
- Ensure that research on **energy communities and energy R&D addresses the resilience** of the communities involved. The construction of new renewable energy or the opening of mines in Europe is often blocked by justified resistance from local stakeholders and authorities, yet innovation can contribute to new win-win solutions. Innovative financial models can ensure financial participation of the affected local community through equity models, lower energy prices or economic compensation for local stakeholders for the deterioration of their natural capital. For employment creation, power-sharing with greenfield investment could be incentivised through EU top-up innovation funding targeting the incoming firms to upgrade and connect their energy sourcing to local renewable energy facilities[23].
- Integrate research on the social costs and benefits of resilience measures into **Horizon Europe R&I funding calls.**

Trusted international partnerships for systemic resilience

In an age of strategic uncertainty and rapid global reordering, Europe cannot - and should not - seek to stand alone. Yet neither can it afford to remain entangled in fragile or unbalanced dependencies. Europe's resilience will be built not through isolation but through a new architecture of trusted international partnerships, designed deliberately to reinforce its autonomy while embedding it in stable, mutually beneficial global ecosystems. Europe's R&D programs can contribute to building such partnerships. Trusted international partnerships are another of ESIR's (2025b) ten policy pressure points. In order to be stable, they must be in mutual interests and can therefore not be defined by the EU alone, but require to link to place based initiatives and the context specific conditions of the ecosystems in the partnering country as well.

Recommendations

- **Advance global green alliances**. Co-develop clean technologies, sustainable agriculture and food systems, sustainable infrastructure, and regenerative supply chains with priority regions such as Africa, ASEAN, Mercosur, and the Mediterranean. Establish specific research programs on resource productivity and sustainable mining, which open up towards ecological alliances based on jointly protecting biodiversity and critical nature resources and nature-based solutions, involving such partner regions establishing projects which integrate local manufacturing and skills development.
- **Pursue geo-industrial deal** logic in relations with partners, helping them to move up the value chain, while taking advantage of new trading opportunities, more symbiotic relations and diversified sourcing of industrial inputs.

[23] See also Kivimaa, P. and Rogge, K, (2024).

- **Lead on global commons governance**. Champion rules-based governance of oceans, cyberspace, outer space, and biodiversity at international fora based on a common understanding of resilience and security. Green skills, mindsets and leadership capabilities fit for complexity and for resilience through very volatile contexts are in extremely short supply. Support research that develops and evaluates governance frameworks for climate, ocean governance, biodiversity, space, and cyberspace. Pool resources with trusted partners for planetary-scale stewardship missions, e.g., climate monitoring constellations or biodiversity data platforms. Social political and economic stability depends on it.
- **Invest in people-to-people diplomacy**. Expand Erasmus+, Horizon Europe mobility, and cultural exchange programmes with partner countries to build societal trust and shared innovation ecosystems. Negotiate bilateral and regional mobility frameworks for researchers, innovators, and green tech specialists, aligned with Europe's innovation and skills strategies.

3. DESIGNING FOR NEW FORMS OF RESILIENCE IN EUROPE: THE ROLE OF INCUMBENTS AND START-UPS

In a world where the US is mobilising significant efforts to rebuild its manufacturing strength, and China – within a very short time span – has risen to become a world leader in manufacturing in both scale and sophistication, we need to remind ourselves that Europe is a continent of industrial large and small companies, which form a critical foundation for value creation, exports and innovation. They are also essential to driving the green transition, both by decarbonising their production and by providing goods and services upon which a green economy and society will be built. Europe's industry is also critical for the service sector, as can be seen in the fact that a large share of Europe's service export is linked to and embedded in manufactured goods (e.g. trucks which contain sophisticated software systems).

