EARTO Policy Recommendations 2024-2029:

No EU Tech, No EU Competitiveness

European RD&I: A Catalyst for Europe's Prosperity

Final Version – 5 September 2024

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Foreword by EARTO President: No EU Tech, No EU Competitiveness

Strengthening Europe's Prosperity and Competitiveness

Dear readers,

President Ursula von der Leyen has highlighted prosperity and competitiveness as the European Union's top priorities for the next five years. Competitiveness lies at the heart of Europe's response to the numerous challenges we face today. The COVID-19 pandemic revealed the EU's heavy reliance on external suppliers for essential products, from medical masks to basic medical compounds and semiconductors. In 2022, the surge in energy prices following Russia's invasion of Ukraine further underlined the EU's lack of autonomy in a domain critical to our entire economy. Recent events have also underscored the necessity of building a competitive European industry, particularly in the clean technology sectors, to ensure a successful climate and energy transition. Amid escalating geopolitical tensions, it is imperative to develop a robust European economic and industrial base to address societal challenges and safeguard our security.

Research, Development, and Innovation (RD&I) activities are pivotal to enhancing the EU's capabilities, resilience, security, and crisis management. Strengthening our strategic competitiveness by reducing industrial dependencies in critical sectors and securing vital components within European strategic value chains will require concerted efforts to strengthen our EU RD&I ecosystem. Major global economies, notably the United States and China, are engaged in a race for technological leadership, significantly increasing their RD&I investments. Europe, therefore, faces a significant risk of falling behind. Industrial competitiveness is essential for navigating societal transitions and political challenges, and it hinges on technological leadership. However, recent European initiatives often overlook the interconnectedness of these dimensions, with the notable exception of the EU Chips Act. A more coherent and systematic approach is essential to better align EU industrial policy, the Green Deal, and its digital compass with our RD&I policy. These priorities are interdependent and must be addressed as a cohesive whole. To enable European industry to thrive, it must be supported by excellent RD&I. By strengthening its industrial base, the EU will create an environment conducive to increased private RD&I investment, complementing public funding and fostering a virtuous cycle of innovation.

Achieving this vision requires increased public investment in RD&I, which is crucial for developing innovative solutions, securing access to materials within global strategic value chains, and establishing a more efficient regulatory framework for critical technology development and deployment. Europe's industrial policy must prioritise supporting its key industries by enhancing RD&I capabilities. To that end, EARTO members present in this report six policy recommendations, aimed at bolstering EU competitiveness through measures that promote innovation across Europe.

EARTO represents over 350 Research and Technology Organisations (RTOs) from across Europe and beyond, conducting RD&I services in a wide range of fields. From green and digital transition to healthcare, these innovations aim to result in technological and social innovations and system solutions that contribute to and mutually reinforce their economic, societal and policy impacts. RTOs operate at the intersection of science, industry, and government, aiming to bridge the gap between fundamental research and its practical and market-oriented application in industry. This gap is often referred to as the "Valley of Death", which represents a challenging phase where promising research outputs often fail to advance to commercial products due to a lack of funding, market validation, or technological readiness.
As key players in the European RD&I ecosystem and strategic value chains, RTOs are therefore instrumental in accelerating innovation, reducing costs and risks, enhancing productivity, and supporting sustainable growth. EARTO and its members reaffirm their commitment to supporting the European institutions and Member States in shaping policies that will further boost Europe's competitiveness.
Wishing you a good reading,
Best regards,

Mr Francois Jacq
EARTO President
CEO of CEA, France

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Executive Summary

In today's rapidly evolving global landscape, innovation stands as the cornerstone of our economic growth and competitiveness. Research, Development and Innovation (RD&I) are the key drivers of productivity and hence prosperity and growth. Innovation has spurred about two-thirds of Europe's economic growth in recent decades.

EARTO members present in this paper a set of 6 policy recommendations on how to further boost competitiveness by taking a set of measures to enhance innovation in Europe as follows:

1. **Commit to EU RD&I and technological leadership as key drivers of EU competitiveness and economic security,**
2. **Better articulate EU RD&I and Industrial Policies: Technology leadership is necessary, but not sufficient alone to ensure competitiveness,**
3. **Mobilise and strengthen collaborative RD&I and European RTOs capabilities across Europe,**
4. **Increase and coordinate pan-EU investments in Technology Infrastructures essential to develop and mature technology and to enable industry's uptake,**
5. **Boost technology transfer in EU with a more proactive knowledge valorisation policy and a proper legal framework for pre-commercial procurement,**
6. **Support the development of a highly skilled and adaptable workforce: RTOs' role and needs.**

EARTO members remain ready to further support the European Institutions in defining further EU policies in support of EU competitiveness.

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1. Innovation as an essential factor of competitiveness

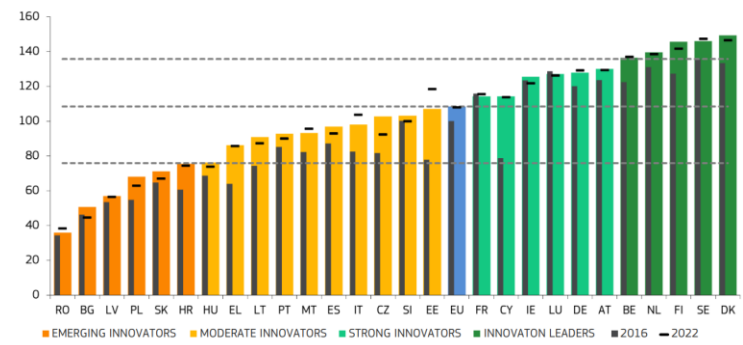
In today's rapidly evolving global landscape, Research, Development and Innovation (RD&I) stand as the cornerstone of our economic growth and competitiveness. RD&I are the key drivers of productivity and hence prosperity and growth. Innovation has spurred about two-thirds of Europe's economic growth in recent decades[1]. The World Economic Forum estimates that 70% of the new value created in the global economy over the next 10 years will be digitally enabled. Technological sovereignty (meaning the availability of key technologies, the possession of skills to evaluate, test, and use innovative technologies as well as the opportunities to successfully scale up innovative businesses) is the decisive strategic factor to secure Europe's seat amongst the frontrunners of the global technology race.

RD&I investments determine Europe's technological capabilities and innovation capacity to answer industry and society's needs. Encompassing investments will be the key to developing, testing, and implementing impactful solutions to global challenges, such as tackling climate change, ensuring citizens' health, well-being, mobility, and security, and fighting poverty and social exclusion, all while boosting economic competitiveness and creating jobs.

RD&I efforts play a pivotal role in making European industries more competitive globally. As businesses invest in innovation, they gain a competitive edge by introducing new products, processes, or services that meet or exceed market demands or solutions that boost productivity, cost-efficiency, and sustainability. This competitiveness not only boosts the EU's economic performance but also positions its industries favourably in the international marketplace.

