Impact of European RTOs | IDEA Consult

Final report – 18 October 2024

Commissioned by EARTO – European Association of Research and Technology Organisations
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EXECUTIVE SUMMARY

The economic footprint of 15 European RTOs in 2021 and 2022

The primary mission of RTOs is to leverage fundamental science to generate knowledge and technology that drive innovation, enhance quality of life, and bolster economic competitiveness, delivering significant benefits to society. Positioned between the public and private sectors, RTOs operate as not-for-profit organizations, reinvesting their revenues into new innovation cycles. Their focus is on applied research, supporting both fundamental and near-market research, with the goal of bridging the gap between basic science and comprehensive market solutions[1]. With their open-innovation business model, one of the core missions of RTOs is to transfer research and technology to the market with high impact for society. It is important to note that this study did not seek to fully evaluate the potential value of the knowledge generated or the technologies developed by RTOs. Rather, the focus was on shedding light on another crucial aspect: the 'economic footprint' left by their business activities in society – an impact that is less known and documented.

This study specifically aimed to highlight the economic footprint resulting from the business activities of 15 European RTOs, all of whom are members of the European Association of Research and Technology Organisations (EARTO). Collectively, these 15 RTOs represented approximately 20% of EARTO's members in terms of employees. By emphasizing this economic dimension, the study offered valuable insights into the broader societal contributions of RTOs beyond their technological and knowledge outputs. Data has been gathered from the following RTOs: AIT (AT), CEA (FR), DTI (DK), Eurecat (ES), imec (BE), INESC TEC (PT), JSI (SI), NIC (SI), RISE (SE), SINTEF (NO), Tecnalia (ES), TNO (NL), Tyndall (IE), VITO (BE), VTT (FI). This group of RTOs represented a mix of smaller and larger organisations across Europe.

In the analysis, we focused on two types of activities that were expected to generate a strong economic impact:

- **The economic leverage of the RTOs' core activities through spending and employment;**
- **The economic leverage of the knowledge transfer through contract research, spin-offs and outflow of staff.**

Although we are well aware of the fact that the total economic footprint of RTOs goes beyond the above-mentioned effects, we have consciously chosen for a conservative estimation of the economic footprint, to avoid double-counting (and thus overestimations). The analysis resulted in objective and robust observations on the economic effect of RTOs on the European economy – results that could be quoted as a lower boundary.

For 2022, the analysis showed that:

- **Around 245 000 jobs (HC) or 230 000 FTEs were created in the European economy that could be linked to the activities of the RTOs included in this footprint, corresponding to a total turnover of around 37.7 billion euro and a total value added of around 16.5 billion euro. The fiscal return added up to around 6.6 billion euro (core activities, contract research, spin-off activities), of which around 3 billion euro stemmed from the RTOs' core activities.**
    - **Core Activities:** almost 122 000 jobs (HC) or 115 000 FTEs in Europe stemmed from the core activities of 15 RTOs, corresponding to a total additional turnover of 18.8 billion euro and a value added of around 8.2 billion[2] euro. This also led to 3 billion euro of fiscal and parafiscal return to governments.
    - **Contract Research:** around 2 billion euro worth of contracts (of which 1.5 billion euro in Europe) resulted in an annual technological value creation of 3 billion euro (directly). This in turn translated into an additional 104 000 jobs (HC) or 99 000 FTEs, a turnover of 16.1 billion euro, and an added value of 7.1 billion euro in the European economy. Furthermore, it resulted in 3.1 billion euro of

[1] EARTO (2021). The position of Research and Technology Organisation (RTOs) in the EU Framework Programmes.

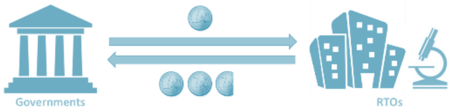
[2] Direct value added is defined as direct revenue, including the operational grant, minus the costs which include the costs for commodities, raw materials, consumables, services. Salaries are not taken into account.

fiscal and parafiscal return to governments. Publicly funded research projects are treated separately in this study as they prioritize foundational knowledge creation and long-term societal and economic growth over immediate government benefits.

- **Spin-off Activities:** 393 deep-tech spin-offs created by the RTOs and active at some point during the period 2021-2022 resulted in almost 19 000 jobs (HC) or 17 000 FTEs, 2.8 billion euro turnover and 1.2 billion euro value added for the European economy. In addition, their activities led to over 0.5 billion euro of fiscal and parafiscal return to governments. Considering all spin-offs whether or not still active in 2021 or 2022 (636), the survival rate in the first year was 98%. On average, the spin-offs of the RTOs were active for 9.7 years before they stopped or merged their activities.

- **For each job in RTOs, almost 5 jobs were created elsewhere in the European economy (on top of the 1 direct job in the RTO)** either at the suppliers of the RTOs and further upstream, or in the broader economy, thanks to the economic activity of the employees of both the RTOs and their suppliers, and especially thanks to the effects of knowledge transfer through contract research and spin-offs.

- The operational grants[3] received by RTOs, were earned back by national governments through fiscal return mechanisms. **For each euro invested in the form of operational grants, more than 2 euro flew back to the national governments.** In other words, 228% of the amount spent on operational grants for RTOs returned to governments through fiscal revenues, which signifies that the investments made by national governments in RTOs are generating additional economic benefits beyond the initial expenditure.



This is a lower boundary to the total economic leverage effect, which would take into account all other types of impact (technological, social, tourism, human capital development, etc.). The figure below summarises the key results from our economic footprint study of 15 RTOs in Europe (with HC=head counts and B€=billion euro).

	Turnover (B€)	Value added (B€)	Employment (FTE)
Direct	8.876	3.605	41 548
Indirect	8.423	3.906	61 883
Induced	1.509	0.710	11 547
Total core	18.808	8.220	114 978
	Corporate tax	VAT revenues	Wage tax & social security contributions
Fiscal return (B€)	0.317	0.582	2 113
= 3.0 billion fiscal return from core activities			
Contract research	16.139	7.054	98 663
Spin-offs activities	2.753	1.204	16 826
Total	37.701	16 478	230 467

= 6.6 billion euro fiscal return from core activities, contract research, and spin-off activities

[3] Operational grants are defined as the revenue received directly from government in the form of (non-competed) block or base funding which can be flexibly used by the RTO.

INTRODUCTION

EARTO is an international non-profit organization that represents the interests of over 350 RTOs in more than 32 countries. EARTO members represents 150 000 of highly-skilled researchers and engineers managing a wide range of technology infrastructures. All scientific fields are covered by EARTO's members and their[4] work range from basic research to new products and services development.

EARTO's mission is:

- *"to promote and defend the interests of RTOs in Europe by reinforcing their profile and position as a key player in the minds of EU decision-makers and by seeking to ensure that European R&D and innovation programs are best attuned to their interests; to provide added-value services to EARTO members to help them to improve their operational practices and business performance as well as to provide them with information and advice to help them make the best use of European R&D and innovation program funding opportunities"*[5]

EARTO defines the RTOs as organisations with the *"core mission is to produce, combine and bridge various types of knowledge, skills and infrastructures to deliver a range of research and development activities in collaboration with public and industrial partners of all sizes."* [6].

RTOs distinguish themselves from universities and enterprises in several ways. Universities primarily focus on knowledge creation and education, driven by a mission to advance scientific understanding and produce educated graduates across various disciplines. Their activities are often funded by public sources, such as government grants and tuition fees, with a strong emphasis on academic research and scientific exploration. Universities often prioritize theoretical advancements and the dissemination of knowledge through academic channels, with less direct involvement in the commercialization of research outcomes[7]. Enterprises are primarily engaged in the production and sale of goods and services. Their main goal is to generate profit by developing, manufacturing, and marketing products. Enterprises typically focus on applied research and development (R&D) that directly supports their business objectives, aiming for innovations that can be quickly commercialized to gain a competitive advantage in the market.

RTOs operate at the intersection of these two domains. Their core mission is to harness science and technology to drive innovation, improve quality of life, and enhance economic competitiveness. They are producers of high quality knowledge which supports industrial innovation[8]. Indeed, unlike universities, RTOs are more focused on applied research and technological development that can be directly transferred to industry. They work closely with different partners, especially small and medium enterprises (SMEs)[9], to translate scientific discoveries into practical applications and market-ready solutions. Moreover, RTOs often engage in bilateral or collaborative projects that bring together academia, industry, and government playing a crucial role in regional research and innovation ecosystems. They *"actively contribute to the European innovation ecosystem by fostering partnerships between academia, RTOs, industry, and government entities. RTOs adopt the results of basic research performed in academia and convert that fundamental knowledge into knowledge that applies to industry, thereby acting as the linking pin in the European innovation ecosystem. Apart from this vertical integration, RTOs also often play a pivotal role in national and regional innovation ecosystems, e.g. by managing regional innovation centers"* [10].

To support EARTO in its mission to reinforce the profile of RTOs in an EU R&I policy environment where data on RTOs from official EU sources is largely lacking and to further support the work done at OECD level in

4 Website EARTO: https://www.earto.eu/about-earto/members/.

5 EARTO (2019). Recommendations for European RD&I policy post-2020.

6 Website EARTO: https://www.earto.eu/about-rtos/.

7 Giannopoulou E., Barlatier P. & Pénin J. (2019). Same but different? Research and technology organizations, universities and the innovation activities of firms, Research Policy, Volume 48, Issue 1: 223-233. ISSN 0048-7333.

8 European Commission (2020). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: A new ERA for Research and Innovation.

9 Larrue P. & Strauka O. (2022). The contribution of RTOs to socio-economic recovery, resilience and transitions. OECD Science, Technology and Industry Policy Papers, No. 129, OECD Publishing, Paris.

10 EARTO (2024). Unlocking Innovation: The Role of RTOs as Intermediaries in Knowledge Valorisation.

NESTI[11], IDEA Consult has estimated the economic footprint of 15 of its RTO members. The first version of RTOs' Economic Footprint was based on data from 2013-2014 and it was published in 2015[12]. A second version was published in 2018, and it was based on data from 2015-2016[13]. This third version is based on data from 2021-2022.

The methodology to measure the economic effect of the RTOs' day-to-day activities was based on the input-output approach, combined with micro-data input from the RTOs on their purchases (upstream effects).

- The advantage was that **direct economic effects** of the RTOs were exact and that the quantification of the **indirect effects** (at the suppliers of the RTOs and further upstream) was based on the RTO-specific data rather than on sector averages. Both elements benefitted the accuracy of our results.
- In addition to the direct and indirect economic effect, also **induced impact** (the effect of additional direct and indirect employment leading to extra consumption in the local economy) and **fiscal return** (the return for the governments via fiscal flows originating from direct, indirect and induced impacts) were calculated.
- Particularly interesting were the **leverage effects** we saw arising from the economic footprint results: what was the additional employment in the European economy that could be related to one person employed at an RTO? If operational grants were received, how many euros flew back to governments for each euro they invested in the (daily operation of) RTOs?

It is important to note that the impact of RTOs' activities may not be immediate. For example, training and developing employees' necessary competences often require several years of investment by the RTO. Consequently, since our data collection spans only two years, this may not fully capture the long-term impact of all the activities undertaken by RTOs.

We further complemented this economic footprint analysis with several indicators on downstream effects: the scientific and technological activities of the RTOs. For this report, we focused on three forms of knowledge transfer and knowledge conversion[14] that typically have a strong economic impact as well:

- **Outflow of staff**: RTOs transfer highly-educated staff to the private sector along with the valuable knowledge and know-how acquired by working within the RTOs, strongly contributing to the availability and absorption of high-value knowledge by companies and their related industries.
- **Contract research**: RTOs carry out contract research in collaboration with their industrial partners, from large companies to SMEs, supporting them to bring technology to the market and increase their competitiveness while creating high impact for society. We complement the assessment of the economic impact of contract research through application of a technology multiplier effect with an additional input-output approach measuring the (monetary) downward effects. The latter is a lower boundary and benchmark to the first.
- **Publicly funded research projects:** RTOs attract each year a significant amount of public funds for research thanks to their scientific focus and available resources (staff, infrastructure). Publicly funded research is considered separately from contract research in this study as it tends to support broader knowledge creation, serving as fundamental investments in research and innovation. These investments are more focused on foundational advancements rather than immediate government benefits, contributing to long-term societal and economic growth.

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11 Galindo-Rueda F. & Van Beuzekom B. (2023). The contribution of R&D specialist institutions to R&D performance: Findings from the NESTI 2022 pilot data collection. OECD Science, Technology and Industry Working Papers, No. 2023/04, OECD Publishing, Paris, https://doi.org/10.1787/d7917b11-en.

12 See "Economic Footprint of 9 RTOs" (2015), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

13 See "Economic Footprint of 9 European RTOs in 2015-2016" (2018), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

14 Another term more recently used to define these types of activities performed by RTOs is knowledge valorisation (see for example: European Commission (2022). Proposal for a COUNCIL RECOMMENDATION on the guiding principles for knowledge valorisation). For consistency with the previous reports, we kept the term "knowledge transfer and knowledge conversion."