A European manufacturing initiative

The notion of a European manufacturing initiative acknowledges the renewed importance of reducing European dependencies on products and services, such as critical minerals and rare earths or computer chips, that increase its vulnerability to economic and political coercion and undermine its ability to defend itself against foreign aggression. The success of such an initiative critically depends on strengthening both the demand for and supply of advanced manufacturing products and services. The former requires market integration and creation (e.g. through public procurement), while the latter could be driven by new forms of public-private partnerships, groupings of member states and/or companies leading such initiatives, but also strengthening framework conditions, such as European standards strategies, innovation-friendly regulation, the availability of affordable clean energy, adequate public infrastructure, and the mobilization of private investments. In essence, such an initiative will need to embrace a multi-scalar manufacturing (micro-massive) approach which would make a virtue and a competitive strength of Europe's distributed capability, decoupling industrial production from virgin materials/major leap forward in resource efficiency, productivity and circularity.

A major potential for Europe to reap the economic benefits of artificial intelligence lies in industrial applications of AI. While the US, and particularly Silicon Valley, has been the epicentre of the AI revolution, in terms of the development of foundation models, the erosion of its manufacturing base is currently impeding its ability to develop industrial applications of AI. China combines prowess in AI with a strong and increasingly sophisticated manufacturing sector, allowing it to combine the two to potentially establish lasting competitive advantages in both AI and manufacturing. Europe has a huge potential with its strong industry base, but lags behind China in the adoption of AI. A research and innovation policy focused on European firms' digitalisation, and particularly the adoption and development of AI-based systems is both urgent and essential for Europe's future competitiveness and value creation, as well as in driving the green transition.

A strong industry, ultimately, will be the backbone of European security, sovereignty and resilience in a time of increased threats of foreign interference and aggression and disrupted and weakening global supply chains.

Recommendations

- **Launch a European Manufacturing Initiative** that combines a range of measures. These should include the following: the revitalisation of partnerships in European

research and innovation policy in promoting pre-competitive, cross-country, and cross-sectoral collaborations focused on technological development that contributes to Europe's future industrial strength and competitiveness; strengthen the EU's role in international standard-setting and use public procurement as vital driver of technological development (market creation); pay particular attention to sectors where Europe is lagging behind, such as strong magnets, batteries; solar PV; data storage and servers; smartphones, tablets and laptops; and drones, as well as particular mining sectors in areas of critical raw materials.

- **Support greater complementarity of the human and the machine** in training and retraining programmes to limit the scope of the labour market disruption and ensure optimal productivity benefits from the rollout of AI.
- **Acknowledge the important role of defence in driving technological development and industrial competitiveness** by strengthening dual use and defence innovation. This includes more joint procurement of defence solutions by Member States and at the EU level.
- **Recognise the importance of place-based initiatives in driving industrial revitalisation and upgrading** to ensure a level playing field for European industry in a world increasingly dominated by state-driven and supported industrial development (particularly in China) and avoid current industries and firms setting the policy agenda at the expense of future industries and firms.
- **Emphasize the need for upskilling and reskilling, including technical education** ensuring that Europe's workforce is better prepared to support industrial transformation, in particular the adoption of emerging technologies such as AI and advanced manufacturing. This recommendation is in line with the recent EU initiative 'The Union of Skills' (2025) which proposes a new integrated approach combining education, training, and employment policies under a shared vision of competitiveness.

Start-ups as civilian drivers of strategic capabilities and defence tech

At the same time, new start-ups will bring new innovation and business models - whether in regions away from current economic activity or in small firms that are challenging particular incumbents. In an era defined by rapid technological advancement, shifting geopolitical landscapes, and the blurring of lines between civilian and military innovation, the EU cannot afford to rely solely on its current economic geography and must encourage new entrants to markets and new regions with innovation potential.

Looking at firm level, start-ups have long been pivotal actors in shaping Europe's strategic capabilities. Their agility and innovative drive allow them to develop dual-use solutions that strengthen both economic growth and security resilience. European policymakers now actively support start-ups as part of efforts to boost technological sovereignty and crisis preparedness. The EIC, the EU Startup and Scaleup Strategy[24] and the European Defence Innovation Scheme[25] (EUDIS) are key initiatives, aiming to help startups scale, access funding, and bring innovations to market.