The latest European Innovation Score Board 2023 shows a substantial improvement in the innovation performance of approximately 8.5% since 2016 (Figure 1). Between 2022 and 2023, the annual innovation performance of the EU has improved at a reduced rate of 0.6% points.

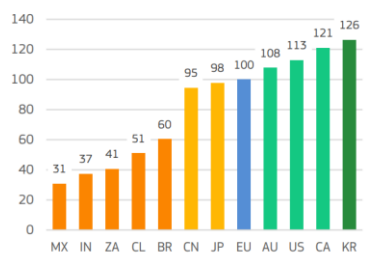
Figure 1: Performance of EU Member States' innovation systems



Source: EU Innovation Score Board 2023

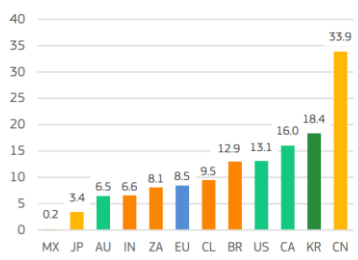
In parallel, Europe is clearly facing strong challengers in the technology race. In international comparison, the EU has an innovation performance gap with South Korea, which is the best-performing country in EIS 2023, as well as Canada, the United States, and Australia (Figure 2). Between 2016 and 2023, the innovation performance of the EU has grown at a lower rate than that of six global competitors (Brazil, Canada, Chile, China, South Korea, and the United States, Figure 3).

Figure 2: Performance global competitors



Coloured columns show performance in 2023 relative to that of the EU in 2023.

Figure 3: Performance change between 2016 and 2023



Performance change is measured as the difference between the 2023 and 2016 scores relative to that of the EU in 2016.

Source: EU Innovation Score Board 2023

These two innovation performance gaps (first, within the EU and second, towards EU key global competitors) are now well recognised and the next EU competitiveness strategy must target both.

[1] Innovation Overview 2023, European Investment Bank, 2023

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2. Technological advancements: The primary way innovation boosts competitiveness

2.1. Key enabling technologies are essential to Europe's global leadership

One of the primary ways innovation boosts competitiveness is through technological advancements. In the fast-paced landscape of the 21st century, cutting-edge technologies have emerged as powerful tools for reshaping the global economy. The Organisation for Economic Co-operation and Development (OECD) recognises the pivotal role these technologies play in driving productivity gains and fostering economic growth across countries[2]. Key enabling technologies are the essential technology building blocks that underpin Europe's global leadership in various industries, especially in high-value-added and technology-intensive products and services.

In addition, key enabling technologies enable industries to achieve unprecedented levels of productivity and efficiency. Technologies such as automation, data analytics, artificial intelligence, and smart manufacturing processes streamline operations, reduce costs, and enhance output quality. By maximising resource utilisation, these advancements drive economic growth and contribute to the objectives of the Green Deal. But Europe's competitiveness is being compromised as it lags in transversal technologies, including in digitalisation. Europe's weakness in the development and application of digital technologies has long been justified by specialisation in other sectors. However, as digital technologies are now being applied across sectors, the digital deficit in Europe can no longer be disregarded. In 2022, the McKinsey Global Institute estimated that between two trillion to four trillion euros a year corporate value could be at stake by 2040.[3] The global economic landscape is dynamic, with markets evolving rapidly. Industries adept at adopting and adapting key enabling technologies can actively shape and respond more effectively to market changes. This adaptability ensures that industries remain agile, resilient, and capable of seizing emerging opportunities, contributing to sustained economic growth.

The development and integration of key enabling technologies for/by industry necessitate the production, combination and transfer of knowledge, skills and infrastructure provided by European Research & Technology Organisations (RTOs)[4]. In close collaboration with public and industrial partners of all sizes, RTOs deliver a range of research and development activities. The technologies developed by RTOs have a strong industry focus and could be divided into two different categories: 1) breakthrough innovation creating new markets based on disruptive technology, and 2) incremental innovation through use, resolving large profit and loss problems. Both are needed today in Europe. RTOs support technology diffusion, developing applications in areas far removed from the original goal of the original research idea. RTOs' capabilities need to be further developed across Europe to further boost the 'innovation leaders' countries in their global position and to bring the others into the leading pack.

In an increasingly global competition with markets underlying the "winner-takes-most" dynamics, the EU's future industrial policy needs to focus on its core competence: the play at full scale, with increased speed creating a level playing field for its companies. In recent years, the focus of the EU industrial policy turned towards protecting EU key industrial sectors and their value chains. The EU also recently started to look at what are the critical technologies needed by those key industrial sectors. Continuing the same line, the European Commission (EC) recently proposed a new EU economic security strategy package. It recognises the need for a comprehensive European approach to economic security, de-risking and promoting its technological competitive edge. Central to all international cooperation projects should be the notion of reciprocity, accentuating fair framework conditions for international collaboration and a level playing field for European industry. Developing an open and autonomous strategy for Europe requires balancing priorities to ensure security, competitiveness, and societal well-being. The European industrial policy needs to be closely linked to such development. At the same time, it should be noted that reducing access through geopolitical protection limits the scope of options and innovation opportunities for international active RTOs.

The changing geopolitical situation has increased uncertainties about the global and security outlook, which calls for strengthening the EU's strategic competitiveness: reducing industrial dependencies in strategic sectors and securing key elements of the EU's strategic value chains. RD&I activities play a central role in developing EU capabilities, resilience, security, and crisis management. In the current geopolitical context with wars at our doorsteps, the focus today on technologies with dual-use potential is very well understandable. However, this focus should not prevent from looking at future EU competitiveness. To that end, a more coherent and recurrent EU approach needs to be developed to further link the EU industrial

[2] "Innovation is clearly central to the idea of green growth and its role is described in a recent OECD (2010b) report on Fostering Innovation for Green Growth. It was mentioned earlier that innovation drives multi-factor productivity change, and so helps the decoupling of outputs from inputs in general." Towards Green Growth: Monitoring Progress OECD Indicators, 2011

[3] Securing Europe's competitiveness. Addressing its technology gap, McKinsey Global Institute, 2022

[4] The Contribution of RTOs to Socio-Economic Recovery, Resilience and Transitions, OECD, 2022

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policy to the EU RD&I policy to jointly develop a competitive EU industrial base with strengthened innovation capabilities.

