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EUROPE'S ECONOMIC SECURITY PROJECT

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Funding Europe's Technology Revival

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EPC's Economic Security project brings together actors from EU institutions and the wider stakeholder ecosystem to work on EU policy questions and solutions in response to today's paradigm shift to economic security through a number of expert roundtables, policy dialogues, and thematic policy papers. The EPC is grateful to the partners supporting this project, an updated list of which can be found on the EPC's project website.

1. Executive summary

High value economic activity needs to encompass technology leadership. It is high technology that delivers faster sales and profits. As such, **it also contributes to economic security**, an increasingly important policy objective in the age of global shocks. Due to its past industrial strength, Europe has comparatively more to say in mid-technology areas. Its excellence in high technology is limited to several niche areas. The main drawbacks which account for this situation have to do with an insufficiently conducive ecosystem, inferior demand and inadequate funding.

To address these key challenges from an investment perspective, **the European Policy Centre in partnership with the European Investment Bank Institute organised a high-level roundtable discussion** on 13 May 2024 in Luxembourg, **as part of the Institute's new foresight initiative** to build out the Bank's thought leadership and preparedness for future investment needs. Opening plenary address was given by Ms Yuriko Backes, Luxembourg's Minister of Defence, Public Works, Transport and Equal Opportunities who outlined the challenges and opportunities EU member states face in rising to the occasion and investing in greater security in cooperation with partners. The opening was followed by a series of panels on critical digital and green technologies as well as an exploration of the transatlantic perspective on energy security. This paper captures the main take-aways from a wide range of high-level experts, senior executives, policymakers and investors. It offers new insights on how to systematically enhance Europe's economic security through more efficient funding of critical technologies.

The paper argues that **a new comprehensive European Technology Development Strategy is needed with a two-tier focus**: on technologies where Europe aims to develop leadership capability, and those where minimum capacity is required for resilience. This means that **less is more**, and strategic choices must be made regarding resource allocation for selected technologies. At the same time, complete dependencies must be avoided in areas where leadership is not within reach.

When it comes to public policy to support technology development, whole-of-government strategies are needed, aligning closely with what is done at different levels.

A balance needs to be maintained between deployment and support for breakthrough innovation. The latter brings knowledge spillovers, although the former is needed to achieve policy objectives.

Incremental measures will not solve **Europe's biggest funding problem, which affects companies in the growth phase**. Larger rounds are needed, coming with longer timelines, ideally in the range of 15-20 years. **Dormant capital should be activated** through public sector derisking activities combined with a spirit of partnership in concluding investment agreements. The resulting Futura Tech Fund would complement the existing spectrum of European investment tools. Encouraging the participation of the wealth of capital residing with European pension funds, insurance companies, or family offices requires engaging such actors on an equal footing with the public sector institutions.

The resulting Futura Tech Fund would complement the existing spectrum of European investment tools. It would address Europe's scaling challenge by pursuing **direct and indirect investments in support of companies and venture capital funds active in the four technology areas** prioritised in the European Economic Security Strategy: Advanced Semiconductor technologies, Artificial Intelligence technologies, Quantum technologies and Biotechnologies.

Since the best innovation policy is one where governments become initial customers of emerging technologies, **a dedicated European procurement framework** should be established with indicative purchases being made at the EU-level. Advanced market commitments should also be pursued, guaranteeing take-up of innovation in a similar way to how vaccines were purchased during the pandemic. In critical technology areas, public institutions and agencies should procure market-enhancing products and services, along the lines of how the European Space Agency is now contracting commercial cargo services to the International Space Station. Finally, **improvements in the ecosystem for innovation** and steps towards greater **availability of talent** are as important as funding.

2. Less is More: Priority-setting in the age of technological acceleration

2.1. NO ECONOMIC SECURITY WITHOUT TECHNOLOGY LEADERSHIP

As the international environment has become more conflict-prone, there is a **greater focus on economic security**[2] in order to optimise economic welfare while addressing newly emerging risks and vulnerabilities. In its basic form, economic security is about preventing negative economic outcomes, reducing unwanted dependencies, lowering volatility and strengthening resilience. As Chief Economist of the US Department of State Chad P. Bown puts it, "modern concerns over economic security involve the recognition that others – typically policymakers abroad – may be working against a country's effort to achieve its objectives".[3] The broader goal is to build a position of strength in the "exponential age"[4] when the acceleration of technological development becomes transformative for entire economies.

This expanded approach has led European efforts to strengthen economic security. The recent European Economic Security Strategy makes this clear when saying its aim is to "protect the EU's economic security and reinforce the resilience of our economy, while working to ensure that we maintain and grow our technological edge. This means investing in EU's competitiveness, diversifying supply chains, and responding to practices such as economic coercion".[5]

A **technology focus is central to economic security** because the high technology sector is responsible for a real location of resources to more productive, valuable activities. By introducing new products and services, it has an impact on the entire economy,[6] enabling larger returns and higher growth. Furthermore, the ongoing process of technology convergence, with highly interrelated and transversal developments in different domains, makes high-risk exposures more pronounced.

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There is no economic security without investment, particularly given the massive amounts spent internationally on market creation and technological scaling. To paraphrase American Noble Prize Winner Paul Krugman's aphorism about productivity, **funding is not everything, but in the long run, it is almost everything**. In today's economy, the volume of capital invested determines whether the position of leadership can be reached. In this area, Europe's growing distance is increasingly clear. Largely as a result of high capital expenditures of the technology sector, the investments of large US companies were 60% higher than those of their European counterparts by the end of 2022.[7]

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2.2. EUROPE'S CHOICE OF FOCUS

Today's global reality is that the two dominant powers, **China and the United States, are locked in a race for domination**, which is increasingly characterised by the winner-takes-all dynamic. China is thoroughly focused on capturing and internalising all parts of the supply chain in advanced technologies, while the US is deploying large-scale industrial policy to restore high-value domestic manufacturing while applying protectionist means to exclude competitors and reorient supply chains.

The choice for Europe is between attempting to lift capacity across the entire technological spectrum or focusing on the Japanese-style approach of **"strategic indispensability"**, with a narrower focus on one-of-a-kind technologies and capabilities that no other country possesses. Analogously to Tokyo's expectations behind its economic security strategy, the latter approach could make Europe less susceptible to pressure from other countries.[8] In line with this logic, leading European semiconductor manufacturers would not need to aim for vertical integration, and costly control over every aspect of the supply chain, as long as their frontier products remain indispensable for others.