At territorial level, innovation ecosystems have emerged with, often without, the support of national industrial policy. The experience from across the different EIT KICs, illustrate why and how to move from startup incubation and acceleration 'en masse' to the careful construction, nurturing and capability building of innovation clusters and ecosystems. To

[24] EU Startup and Scaleup Strategy - Research and innovation

[25] About EUDIS

revive EU manufacturing, place-based initiatives are needed to drive industrial revitalisation and upgrading.

At the same time, the European defence tech startup ecosystem is expanding rapidly, with venture capital investment in the sector growing by over 500% between 2021 and 2024. However, the European deal volume for defence tech start-ups is approximately 2.4 times smaller than in the US. Start-ups like Helsing (AI for battlefield analysis), Quantum Systems (autonomous drones), and Project Q (integrated defence software) are delivering breakthrough capabilities that enhance both military effectiveness and civilian resilience[26]. These companies demonstrate the sector's potential to reinforce Europe's preparedness for emerging threats and to maintain technological leadership.

However, significant challenges and complex market access rules hinder startups' ability to scale across borders. European startups also face a persistent funding gap, particularly in later-stage rounds, often relying on US investors to grow and commercialize their innovations[27]. Access to military end-users for testing and procurement is limited, and risk-averse institutional cultures can stifle the dynamism that startups bring.

Key challenges for European defence start-ups

Funding gap at later stages: early-stage funding has surged (500 % increase from 2021–2024) but late-stage rounds (> $200M) are dominated by US investors who provide over 60 % of capital [1].

Public perception & talent pipeline: dual-use or military work is often stigmatized, reducing founder interest and limiting defence-relevant research.

Fragmented procurement & capacity: Europe lacks scaled procurement mechanisms; national procurement and equipment rules vary widely, raising costs and complicating contracting.

Trust and trust lock: initial success creates barriers - new start-ups struggle to enter once a "winner" is crowned.

Talent & organisational ecosystem: defence - industry faces aging workforces, skill shortages; startups often lack engineering managers and repeat-founder networks.

To unlock the full potential of startups as civilian drivers of strategic capabilities, Europe must streamline regulations, harmonize markets, and boost both public and private investment. Facilitating collaboration - through innovation hubs, accelerators, and matchmaking platforms - between startups, corporates, and military end-users is essential[28] [29] [30]. The Swedish "triple helix" model, which integrates government, academia, and industry, offers a proven approach for accelerating dual-use innovation and sharing resources effectively[31].

[26] Meaker, M. (2023).

[27] Atomico (2024).

[28] Mckinsey (2025)

[29] EUDIS (2025).

[30] EC (2025a).

[31] Saab (2020).

Recommendations

- **The EIC becomes also the coordination tool for national and regional innovation support programmes,** in line with the Letta proposal for a 'European Code of Business Law' "providing businesses with a 28th regime to operate within the Single Market". The focus will be on creating the conditions for a truly European, harmonised venture capital market. Letta's proposed Code would make domestic and EU-wide expansion more appealing particularly to start-ups, while at the same time create conditions for the emergence of a harmonized European capital market offering now an optional 28th regime "address[ing] the current patchwork of national regulations, [and] acting as a key to unlock the full potential of free movement within the EU"[32]. In short, with respect to the EIC and the creation of new start-ups, the focus should be more on regulatory bottlenecks in the EU and ways to incite European private capital markets to become involved in more risk-taking activities than on the need for European public funding support.
- **Streamlining access to multiple national, regional and European funding for territorial security.** Such funds will need to be managed under an emergency logic, with faster and more agile procedures than those used for Horizon or ERDF. In some cases, they will need to be implemented in synergy with national defence funds, sometimes even coordinated within the framework of the NATO alliance and hence will need to be managed in different ways than the current EC's administration and auditing rules. Furthermore, coordination with the European Defence Fund and other funding mechanisms for dual-use technologies, implies that there will be a strong need for streamlining access to multiple national and European funding sources[33].
- Create a **European defence procurement agency** to harmonize requirements, run pan-EU tenders, and scale demand. Ensure innovation procurement across the EU Member States prioritises startups with strategic capabilities.