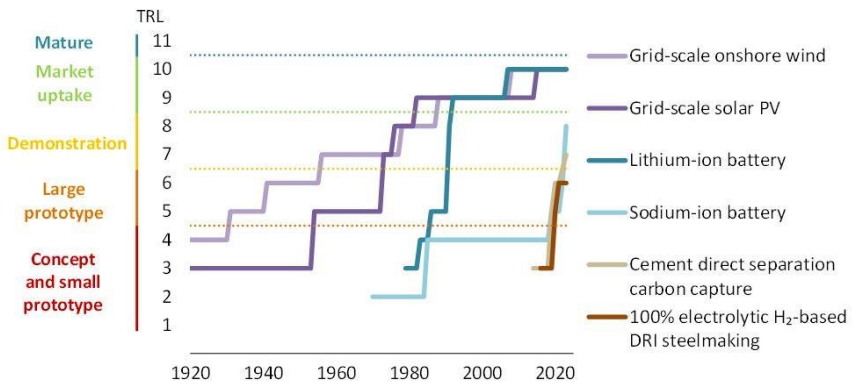
It is not enough to ensure risk management for critical technologies, for example in relation to technology leakage. Recent crises and geopolitical tensions have made it even more urgent to strengthen Europe's leadership in key technological areas. This requires increased and more efficient spending on RD&I, which is crucial for the development of innovative solutions. It also requires improving access to materials in strategic global value chains and creating a more effective regulatory framework for the development and deployment of critical technologies. Europe's industrial policy needs to foster its key industries by enhancing its RD&I capabilities.

One already implemented policy example to be picked up and extended to other key EU industrial sectors is the EU Chips Act. Indeed, the EU Chips Act includes a clear RD&I pillar (Pillar 1) to support the maturation of microelectronics technologies in Europe. Hosted by institutions such as RTOs, this initiative aims to strengthen Europe's technological leadership in the microelectronics sector, which has been defined as a priority industrial sector. The Green Deal Industrial Plan, including the Critical Raw Materials Act and the Net-Zero Industry Act, must be equally supported by a dedicated RD&I Pillar. This pillar would focus on the development, maturation, and scale-up of almost ready net-zero technologies. Investments in RD&I are needed to enable the long-term competitiveness of the net-zero industry and assure the supply of new technologies and new industrial sectors that will be deployed after 2030. This approach should be replicated in every future industrial policy action.

2.2. Nurturing and supporting early RD&I to increase the chances of technology breakthroughs

Innovation is integral to achieving sustainable development goals, and Europe's emphasis on sustainability via the EU Green Deal and the EU Net-Zero Industry Act is not only commendable but also a strategic move for long-term competitiveness. Green and digital technologies contribute to Europe's commitment to a sustainable future and position European companies as leaders in their industries.

As noted by the IEA, "*reaching net zero CO2 emissions from the energy sector by 2050 does not necessarily require fundamentally new scientific concepts or breakthroughs comparable to the initial discovery of solar, wind or batteries. However, innovation still plays an important role: about 35% of the CO2 emission reductions needed in the recently updated Net Zero Emissions by 2050 Scenario (NZE Scenario) in 2050 come from technologies that are still in development and thus have not reached markets at commercial scale. Continued innovation will also be needed to improve performance and reduce costs of technologies already delivering emissions reductions, as well as to improve manufacturing processes. ... even the most ambitious technology improvements in the NZE Scenario could be considered incremental in comparison to major discoveries. In many cases, the challenge is to bring new technologies to commercial scale in time to ensure an affordable energy transition. This calls for better designs or new combinations of existing technologies that can help to reduce costs, improve performance, address new use cases, minimise the use of critical resources, and mitigate other environmental impacts. Of course, completely new ideas may still arise, leading to new technology concepts or materials that could further accelerate the clean energy transition and broaden its scope.*"



Source: IEA

Building on IEA's conclusion, Europe must further support and develop green technologies and invest in early RD&I to increase the chances of breakthroughs. Europe needs to achieve these technological breakthroughs and ensure scaling up by industry. By combining the knowledge gained from supporting the industry and collaborating with academia, RTOs identify the potential of new technology developments as solutions to societal challenges - solutions that may not yet have been identified by industry. The key issue

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in Europe is now solving market failures and enabling industry to cross the "valley of death" with their RD&I partners. This support is also necessary in areas not (yet) covered by industrial interests, where RD&I actors like RTOs play an extra role. EU policies need to facilitate the development of sustainable technological solutions, and later the production of innovative products, by bringing different types of public and private stakeholders together.

2.3. Providing RD&I solutions to the EU green & digital transitions and other global challenges requires EU-level investments and partnerships

Almost 40% of the European industrial workforce is structured around different industrial clusters and ecosystems. With the evolution of RD&I and the increased importance of collaboration and networks to develop breakthrough technological solutions, the emergence of innovation hubs and ecosystems at regional and national levels grew over the last two decades. Supporting existing networks and the creation of new networks of RD&I stakeholders, including SMEs and subcontractors, is key to enabling the European Industry transition and finding appropriate and economically viable solutions to today's challenges.

In this context, pan-EU RD&I collaboration is essential to pool resources and expertise and jointly find solutions to address current industrial & societal challenges. Strengthening joint efforts at EU level is crucial to drive Europe's transformation. The EU RD&I Programmes facilitate solving today's challenges while preparing for future ones. Europe's commitment to fostering cross-border RD&I collaboration and partnerships has resulted in key joint research initiatives, shared infrastructures, and collaborative projects across EU borders.

By pooling resources and expertise within EU Framework Programmes targeting RD&I, such as Horizon Europe, Digital Europe Programme, and European Defence Fund, European Member States aim to tackle complex challenges collectively, accelerating the pace of innovation and supporting the EU positioning in today's technology race.

The recent Ex-post evaluation of Horizon 2020, the last EU Framework Programme for Research and Innovation, demonstrated the significant impact of collective and coordinated EU investments:

- Horizon 2020 would have required an additional €159 billion to fund all high-quality proposals submitted.
- It is estimated that every euro invested in Horizon 2020 will yield five euros of benefits for EU citizens by 2040.
- The programme is projected to contribute an average annual increase of €15.9 billion to EU GDP, totalling an impressive €429 billion over the period 2014-2040.
- The programme was especially effective in the private for-profit sector, where for every euro of funding, project participants invested an additional €0.57. The greatest financial leverage was seen in European partnerships: in joint undertakings, private partners' contributions (in cash or in-kind) more than doubled or even tripled the volume of EU funding.
- Within the programme, the implementation of collaborative research through the European public-private partnerships allows for the sharing of knowledge, risks and optimising efforts and resources. These are also networks and forums that no single country, entity or a single RD&I actor can provide to companies and their suppliers (See upcoming EARTO Paper on EU Partnerships).