- **Spin-off creation**. RTOs nurture and create deep-tech start-ups with great life expectancy and low rate of failure. RTOs' spin-offs have great chances of scaling-up in the deep-tech area, creating new industrial champions in Europe and a high number of high-quality jobs.

It is important to emphasize that while we have supplemented this economic footprint analysis with the indicators on the downstream effects resulting from the RTOs' scientific and technological activities, this study did not aim to fully capture the potential value of the knowledge generated by the RTOs nor the technologies developed based on this knowledge. To fully capture and analyse this broader impact and significance, a dedicated study would be necessary. However, the indicators on the downstream effects resulting from the RTOs' scientific and technological activities helped to highlight the broader and more significant contributions that RTOs can have on society, which may be larger and more impactful than what economic metrics alone could capture[15].

Nonetheless, taken togheter, the quantification of these economic effects should be seen as an important value added in the demonstration of the RTOs' value for the economy and society in Europe.

In the underlying report, we present the methodology and results of the economic footprint of the 15 European RTOs. We first define the scope and outline the methodological framework of the economic footprint in Part 1. Next, we guide the reader through the methodology for the economic footprint (Part 2) and that for the economic valuation of scientific/technological activities (Part 3). In these parts of the report, we also present the detailed results of each step. In Part 4, we synthesise the results and formulate our conclusions.

As we explain in Part 1 on the scope of this study, we are aware that we do not measure the full impact of RTOs in Europe – which would be scientific and technological in the first place. Instead, we focus on the footprint which their activities generate throughout the European economy. To fully grasp the meaning of the results, it is interesting to situate and compare them with results from other existing footprint and impact studies in the field (mainly for universities). In many cases, however, the methodology or parameters applied are responsible for different outcomes and it is important to understand these to the full extent before considering the existing material as a reference or benchmark. We will guide the reader as much as possible in the comparison of our results with these existing studies, throughout the report and summarised in Part 4.

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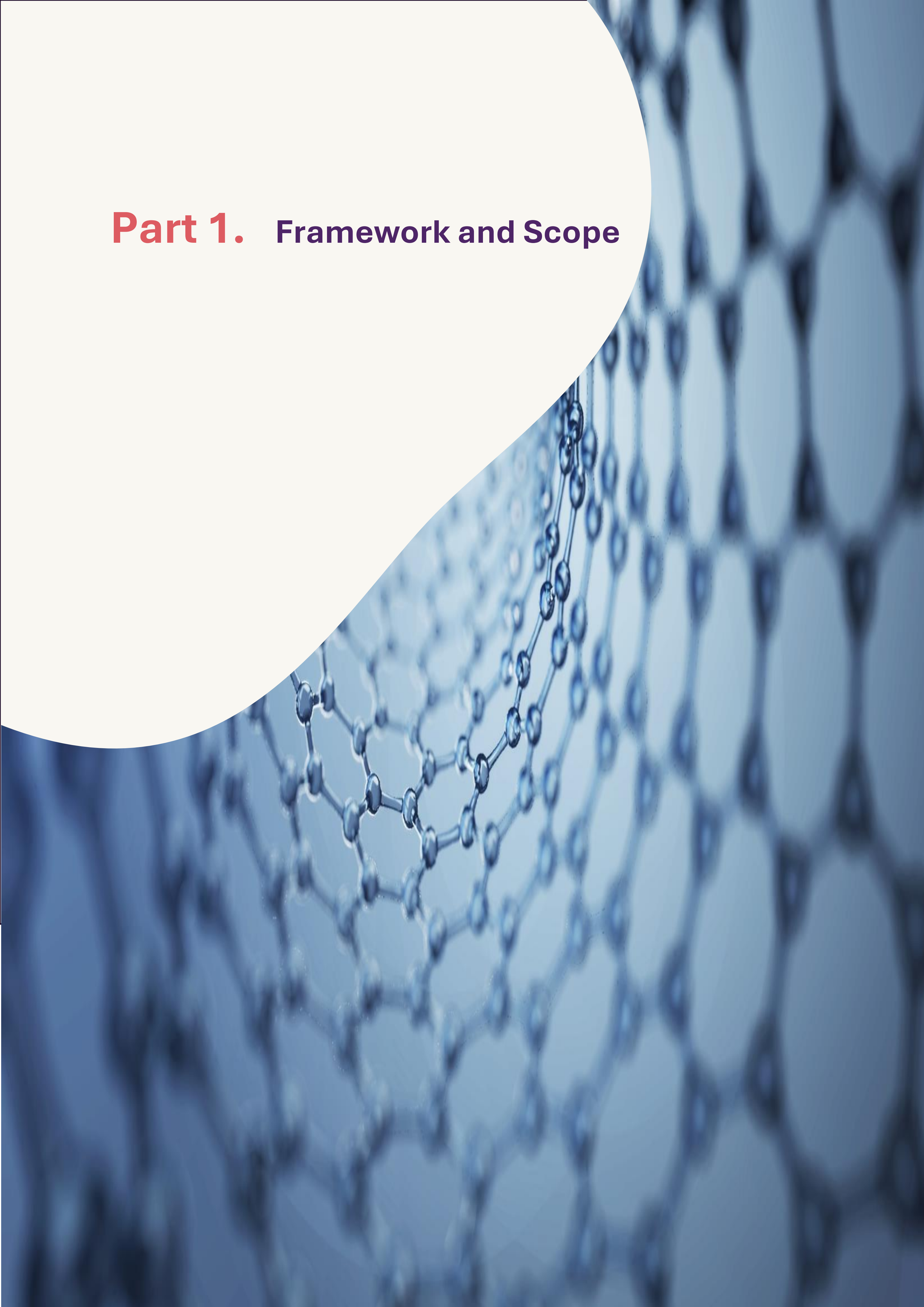
15 Roessner D., Manrique L. & Park J. (2010). The economic impact of engineering research centers: preliminary results of a pilot study. Journal of Technology Transfer, 35, 475–493. https://doi.org/10.1007/s10961-010-9163-x.

Part 1. Framework and Scope



1. Objectives

Despite the general recognition of the relevance and importance of RTOs for the scientific community, companies and society at large, the impact of the RTOs' activities in the European economy or the economic value of technological spillovers to European industry, had not been mapped before 2015. The report "Economic Footprint of 9 European Research and Technology Organisations (RTOs) in 2013-2014"[16] showed this impact for the first time. This report aimed to map the economic footprint of 15 RTOs with 2021-2022 figures and refined it with more detailed data.

Economic impacts are generally defined as the effects of an event, organisation, policy, etc. on the economy in a specific area or region. An economic impact analysis measures the change in economic activity in case an 'event' occurs, compared to the situation where it does not occur (counterfactual). **In this study, we measured the economic effects of the RTOs activities in the European Union, compared to a situation where the RTOs would not exist[17].** Our economic footprint model measured output effects as the total increase in revenues in the economy, based on the costs or supplier invoices of the RTOs.

We have accounted for:

- The economic leverage effects that RTOs have generated via their day-to-day activities and their purchases of goods and services in the European economy
- The economic leverage effects of RTOs as 'senders' of knowledge, in particular through outflow of staff, contract research and spin-off creation. For contract research, we have also included collaborative contract research next to bilateral contract research.

2. Framework

2.1 Dimensions of impact

In the underlying study, we have deliberately chosen not to cover the full spectrum of dimensions of impact. Instead, we concentrated on a detailed analysis of the activities mentioned earlier, which have a significant economic impact. However, to properly contextualize this economic footprint analysis, this section highlights other types of impacts and effects that RTOs can have, which are not measured in this study.

Important to mention in this respect, is that:

- An RTO's mission is not necessarily economic but rather scientific/technological, so the analysis grasped only a specific dimension of their impact.
- Many more dimensions of scientific and societal impact are being realised in the RTOs that one could (try to) translate into economic value, such as cooperation, training, conferences and events, etc.

Without meaning to be exhaustive, Figure 1 below gives an overview of the outputs and impacts that can be expected in relation to the role and objectives of the RTOs and their inputs (labour, supplies, R&D expenditures, social environment)[18]. Many are indeed related to their technological mission, and in particular to the transfer and conversion of knowledge: to have a technological impact in Europe, the results of research are further transferred to relevant knowledge receivers. These receivers gain more in-depth knowledge and apply or modify the knowledge to the specific needs of the economic or social framework, region or company. The following phases can be distinguished in the process from research to innovation/commercialisation:

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16 See "Economic Footprint of 9 RTOs" (2015), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

17 In this, we do not consider the operational grants that would be otherwise saved if the RTO would not exist.

18 Based on previous work by IDEA Consult and a review of existing studies.

1) **Knowledge creation**: knowledge base and know-how built up over the lifetime of the RTO.

2) **Knowledge transformation and knowledge transfer**: transformation and transfer of knowledge through a variety of channels such as research collaborations with both academia and industry, publication, lectures, training, etc.

3) **Knowledge conversion**: reaching a diversity of knowledge receivers, who take up the knowledge and further apply it. For the receivers, the knowledge has a particular value as it entails the potential for innovation in the production process or product design.

Next to the primarily scientific/technological impact of RTOs, the following are also dimensions of the total impact of an RTO:

- Catalytic impact: The presence of RTOs in Europe is an important element in the location and collaboration decisions of many enterprises. RTOs offer a wide range of services to enterprises supporting them in the economic and social valorisation of research and technological advancements. These services help mitigate technological risks more swiftly, advance technologies to higher levels of market readiness, and facilitate user testing. As a result, new technologies, products, and services can reach the market and users more rapidly or be discontinued early if they show insufficient market potential. The attractiveness and specialisation of a region in a specific field, combined with the technological and scientific cooperation of RTOs with both universities and industry, further supports regional (smart) specialisation.
- Human capital impact: Through employment, training and interaction with higher education, RTOs are expected to have a positive impact on the development of research capacity in Europe. Also the mobility of RTOs' personnel to other sectors in the economy, and in particular to industry, is considered as a strong contribution to the European knowledge economy.
- Societal impact: The societal impact refers to the role that an RTO plays in supporting and informing the society at large through education, communication, interaction with the broader public, but also by addressing the societal challenges through research.
- Tourist impact: RTOs organise events, trainings, conferences that attract local but also international visitors to their region, who in turn consume in hotels, restaurants, transport, etc. in the region.
- Economic impact: Through its day-to-day activities, RTOs -as any other organisation- generate employment, value added and turnover. They buy from suppliers in the local (EU) economy, generating also additional turnover at these suppliers, and at these suppliers' suppliers and so on. The activities of RTOs thus also have a purely economic effect.

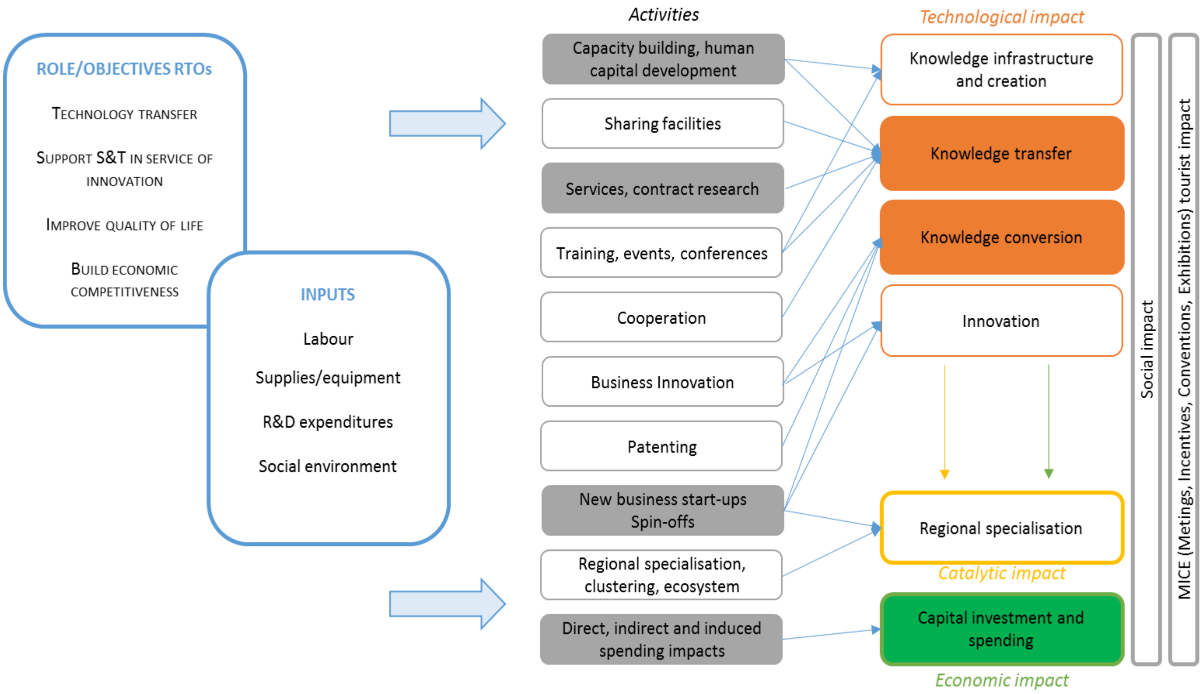
A typical characteristic of these different types of impact, is that they are in constant interaction with each other and consequently create a dynamic process. For example, an excellent reputation in R&D (technological effect) is reflected in the revenues from contract research (economic effect) and will stimulate further collaboration of European industrial and academic partners with the RTO and possibly international investments in the proximity of the RTO (catalytic effect). The presence of foreign top companies (catalytic effect) in turn gives a positive impulse to the knowledge creation process within the RTO (technological effect).