A recent DGAP report suggests that Europe should complement its de-risking policy, which is seen as "virtually impossible" to achieve in the light of its enormous costs, with **efforts to maintain reverse dependencies** to keep itself technologically indispensable to China.[9] It argues that the European strategic indispensability will emerge in areas where a combination of excellence in three areas - research and innovation, IP & patents, production and commercialisation - produces technological champions in areas of high demand in the rest of the world.

If cycling terminology were to be used to describe the global technology race, **the US and China are the Breakaway**, a duo that is front of the peloton, attempting to distance themselves from the pursuing group, while **Europe is in the Chase Group**, a small team of cyclists who are ahead of the peloton, hoping to catch those in the breakaway.

As the Australian Strategic Policy Institute (ASPI) shows in its Critical Technology Tracker, **China is a global leader in 37 out of 44 crucial technology fields**. It is "further ahead in more areas than has been realised". For some technologies, "all of the world's top 10 leading research institutions are based in China and are collectively generating nine times more high-impact research papers than the second-ranked country (most often the US)".[10] Technological competition is assessed in terms of scientific and research breakthroughs as well as the ability to retain global talent, given the latter's importance in developing and controlling the technologies that are still to emerge.

2.3. TOWARDS A WHOLE-OF-GOVERNMENT APPROACH

Technological leadership requires **a holistic, cross-agency strategy**, with ambitious deadlines and rigorous execution. While China has often unscrupulously benefited from inventions made elsewhere and absorbed intellectual property from foreign companies, it has also consistently pursued a planning-based approach to technology development, building a position of strength in research and innovation.

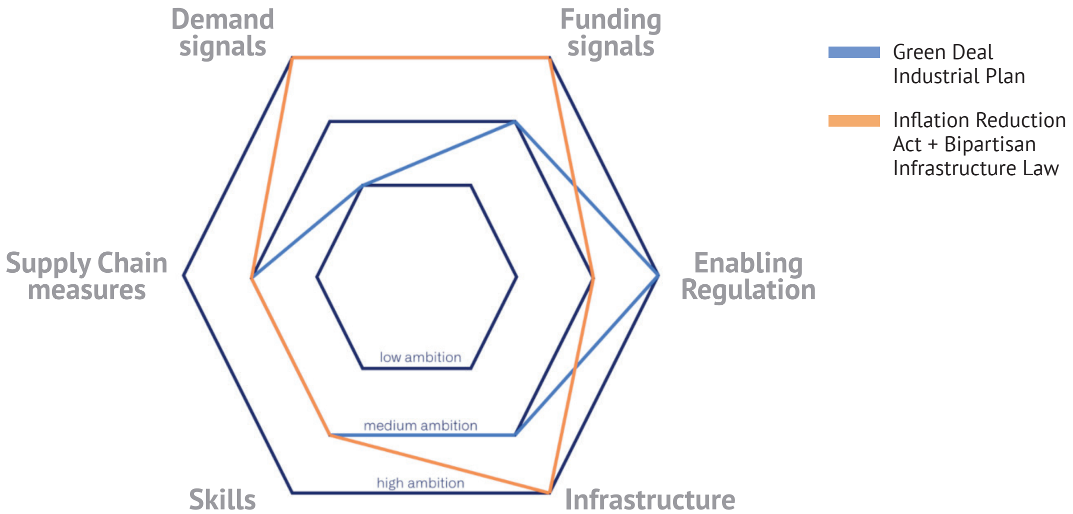
The US has applied a similarly thorough approach although not as much across the entire spectrum, as China has. Increasingly, however, it is filling technology leadership gaps, as evidenced by the recent Executive Order on Advancing Biotechnology and Biomanufacturing Innovation.[11] The approach relies on **a whole-of-government approach** to advance the US bioeconomy valued at over $950 billion. The Executive Order (EO) foresees 40 tasks to be assigned to different federal agencies, to create a national framework and leverage bio-based innovations for sustainable economic growth. The Federation of American Scientists now maintains a living Bioeconomy EO tracker to monitor progress and enhance accountability of government action.[12]

In Europe, **efforts to overcome fragmentation are needed at the EU and national level**. As an illustration, a recent report commissioned by the French government, advocates an overhaul of the country's system for managing and funding biomedical research, with a view to create a national agency along the lines of the US National Institutes of Health.[13] The report argues that France suffers from a "lack of national strategy for biomedical research, a deeply fragmented yet often redundant research and funding landscape, cumbersome regulations and administrative burdens, and chronic underfunding". As the President of the French Academy of Sciences Alain Fischer, says "No one in the country has a global view of what's going on". His conclusion is clear: **"We need to have a pilot in the plane"**.[14]

Rather than relying on a single supporting factor, **a comprehensive set of interventions** needs to combine funding signals with demand signals, enabling regulation, infrastructure, skills and supply chain measures. Each large-scale initiative should be assessed against these combined factors, as shown in this comparison of the impact of the EU Green Deal Industrial Plan and the US Inflation Reduction Act and Infrastructural Law.[15]

Fig. 1

FACTORS IMPACTING INVESTMENT IN CLEANTECH



Source: Cleantech for Europe

2.4. MAPPING EUROPE'S STRENGTHS

The former President of the European Central Bank Mario Draghi recently pointed out that the EU needs a "leading position in the deep-tech and digital innovation that is close to our manufacturing basis".[16] His forthcoming report is said to focus on **ten of the macro-sectors with the highest exposure to green, digital and security challenges**. In this context, mapping technological advancement and arriving at **long-term choices** about technological leadership will be necessary for the EU, to identify strategic sectors and determine who should advance them.

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A clear example of strategic indispensability is Europe's leadership in the **semiconductor lithography technology**, with ASML as the undisputed global leader. Regarding **semiconductors**, Europe stands out for its **research excellence**, exemplified by IMEC's role as the world's largest independent R&D organisation on semiconductor technology. Its strong position is a result of significant investments in the advanced, independent R&D pilot line, the talent pool of 5,500 top scientists from around the world, and the conducive ecosystem and culture of collaboration with industrial and academic partners.[17]

Medical equipment enhanced by AI is also an area of potential leadership, although many of the European innovations have been developed in the past two decades in the United States. Europe's leadership in the **AI-enhanced automobile industry** will be a function of how it handles a variety of applications, from driver assistance systems, and automotive diagnostics to AI-powered fleet management.