The key role of an EU RD&I investment policy has been acknowledged in the Report from the EC to the European Parliament and the Council - Progress on competitiveness of clean energy technologies: *"To boost the EU's competitiveness, resilience and leadership, it is crucial to ensure that capital keeps flowing to EU companies at the scale needed to accelerate the roll-out of strategic net-zero technologies".*

Such collective RD&I investments need to be reinforced in the next EU budget/MFF, complementing rather than replacing national and private investments (See EARTO-EUA-Science Europe open letter: Investing more in RD&I as a strategic move for Europe's future prosperity). These investments secure funding for medium-term strategic pre-competitive technology development and support the continuity of pan-European industry-led public-private partnerships essential for advancing basic research results to industrially mature technologies.

In addition, the EU Framework Programmes have been particularly important for de-risking early-stage research and helping to overcome scientific and technological challenges. However, there are limited funding instruments available for first-of-a-kind plants which are particularly critical and challenging steps for many projects. Recognising the importance of risk-sharing for the deployment of breakthrough technologies in industry, this gap should be filled by favouring simplifications and synergies between structural funds and sectoral programmes at regional, national and European levels.

2.4. Promoting economic diversification

Boosting the development and diffusion of emerging technologies is essential for the shift towards the next green and digital industrial transitions. The capacity to innovate improves with economic development if governments set the right framework conditions with an effective industrial policy[5]. Europe needs to tackle two main challenges: 1) increasing productivity in established companies which face obstacles to implementing new technology, and 2) increasing the number of new companies entering the market and helping them to grow.

Innovation boosts the revitalisation of existing industries

The digital transformation poses a great challenge for Europe's industry: in 2021, less than 25% of all EU enterprises have reached a high level of digital intensity[6]. As the EC's Report on the State of the Digital Decade 2030 shows, the achievement of the EU's digital transformation is far from assured[7]. The World Economic Forum also estimates that 70% of the new value created over the next ten years will be digitally enabled. In parallel, the manufacturing sector represents 2 million enterprises (out of which 99.2% are SMEs), but only one in five had already used advanced manufacturing solutions in 2016[8].

Enhancing the economic performance and resilience of industry is at the core of RTOs' mission. Accordingly, RTOs conduct applied research and development to support innovation in various sectors and domains. The OECD study on The contribution of RTOs to socio-economic recovery, resilience and transitions highlights the key role of RTOs in fostering economic diversification by providing the central functions:

- RTOs identify and anticipate emerging technologies, trends, and opportunities that can create new markets or disrupt existing ones.
- RTOs collaborate with industry (OEMs and suppliers), and government to develop and transfer innovative solutions that address the challenges and needs of different industrial sectors. They help establish transnational collaborations with industry. Many RTOs have also dedicated in-house technology transfer programmes to that effect. RTOs support industry in their transition management providing and supporting the digitalisation and green transition of the industry itself.
- RTOs provide access to specialised facilities and equipment (so-called research and technology infrastructures), expertise, and networks that enable and accelerate the innovation process by industry. RTOs' operated research & technology infrastructures are most of the time operating with equipment similar, if not identical, to those used by industrial players, which guarantees that the developed processes can be efficiently transferred to industry. There is a broad diversity of available hardware and software infrastructures proposed by European RTOs and all industry sectors de facto benefit from the innovation developed by RTOs thanks to these infrastructures.
- RTOs play a pivotal role in local and regional innovation ecosystems, and in their technological specialisation, by facilitating industry access to RD&I within the proximity of their location.
- RTOs increasingly co-create scientific output in close collaboration with all types of partners, deepening the role as a transversal intermediary organisation and in turn contributing to the development of norms and standards.
- RTOs also provide professional educational and training programmes to industries to help them adapt to new technologies and methodologies.

For specific examples of technology breakthroughs, the annual EARTO Innovation Awards rewards innovations with significant social and/or economic impact produced with a major contribution from an EARTO member. Two categories have been created, the Impact Delivered Award is given to an innovation already in the market and which has proven its impact on Europe's economy and/or society, while the Impact Expected category rewards an innovation that is not yet on the market but has great potential.

Innovation encourages the emergence of new industries: deep-tech start-ups' creation

Deep-tech start-ups are key to Europe's competitiveness and industrial renewal, delivering high socio-economic impact. Contrary to US-type companies, EU-type deep-tech start-ups have a great life expectancy and low rate of failure, as demonstrated by EARTO economic footprint study. However, to deliver such good results, the support that these EU deep-tech start-ups need early on to make innovation investment-ready is much higher, even though they tend to balance out at a later development stage.

RTOs provide essential support for the creation of these deep-tech start-ups. When the innovative technologies developed by RTOs are mature, one of the ways for RTOs to make sure that such technologies can reach the market is to create successful deep-tech start-ups themselves. This often happens when no existing company is willing to take the risks and bear the investments needed to commercialise a new

[5] The Future of Growth Report, World Economic Forum, 2024
[6] Digital Intensity Index (DII), Eurostat, 2021
[7] 2030 Digital Decade, European Commission, 2023
[8] Re-finding industry: Defining innovation, EC, 2017

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technology. These RTOs' spin-offs are based on deep technology: unique, differentiated, and often IP-protected or hard to reproduce. The creation of these start-ups requires four key actors with aligned incentives: 1) a strong and smart team combining both technology experts and entrepreneurs, 2) developing a promising technology with strong IP, 3) a market-oriented approach and potential industrial clients, and 4) smart capital fuelling the whole process.

RTOs' specific in-house support for their spin-offs, often called "tech start-up accelerators", is the key to their success. Such multifaceted support can range from giving access to in-house financial and legal support to staff detachment or running a joint applied R&D programme to accelerate prototypes, minimum viable products or first products, or to support in launching and implementing these companies' business plans. RTOs have strict spin-off policies that leverage the inherent risk of these operations and are oriented at producing investable opportunities for "smart capital" to invest in. Thanks to these internal programmes, RTOs support new entrepreneurs to create business models, produce prototypes, assess IP issues, connect to industry, find seed money, and finally create a spin-off company that transforms innovation into a commercial innovative product.

Existing funding mechanisms and instruments that support research and innovation are not yet fully exploited, especially by VSEs, SMEs, and start-ups, often not mastering the mechanisms very well. The intermediate role of RTOs is essential for these companies, to help them to develop new technologies or bring them to the relevant scales.

More focus should be given to support, and when not yet existing, help RTOs to develop, those very specific deep-tech start-up programmes. There is only limited support today in current EU RD&I policies and instruments via the European Investment Fund (EIF) and the European Innovation Council (EIC) (See EARTO proposals for improving current EU support).

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3. Recommendations

EARTO members would like to hereby present a set of 6 recommendations on how to further boost competitiveness by taking a set of measures to enhance innovation in Europe.

1. Commit to EU RD&I and technological leadership as key drivers of EU competitiveness & economic security

Boost RD&I public investments as key driver for sustainable competitiveness

Committing to EU technological leadership should translate into both developing the needed policies and instruments as well as ensuring proper timely investments are made. Public investments in RD&I are crucial to alleviate market failures, as well as to stimulate private RD&I investments by lowering the risks that such investments represent for industry. Despite the accelerating global technological race, the EU still lags behind its global competitors in terms of public and private investment in RD&I.