In this study, we have measured the economic footprint for the 15 European RTOs related to those activities in the filled boxes in Figure 1: human capital development (employment, transfer of heads), contract research, spin-offs and spending impacts. Furthermore, the footprint has concentrated on the economic effects of spending and on the economic effects of knowledge transfer and conversion through a selected number of channels. **The focus of this study is thus not on trying to identify the full impact, which would be primarily scientific and/or technological. The focus is on demonstrating the economic value of RTOs in the European economy – a dimension much less known.**

This choice was also a pragmatic one, in the first place to reduce the data requirements put upon individual RTOs. It is also known that the further one moves away from traditional quantitative methods, the more results depend on hypotheses and assumptions and the less robust results turn out to be.

Therefore, our rather 'conservative' approach had the advantage that **it avoided overestimations and results in objective and robust observations on the economic effect of RTOs on the European economy** – results that could be quoted as a lower boundary and replicated.

Figure 1: Logic frame of expected outputs and impacts of RTOs



Source: IDEA Consult

2.2 Economic impact framework

An economic impact analysis measures the change in economic activity in a specific region in case an 'event' occurs, compared to the situation where it does not occur (counterfactual). In this study, **we measured the economic effects of the RTOs activities in the European Union, compared to a situation where the RTOs would not exist**. Building on previous literature on impact analysis[19], our economic footprint model measured output effects as the total increase in revenues in the economy, based on the costs or supplier invoices of the RTOs. The framework is described in the following paragraphs and shown in Figure 2, the methodology is explained step-by-step in Part 2 of this report.

- Via its day-to-day activities, an RTO generates employment and economic added value within Europe. Often, this economic impact is only measured by means of the **direct effect** of the research activities: the employment, value added and output at the organisation itself.

Yet, the total economic impact goes beyond this direct effect. Through upstream relations (with suppliers) and downstream relations (with client-users), an RTO creates an additional economic effect:

- The organisation buys goods and services from EU companies in a series of other industries. This in turn leads to additional employment and additional demand of these EU companies upstream. This expanding impact of an RTO on the economy is what we call its **indirect economic effect.**
- The **induced economic impact** is created through the directly and indirectly created employment. These employees receive a wage higher than the social benefits at unemployment. This additional income is partly spent in the European economy through consumption of goods and services. This spending generates additional upstream turnover and employment at the suppliers' side.
- Each of the above dynamics leads to a form of f**iscal and parafiscal return towards the respective governments** of EU countries where the RTO generates economic effects: the additional employment (direct, indirect and induced) leads to additional social security contributions in different EU countries; the additional production and turnover leads to additional VAT and corporate taxes. We value each of these effects and calculate the multiplier effect of the government grants in the RTOs with respect to this total return. The fiscal multiplier specifically helps to quantify how much economic activity is

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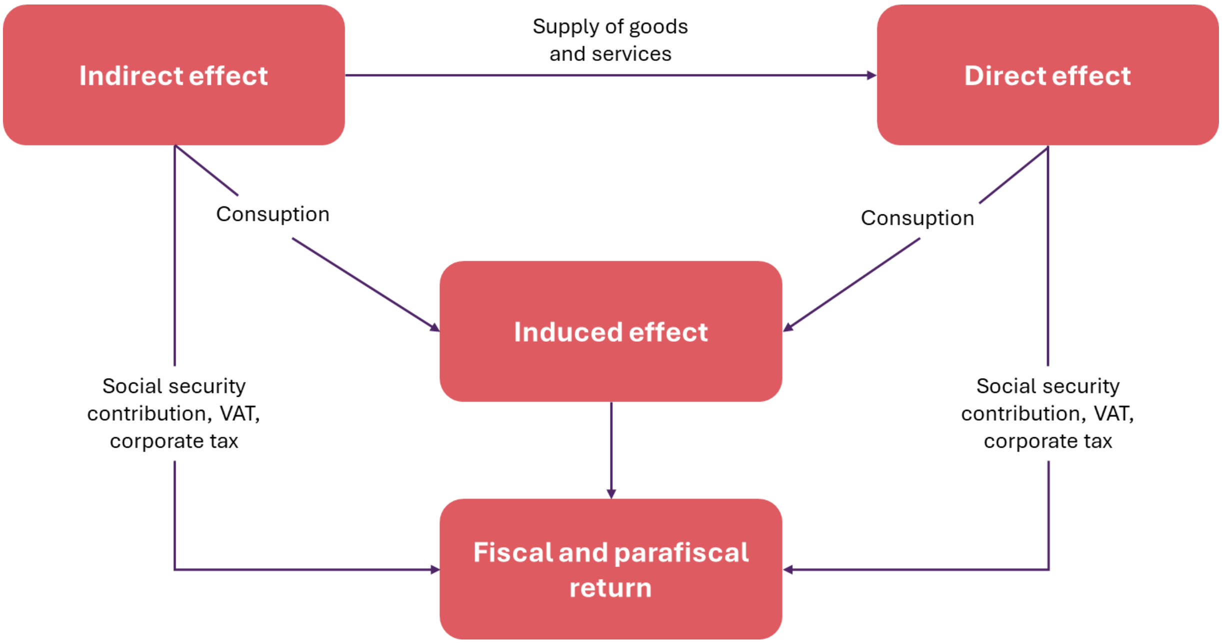
[19] See for example: Hughes David W. (2003). Policy Uses of Economic Multiplier and Impact Analysis. Choices. 2nd Quarter: 25-30, choicesmagazine.org; Miller R.E., and P.D. Blair. (2009). Input-Output Analysis: Foundations and Extensions. Cambridge University Press, 2nd Edition; Swenson D. (2002). An introduction of Economic Impact Assessment

generated per euro of government investment and provides an indication whether the government's investment is effectively recovering its initial cost through increased economic activity.

- Finally, the **technological spillover effects** of the RTO also create an economic leverage effect with its knowledge receivers through the valorisation of the technological knowledge into commercially viable activities. We will include two specific forms of knowledge transfer that typically have a substantial economic effect: contract research and the creation of spin-offs.

Figure 2: Analytical framework for the economic impact assessment



Source: IDEA Consult

3. Scope

3.1 Sample of RTOs

Fifteen of EARTO's member RTOs have participated in this study. Data was gathered from the following RTOs: AIT, CEA, DTI, Eurecat, imec, INESC TEC, JSI, NIC, RISE, SINTEF, Tecnalia, TNO, Tyndall, VITO, VTT (see Table 1). This group of RTOs represents a mix of smaller and larger organisations across Europe operating in various scientific fields. Annex 1 provides more details about RTOs' main activities and fields of operation.

Table 1: RTOs in the scope of the study

RTO	RTO Full name	Country
AIT	Austrian Institute of Technology	Austria
CEA	Commissariat à l'Énergie Atomique et aux Énergies Alternatives	France
DTI	Danish Technological Institute	Denmark
Eurecat	Eurecat, Centre Tecnològic de Catalunya	Spain
imec	Interuniversitair Micro-Elektronica Centrum	Belgium
INESC TEC	Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência	Portugal
JSI	Jožef Stefan Institute	Slovenia
NIC	Kemijski Inštitut	Slovenia
RISE	RISE Research Institutes of Sweden	Sweden
SINTEF	SINTEF	Norway
Tecnalia	Tecnalia Research & Innovation	Spain
TNO	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek	The Netherlands
Tyndall	Tyndall National Institute	Ireland
VITO	Vlaamse Instelling voor Technologisch Onderzoek	Belgium
VTT	VTT Technical Research Centre of Finland Ltd	Finland

Source: IDEA Consult

3.2 Data coverage and quality

The data were collected by the 15 RTOs in the period November 2023 – April 2024. Annex 2 gives an overview of the data requests and availability at the different RTOs.

All RTOs managed to deliver the requested data - if sometimes in a more aggregated form. Where data were more aggregated or not available, we have used a simple extrapolation in order to come to the required level of detail. Examples are extrapolations based on the remaining RTOs' aggregated data (e.g. for bilateral or collaborative contract research) or based on information available in another year or unit (e.g. spin-off employment information in head count or FTE or purchase data for which the sector distribution is only available for national suppliers but not for international suppliers). The number of extrapolations was limited due to a better accuracy of the primary data. More detail on data availability, extrapolations and hypotheses made in the calculations have been provided per indicator in the specific sections.

One important element to consider is that, compared to the previous version of this report[20], the group of RTOs included in this version has substantially changed. As showed in Table 2, 15 RTOs have participated in the current report while only 9 participated in the previous report. The comparability of the results is not straightforward due this change. It should be noted that:

- There is a clear impact on scale and leverage factors since one of the larger RTOs (Fraunhofer) has not participated in this edition.
- The participation of several new RTOs implies a new yet previously unknown impact on the outcomes and leverage factors.

Table 2: Coverage of RTOs in 2015-2016 and in the current study

RTOs in the previous report	Country	RTOs in this report	Country
AIT	Austria	AIT	Austria
CEA	France	CEA	France
DTI	Denmark	DTI	Denmark
imec	Belgium	imec	Belgium
SINTEF	Norway	SINTEF	Norway
Tecnalia	Spain	Tecnalia	Spain
TNO	The Netherlands	TNO	The Netherlands
VTT	Finland	VTT	Finland
Fraunhofer	Germany	Eurecat	Spain
		INESC TEC	Portugal
		JSI	Slovenia
		NIC	Slovenia
		RISE	Sweden
		Tyndall	Ireland
		VITO	Belgium

Source: IDEA Consult

3.3 Points of attention with respect to this footprint study

Important when reading the results is to keep in mind the activities that are included or excluded from the analysis:

1. The analysis focused on the **economic footprint of the core activities** of the RTOs. A list of the coverage and 'definition' of each RTO is provided in section 3 of Part 1 and in Annex 1.

2. Three types of technological activities were included as an illustration of how this type of knowledge transfer activities have generated economic value for the receivers:

    a. **Outflow of staff** from the RTOs: the outflow of highly-qualified staff towards industry contributes strongly to the availability and absorption of highly-valued knowledge enterprises and their related industries. Many of the outflowing employees/researchers go to industry, not rarely taking up positions with high levels of responsibility (management, product development, strategic business

[20] See "Economic Footprint of 9 European RTOs in 2015-2016" (2018), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

development, etc.). As such, very highly-educated people flow from the RTOs to industry, with a high degree of knowhow.

b. **Contract research:** these contracts between the RTO and an individual organisation reflect the value that knowledge or technology have for the organisation (willingness to pay), and we analyse how this value further translates into economic effects. Collaborative contract research is included alongside bilateral contract research.