Europe has a strong, although not unrivalled position in the **pharmaceutical and biotechnology industry**. Among the 11 best performing European companies, six are pharmaceutical companies. However, the **transition to a more tech-based pharma** is ongoing, with technology increasingly permeating life science and healthcare. Biology is becoming "engineered" and "industrialised".[18] A new growth phase can be expected, as AI helps with the design and execution of clinical trials, and when progress in AI is combined with innovation in data collection. Arrival of Large Language Models and foundational models opens further avenues for scientific discovery by enabling the use of not only structured but also unstructured data, which is substantially more ubiquitous. Maintaining a position of strength will require constant, ongoing innovation.

The exercise of mapping European technologies mentioned above needs to be granular and involve successive elements of the value chain, such as semiconductor design or greater emphasis on hardware for AI, currently dominated by the Big Tech. More value will result from investing in ecosystems and leveraging multipliers in ecosystems, including by sharing risks and resources to reduce the impact of risks and disruptions. Public institutions must engage closely with industry to understand the supply chains better and tailor their interventions accordingly.

2.5. DOUBLING DOWN ON TECHNOLOGY CONVERGENCE

Across Europe, new consortia will be needed, to enable breakthroughs in the environment of **technology convergence**, a defining feature of the current phase of technology development. Diverse fields are increasingly intersecting and a blending of technologies takes place. Emerging innovations would not be possible in a single domain. The convergence of digital technologies (such as AI, Internet of Things, and Big Data) with physical systems (like robotics, manufacturing, and smart devices) create novel, more efficient, and interconnected products. Advances in communication technologies enable seamless connectivity between devices, systems, and networks, while integration of AI and Machine Learning into various technologies can enhance their capabilities.

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The convergence-based emphasis is particularly relevant for defining the **European approach to AI**, enabling focus **on how AI links with other technologies**, such as biotechnology. Given the technology's breakthrough potential when applied to intractable scientific problems, there is merit in specialisation in "Applied AI", namely AI that can transform different scientific disciplines and sectors of the economy by applying its pattern-recognition abilities. At the same time, adaptability and flexibility will be needed, given the evolving nature of the technological landscape.

2.6. THE VALUE CHAIN APPROACH

Growing significance of economic security means that greater attention needs to be applied to the world of networks, nodes and choke points. Until recently, this has been neglected **"land in-between"** of macro- and micro-economics and is now becoming the basis for a mesoeconomic approach.[19] **Economic security means de-risking the constituent parts of the value chain**, as exemplified in the EIB's recent EUR 1 bn investment in the Northvolt battery factory.

A chain is only as strong as its weakest link. Robust protection of supply chains is necessary, which means that interventions should consider a more fine-grained analysis. This is where public spending, and especially EU-level spending, has an important signalling effect on the market. In addition, investing in industrial value chains is highly efficient, and rightly forms the backbone of initiatives such as the Net-Zero Industry Act.

The issue is important because **Critical Raw Materials** (CRM) is needed. The necessary financial means will be defined one-by-one for each of the new strategic projects that the CRM Act foresees. The process will involve the European Commission, the EIB, EBRD, and the private sector interested in developing CRM approaches. In addition, Mario Draghi has floated the idea of a dedicated EU Critical Minerals' Platform for the purpose of joint procurement, secure diversified supply, the pooling of financing, and stockpiling.[20]

2.7. TWO-TIER TECHNOLOGY STRATEGY

While the EU has undertaken several important initiatives aimed at technological acceleration, including the Chips Act and the Net-Zero Industry Act, it needs to complement them with **a comprehensive European Technology Development Strategy**, covering the entire spectrum of areas, including those where the EU would only decide to maintain a residual capacity, due to the lack of competitive advantage. Not to replicate existing initiatives, the **Strategic Technologies for Europe Platform**,[21] was created to raise and steer funding into three target investment areas: a) digital technologies and deep-tech innovation, b) clean and resource efficient technologies, c) biotechnologies, should be transformed into **a forum for policy and funding coordination** across a broader array of technologies, with a **two-tier system** in mind:

- Technologies where Europe aims to develop leadership capability.

- All other technologies where minimum capacity is required for resilience.

This two-tier approach would determine the priorities that investment and funding should address. It would lead to **aggregating funding in a select number of critical technology areas**, with lower but meaningful amounts allocated for second-tier capabilities. As such, it would also shape the renewed industrial policy, the bulk of which should focus on technology leadership and on maintaining a manufacturing capacity for resilience-related purposes.

Apart from envisaging several EU-level actions, the European Technology Development Strategy should consist of **a coordination mechanism** across the EU to make sure that the European and national technology roadmaps converge. **Systemic investing** would need to be applied to ensure that solutions are linked together, rather than seen as standalone projects. To assist its implementation, **funding dashboards** would need to be created for different technologies, integrating data about all European, national and regional funding streams and support schemes.

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2.8. INFRASTRUCTURE AS A PUBLIC GOOD

Economic security, as well as the prerogatives of scale in the green transition and digital transformation require effective infrastructure. Network development is an excellent example of a European public good that benefits cross-border service providers and also enables a systems-level transformation. Given the role of electrification in the transition towards the net zero economy, **an efficient energy grid infrastructure is a prerequisite for a flexible system** that properly balances demand and supply.

The European Commission's modelling has shown that investments of around EUR 660 bn per annum will be needed in the energy system, excluding transport, in the period of 2031-2050. Modernisation of grids, bringing in additional capacity, and improving energy efficiency will all demand significant **investment, to which there is practically no alternative**: without modernisation of the infrastructure, connecting new renewables will be impossible. These types of investments needs will inevitably require **common borrowing** through an extension of the Recovery and Resilience Facility, to ensure that the gains of existing programmes such as RePower EU and NextGenerationEU are maintained.

The fact that all the main **hyperscalers are American companies** in the ICT infrastructure, **has undoubtedly helped US organisations become early adopters of cloud**, with all the ensuing benefits, such as greater customer engagement and business agility. Hyperscalers have since expanded across Europe and made substantial efforts to satisfy governments with respect to security and sovereignty concerns. In parallel, Europe has tried to regain the initiative through the European Alliance on Industrial Data, Edge and Cloud or the recently authorised Important Project of Common European Interest on Next Generation Cloud Infrastructure and Services. The overall objective is for 75% of European businesses to use "cloud-edge" technologies by 2030.

In a recent paper, ECIPE estimates that to catch up by 2030, 2040, and 2050, European technology companies would need to substantially increase annual investments, from approximately $157 bn to $1.2 trillion annually, representing 0.8% to 6.4 % of the EU's GDP. This raises the question of **potential trade-offs needed to optimise resource allocations**. Investments which are necessary for European firms to emerge as global leaders in one area mean that other sectors would have to come to terms with lower funding levels.