First, the EU 3% target of GDP investment in R&D should not be questioned and should rather be increased. In any case, the next Multiannual Financial Framework (MFF) should aim at making it a reality. A concrete roadmap to fulfil such commitment should also be the focus of the upcoming revision of the European Research Area's Policy Agenda by the Council.

Second, EU Programmes with an RD&I focus (i.e. FP10) and targeted industrial programmes (i.e. DEP and EDF 2.0) should receive increased support in the next MFF. For FP10, EARTO, along with other key RD&I stakeholders, has already argued for a €200 billion budget (See EARTO-EUA-Science Europe open letter: Investing more in RD&I as a strategic move for Europe's future prosperity).

Thirdly, EARTO with more than other 100 European Industry Associations also noted that FP10 should focus on excellent cross-border collaborative RD&I, with a strong industrial participation. To do so, the focus on competitiveness must be reinforced in Pillar II, and should similarly be a key driver for activities in Pillar I and Pillar III. Pillar II is the only truly collaborative part of the FP today, breaking silos to promote the flow of knowledge between and within the private and public sectors as well as between basic and applied research. A significant part of FP10's total budget should not only be allocated to Pillar II, with an enhanced focus on European Industrial Competitiveness but the activities in Pillar II must also be driven by strategic EU priorities and clearly defined industrial needs (See Joint Statement for an Ambitious FP10: Investing in Europe's Future Competitiveness through RD&I).

Boost RD&I public investments' quality/impact and improve the regulatory framework to attract & leverage private investments

Continued commitment to RD&I remains crucial for sustaining and advancing the EU's economic prosperity in an increasingly competitive global landscape. The EU especially has a much lower rate of R&D investments from the business sector than its international competitors and thus, incentives for European businesses and industry to invest in renewal through RD&I are needed. Public investments can only be a part of the total RD&I investments, they should aim at leveraging private investments.

The EU needs to ensure effective competition and a functioning single market, which are a key source of innovation. An innovation-friendly regulatory framework drives investments and innovations. This framework significantly influences the innovation performance of businesses and the economy. The challenge in preparing EU legislation is to find the right balance between the precautionary principle and the innovation principle. Innovation challenges traditional regulatory approaches, as governments and the EU struggle to keep pace with rapid technological transformations and to design regulations that are fit for purpose, often transcending administrative and sectoral boundaries. RD&I has a key role in providing foresight and evidence for better regulation and setting standards. Given the complexities of climate change and achieving carbon neutrality, research must be equipped with the necessary tools for observation, analysis and monitoring throughout the design, testing, deployment, or transition phases. Establishing a regulatory framework that encourages innovation and the development of new industrial sectors, while maintaining technology neutrality, is essential.

Today, the industry calls for regulations that are more effective and less burdensome. In this context, to attract extra private investments in Europe, public investments must be seen as high-quality and targeted at precise industrial needs. As an example, forgoing steps further in this direction: in Finland, the Act on Research and Development Funding entered into force on 1 January 2023[9], leading to a significant increase

[9] The national plan to raise R&D funding, State Treasury Republic of Finland, 2022

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in government R&D funding between 2024 and 2030. The Finnish Parliament has committed that the combined level of private and public R&D spending will reach 4% of GDP by 2030. However, this requires private sector R&D spending to account for at least two-thirds of total R&D spending. Encouraging and involving the private sector is at the heart of the implementation of the Act to reach the target of one-euro public R&D funding encouraging two euros private R&D investment.

Higher RD&I spending is not an end in itself but the prerequisite to provide innovative solutions to Europe's most pressing industrial and societal challenges, thereby securing the EU's productivity, competitiveness, and sovereignty for the future. To maximise the benefits of R&D investment at EU level and to increase investments, Europe must promote a comprehensive range of interconnected instruments that facilitate the seamless progression from idea to deployment and provide new insights for future basic research.

2. Better articulate EU RD&I and Industrial Policies: Technology leadership is necessary, but not sufficient alone to ensure competitiveness

Despite growing competition, the EU remains a scientific powerhouse, with 20% of world publications. Low-carbon technologies are a specific strength of the EU, which accounts for 28% of patents worldwide[10]. Indeed, the EU is still lagging behind other regions of the world on ICT patents[11] while a recent study from the European Patent Office and the International Energy Agency shows that the EU is a global leader in patenting of hydrogen technologies[12].

It is the insufficient capacity to translate its research results into commercial innovations that remains a chronic weakness of the EU. As stated in the Science, research and innovation performance of the EU 2022 report by the EC, *"the EU would need to step up commercialisation of its research results. Although the EU is still strong in the production of scientific knowledge, challenges persist in translating scientific results into market products. Firms outside the EU often benefit from the EU's scientific results and successfully commercialise them"*[13].

In recent months, many cleantech European sectors have raised concerns about facing strong competition from third countries. For example, the European Solar Manufacturing Council explains that EU manufacturers are *"competing against heavily subsidized foreign PV module manufacturing — that currently offers modules on the European market at prices below profitability even for these subsidised actors — creating an uneven playing field that ultimately leads to closures and bankruptcies of European companies"*[14]. In the wind sector, the trade deficit with China has grown rapidly since 2019 (€464 million in 2022). Chinese imports, which account for almost 65% of the sector, are priced 20% lower than those from the EU. The EU has recently opened anti-dumping investigations into imports from China concerning heavily subsidised[15] [16]. In parallel, the $370 billion US Inflation Reduction Act (IRA) is creating substantial incentives for cleantech companies to locate their investments in the US. The IRA supports CAPEX and offers a production tax credit over ten years, with clear and simple access conditions.

In this scenario, it will be difficult for the EU industry to compete globally and leverage its technological leadership. This is why any RD&I policy should be strategically aligned with an industrial policy. Efforts to enhance the EU's technological leadership and innovation capacity should therefore be complemented by measures ensuring that these technologies can be translated into industrial deployment by EU firms.

3. Mobilise and strengthen collaborative RD&I and European RTOs capabilities across Europe

The EU produces 20% of the world's scientific output, despite having only 6% of the world's population indicating that the European science system is working well. However, the uptake of RD&I results in the EU remains a challenge. We should continue to prioritise improving the EU's ability to translate scientific discoveries into market and non-commercial solutions, as there is a significant gap between scientific research, innovation, and the market. Compared to other major economies, the EU lags behind in exports and job creation in knowledge-intensive services.

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A critical barrier in this process is the "valley of death", which represents the gap between the development of new solutions and their market adoption. Public-private partnerships, fostering collaborative RD&I, are critical to operationalising strategic links and overcoming this valley.