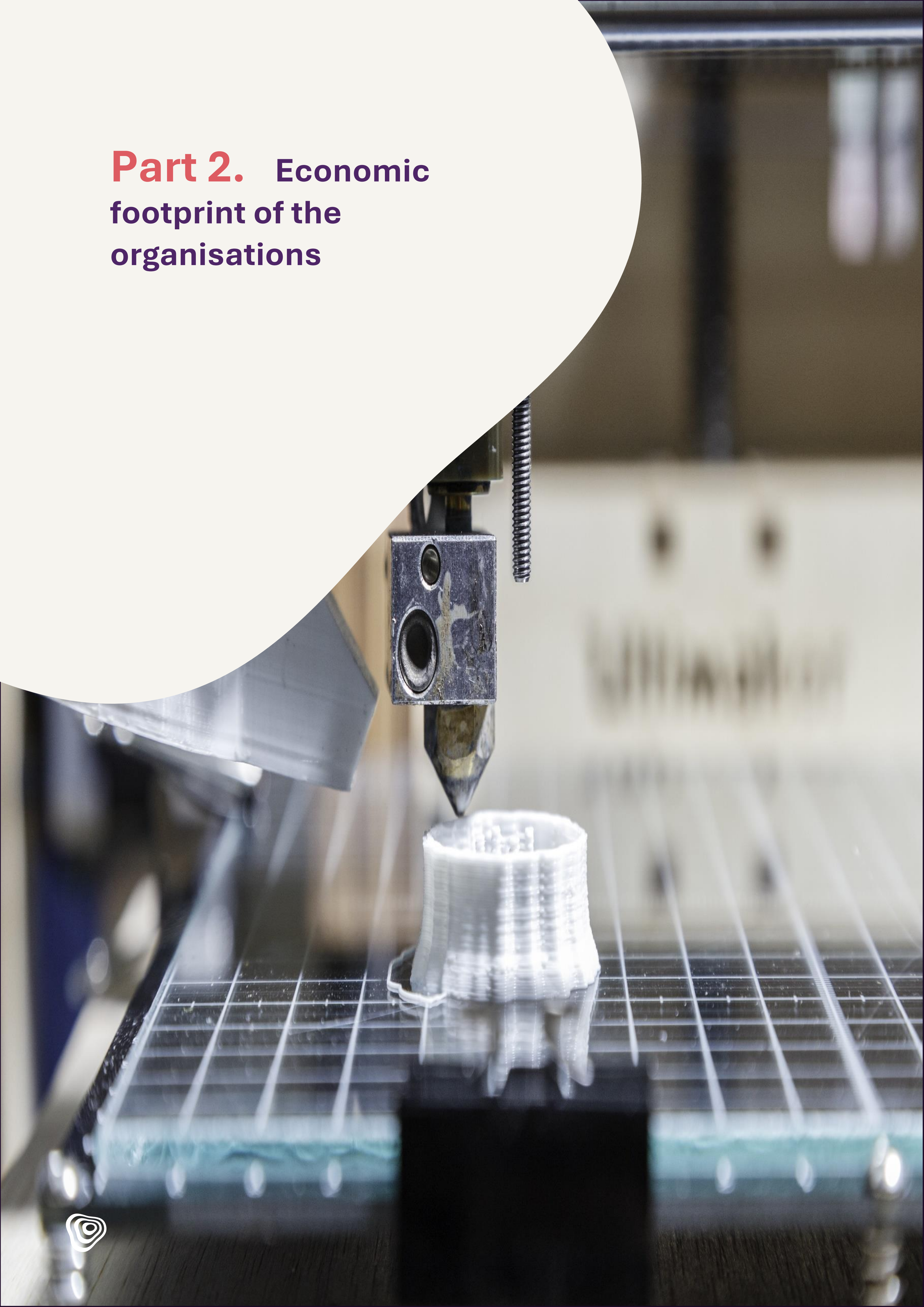
c. The **spin-off activities** of the RTOs. On the one hand, these spin-offs thank their existence to the founding RTO, so their effect is partly attributable to it. On the other hand, they have evolved since their creation and their current impact (in terms of employment, output and value added) is not only and entirely attributable to the RTOs anymore. This impact is influenced by a combination of other factors (e.g. management of the spin-offs, their collaborations with third parties, financial structures, etc.). We therefore cannot simply add the impact of the spin-offs to the footprint of the RTOs' core activities. The economic impact of the spin-offs is thus calculated and analysed, but separately from the RTOs' core activities and as an illustration of the importance of knowledge conversion from an economic point of view.

In geographical terms, this study focused on the footprint of the RTOs in the **EU27 and Norway** (hereafter equally called 'Europe', unless specified differently). Most parameters were only available at EU27 level. In this case, we have applied the same parameter for Norway as for the rest of the EU, assuming that the Norwegian economy and actors have similar patterns as the EU27. Other points of attention are:

1. The direct effect was concentrated in the home countries of the RTOs.
2. The first order indirect effect was measured by means of incoming invoices from all European countries to the RTOs.
3. The higher order indirect effect, at the suppliers of the suppliers, was calculated at an aggregated EU level. This means that the aggregated purchases in Europe (EU27 and Norway) were used as input for the model and the result was the aggregated higher order effect in Europe. Inter-EU flows were accounted for in this model, but imports and exports outside Europe were not.
4. The fiscal and parafiscal return concerned the tax flows to all national governments in Europe from the additional direct, indirect and induced impact in their country.

For further methodological details, we refer to Parts 2 and 3.

Part 2. Economic footprint of the organisations



1. Direct economic effect

1.1 Methodology

The direct economic effect was measured at the level of the RTOs, and it is based on the data delivered by the RTOs, combined with information from the institutes' websites and annual reports. The following data have been used:

- Employment: number of full-time equivalents (FTE) and head counts (HC) on the payroll;
- Employment: number of Science and Technology (S&T) staff on the payroll;
- Employment: number of researchers on the payroll;
- Revenue;
- Costs[21]

Data on the number of full-time equivalents (FTE) and head counts (HC) on the payroll, revenue and costs were available for all 15 RTOs. Data on the number of Science and Technology staff and researcher on the payroll was available for 10 RTOs. Values for the other RTOs have been extrapolated assuming that the ratio between the total number of staff and the number of Science and Technology staff or researcher was similar across RTOs. For each RTO, value added has been calculated by subtracting costs from revenue (including operational grant).

1.2 Results

The direct economic effect of an RTO is defined by its in-house activities: the people it employs and the turnover and added value it creates as an organisation. An RTO has a particular profile in this respect: the majority of the staff is highly-educated and/or works as researcher. Their mission is first to develop scientific and technological activities, not to develop an economic activity as such. Generating a direct economic effect is a derivative of the scientific and technological activities. Figure 3 provides an overview of the direct economic effect of RTOs' activities.

Figure 3: Direct economic effect – overview

Direct revenue

- 8.2 billion euro in 2021 and 8.9 billion euro in 2022

Direct value added

- 3.3 billion euro in 2021 and 3.6 billion euro in 2022

Direct employment

- RTOs employed 42 519 HC (40 268 FTE) in 2021 and 43 986 HC (41 549 FTE) in 2022
- Science and Technology staff accounted for 83% in 2022 (researchers for 70%)

Source: IDEA Consult based on RTO data

[21] Costs include the costs for commodities, raw materials, consumables, services. Salaries are not taken into account.

Each year, the 15 RTOs have generated a total revenue of between 8 and 9 billion euro. This includes the operational grants[22] that the RTOs receive (5.1 billion euro in 2021 and 5.5 billion euro in 2022) and which have been delivered by the RTOs. Excluding the operational grants, the 15 RTOs have generated a revenue of around 3.1 billion euro in 2021 and 3.4 billion euro in 2022. In terms of value added, the RTOs have produced around 3.3 billion euro in 2021 and 3.6 billion euro in 2022.

Table 3: Direct revenue and direct value added (billion euro)

Type	Year	Total
Revenue	2021	8.233
	2022	8.876
Value added	2021	3.305
	2022	3.604

Source: IDEA Consult based on RTO data

The 15 EARTO members have jointly employed 42 519 knowledge workers (HC) or 40 268 FTE in 2021 and 43 986 knowledge workers (HC) or 41 549 FTE in 2022 in Europe[23]. Science and Technology staff accounted for 82% of the total in 2021 and 83% in 2022. Researchers accounted for 66% of the total in 2021 and 70% in 2022.

Figure 4: Direct employment – all, S&T staff, researchers (FTE)

Source: IDEA Consult based on RTO data

22 Operational grants are defined as the revenue received directly from government in the form of (non-competed) block or base funding which can be flexibly used by the RTO.

23 14 RTOs are located in the EU27, one in Norway. All effects thus take place in the EU27 and/or Norway, to which we refer to as 'Europe'.

2. Indirect economic effect

The direct economic effect of the RTOs primarily targets the income side and employment within the RTOs. To generate revenues, RTOs need to purchase goods and services, make investments, and pay wages, which are then partially spent. These activities, in turn, generate employment in other sectors. Employment created at suppliers (and their suppliers) due to the purchases of RTOs is called indirect employment. Employment resulting from wage consumption is called induced effect (see Part 2, section 3).

To estimate the indirect economic impact, we first calculated the output[24], value added, and number of full-time jobs created by RTOs at their own suppliers and service providers in Europe. These are the first-order economic effects, measured through incoming invoices from all European countries to the RTOs. Next, we estimated the higher-order economic effects, including output, value added, and employment further upstream in the value chain at the suppliers' suppliers of the RTOs and even further upstream in the chain.

2.1 Methodology

2.1.1 First order indirect economic effect

Incoming invoices from the RTOs formed the basis for calculating first-order indirect effects. This method offered the advantage of providing more specific multipliers for the relevant RTOs compared to national input-output tables. Essentially, it allowed us to understand how RTOs' purchases were distributed across sectors, eliminating the need to rely on the broader purchase patterns of the NACE sector 72 'Scientific research and development,' which aggregated all companies and organisations that were active in this sector. Although input-output analyses are basically estimates at a sectoral / meso level, it has to be indicated that the accuracy can be significantly improved by capturing the RTO specific outlays, and therefore estimate at least the first round indirect effects in a precise manner.

The purchase data reflected the turnover realized by the RTOs' first tier suppliers. To derive the associated value added and employment, EU sectoral averages for the ratios of "turnover to value added" and "turnover to employment" were used.

It is important to note that the first order indirect effects were based on the products and services invoiced directly to the RTOs. Activities such as taxis, restaurants, or hotels linked to RTO activities (e.g., conferences, training) but not directly paid for by the RTOs, were not included in this analysis. These were related to the tourist effect of RTOs, which was outside the scope of this study (see Part 1, section 2).

- Data

All fifteen RTOs have provided IDEA Consult with a list of purchases based on invoice data. For three RTOs, the sector distribution was not available for the international purchase data and the sector distribution of the national purchase data was applied. For one other RTO, no sector distribution was available, and the overall sector distribution calculated for all RTOs was used.

- Hypotheses for the analysis

The use of EU sectoral averages to translate the first order turnover into employment and value added constituted an approximation. In practice some EU countries (home countries in the first place) received a higher share of the purchases of the RTOs compared to their share in the EU economy, and vice versa.

2.1.2 Higher order indirect economic impact

The expenditures of RTOs at their suppliers lead these suppliers to increase their demand from their own suppliers, creating additional production and employment further up the supply chain. Ideally, this process could be repeated for each supplier, using their incoming invoices to calculate higher-order economic

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[24] I.e., the share of turnover at the suppliers that is attributable to the RTOs invoices.

effects with great accuracy. However, the practicality of this approach diminishes with each successive order of impact.

To calculate the effect further upstream, we have therefore used the latest input-output tables available at Eurostat. In order to calculate the higher order indirect effect, we introduced the RTOs' expenditures as a demand shock in the EU input-output table and derived the corresponding output, employment and value added effects. Based on the estimations of the higher order indirect turnover, we subsequently computed the higher order indirect employment and value added, using the sector ratios identified before (Eurostat).

Since we focused on the 'domestic' effects in the EU, import and export outside the European Union were not considered. However, cross-border purchases patterns within the European Union were considered in calculating the economic impact.

- Data

The starting point was the data on purchases of RTOs at their various suppliers (the first order indirect effect). Subsequently, through the information contained in the input-output tables, the ultimate indirect effects, capturing the effects of spending for suppliers in various rounds could be modelled.

2.1.3 Total indirect economic effect

- Methodology

The first order indirect effects refer to the immediate relations with the RTOs' suppliers. To calculate the first order indirect effect, we considered only those invoices that effectively bring about additional turnover and employment in the European economies. The higher order effects relate to the purchases that the first tier suppliers of the RTOs made at their suppliers. In order to calculate the total indirect economic effect, the first and higher order effects were added up.

2.2 Results

To support their activities, RTOs bought goods and services from companies in a series of other industries. Purchases from the RTOs with European companies amounted to around 4.1 billion euro in 2021 and 4.4 billion euro in 2022. This in turn lead to additional demand, employment, and value added further up the supply chain. This expanding effect on the economy is what we call the indirect economic effect. Figure 5 provides an overview of the impact of this effect.

Figure 5: Indirect economic effect – overview

Indirect turnover

- 8.0 billion euro in 2021 and 8.4 billion euro in 2022

Indirect value added

- 3.7 billion euro in 2021 and 3.9 billion euro in 2022

Indirect employment

- Creation of 61 154 HC jobs (57 915 FTE) in 2021 and 65 515 HC jobs (61 883 FTE) in 2022

Source: IDEA Consult based on RTO data

In consecutive rounds of spending, a total turnover of around 8.0 billion euro in 2021 and of around 8.4 billon euro in 2021 has been generated in the European economy. It can be noted that around half of this indirect turnover was created at the direct suppliers of the RTOs (1st order). The other half was created further up in the value chain. In total, the value added created throughout the economy as a result of the purchases of goods and services by the RTOs amounted to about 3.7 billion euro in 2021 and about 3.9 billion euro in 2022, of which around half has been created at the direct suppliers of the RTOs.