When seeking to limit reliance on larger platforms, a helpful role can be played by **decentralised connectivity**. Creation of digital assets and the instituting of smart contracts can open the way to decentralised and regenerative finance. Apart from legislation and policy, development of European blockchain infrastructure would be necessary for this purpose, building on the development of the European ID wallet and the ongoing work on the digital euro. Having a platform to connect and identify partners, with the relevant way of payment, can lead to the emergence of a whole new structure for the digital society.

3.Balancing deployment and disruptive innovation

The ultimate objective of innovation is to improve the provision of goods and services in the economy, when deployed at scale. Both dimensions are, therefore, equally relevant: coming up with breakthroughs, which creates positive knowledge spillovers, but also being able to put them to the best use in the interest of broader societal objectives. In fact, **technology deployment must be balanced with development of new disruptive technology**. There are currently market failures in the industrial scale-up of lead technologies in Europe and funding gaps for Europe's green transition and infrastructure development, requiring a more classic mix of public and private spending, including availability of lending instruments.

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Similarly, **extensive investment is needed to boost European semiconductor fabrication capacity**, as set out by the EU Chips Act. Around 80%of all chips continue to be manufactured in "fabs" in Asia, with the remaining 20%being produced in the United States and Europe. Increasing domestic production is needed not only to reduce vulnerabilities but also to strengthen the innovative network of suppliers, research and startups, hence fueling further innovation.

The advantage of the Inflation Reduction Act in the US is that it creates **clear deployment frameworks** and relies on swiftly applied tax credit schemes. In the European context, arriving at an equivalent solution would require establishing the EU's own fiscal capacity. Short of that, the best the EU can do is to improve the existing framework, consisting of EU-level investment tools, and national state aid schemes.

Deployment is also the relevant framework for generative AI, which can bring a substantial boost to innovation, climate and clean tech. It will enable a much more democratic access to AI. Currently, only 20% of businesses use AI in Europe, short of the 79% assumed in the Commission's Digital Decade. Combining generative AI with expertise in manufacturing should be seen as Europe's potential strength.

At the same time, many breakthrough technologies cannot easily be located on the list of strategic technologies in a particular domain. **Therefore, preserving an open category of innovation is essential.** Top US companies have completely changed in recent past, building on the market-creating innovation stemming out of fundamental breakthroughs. It is, therefore, important not to have the end-results overtly prescribed, hence giving innovation an opportunity to flourish.

Learning and knowledge spillovers are important outcomes of investing in research. Therefore, a level playing field needs to be maintained between incumbents and new entrants in the policy design. As one example, although the newly launched European Defence Fund will primarily focus on technologies close to commercial application, it should also allocate part of its budget to transformative breakthrough technologies.

Keeping Deployment and Disruptive Innovation in Balance: The Case for the Chips Act 2.0

Semiconductors have become the melting pot of innovation in the most critical technological value chain of today, spanning chips, cloud, data and AI. The last few years have seen **a spectacular rise in prominance of AI chips**, which are specially designed to handle AI tasks, such as data analysis, Machine Learning or Natural Language Processing.

For AI to remain compatible with climate targets, it must become vastly more power efficient. This requires innovation and breakthroughs that reduce the energy consumption of AI by large factors, potentially in the range of hundreds to thousands. AI chips are optimised for parellel processing and matrix operations, which are common in AI tasks. **Innovations in chip design** can lead to significant reductions in power consumption per operation: from reducing the process node size, through designing AI chips for edge computing, all the way to exploring new architectures like neuromorphic computing. The challenges are daunting, but they are also synonymous with opportunities for Europe which has leading R&T ecosystems and strengths in core areas.

Given its weakness in cloud services vis-à-vis US hyperscalers, **Europe must full-heartedly position itself in semiconductors to play a part in the emerging universe of AI**: the battle Europeans cannot afford to lose is that of industrial AI and the 'AI of Things' (AIoT) where inference chips are critical, providing for real-time processing, energy efficience, and robust performance. For an EU flagship technology and industrial policy that was adopted as recently as July 2023, the Chips Act is surprisingly little focused on AI, power efficiency and inference. It emerged after the post-Covid chips crunch and was largely directed at avoiding future shortages in traditional industries. The **Chips Act 2.0** is now urgently needed with a focus on the **technological challenges of AI chips**, from energy efficiency, effective thermal management, performance scalability, integration of different types of processing units, edge AI and on-device processing.

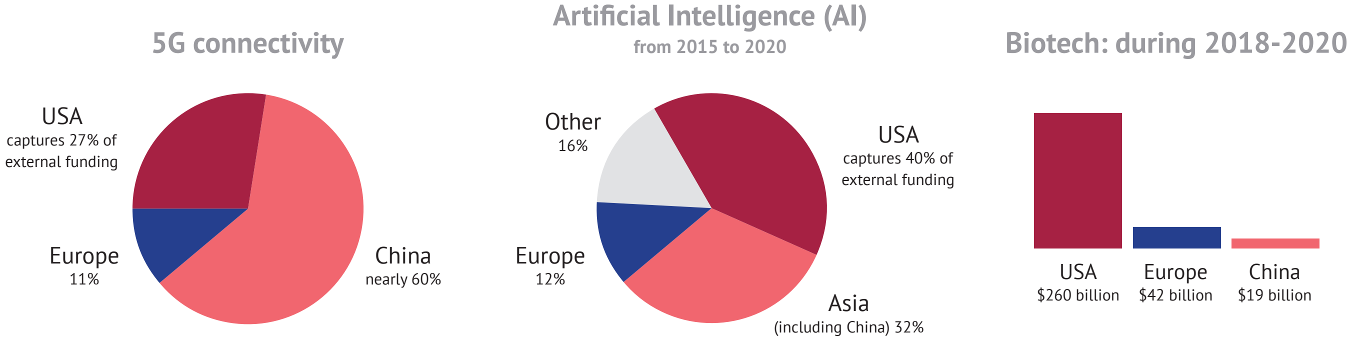
4.Minding the gap in funding

Substantial funding disparities exist globally with respect to technology development, with the US and China attracting most venture capital and external funding, and Europe lagging behind.

Although venture capital investments in Europe have grown, they remain at the level of about a quarter of what is invested in the United States. Securing adequate resources for Europe's technology development cannot

Fig. 2

FUNDING FOR TECHNOLOGY DEVELOPMENT. OVERVIEW OF EUROPE'S POSITION



China captures nearly 60% of external funding in 5G connectivity, the United States 27%, and Europe 11%.

From 2015 to 2020, the United States captured 40% of external funding in Artificial Intelligence, Europe 12%, and Asia (including China) 32%.