It is critical to strengthen collaborative applied research actions for long-term competitiveness and to establish trusted networks. Continuity and complementary expertise are of particular importance in long-term network operations. Innovations emerge when applied research works with industry to translate new knowledge into practice. Collaborative applied research funding is vital to support medium to long-term research and development that would be a risky investment for businesses.

EARTO represents more than 350 Research and Technology Organisations (RTOs) from all over Europe and beyond. The core mission of RTOs is to harness science and technology in the service of innovation, to improve quality of life and to build economic competitiveness. They have a public mission, supporting fundamental and close-to-market research, aiming to bridge the gap between basic science and market solutions. They are distinct from universities, whose main mission is education and fundamental research, and from enterprises, which produce goods and services driven by commercial interest. However, RTOs closely collaborate with both, in addition to local, regional and national governments.

As innovative problem-solvers, RTOs are key to what many see as the next production revolution, yielding cheaper and cleaner energy, new methods transforming manufacturing and services, shaping the digital transformation and developing novel responses to social and environmental challenges. As key actors in the European RD&I ecosystem and innovation-driven strategic value chains, RTOs have a prominent role to play in fostering EU competitiveness by supporting EU technological leadership.

RTOs have a high impact in Europe, both from a science and technological perspective, but also in socioeconomic terms. EARTO has commissioned several studies on the impact of RTOs over the years that highlight the significant contributions of RTOs to Europe's competitiveness (See Review of impact assessment studies of RTOs and Economic Footprint of 9 European RTOs in 2015-2016).

Future EU policy developments aimed at boosting competitiveness should 1) further utilise RTOs' capabilities to define further industrial needs for technology development across Europe, and 2) support RTOs in continuously developing and expanding their range of capabilities.

4. Increase and coordinate pan-EU investments in Technology Infrastructures essential to develop and mature technology and to enable industry's uptake

Technology Infrastructures are the backbone of dynamic RD&I ecosystems and stable innovation-driven value chains. These physical or virtual user environments are essential for industry to undertake a system-level testing of entire products, services, or processes in controlled and safe conditions, and validate them to end-user clients and investors. Industry depends on the availability of technology infrastructures for upscaling, prototyping and validating new solutions before they can enter the market.

Industry may own some production facilities: those are typically designed to analyse and develop existing solutions incrementally, and rarely suitable for the development, maturation and testing of new technologies. When developing the readiness of a manufacturing process for a new technology alongside the product itself, it is necessary to enable scaling of production from single demonstrators to small series. This often requires dedicated technology infrastructures, which typically exceed the investment capabilities and operational skills needed by even large industrial stakeholders. Today, funding dedicated to demonstrators targeting green and digital transitions in Europe is often insufficient for such projects.

RTOs have long taken the role of supporting industrial value chains by housing those complex large-scale technology infrastructures, including multi-use research (prototype) and low-rate manufacturing (test & validation) facilities offering technology neutrality that would not be granted when in the hands of, for instance, a technology supplier. Depending on the context, a single technology infrastructure can be used for a wide range of activities: from investigating completely new technology to piloting, but also spin-off incubation, testing changes in existing products, and validating emerging concepts, either with single industry partners (large and small) or together with a consortium of several players. This is essential to manage both the costs and the risks of RD&I investment, making it more accessible to industries of all sizes.

Therefore, to maintain and sustain Europe's technology leadership and innovation capacity, the long-term sustainability of its technology infrastructures must be ensured, with a balanced portfolio of activities and sources of operational income. These technology infrastructures require high-level investments and highly skilled technical staff to be maintained and kept at the forefront of innovation.

Members States and the EC have developed the so-called European Research Area (ERA) Action Plan in which the ERA Action 12 is looking at setting up a new EU strategy on Technology Infrastructures. This

action stemmed from an EC work since 2019: see EC Staff Working Document on Technology Infrastructures and EC JRC report on this topic. Key advances are expected in 2024 in setting up such a new strategy aiming at supporting the elaboration by the EC services of a new Communication on Technology Infrastructures by early 2025. This exercise is viewed as crucial for the RTOs' sector to plan strategically across Europe further investments on their infrastructures based on the needs of our EU industry. EARTO is calling for a specific instrument for Technology Infrastructures under the next EU MFF of €10 billion to support future investments and bring the gap in capabilities compared to Europe's global competitors. Such a specific instrument would encourage the systematic transfer of RD&I results into key EU industrial ecosystems via the development of an appropriate Technology Infrastructure landscape.

5. Boost technology transfer in EU with a more proactive knowledge valorisation policy and a proper legal framework for pre-commercial procurement

More proactive knowledge valorisation policy required

In addition to the availability of Technology Infrastructures, the intellectual property (IP) management strategy is a determining factor in the dynamism of collaboration between private research and industry and innovation. In this respect, the EU and the Member States should adopt stronger measures to encourage the development of intellectual property management strategies in public research organisations.

Such measures, to be adopted and implemented consistently throughout the EU, could be inspired by the US example of the Bayh Dole Act of 1980 for universities and the Stevenson Act of 1980 for federal laboratories. Both have proved their impact in supporting the transfer of knowledge to industry and the dissemination of technological innovation in the United States over the last forty years. They are based on the following principles:

- Public bodies should own the research results they have developed and protect them through patents, which is a major factor of credibility and attractiveness for companies, as well as for start-up creation.
- The transfer to industrial partners should be done through the granting of rights of use tailored to the needs of industry, in the form of operating licences. These licences can be exclusive in a given field of application and for a predefined period of time. To protect the public interest, exclusive licences for a given field must be limited in time and with thresholds to avoid blocking innovation by default of exploitation: below an exploitation threshold (measured by the level of royalties) the exclusiveness is lost. If there is no exploitation, the licence is terminated.
- These exploitation licences granted by public research organisations to companies must be financially compensated.

Using the example of the Bayh Dole Act, Europe should boost its IP policy as well as promote a level playing field for EU vs the rest of the world. Indeed, the Bayh Dole Act and the Stevenson Act of 1980, which govern the conditions of intellectual property in projects funded by the major US federal agencies (DoE, DoD, NASA, NIST, etc.) also contain clauses designed to protect the economic and industrial sovereignty of the US. For example, in the case of exclusive licences by domain, exploitation must take place in the United States and preferably by SMEs (See EARTO Background Note on US Federal Agencies Data Sharing Policies and EARTO Background Note: Shift of US Federal Competition Policy towards Standard Setting Organisations (SSOs)). Accordingly, Europe should aim at creating a level playing field in terms of technology transfer when looking at the existing provisions in other regions of the world[17].