Table 4: Indirect turnover and indirect value added (billion euro)

Type	Year	1° order	higher order	Total
Turnover	2021	4.167	3.808	7.974
	2022	4.408	4.015	8.423
Value added	2021	1.949	1.735	3.684
	2022	2.073	1.832	3.906

Source: IDEA Consult based on RTO data

The total indirect employment created in the European economy through the purchases of the RTOs amounted to 57 915 FTE or 61 154 HC jobs in 2021 and to 61 883 FTE or 65 515 HC jobs in 2022. More than half of the indirect employment creation happened at the direct suppliers of the RTOs (1st order indirect employment effect). 31 228 FTE or 32 974 HC jobs in 2021 and 33 728 FTE or 35 707 HC jobs in 2022 have been created there thanks to the purchases of the RTOs. Another 26 688 FTE or 28 180 HC jobs in 2021 and 28 156 FTE or 29 808 HC jobs in 2022 have been created further upstream in the value chain, with the suppliers of the RTOs' suppliers (higher order indirect employment effect).

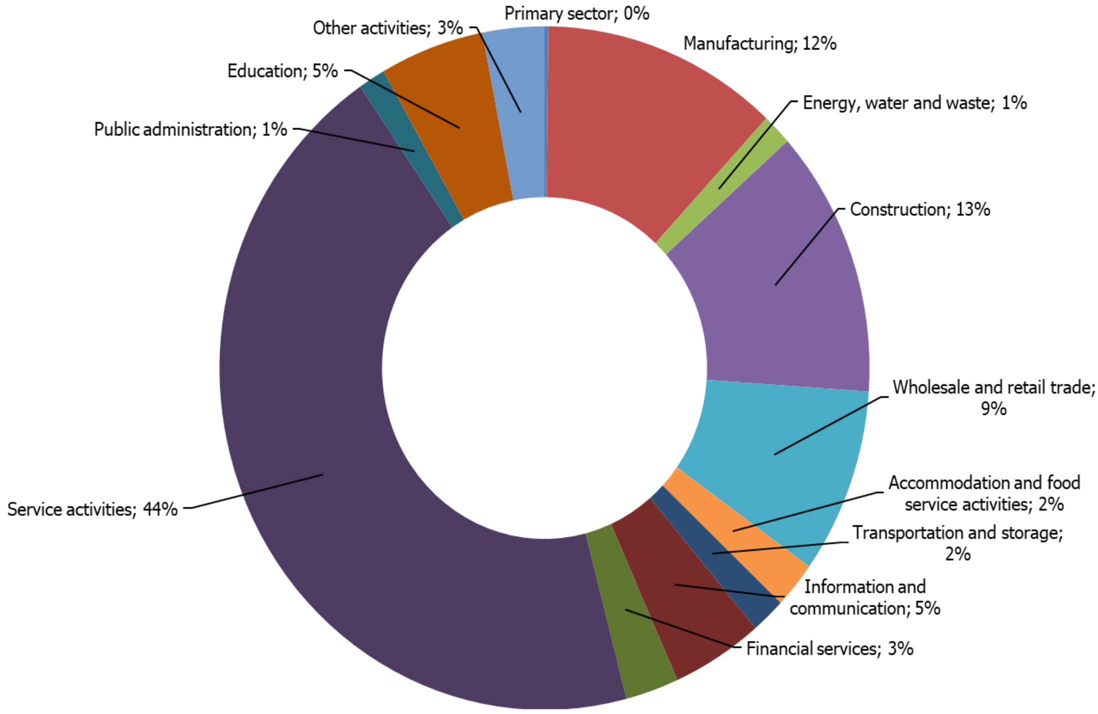
Table 5: Indirect employment (FTE and HC)

Year	1° order		higher order		TOTAL	
	FTE	HC	FTE	HC	FTE	HC
2021	31 228	32 974	26 688	28 180	57 915	61 154
2022	33 728	35 707	28 156	29 808	61 883	65 515

Source: IDEA Consult based on RTO data

As RTOs relied on a broad range of suppliers of goods and services, their activities resulted in the creation of employment across many different sectors. The three main benefitting sectors were the business service sector (44%) consisting of many specialised organisations that support the research activities of the RTOs, the construction sector (13%) taking care of the RTOs' needs for research facilities, and the manufacturing sector (12%) supplying primarily high-tech research equipment. Within the business service sector, division NACE 71 ('Architectural and engineering services; technical testing and analysis services') accounts for 57.6% of the employment generated in this sector or 25.6% of the total employment generated considering all sectors. Other important divisions within the business service sector are NACE 80-82 ('Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services') accounting for 17.8% of the employment generated in the sector or 7.9% of the total employment generated considering all sectors and NACE 78 ('Employment services') accounting for 10.1% of the employment generated in the sector or 4.5% of the total employment generated considering all sectors.

Figure 6: Distribution of indirect employment by sector (2022)



Source: IDEA Consult based on RTO data

3. Induced economic effect

3.1 Methodology

The activities of RTOs generate income for their employees (direct effect), for additional employees at their suppliers (first-order indirect effect), and further upstream in the supply chain (higher-order indirect effect). The spending of this additional income within the economy created a third type of economic effect: the ‘induced effect’.

The total additional wage expenses of households, minus VAT[25], generate additional output across several sectors. Since we lacked detailed insights into how these wages were precisely spent, we estimated the induced value added and induced employment based on economy-wide average ratios of value added to turnover and employment to turnover. An alternative method used a closed model of the EU input-output table. However, this approach has proven unreliable, as it does not account for import leaks, household expenditures outside the EU, and savings, leading to an overestimation of the real impact. Our approach could be considered a conservative estimate, indicating the minimum potential effects.

It is important to remember that we compared the current situation with a scenario where the RTOs were not active. In doing so, we assumed that employees (both direct and indirect) would be unemployed if the RTOs did not exist. The additional impact of an RTO was therefore the difference between employment and unemployment of these employees. We also assumed that the unemployed would receive unemployment benefits, so their income would not drop to zero. Other impact studies in this field assumed that the unemployed have zero income, which resulted in an overestimation of the additional effects of the RTOs. Furthermore, we did not account for the unemployment benefit itself.

- Data

As a starting point, we used figures on direct and indirect employment. These were multiplied by average net wages[26] in the various sectors in the EU where the RTOs create direct and indirect employment. Then, these amounts were multiplied by the average wage-spending quota[27], representing how much of an income is actually spent by a household. Next, the fraction of income spent outside the EU was subtracted to determine the net spending in the EU economy induced by the RTOs' activities[28].

However, not all of these expenses could be attributed to RTO activities. Only the portion resulting from the difference between the average unemployment compensation[29] and the average net wage of the direct and indirect employment could be considered an induced impact of the RTOs. Therefore, the average unemployment compensation was also subtracted from the average net wages.

- Hypotheses for the analysis

Using EU averages for all parameters in calculating the net spending by the employees of RTOs and their suppliers was an approximation due to the unequal geographical distribution of the RTOs in our study across Europe, and the inclusion of a Norwegian RTO. We also assumed that all employees (both direct and indirect) would be unemployed if the RTOs were not active.

3.2 Results

The induced economic effect was created through the RTOs’ directly and indirectly created employment. These direct and indirect employed people received a wage which was higher than an unemployment benefit. They spent part of their additional income in the European economy through consumption of goods

25 Taxation trends in the European Union (2022).

26 Eurostat data for the EU27.

27 Eurostat data. The average domestic wage-spending quota is the percentage of the wage income of a household that is on average spent on the purchase of goods and services from the domestic market (thus not imported).

28 Eurostat data on final consumption expenditures in the EU and abroad.

29 Eurostat data for the EU27.

and services, and in turn this spending generated additional turnover and value added in the European economy.

Figure 7 provides an overview of the induced economic effect generated through the RTOs' directly and indirectly created employment.

Figure 7: Induced economic effect – overview

Induced turnover

- 1.3 billion euro in 2021 and 1.5 billion euro in 2022

Induced value added

- 0.6 billion euro in 2021 and 0.7 billion euro in 2022

Induced employment

- Creation of 10 130 HC jobs (9 594 FTE) in 2021 and 12 225 HC jobs (11 547 FTE) in 2022

Source: IDEA Consult based on RTO data

We remark that the results of other impact studies often did not account for an unemployment benefit but rather assumed a zero income as alternative to working at the RTO, leading to an overestimation of the additional induced effects.

We can therefore not compare the results with other benchmarks or studies. The turnover generated at companies who benefitted from the extra[30] household expenditures from the direct and indirect employees linked to the RTOs, amounted to approximately 1.3 billion euro in 2021 and 1.5 billion euro in 2022. The corresponding value added generated by these companies was around 0.6 billion euro in 2021 and around 0.7 billion euro in 2022.

Table 6: Induced turnover and induced value added (billion euro)

Year	Turnover	Value added
2021	1.280	0.599
2022	1.509	0.710

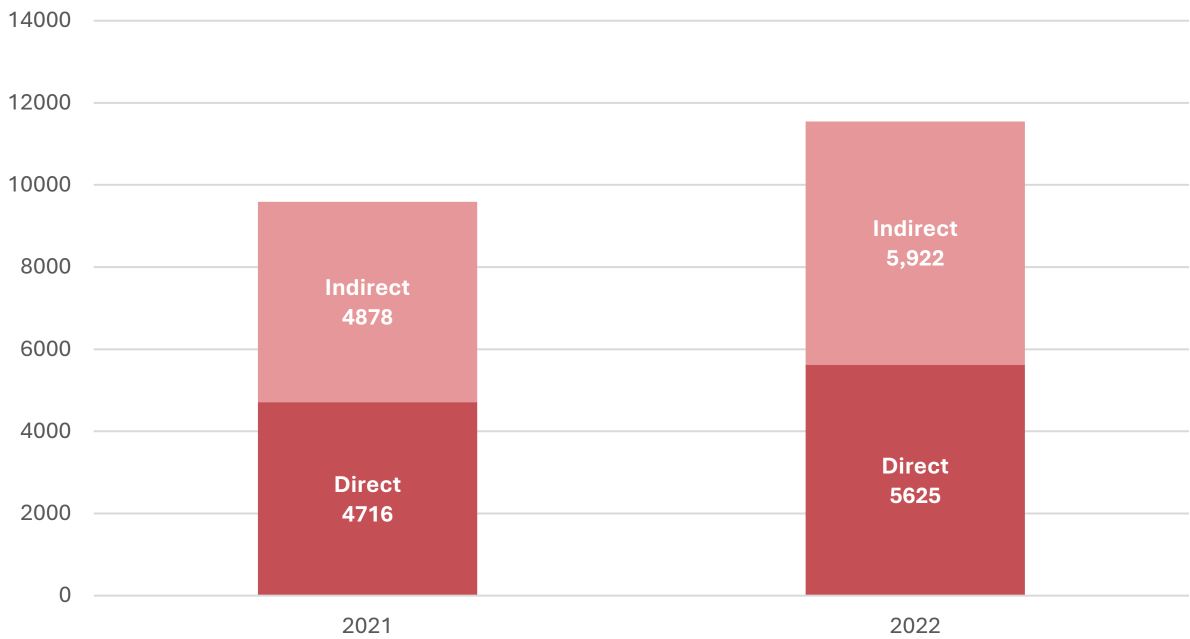
Source: IDEA Consult based on RTO data

The employment generated at the 15 RTOs directly and indirectly at their suppliers, resulted in additional household expenditures in the European economy, which in turn created new employment. In 2021, 9 594 FTE or 10 130 HC jobs existed in Europe as a result of this consumption.

In 2022, these numbers have increased to 11 547 FTE or 12 225 HC jobs. In both years, around half of this induced employment has been generated by the household expenditures of the employees of the RTOs while the rest has been generated by the indirect employees linked to the RTOs' purchases.

30 I.e. on top of what would be consumed if these persons were unemployed and received unemployed benefits.

Figure 8: Induced employment (FTE)



Source: IDEA Consult based on RTO data

4. Fiscal and parafiscal return to national governments in Europe

Based on the direct, indirect and induced effect, it was possible to estimate the fiscal and parafiscal return to the national governments in Europe. This fiscal and parafiscal return was mainly generated through three main channels:

- the additional employment (social security contributions, wage tax);
- the additional output (corporate tax);
- the additional value added (VAT).

The estimation of the fiscal and parafiscal return was based on direct, indirect and induced effect on the employment, output and value added, as outlined in the previous chapters.

We have collected the following financial parameters, necessary to estimate the fiscal and parafiscal return in Europe:

- gross wages and labour tax rates[31] - these were already used for the calculation of induced effects;
- sectoral profitability rates[32] and corporate tax rates[33];
- VAT rates[34].

The average tax rate for the EU27 was applied each time.

4.1 Methodology

4.1.1 Labour taxes

Data on the average implicit tax rate (ITR) on labour for the EU was used[35], which includes the various social security contributions (of both employers and employees) as well as personal income tax. This ITR was applied to gross wages paid by RTOs and suppliers, which was obtained from Eurostat (NACE 2 sectoral level).

In the assessment of fiscal and parafiscal return due to additional employment, we did not account for the potential reduction in unemployment benefits when additional people are employed compared to unemployed.