During 2018-2020, the United States spent $260 billion on biotech, Europe $42 billion, and China $19 billion.

Source: McKinsey Global Institute on the basis of PitchBook data[22] be achieved without the **creation of an efficient EU financial ecosystem**. The Capital Markets Union would make Europe more resilient, support high growth firms and the objectives of the continent's green transition.

Failure to build it would make Europe more and more depended on US funds for the development of its technological champions, including at the IPO stage. The US ecosystem includes a variety of tools such as: general and specialised funds, powerful financial sponsors, a diversified supply of financial products, efficient trading infrastructures, tax incentives for long-term financial savings, common rules for insolvency and accounting, plus the role of US public debt as "safe asset" for all financial actors. **A shift is needed from short-term to long-term in the approach to saving and investment in Europe.**

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4.1. INVESTING AT THE TECHNOLOGICAL FRONTIER

In the age of exponential growth of technology, strength in the high value-added sectors is a prerequisite of economic success. At this point, the **European economy is primarily dominated by mid-tech industries** that account for 50% of the business R&D spending (BERD), whereas in the US, high-tech industries (software & computer services and pharmaceuticals & biotechnology) account for 85% of the BERD.[23] As a recent report on innovation differentials argues, mid-tech industries have only limited scope for sustained growth. **Sales and profits tend to grow faster in high-tech industries.**[24] On the bright side, the investment opportunity in Europe's technology companies has recently been assessed to amount to an additional €1 trillion over the next five years,[25] building on the almost 50-fold growth in the size of the sector in the past two decades.

Europe's hidden growth champions are mid-caps, or medium-sized enterprises, which are an essential part of industrial ecosystems in electronics, health, energy and aerospace or defence. They are more likely to invest than SMEs and large firms, and their investment volumes are larger.[26]

European entrepreneurs are often said to be risk-averse but this is more a function of the limitations of the eco-system than the question of the mindset. As many as 1 in every 5 founders of unicorns in the US are immigrants from Europe, which means that the **Europeans are perfectly capable of achieving entrepreneurial success, if they are not held back** by the constraints of inadequate scale and insufficient acceleration potential.

Access to funding remains the most significant barrier to technology entrepreneurship. Availability of external financing ranks first with 59%, while personal financial constraints come close second, with 48%, in the survey of Atomico, leading them to conclude that "entrepreneurship is a luxury for those that can afford to pursue it".[27] For every technology startup, which receives adequate funding, there are 20-30 companies not passing the *valley of death*. Understanding the reasons of this failure is of essence. An underestimated factor pushing companies into existential difficulties has to do with the **funding timelines** on the part of the venture capital (VC) investors. In Europe, most critical technologies face a valley of death in the growth stage. Forward-looking teams tend to move to the United States or welcome non-EU capital.

Low investment values restrict the ability of companies to develop new products, limiting their number and potential scope. It also makes portfolios of products difficult to emerge and increases the risk, given how much of the stake hinges on the success of one product. Limitations on long-term strategies for independent growth often result in foregoing intellectual property at an early stage and accepting lower valuations.

The **size of funding** rounds is also of essence. As an illustration, in the fusion energy area, the $7 million raised by Proxima Fusion, a spin-out of Max Planck IPP in its first round, are massively below the $2 billion raised by the Commonwealth Fusion Systems, a spin-out of MIT in the US. In addition, **speed of funding rounds and complexity of the process** are areas where Europe must do better.

4.2. SECURING ADEQUATE SCALE-UP FUNDING

Public policy needs to support the entire cycle of **technology development**, from its scientific underpinnings to diffusion, so that breathroughs in fundamental science have a streamlined way to the market. Europe's challenge is less pronounced regarding startups, of which more are created than in the US, with a stable share of repeat founders.[28] In the area of scaleups, however, the difficulties persist.

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Europe's agency for disruptive innovation, the European Innovation Council, has now created a venture arm, the **EIC Fund**. Relying on a budget of €10 billion, the EIC aims to generate a pipeline of startups with the potential to become leaders in deep tech innovation. The Fund has approved 350 investments in deep-tech companies for the overall amount of €2 billion.[29] The EIC has increasingly engaged in late-stage deals, the share of which has risen from 9% on average prior to 2020 to more than 80% recently,[30] although the number of investment rounds remains small (23 in 2023, with the late-stage volume of €0.9 billion).

In addition, the EIB Group is active in closing the gap in terms of access to risk capital to accompany the growth of young and high-risk companies pursuing disruptive technologies. The EIF is the largest fund-of-funds investor in Europe, supporting European private equity value chain from technology transfer to late-stage funds. In the course of 2023, the European Investment Fund (part of the EIB Group) launched the **European Tech Champion initiative**, with the contribution of EU member states. It has also confirmed its readiness to further deepen its risk-absorbing financial instruments, with the support of the EU budget.

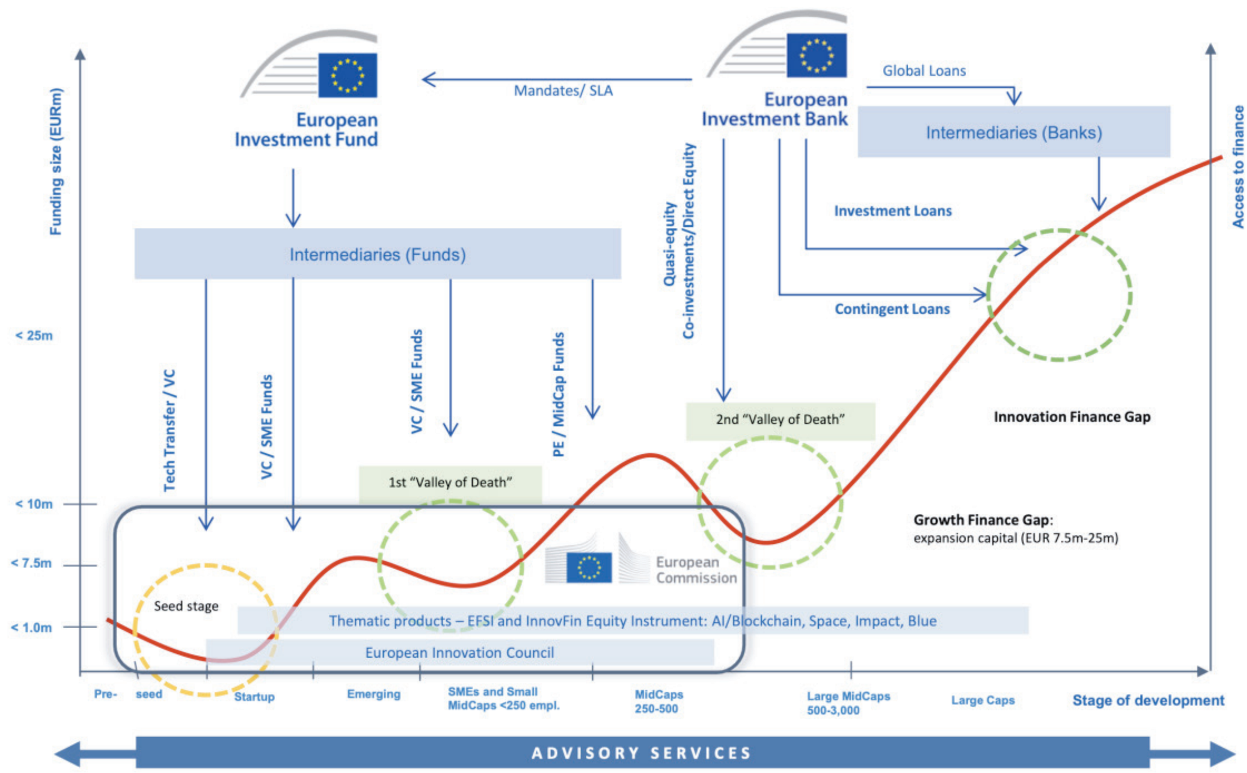
The **Strategic Technologies for Europe Platform** (STEP) is a more ambitious undertaking aiming to function as a "sovereign fund", and has been significantly reduced in scope, as a result of the political process. Its original objective was to channel funds to Europe's digital, deep tech, cleantech and biotech sectors but has had to focus instead on reprogramming unspent EU resources, including from cohesion funds.