Improved legal framework to pre-commercial procurement needed

In addition, to completely boost its support to tech transfer in Europe, the EU should also boost its pre-commercial procurement (PCP) which is a very effective tool for the development of start-ups. This type of

[17] In China, article 21 of the Law of the People's Republic of China on Progress of Science and Technology of 1st July 2008 states that: *"The State shall encourage the exercise of the intellectual property rights obtained in projects covered by the scientific and technological fund established with government funds, or by scientific and technological plans, within the territory in the first place"*. In the USA, title 35, chapter 18, section 209-b) of the US Code indicates that "*A Federal agency shall normally grant a license under section 207(a)(2) to use or sell any federally owned invention in the United States only to a licensee who agrees that any products embodying the invention or produced through the use of the invention will be manufactured substantially in the United States*".

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public procurement remains largely under-utilised in Europe compared with other parts of the world, despite the efforts made by the EC to promote it. This is mainly due to the separation of innovation procurement into two distinct phases, with two separate calls for tender and therefore with competition between the two phases:

1. The high TRL research and development phase,
2. The manufacturing phase of the corresponding products or services, with re-tendering between the two phases.

While the first phase may be reserved for European stakeholders, the second is widely open to any company including beyond the EU (See EARTO Paper on How to Boost Pre-Commercial Procurement and EARTO Proposals to Leverage the Untapped Opportunities of Public Procurement of R&I in Europe). This is again not the case in other countries such as the United States where, for example, half of the SBIR (Small Business Research and Innovation Act) programmes are used by the major federal programme agencies to make public purchases of innovation for their own needs. Thanks to the interweaving of the Bayh Dole Act and the Small Business Act, large US federal agencies, and more generally US public purchasers, can make these innovation purchases in a single phase and reserve them for SMEs, thus creating intellectual property conditions in line with the above principles when SMEs respond to these public innovation purchases in collaboration with public research. These purchases can then also be reserved for American SMEs, for whom the intellectual property conditions are also more attractive.

Such difference is mainly due to the World Trade Organisation's Government Procurement Agreement (WTO GPA), which requires that open, fair and transparent conditions of competition are ensured in government procurement. However, these rules do not automatically apply in the same way to all procurement activities of all countries. Indeed, the US has succeeded in removing all public procurement of R&I from the WTO GPA (R&I and manufacturing/commercialisation phases) when public procurement of R&I is reserved for SMEs, presumably by linking this to the "Buy America Act" (1933) and the "Small Business Act (1953). Moreover, the US SBIR Policy Directive aims at ensuring that successful products and services developed in the SBIR Programme are purchased by public institutions, ensuring market-creation for the innovative products and subsequent commercialisation by the awardee.

However, the EU has only succeeded in removing the R&I phase from the WTO GPA, but not the manufacturing/commercialisation phase, which is therefore covered by the WTO GPA. As a result of the lack of such derogation, the EC's Communication on PCP (2007) provides for the separation of the pre-commercial procurement phase from the public procurement for the manufacturing/commercialisation phase, with the need to re-compete by tender between the two phases. Besides, the EU RD&I Framework for State aids (2014) details the cumulative conditions which need to be met for PCP not to entail state aid, including the fact that "the procurement does not give any of the participant providers any preferential treatment in the supply of commercial volumes of the final products or services to a public purchaser in the Member State concerned". On this legal basis, neither the EU nor its Member States can design their schemes falling under PCP in such a way that they commit themselves to purchasing the developed products by start-ups/innovative SMEs. This should be rectified in the next WTO negotiations.

6. Support the development of a highly skilled and adaptable workforce: RTOs' role and needs

Ensuring EU technological leadership and industrial technology updates demand a highly skilled and adaptable workforce. For this, Europe will need to use as well as support its RTOs' sector for developing the skills of the future for industry.

Adopting an integrated approach for the development, maturation and dissemination of cutting-edge technologies should include the acquisition of the necessary skills for the deployment of such technologies by industry. Such skills are a prerequisite for a successful industry's uptake of new technologies, especially for SMEs. RTOs deliver first-hand knowledge from industrial reality and play a crucial role in professional education for industrial transformation. These training activities should be integrated as part of Horizon Europe's collaborative projects, beyond the only Marie Skłodowska Curie Actions (MSCA) and accepted as eligible costs of the projects. A pan-European approach to such professional trainings in key industrial sectors would boost the impact of the EU FPs.

Europe needs to develop specific support for the training and transfer of skills from RTOs to industry, which is essential for the uptake of new technologies, especially for the digital transformation of industry.

Closer to the market, the need for specialised and highly skilled personnel and know-how is high in sectors like green tech. RTOs serve as valuable sources of highly skilled and specialised human capital and know-how, crucial for bridging the disciplines necessary to solve societal and industrial challenges. RTOs maintain strong connections with both the academic research world and the close-to-market industrial world,

ensuring their facilities operate across the TRL scale. It is common for RTO employees to hold part-time positions as university professors and co-supervise these projects. RTOs strongly contribute to on-the-job training at the front end of industry's technology needs, supporting the development of T-shaped profile skilled employees capable of co-creating and collaborating across disciplines. This enables applied research to transition into industry innovations. Transfer of heads between RTOs and industry is frequent.

A comprehensive approach to the development, maturation and dissemination of cutting-edge green technologies should also include the acquisition of the necessary skills for the deployment of such green technologies by industry. In this sense, training, upskilling, and re-skilling opportunities for the EU professionals may benefit from access to RTO-hosted labs/technology infrastructures (reaching industry-relevant TRL levels) where the highly skilled personnel from the RTOs may provide those capacity-building activities on immersive environments through realistic *"feel-and-experiment"*-like approaches.

Current EU skills' agendas focus either on academics or on industry, often overlooking the professional training on new technologies provided by RTOs and their role in orchestrating skills developments for academic and industry needs. To further support the EU Green Deal Industrial Plan and Net-Zero Industry Act, skills agendas should be closely linked to existing instruments under Horizon Europe, extending them to cover industry-green tech skilling/reskilling activities. EU mobility programmes like MSCA could target skills development in knowledge and technology transfer for green tech sectors.

RTOs are committed to supporting their own researchers' skills, career paths and working conditions, by offering trainings, skills and competences' development in many areas (e.g. quality aspects, IPRs and standardisation, data management, ethics, research integrity, project management, etc.).

Furthermore, technology plays a key role in reducing the need for highly skilled staff in the marketplace, by enhancing human capabilities through intelligent and adaptable equipment, as understood in the Industry 5.0 concept.

The lack of consistency in the European labour market presents significant hurdles to the mobility of researchers and the posting of workers across EU member states due to varied national regulations and complex administrative procedures caused by EU directives. These obstacles impede the free movement of talent and stifle innovation and research collaboration across the continent. This issue has been raised also at EU level (See EARTO Position Paper on Current Hurdles to Mobility of Researchers).

With this set of recommendations, EARTO members remain ready to further support the European Institutions in defining further EU policies in support of EU competitiveness.