- Hypotheses for the analysis

As was already indicated earlier, and as also applied to the corporate tax and VAT estimations discussed further on, the use of EU averages was an approximation in the sense that only a subset of EU countries was represented through the fifteen RTOs (among which Norway), and that the countries where most economic effect took place may have different average parameter values than the EU27 as a whole.

4.1.2 Corporate tax (turnover)

Next to the additional employment, a second source of government income comprise the fiscal and parafiscal return from the corporate tax on the additionally created turnover. For each sector, we converted the increase in turnover (direct, indirect and induced turnover creation per country) to profits (using data on gross profitability per sector) and imposed the average EU corporate tax rate on these profits. For the RTOs (the direct effect) as well as sectors NACE 84 'Administration, defense; compulsory social security'

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31 Taxation trends in the European Union (2022) and Eurostat data for EU27.
32 Eurostat data for EU27.
33 Taxation trends in the European Union (2022).
34 Taxation trends in the European Union (2022).
35 Taxation trends in the European Union (2022).

and NACE 85 'Education', a zero profit rate was maintained in line with the mission of the RTOs and of most organisations falling under these two NACE codes.

- Hypotheses for the analysis

As noted earlier, the use of EU average tax rates was an approximation as only a subset of EU countries is covered, who may not have the same average rates as the EU as a whole.

4.1.3 VAT (value added)

A third pillar of the fiscal and parafiscal return to the government was the amount of additional VAT revenues. These VAT revenues were estimated by applying the EU average VAT-rates on the additional value added creation in the EU (calculated as the sum of direct, indirect and induced impact).

- Hypotheses for the analysis

Also here, the use of EU average tax rates was an approximation as only a subset of EU countries is covered, which may not have the same average rates as the EU as a whole.

4.2 Results

The direct, indirect, and induced dynamics in terms of employment, turnover, and value added each resulted in a form of fiscal and parafiscal flow-back to the governments of the European countries where the RTOs generated economic effects. Below, we assessed each of these effects and calculated the multiplier effect of the government grants in the RTOs concerning this total flow-back.

Figure 9 provides an overview of the fiscal and parafiscal return.

Figure 9: Fiscal and parafiscal return – overview

Total effect

- 2.7 billion euro in 2021 and 3.0 billion euro in 2022 flew back to national governments

Components

- 1.8 billion euro in 2021 and 2.1 billion euro in 2022 of social security and income taxes
- 0.3 billion euro each year of corporate taxes
- 0.5 billion euro in 2021 and 0.6 billion euro in 2022 of VAT

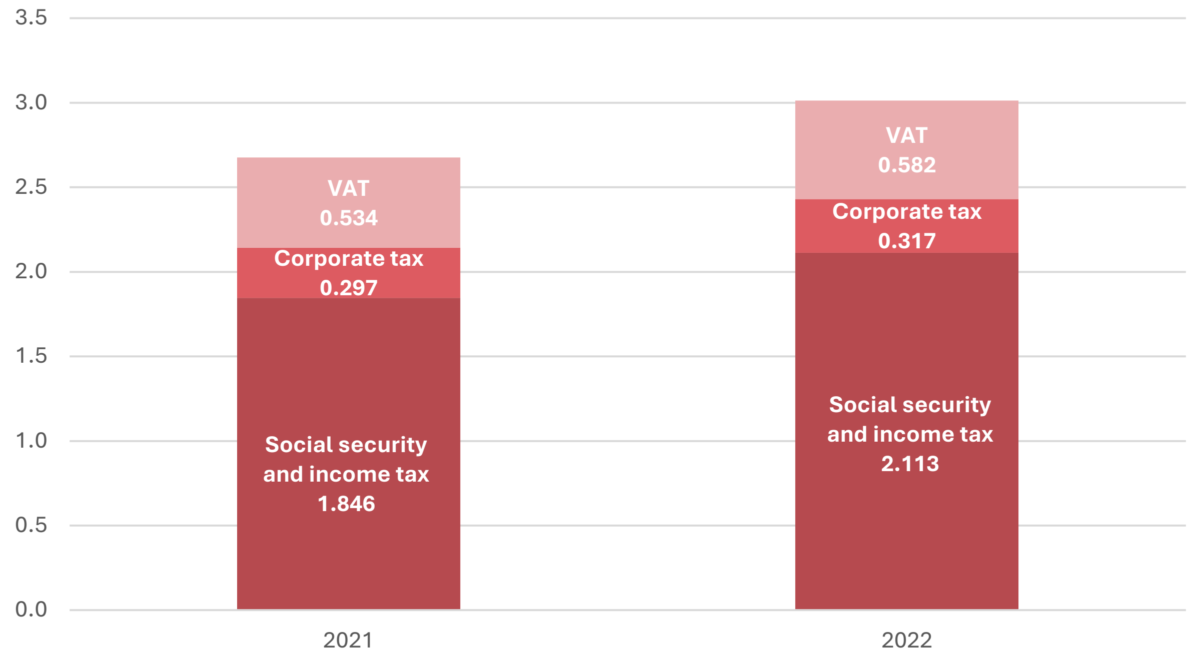
Leverage effect

- Around 100% of government funding for civil research activities at the RTOs returned to national governments through fiscal and parafiscal flows each year

Source: IDEA Consult based on RTO data

The direct, indirect, and induced economic activities generated by the RTOs significantly contributed to fiscal and parafiscal revenues for European governments, totalling around 2.7 billion euro in 2021 and around 3.0 billion euro in 2022. These revenues stemmed from social security and income taxes, VAT, and corporate taxes paid by the RTOs, their suppliers across the value chain, and through the induced effect. The primary component of these revenues were the taxes levied on the income of employees whose jobs are directly or indirectly linked to the RTOs (social security contributions and income taxes).

Figure 10: Fiscal and parafiscal return (billion euro)



Source: IDEA Consult based on RTO data

In total, 1.8 billion euro of fiscal return in 2021 and 2.1 billion euro of fiscal return in 2022 were generated through social security and income taxes. Of this, 0.8 billion euro in 2021 (43%) and 0.9 billion euro in 2022 (42%) were paid by the employees of the RTOs (direct effect), another 0.9 billion euro in 2021 (49%) and 1.0 billion euro in 2022 (49%) were paid by the employees of the suppliers in the value chain (indirect effect) and around 0.1 billion euro in 2021 (7%) and 0.2 billion euro in 2022 (8%) came from employment that was created through extra household expenditures of the direct and indirect employees (induced effect).

The second, relatively minor component of the fiscal revenues were the corporate income tax revenues collected from companies that supplied the RTOs (indirect effect) or its employees (induced effect) with goods and services. This third component amounted to around 0.3 billion euro each year (approximately 11% of the total fiscal return each year). We assumed that the RTOs themselves do not pay any corporate income tax, so the direct corporate income tax was 0. Each year, the corporate income taxes through the indirect effect amounted to around 0.3 billion euro and through the induced effect to around 0.04 billion euro

The third source of fiscal revenue was the value added tax (VAT) originating from the purchase of goods and services by companies and households. The fiscal return from VAT amounted to around 0.5 billion euro in 2021 and around 0.6 billion euro in 2022. The VAT at the level of the RTOs (direct effect) was limited since the operational grants are excluded. In 2021 and 2022, the value added did not exceed the operational grants, so no value added was accounted for in the fiscal return. Most of the VAT revenues were realised through the suppliers in the value chain (indirect effect): approximately 0.4 billion euro each year. The induced effect resulted in a VAT effect of around 0.1 billon euro in 2021 and 0.2 billion euro in 2022.

Table 7: Social security and income taxes, corporate taxes, and value added taxes (billion euro)

Year	Year	Direct	Indirect	Induced	Total
Social security and income taxes	2021	0.803	0.907	0.136	1.846
	2022	0.898	1.038	0.178	2.113
Corporate income taxes	2021	0	0.261	0.036	0.297
	2022	0	0.275	0.043	0.317
Value added taxes	2021	0	0.405	0.129	0.534
	2022	0	0.430	0.153	0.582

Source: IDEA Consult based on RTO data

The operational grants[36] that the RTOs received from national governments, triggered economic activity at both the RTOs as well as indirectly at their suppliers. As a result, a financial flow-back was generated for the national governments in Europe. To quantify this effect, we have thus calculated the fiscal multiplier as the ratio between the total fiscal and parafiscal return and the total operational grants received by the RTOs. The fiscal multiplier specifically helps to quantify how much economic activity is generated per euro of government investment. We have calculated two types of fiscal multipliers: one considering all operational grants that RTOs have received and one excluding the substantial operational grants for defence activities received by CEA. The fiscal leverage including all operational grants was equal to 0.522 in 2021 and 0.551 in 2022. If we exclude the operational grants received by CEA for defense activities, the leverage effect amounted to 1.020 for 2021 and 0.965 in 2022 (Figure 11). This means that for each euro of government funding at the RTOs (through the operational grants), about 1 euro returned to national governments through fiscal and parafiscal flows each year. This indicates that the government's investment is effectively recovering its initial cost through increased economic activity.

Figure 11: Leverage effect (fiscal return per euro operational grant)

Year 2021	Year 2022
1.020	0.965

Source: IDEA Consult based on RTO data

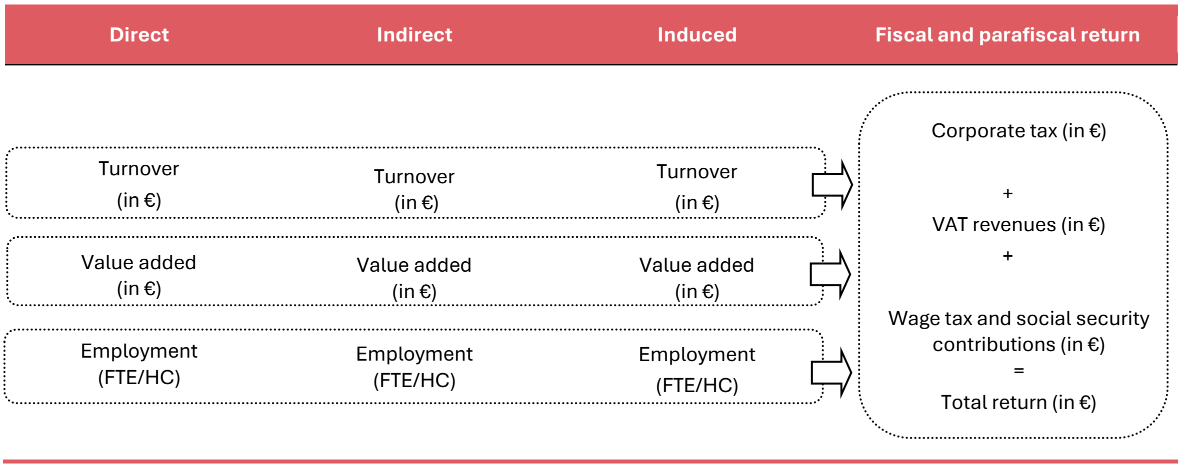
[36] Operational grants are defined as the revenue received directly from government in the form of (non-competed) block or base funding which can be flexibly used by the RTO.

5. Combined economic effects of the organisations

5.1 Methodology

To gain a comprehensive understanding of the economic impact of the RTOs, we have combined the results from the previous four chapters, including direct, indirect, and induced effects, as well as fiscal returns. It is important to note that not all results can be directly aggregated. Figure 12 outlines which components can be methodologically combined.

Figure 12: Overview and add-up of the different economic impact elements



Source: IDEA Consult

We can sum the employment created by the direct, indirect, and induced effects (horizontally). This approach also applies to the realized turnover and value added creation. However, we cannot sum turnover, value added, and employment (vertically) because they represent the same effect in different terms, leading to duplication.

The various components of fiscal and parafiscal return to national governments, generated by the total turnover, employment, and value added creation, can be summed as they represent actual fiscal flows (as shown in the last column of Figure 12).

5.2 Results

Aggregating the individual economic effects created by the 15 RTOs (direct, indirect and induced), results in an estimate of the total effect of the 15 RTOs' activities in the economy as shown in Figure 13.