4.3. FUNDING DISRUPTIVE INNOVATION FOR ECONOMIC SECURITY: FUTURA TECH FUND

Technology development is a lengthy and complex process, which requires "patient" capital throughout the entire cycle of innovation. US companies receive five times more private funding than their European peers in late-stage funding. Given the limitations of the venture capital investment model, with its focus on faster pay-back periods, as well as insufficient liquidity of technology IPO markets in Europe, **there is a need for a new funding vehicle, which would bridge the existing gap**.

Fig. 3

FUNDING INTERVENTIONS BY THE EIB GROUP TO SUPPORT THE GROWTH OF EUROPEAN TECHNOLOGY COMPANIES



Source: EIB

The latter cannot happen through the organic evolution of the current funding environment, despite the positive changes, such as the emergence of equity funds with longer holding phases, or crossover funds holding both private and public equity. There are natural limits to extending the fund life excessively in the Venture Capital (VC) investment model, without endangering the interest of limited partners and the investor base, especially in a time of a funding squeeze.

Given the positive returns in the past 20 years from B2B business models, the **funding timeframes rarely exceed 10 years**. Most European VC are used to the more traditional software-as-a-service plays and have less experience with deep-tech. In addition, high barriers to entry related to required sector expertise, specialised VC investors are in short supply in Europe. As a consequence of the mostly return-driven investment model, there tends to be greater emphasis on select areas of technology development.

Frontier technology developments tend to require the medium to long-term to mature. In **fusion energy**, the most ambitious players who explore alternative routes to practical fusion technologies, believe that fusion could be delivering electricity to the grid by 2035, although many experts think technology is still 20 years away. For leadership, much depends on where the first demonstration facilities will be built.

In quantum computing, 15 years is the most optimistic timeline considered when surveying experts about the practical implementation of these new machines and their commercial applications. In fact, "'Hyped' claims, particularly of early usefulness, come with the risk of slowing quantum computing research long-term."[31]

Addressing Europe's scaling challenge requires a **European Futura Tech Fund to pursue both direct and indirect investments** in support of companies and venture capital funds committed to addressing the challenges of the four technology areas prioritised in the European Economic Security Strategy:

- **Advanced Semiconductors technologies** (microelectronics, photonics, high frequency chips, semiconductor manufacturing equipment);
- **Artificial Intelligence technologies** (high performance computing, cloud and edge computing, data analytics, computer vision, language processing, object recognition);
- **Quantum technologies** (quantum computing, quantum cryptography, quantum communications, quantum sensing and radar);
- **Biotechnologies** (techniques of genetic modification, new genomic techniques, gene-drive, synthetic biology).

The Futura Tech Fund should be set up as a fund with a **private manager structure**, pursuing investments as a private investor. The **complementarity with the existing funding instruments** would be insured by means of supporting – inter alia - projects emerging from the EIC pipeline, and acting in parallel to the EIB venture funding. The Futura Tech Fund would support companies which require resources going beyond the limits applied by the EIB, which generally finances one third of each project.

The Futura Tech Fund should be set up as a fund with a private manager structure, pursuing investments as a private investor.

Private status of the fund would enable **sizeable funding rounds**, with initial ticket size of up to €100 million and adequate reserves for follow-up rounds. As a result, companies that receive Futura Tech Fund support will be able to embark on first-of-a-kind production. **A sufficient amount of capital** would need to be allocated to the fund to make a sizeable difference to the prospects of breakthrough innovation in the four critical technology areas of the European Economic Security Strategy.

The Futura Tech Fund would back companies and funds that share the sense of opportunity associated with the development of frontier technology and have expertise in the area. It would bring about a culture change by concentrating financing activities around **systematic collaboration models with "patient" capital investors**.[32] It could play an aggregation role for investors sharing the evergreen philosophy by taking cornerstone positions in existing funds, leveraging such investors with debt instruments, or engaging via co-investment facilities.

The collaboration model envisaged by the Futura Tech Fund would contribute to the **recently proposed investor network**, to encourage venture capital investors to co-invest in Europe's innovative deep-tech companies, together with the European Innovation Council Fund.[33]

An example of a fund with a long-term approach is the recently launched **NATO Innovation Fund**,[34] which is a standalone venture capital fund backed by 24 NATO allies, deploying more than €1 billion. As such, it is the world's first multi-sovereign venture capital fund. It aims to empower deep tech funders to address challenges in defence, security, and resilience. It invests independently and leads initial investments with up to €15 million, with substantial reserves for subsequent rounds.
The NIF meets the needs of various deep tech timelines.