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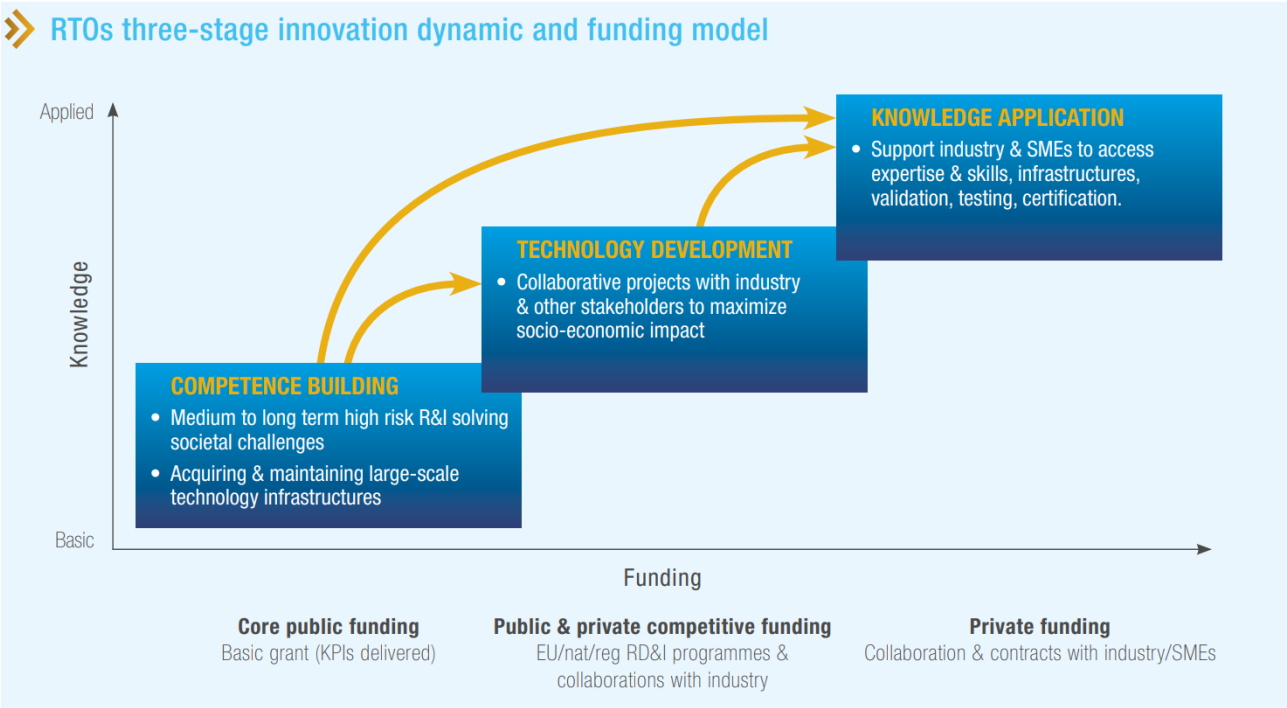
Annex 1 - Grant-based public RD&I funding: key for long-term competence building

The capabilities of European RD&I actors such as RTOs to jointly deliver impact greatly depends on the accessibility of the right funding sources and framework conditions, along all the different steps of the innovation process.

- **RTOs three-stage innovation dynamic and funding model**

RTOs' distinctive mission to harness science and technology in the service of innovation for the benefit of society is further reflected in their three-fold funding scheme, broadly correlated with their three-stage innovation dynamics. Different time spans and target groups imply different budgetary arrangements from different funding sources. Access to adequate finance delivered via appropriate channels is an essential condition of RTOs' successful impact, as it is for industry and academia.



- **Long-term competence building upstream research**

Typically, long-term competence-building upstream research mainly requires long-term stable budgets from public funding sources. For instance, RTOs' long-term competence-building activities are essential for allowing RTOs to perform their strategic roles and are often carried out in close collaboration with universities and academies of science to harvest ideas from basic research done outside of their organisation. This includes strategic high-risk research of medium to long-term duration, in-house competence development, acquisition and maintenance of large-scale technology infrastructures and specialised equipment and platforms.

Depending on each Member State, such core basic public funding is granted to RTOs either unconditionally or upon the fulfilment of a set of Key Performance Indicators. The use of such core funding is generally to be freely managed by the RTO itself. Part of this funding can also be tied to a government mandate to be used for a specific public-oriented mission (e.g. defence, energy). This often explains the differences between the levels of basic funding received by RTOs at national/regional level. Such funding is mostly fixed for several years, which is crucial to enable RTOs to set up long-term strategic plans (incl. investment plans in technology infrastructures) as well as scientific & research roadmaps and strategies.

Sometimes, private companies are interested in participating in such upstream research programme: they can do so via co-funding such activities or by being involved in RTOs' "users' groups" providing directions to RTOs' long-term research programmes.

- **Medium-term high-risk strategic pre-competitive technology development activities**

Strategic public competitive research programmes, mainly targeting key technology and societal challenges, often extend over many years and require a decade or more of programmed work to reach full fruition, having a positive impact on citizens' daily lives. RTOs' pre-competitive technology development activities are typically collaborative research projects and programmes with industry and a variety of other stakeholders. Such technology development is often generic to many possible applications (e.g. key enabling technologies).

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These activities are mostly financed through 1) European/national/regional public competitive research programmes, and 2) collaborative RD&I projects partly funded by industry. These projects are co-funded by RTOs' own funding used as leverage. Such projects provide a medium-term return on investments and often target societal and industrial challenges. RTOs automatically partner with industry and any other stakeholders to maximize the impact and dissemination of research results.

- **Short-term knowledge and technology application activities**

By contrast, knowledge application collaboration between RTOs and industry may last only months. RTOs' knowledge and technology application activities are often short-term either 1) collaborative projects, mostly co-funded by external private funding (or funded 10% plus a margin), or 2) very short term high TRL contract research to provide services such as testing, validation, training (funded 100% full cost plus a margin by the private company). In those projects, RTOs provide short-term added value and foster knowledge co-creation and dissemination to industry.

In those close-to-market applications, RTOs' partners are typically from industry, although partnerships with regulators are not unusual. These activities are a key element of RTOs' business model, where an in-depth understanding of industry's needs and market is key. In this context, "industry" includes large, mid-caps and small companies both based in the RTO's country of origin or abroad. Besides, as RTOs are non-profit organisations, any revenues gained from technology transfer, dissemination and deployment activities are re-employed to fund new innovation cycles and competence building. In addition, RTOs also share the research results with their industrial partners, including IPRs with respect to the value of their contribution and respective interests. RTOs then use such IPRs to increase their own background IP pool, as a means of further technology diffusion, to create new collaborations with other partners in other sectors. RTOs are by their nature spurring knowledge circulation in Europe.

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