Figure 13: Combined economic effects - overview

Total turnover

- 17.5 billion euro in 2021 and 18.8 billion euro in 2022

Total value added

- 7.6 billion euro in 2021 and 8.2 billion euro in 2022

Total employment

- 113 803 HC jobs (107 777 FTE) in 2021 and 121 726 HC jobs (114 978 FTE) in 2022

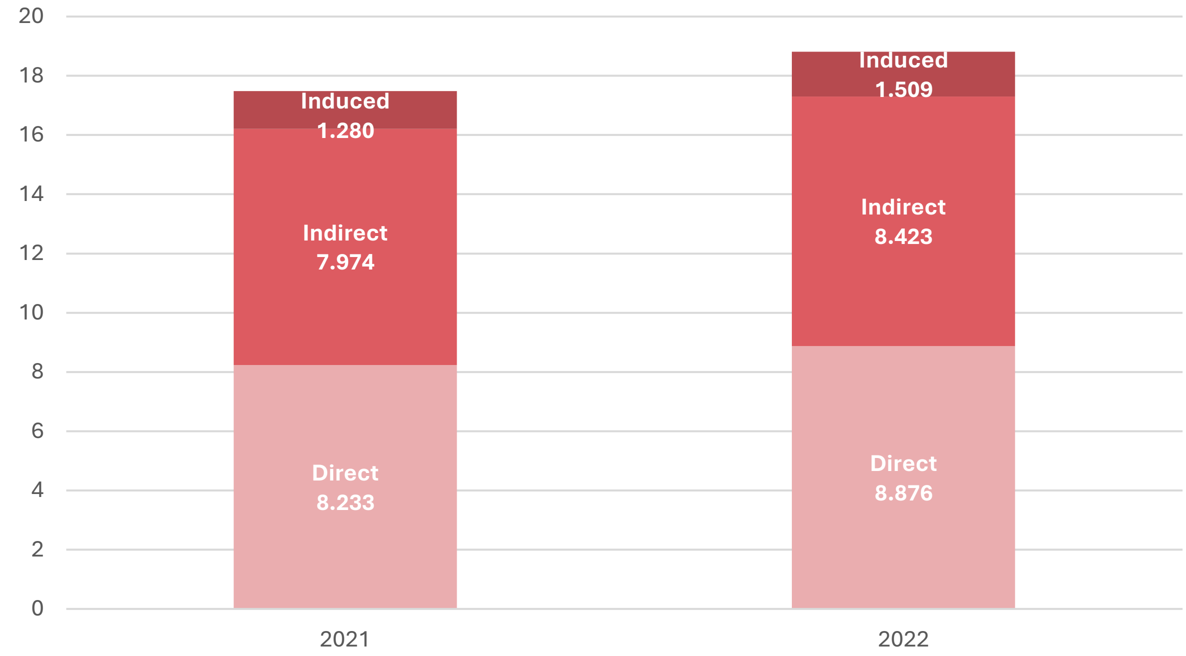
Employment multiplier

- 1.7 jobs in 2021 and 1.8 jobs in 2022 were additionally created as a result of the RTOs' activities

Source: IDEA Consult based on RTO data

Taking together the turnover that was generated directly at the 15 RTOs, indirectly at the suppliers of the RTOs as well as the turnover induced by the consumption purchases of these first two categories, the total turnover created/generated amounted to around 17.5 billion euro in 2021 an around 18.8 billion euro in 2022. A large share of this turnover was generated directly at the RTOs (47% for both years). Indirect turnover accounted for 46% of the total turnover in 2021 and 45% in 2022, while induced turnover accounted for 7% of the total turnover in 2021 and 8% in 2022.

Figure 14: Total turnover (billion euro)

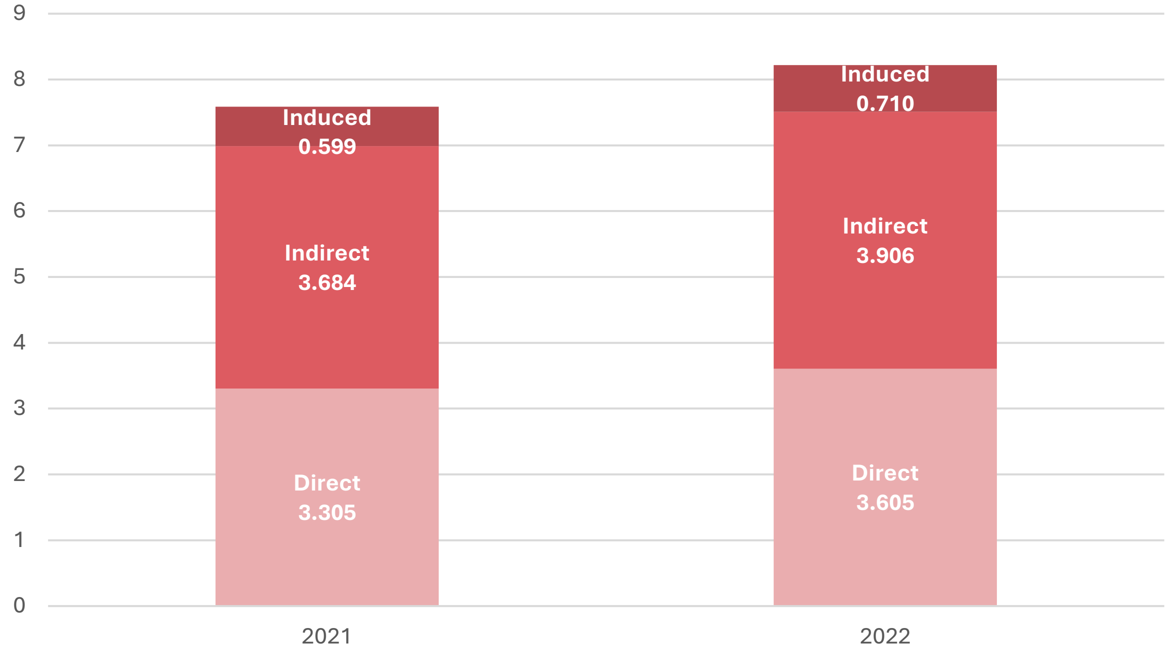


Source: IDEA Consult based on RTO data

Similarly, direct, indirect and induced effects added up to a total value effect of around 7.6 billion euro in 2021 and 8.2 billion euro in 2022 (excluding the operational grants). Direct value added accounted for 44% of the total value added each year.

Indirect value added represented 49% of the total value added in 2021 and 48% in 2022. Finally, the induced value added accounted for a smaller fraction of the total value added (8% in 2021 and 9% in 2022).

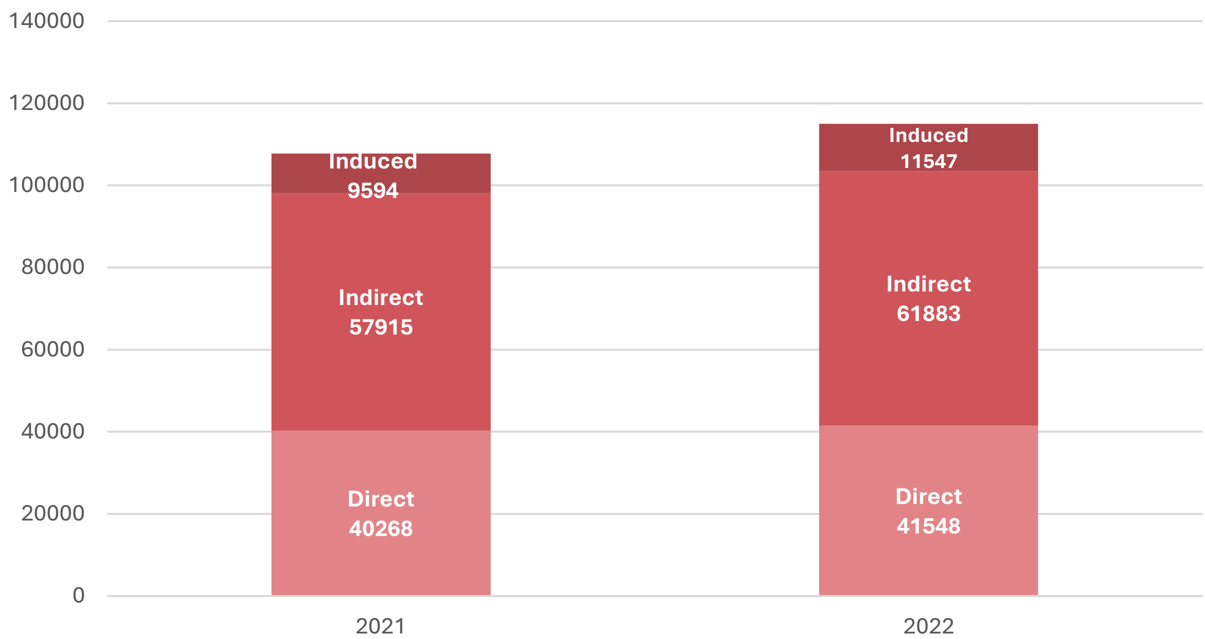
Figure 15: Total value added (billion euro, including operational grant)



Source: IDEA Consult based on RTO data

In terms of employment, the total (direct + indirect + induced) effect of the 15 European RTOs translated into around 107 777 FTE or 113 803 HC jobs in 2021 and around 114 978 FTE or 121 726 HC jobs in 2022. The direct effect represented 37% of the total effect in 2021 and 36% in 2022. Indirect employment accounted for 54% of the total employment in each year, while induced employment accounted for 9% of the total employment in 2021 and 10% in 2022.

Figure 16: Total employment (FTE)



Source: IDEA Consult based on RTO data

To summarize, the results of the 15 RTOs' core activities in 2022 are shown in Table 8.

Table 8: Results from RTOs' core activities in 2022

	TURNOVER (B€)	VALUE ADDED (B€)	EMPLOYMENT (FTE)
Direct	8.876	3.605	41 548
Indirect	8.423	3.906	61 883
Induced	1.509	0.710	11 547
Total core	18.808	8.220	114 978
	Corporate tax	**VAT revenues**	**Wage tax and social security contributions**
Fiscal return (B€)	0.317	0.582	2.113

Source: IDEA Consult based on RTO data

As previously demonstrated, the economic influence of RTOs extended beyond their direct employment. Through indirect and induced effects, the overall employment impact of RTOs more than doubled. We have identified an employment multiplier of 2.7 in 2021 and of 2.8 in 2022 for the core activities of RTOs (Figure 17). This means that for each direct job at an RTO, a total of 2.7 jobs in 2021 and 2.8 jobs in 2022 were associated with the core activities of RTOs, including (of which 1 direct job). Consequently, for every employee working at an RTO, an additional 1.7 jobs in 2021 and 1.8 jobs in 2022 were created elsewhere in the economy, in addition to the direct job within the RTO.

Figure 17: Employment multiplier (direct + indirect + induced employment / direct employment)

Year 2021	Year 2022
2.677	2.767

Source: IDEA Consult based on RTO data

Part 3. Economic footprint of scientific / technological activities

The technological spillover effects of RTOs generate economic leverage by transforming technological knowledge into commercially viable activities for its knowledge recipients. Knowledge transformation and transfer at an RTO encompass various aspects, including industry partnerships and cooperation strategies, shared research and technological facilities, staff outflow, scientific dissemination through publications, presentations, university mandates, supervision of PhD or master's students, academic cooperation, and professional education and training.

This study focused on three specific forms of knowledge transfer that typically have a significant economic impact: staff outflow, contract research, and the creation of spin-offs. Each of these forms substantially affects the economy demonstrating that scientific and technological activities can have positive economic effects on the European economy, even if that is not their primary objective.

1. Knowledge transfer: human capital and outflow of staff

The number and share of Science and Technology staff working in the RTO is a good indication of the knowledge input and absorptive capacity in an RTO. When these employees with a unique combination of knowledge and knowhow leave the RTO to work in another environment, in particular in private industry, they take their knowledge and knowhow with them to apply in their new position. The outflow of highly-qualified staff towards industry contributes strongly to the availability and absorption of highly-valued knowledge enterprises and their related industries. Many of the outflowing employees go to industry, not rarely taking up positions with high levels of responsibility (management, product development, strategic business development, etc.). As such, very highly-educated people flow from the RTOs to industry and their number is an indicator of an important form of knowledge transfer from the RTOs.

1.1 Methodology

One of the most crucial input factors for an RTO is its human research capital. In section 1.2, we reported on direct employment within the 15 RTOs. In this section, we have measured the outflow of staff considering all staff as well as the Science and Technology staff.

- Data

Employment: number of full-time equivalents and head counts on the payroll of the RTO; number of Science and Technology staff; number of researchers. Data on the number of full-time equivalents (FTE) and head counts (HC) on the payroll were available for all 15 RTOs. Data on the number of Science and Technology staff and researcher on the payroll were available for 10 RTOs. Values for the other RTOs have been extrapolated assuming that the ratio between the total number of staff and the number of Science and Technology staff or researcher was similar across RTOs

Outflow of staff: In most RTOs, only aggregate data on the outflow of staff was available, without further specification of the number of Science and Technology staff and/or the destination sector. Nine RTOs distinguished the outflow of staff across different geographical destinations (national, EU, outside EU) and the outflow of staff across different sectoral destinations (private enterprise, public organisation). Overall, there was a large variation across RTOs in the data and data quality. It is therefore necessary to interpret the results carefully. Data for the outflow of staff have been provided in head counts.

- Hypotheses for the analysis

The analysis required no prior hypotheses. When extrapolation was carried out to estimate the total effect of all RTOs based on information of a select number of RTOs, we assumed that the ratios of outflow to private industry and/or abroad were similar in all RTOs.