On 18 June 2024, the NATO Innovation Fund announced its first investments in four companies in the areas of novel materials and manufacturing, AI and robotics.[35]

Among private capital funds, **Sequoia Capital Fund has announced openly that for them, the "10-year fund cycle has become obsolete"**. "Our experience with category-defining companies – Apple, Google, Cisco, Unity, Snowflake, Zoom – has taught us that they take more than a few years to build".[36]

4.4. ACTIVATING DORMANT CAPITAL

There is a wealth of capital in the EU residing with pension funds, insurance companies, or family offices. The total volume of pension assets in the euro area was estimated at 3.42 trillion in Q2 2023.[37] Encouraging its participation in funding technology companies would require **engaging such actors on an equal footing with the public sector institutions** and empowering them to become lead investors or strategic co-investors. Alignment with the overall technology strategy would be necessary, with safeguards included in the Limited Partnership Agreements. Capital investors would need to be offered the ability to profit from the new funds, gain access to information and potential deals.

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The outcome would be in line with the **Savings and Investment Union** envisaged by the former Italian Prime Minister Enrico Letta in his report on the future of the Single Market,[38] with the aim of retaining European private savings and attracting additional resources from abroad by full integration of financial services within the Single Market.

4.5. STRATEGIC AND NON-DISTORTIVE APPLICATION OF STATE AID

Given the reality of a distributed fiscal space, **coordinating and mainstreaming the provision of state aid** will be an important tool of a renewed industrial policy. Rapid mobilisation of targeted national public support for industry needs to focus on strategic areas of the economy, including technology leadership. It also needs to be carried out in a way that avoids distortions and fragmentation of the Single Market. To this effect, Enrico Letta has proposed in his recent report a state aid contribution mechanism, under which a portion of national funding would be allocated to pan-European initiatives and investments.[39] In essence, this is the question of having a single European industrial policy or a patchwork of national ones, with unavoidable challenges of internal coherence.

Given the reality of a distributed fiscal space, coordinating and mainstreaming the provision of state aid will be an important tool of a renewed industrial policy.

Introducing **a rigorous framework for coordination of state aid in critical technology** areas will be of equal relevance. Existing since 1957, the Important Projects of Common European Interest (IPCEI) have been recently extended to include 8 projects firmly focused on critical technologies, including microelectronics, batteries, hydrogen and cloud computing. Altogether, €35 billion in state aid has been approved, which aims to crowd in €60 billion of private investment. In the future, the IPCEI selection process has to be transparent and centred on the observance of technological roadmaps, so as it remains firmly geared towards incentivising innovation.

Economic Security Safeguards

A number of provisions have recently been introduced to **protect against economic security risks** in technology investments. The EIC Accelerator applications in critical areas such as AI and quantum, will be screened for foreign ownership. Similarly, investment agreements concluded by the EIC Fund will include economic security safeguards. In addition, all EIC beneficiaries will have the duty of informing the Agency in cases where the Intellectual Property generated by EIC projects is proposed to be transferred to an entity in a non-associated third country. **Further-reaching clauses to protect IP could be the next step but should be approached with caution**, not to close the European research and innovation system too tightly to international collaboration.

5.Boosting demand for technology innovation

The most effective intervention of the public sector in enhancing the innovativeness of the economy lies in becoming **an early customer, hence creating demand at the outset of the product's journey onto the market**. In this way, the challenge of insufficient product-market fit can be addressed. Learnings from vaccine development offer ample evidence about the usefulness of **advanced public commitments**. An analogous approach is needed in critical technologies, setting end-point objectives, and encouraging technology developments that satisfy stated requirements. Such a way of signaling future demand for critical technologies would go a long way to incentivise founders, investors and corporates to allocate resources to critical tech. This is all the more important given that corporate actors, who are the main customers for critical technologies, are too risk averse to adopt and scale new technology at a pace.

The most effective intervention of the public sector in enhancing the innovativeness of the economy lies in becoming an early customer, hence creating demand at the outset of the product's journey onto the market.

Another important trajectory lies in **linking support for innovative companies with public procurement mechanisms**. Public procurement currently amounts to 16% of EU GDP, with some member states now intending to spend 20% on innovation procurement. The EU should incentivise member states to make better use of this instrument to help innovative companies scale up, in strategic technology areas.

In the US, research agencies such as DARPA are in the position to offer ambitious government contracts. **Similar type of linkage is needed with projects supported by the EIC, EIB and the proposed Futura Tech Fund.** In the area of defence, fragmentation of EU spending leads the collaborative procurement to account for less than 20% of the total spending, while almost 80% of the EU defence procurement over the last two years has been from outside of the European Union.

One possible way of addressing this would be by means of fast-stream and guaranteed access to procurement bids through a simplified "European technology procurement" pathway.

One possible way of addressing this would be by means of fast-stream and guaranteed access to procurement bids through a simplified **"European technology procurement" pathway**. The latter would consist of a uniform procedure, where EU-level spending is matched with the national one. As the EIC President Michiel Scheffer has noted, a top-down approach is valuable only when the entire life cycle of innovation is covered, from the phase of ideation to the public procurement of products and services.[40]

Looking across the Atlantic, **NASA has single-handedly harnessed the market for space rockets, with an impressive result**. Instead of commissioning their development, it opted to to procure flight services from commercial companies in its Commercial Orbital Transportation Services programme, launched in 2006.

Dual-Use: Synergies Between Civil and Defence Applications

Improving synergies between civil, defence and space Research and Development activities has been on the European agenda since 2021, drawing on the realisation that many of the technologies which are critical to Europe's security have both civil and military applications. This is the case for drones, thermal imaging or geolocation data.

As part of the economic security package of January 2024, the European Commission proposed in a White Paper to allow technologies with both civil and defence applications to be funded in the Framework Programme 10 in order to strengthen cross-fertilisation and boost the EU's strategic autonomy. Although some academic institutions would prefer to keep the civilian and military research separate, there is also a growing realisation that **dual use research is becoming increasingly widespread and necessary for the optimisation of resources**. Dual-use tech startups are specifically supported by the Defence Innovation Accelerator for the North Atlantic (DIANA), launched by NATO. In addition, dual use often becomes a natural option in the course of technology development, which can support scaling.

The European Space Agency is now pursuing a similar approach, with recently announced contracts for two winning companies, to develop commercial cargo services to the International Space Station.[41] However, the ESA budgets remain small in comparison to those of NASA, with €25 million allocated to each winner, the Exploration Company and Thales Alenia Space, in the initial round of funding. When the NASA programme was launched, more than $400 million was awarded to two winning companies, including SpaceX. Fixed-price contracts of $3.4 billion followed within two years. One could foresee a similar approach in several other critical technology areas, with SpaceX-like outcomes.