Creating a European defence R&D ecosystem

Institutionally, Europe should not aim at striving towards a DARPA type of singular, monolithic institution. Rather it should aim "to build a diverse and interconnected ecosystem of agencies, each with specialized strengths and capabilities. This ecosystem should be underpinned by robust governance in the form of a network of defence R&D programme managers, support infrastructure, and active engagement with broader societal agendas, such as the twin green and digital transitions"[34].

In the words of Kattel and Entsminger: "Five key lessons emerge for the development of the European defence R&D ecosystem. Firstly, the EU must create multiple high-risk, high-reward programmes, focusing on disruptive innovations, anticipating future technological surprises. Secondly, fostering a culture of "strategic amnesia" within these programmes can encourage risk-taking and the pursuit of novel solutions. Thirdly, these agencies should be surrounded by specialised support structures to navigate bureaucratic inertia and enhance agility. Fourthly, establish annual defence R&D challenges to broaden awareness, foster community engagement, and forge connections with broader societal goals. Lastly, it ensures policy coherence at a high level, aligning defence R&D priorities with other strategic domains, such as green and digital transitions and social cohesion."

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[32] Letta (2024).

[33] See Schwaag Serger, S. and Soete, L. (2025).

[34] Kattel, R. and Enstminger, J. (2025).

Recommendations

- Establish an **innovation hub for strategic innovation**, harnessing an ecosystem typical of Life Sciences where large industry actively draws on innovation of the emerging startups.
- Establish an **EU defence tech fund** to co-invest with private investors, reducing dependency on external capital.
- Launch an **EU-wide public campaign** showcasing dual-use startups and national security impact to boost appeal and signal public backing, in order de-stigmatize defence innovation.
- Support **defence tech fellowships** sponsored by industry.

CONCLUSIONS

To prepare for future disruptions and structural changes in the world economy, the EU needs to link its economic security and competitiveness strategies in a more coherent way taking a longer-term view on how to achieve both open strategic autonomy and comparative advantage over the next 20 years. Ultimately, Europe's best chance of security and resilience - and therefore competitiveness - would be through deliberate investment into a much wider definition of security grounded in stable and sustainable wellbeing (healthy, resilient soils, water, food systems, environment and livable infrastructure). The latter would in turn enable continuation of the social contract through troubled times, with Europe as a positive peace project that has the greatest chance of surviving and thriving.

To do that, R&I policies need to integrate resilience as a central design feature. This requires in the current context of risk and uncertainty an effective, systemic R&I policy to enable European security and resilience and a systematically wider framing of both.

This paper has set out several ways to do that. One is by emphasising resource productivity as a key measure of competitiveness as well as sustainability; a second is resilience in infrastructure, especially for energy; and a third consists of building resilient supply chains for critical materials, components and final products via global green alliances as international partnerships for systemic resilience.

Governments cannot spend the same money twice, but they can spend public money to achieve two objectives at the same time. For public investments to be leveraged, spending needs to be integrated into a strategy to achieve longer-term security. This paper has set out how to maximise the return on research and innovation investment by exploiting dual use, especially in the much larger defence budgets now created across Europe. At the same time, long-term resilience depends not only on innovation and defence but also on sustainable resource use and green industrial transformation. Implementing such policies will have to recognize the critical role of place-based approaches given the nature of the risks, the nature of the shifts underway and the opportunities so that Europe gets this right in a multi-level, multi-scalar and multi-actor way. It calls therefore for closer involvement of European structural development funds in territorial security.

To sustain its global competitiveness and security, Europe must act decisively to integrate innovation, sustainability, security and resilience across all levels of policy - from the EU and national to the regional and local levels.

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This paper proposes to design a strategy for Europe's security and competitiveness through innovation, by linking security with innovation across various policies and leveraging dual-use and place-based investments, with the goal of achieving greater security and competitiveness in the long term for the European Union.

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