6.Facilitating factors and provision of talent

6.1. ONE TECH MARKET

One of the most important reasons behind the emergence of the Valley of Death for European technology companies is the **persistence of significant market barriers**, with Europe failing to offer sufficiently large opportunities for growth. European regulatory frameworks tend to be focused on risk and risk-reduction, rather than incentivising economic opportunity, or the opportunity cost of not engaging. The pursuit of economic security should not lead to greater concentration on risk since what is a risk in the economic sense is not necessarily a security risk.

Facilitating factors must accompany investments, with pro-innovation regulatory frameworks, more robust and better-connected innovation ecosystems and talent attraction schemes, all of which have been identified in the European Innovation Agenda from 2022. Some of these, such as regulatory sandboxes, have been translated into NZIA and other policy initiatives, where the use of sandboxes by member states has been mandated. The idea of setting up a new common regulatory regime for startups in tech has been floated by Mario Draghi.[42]

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Standardisation is essential for the EU's economic security. The EU has a strong position in developing standards, but in order to consolidate this advantage, framework conditions need to be conducive, starting with legal clarity. In the area of AI, challenges can be exemplified by the fact that the AI Act intersects with other regulatory measures, such as the machinery directive, creating a lot of uncertainty and holding up investment. Unnecessary disproportionate requirements for third party product certification can hamper investment. Pace of action is crucial. Faster permitting and certification are particularly important for cleantech competitiveness.[43] Similarly, **regulatory levers could be used to help Europe compete in areas such as cloud infrastructure**, as both the US and China do extensively (US Cloud Act versus EU cloud certification scheme).

Creating links between researchers and experienced entrepreneurs to build companies with go-to-market strategies is now at the heart of **a growing number of deep tech accelerators** in Europe. Some 20 ecosystem builders from 14 European countries have created an organisation called Rise Europe to support deep tech companies and ease their expansion beyond home markets. Research and Technology Organisations, such as IMEC, have also begun to offer ways to spin off, finance, scale and support the international development of deep tech startups and scale-ups. In addition, the **EIC Scaling Club helps growth companies** to connect with more growth capital and gain commitments from large corporate clients they are targeting with their technologies. Finally, hubs such as the Silicon Allee in Germany are becoming magnets for innovators internationally.

However, what prevents startups from scaling in Europe is fragmentation. The number of legal hurdles remains highly elevated. In particular, **a common investment document is needed**. There is merit in investing time and effort in **standardising investment documents** for equity investments. The difficulty of understanding close to 30 legal systems, and the cost of the necessary legal support exceeds by a large margin the simplicity of investing in the US and signing a standard SAFE document with one click. Standardisation of legal documents across Europe could make startup fundraising much easier and less expensive. Given its visibility across Europe, the European Investment Fund is well placed to lead this process.

Public-Private Partnerships can play an impactful role by **securing industry interest in innovation coming out of the labs**. One example of a well-functioning mechanism, which could be replicated in other areas, albiet in a significantly simplified way, is the Innovative Health Initiative, where the industry co-determines the funding priorities and co-shapes the winning consortia.

6.2. BRINGING IN THE TALENT

The European technology sector has expanded its workforce from slightly over one million to more than 2.3 million employees over the past five years, attracting net talent from the US and the rest of the world.[44] At the same time, there are already clear signs of a **shortage of skilled labour** force needed to reach the assumed level of ambition.

In critical areas such as quantum computing, talent is in short supply globally. This slows down product and commercial development. **Clear policies on reskilling are needed**, with resources allocated to reskilling programmes for experienced engineers and STEM graduates towards building a greater knowledge base in critical technologies such as quantum, or neuromorphic computing.

An equivalent programme to the temporary Support to mitigate Unemployment Risks in an Emergency (SURE), established in 2020 in the course of the COVID-19 pandemic, could be considered. -It would need to be oriented towards addressing Europe's skills gap and retraining in the light of technological acceleration and the need for enterprise adaptation. Companies that train in these areas could be supported. In parallel, the **successful model of the 'European batteries academy'**, which develops training content adapted to the new skills needs, should be replicated in other critical areas of technological development.

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Conclusions: Bringing about a change of mindset

The quest for technology leadership is accelerating world-wide. Funding plays an important role in determining its outcomes, given the massive investments undertaken by the US and China across the full spectrum of current and emerging technologies. At a certain point in time, making up for the efforts not taken becomes impossible and bridging the gap can be out of reach.

Funding plays an important role in determining its outcomes, given the massive investments undertaken by the US and China across the full spectrum of current and emerging technologies.

At the same time, leadership in technology cannot be achieved while being on the defensive. Although under pressure in many areas, Europe should confidently focus on a vision of technology development that builds on its strengths, especially in scientific excellence. This is what the logic of bridging the funding gap requires as well. Investors will not be swayed into participating in new funding rounds by the fear of Europe losing out. On the other hand, the language of opportunity and ambition, will speak volumes to them.

Strong European investors are the best guarantee of keeping intellectual property and skills in Europe. New financial instruments are needed to leverage venture capital funds that focus on transformative innovations.

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Frontier technology developments require the medium to long-term perspective to mature. This means patient capital. While in recent past liquidity events have tended to take place 8-10 years after investments, **enabling sufficient time for emerging deep tech firms to develop their technology and products fully is of the essence**. The funding rounds need to be significantly larger and the procedures considerably simpler, including with respect to standardisation of investment documents.

Three-fold action is, therefore, needed to bring about Europe's technology revival:

- A comprehensive **European Technology Development Strategy** needs to be formulated to cover all essential technologies, as well as areas of technological convergence. Europe cannot afford to move forward in a patchy way in a handful of areas, to the disregard of the entire technological landscape.

- The **challenge of scale-up funding needs to be solved**, rather than merely acknowledged. This requires boosting the current efforts of the EIB Group and the EIC, as well as the creation of a new **Futura Tech Fund**, as a fund of funds, to provide a sizeable boost to technology funding, while engaging the "dormant" capital of institutional investors and pension funds.

- **Demand for technology** needs to be ensured through **NASA-style technology procurement and Advanced Market Commitments**.

When coupled with a turnaround in enabling environment, these steps can bring Europe back to the group of key technology players of tomorrow, generating a substantial boost to the continent's economic prospects. Given the high stakes involved, this is an exercise the new European leadership must treat as the utmost priority.

1 The author is grateful for comments of Gilles Briatta, Shiva Dustdar, Lars Froelund, Stefano Gurciullo, Andras Inotai, Elizabeth Kuiper, Kevin Lenehan, Georg Riekeles, Marc Ringel, Andrej Stuchlik, Leonardo Quattrucci and Fabian Zuleeg.

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NOTES

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