1.2 Results

Figure 18 provides an overview of RTOs' human capital and the outflow of staff occurred in 2021 and in 2022.

Figure 18: human capital and outflow of staff – overview

Direct employment

- RTOs employed 42 519 HC (40 268 FTE) in 2021 and 43 986 HC (41 549 FTE) in 2022
- Science and Technology staff accounted for 83% in 2022 (researchers for 70%)

Outflow of staff

- 3 000 highly-educated and experienced employees have left the RTOs each year. Around 80% of them are Science and Technology staff

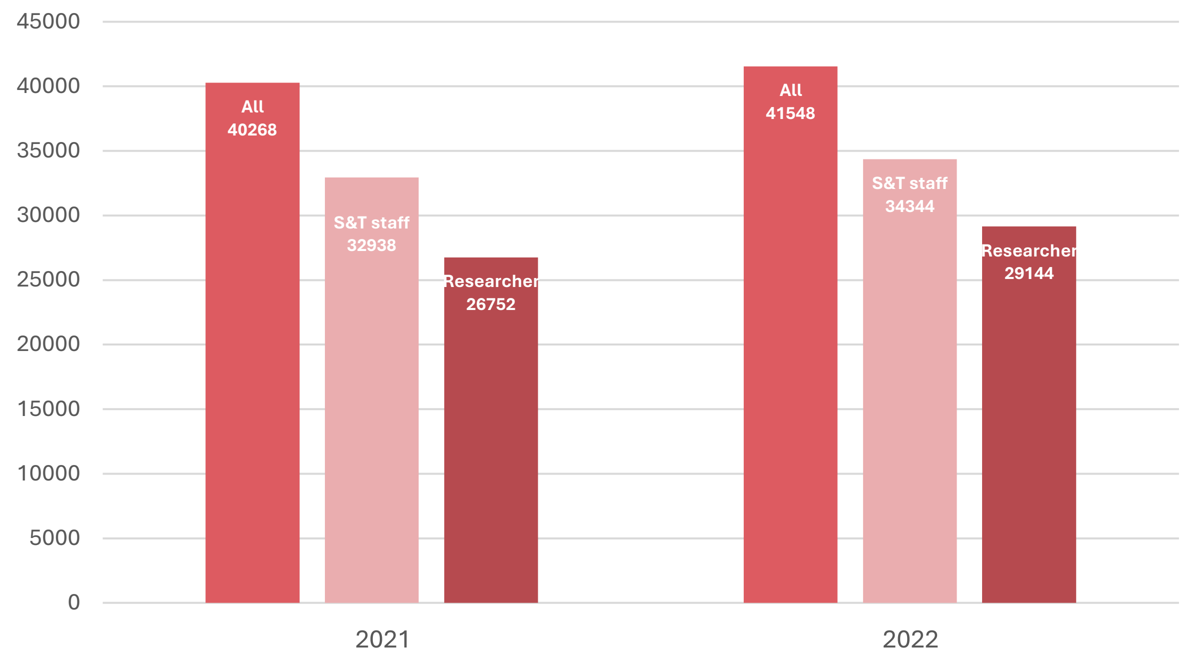
Destination

- 80% of the employees that have left RTOs have remained in the same country of the RTO
- 72% have moved to a private organisation

Source: IDEA Consult based on RTO data

The 15 EARTO members have jointly employed 42 519 knowledge workers (HC) or 40 268 FTE in 2021 and 43 986 knowledge workers (HC) or 41 549 FTE in 2022 in Europe[37]. Science and Technology staff accounted for 82% of the total in 2021 and 83% in 2022. Researchers accounted for 66% of the total in 2021 and 70% in 2022.

Figure 19: Direct employment (FTE)

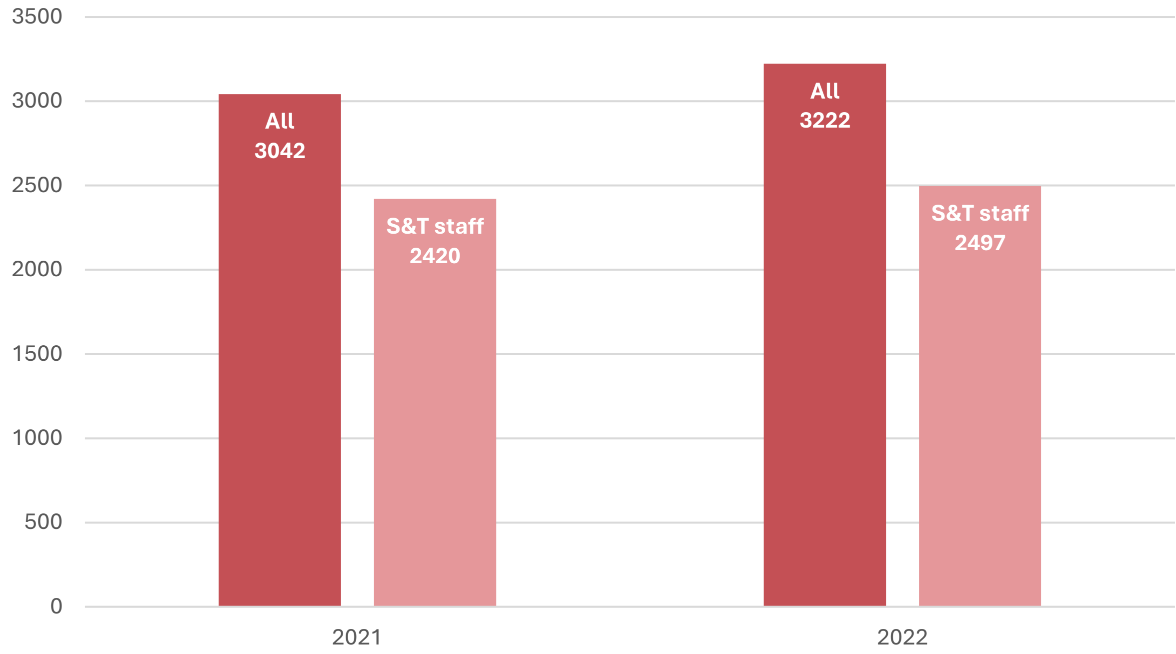


Source: IDEA Consult based on RTO data

[37] 14 RTOs are located in the EU27, one in Norway. All effects thus take place in the EU27 and/or Norway, to which we refer to as 'Europe'.

Over 3 000 highly-educated and experienced employees have left the RTOs each year. Around 80% of them were Science and Technology staff. Even though the results should be interpreted with care, as stated above, it is clear from this first assessment that the mobility effect was substantial.

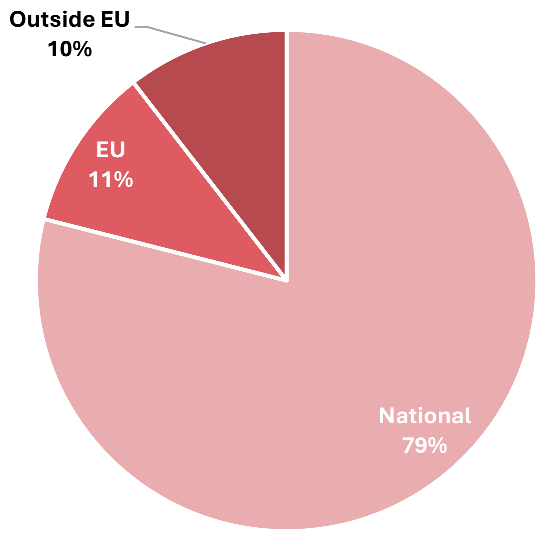
Figure 20: Outflow of staff (HC)



Source: IDEA Consult based on RTO data

For the eight RTOs that distinguished the outflow of staff across different geographical destinations (national, EU, outside EU), over 600 employees remained in the same country of the RTO, over 80 moved to another country within Europe, and over 60 moved outside Europe. An extrapolation for the 15 RTOs in the sample revealed that around 80% of the employees that have left RTOs have remained in the same country of the RTO. The remaining 20% of employees split equally between other countries within Europe and outside Europe. No significant difference could be observed by restring the analysis to Science and Technology staff.

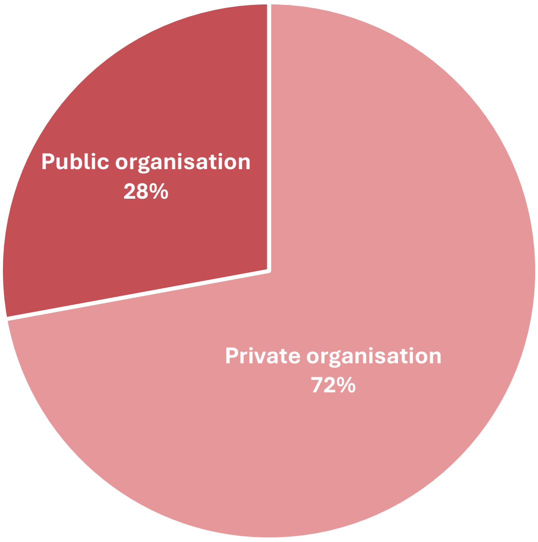
Figure 21: Outflow of all staff – geographical destination (share of HC, 2022)



Source: IDEA Consult based on RTO data

For the eight RTOs that distinguished the outflow of staff across different sectoral destinations (public organisation, private organisation), over 400 employees have moved to the private sector and over 160 moved to a public organisation. An extrapolation for the 15 RTOs in the sample revealed that around 72% of the employees that have left RTOs have moved to a private organisation and the remaining 28% have moved to a public organisation. No significant difference could be observed by restricting the analysis to Science and Technology staff.

Figure 22: Outflow of all staff – sectoral distribution (share of HC, 2022)



Source: IDEA Consult based on RTO data

2. Knowledge transfer: bilateral or collaborative contract research

Knowledge transformation and transfer at an RTO encompass various aspects: industry intimacy and cooperation strategies, sharing of research and technological facilities, staff mobility, dissemination of scientific knowledge through publications and presentations, academic roles such as university mandates and supervision of PhD or master's students, as well as academic cooperation, education, and training.

This study focused on bilateral or collaborative contract research to highlight the economic significance of such knowledge transfer flows. Historically, RTOs have relied on government funding and focused primarily on scientific missions. Today, however, they are increasingly collaborating with firms on research and development, leveraging their expertise to secure private funding through contract research[38]. The interaction between public research institutes and (local) industry significantly enhances the innovative performance and economic development of a region or country. The scale of contract research at an RTO indicates the importance of this targeted knowledge transfer to industry, and the total value of bilateral or collaborative contracts serves as a proxy for the benefit that this knowledge transfer provides to individual companies.

RTOs utilize their knowledge and infrastructure across a wide range of research projects. These include competitively funded public research projects, often in collaboration with other research and industrial partners, as well as specific research topics pursued together with individual public or private organizations through bilateral or multilateral contract research. Both types of projects significantly promote knowledge transfer.

2.1 Methodology

2.1.1 Publicly funded research projects

Publicly funded research projects were measured directly at the RTOs. The total scale of the funding provides an indication of the importance of this kind of research, and a reflection of the research efforts delivered in these projects.

- Data
    - Total amount of government funded research per year
    - Divided by type of projects: national or subnational, European (Horizon 2020, Horizon Europe, other EU), and other international

Data were available for all 15 RTOs.

- Hypotheses for the analysis

The analysis required no prior hypotheses.

2.1.2 Bilateral or collaborative contract research

Bilateral or collaborative contract research was directly measured at the RTOs. Similar to publicly funded research, the total volume of contracts indicates the significance of this type of research. The amount a company or organization is willing to pay for the research reflects the value of the knowledge to the recipient. This indicator was based on data provided by the RTOs.

It is important to note that VAT from contract research was not included here, as it has already been accounted for in the direct effects of the RTOs and their total value added, as reported in section 1.2 of Part2. Including it again would result in double counting.

[38] Suominen A., Kauppinen H. & Hyytinen K. (2021). 'Gold', 'Ribbon' or 'Puzzle': What motivates researchers to work in Research and Technology Organizations, Technological Forecasting and Social Change, Volume 170, 120882, ISSN 0040-1625.

- Data
  - Total amount of contract research per year
  - Distributed by country of receiver and by sector of receiver (NACE2)

- Hypotheses for the analysis

All fifteen RTOs have provided IDEA Consult with a list of bilateral or collaborative research contracts. For one RTOs, the sector distribution was not available for the international contract research and the sector distribution of the national contract research data was applied. For two other RTO, no sector distribution was available, hence the overall sector distribution calculated for all RTOs was used.

2.1.3 Value of knowledge transfer through contract research

Assessing the value of knowledge transfer is complex due to the implicit nature of 'knowledge'. Two key elements are particularly important:

- Measuring the 'deployment' and transfer of know-how/technology.
- Assessing the 'value' of this deployment.

Measuring knowledge deployment and its value requires considering the perspective of the knowledge user, who needs to attribute value to the transferred knowledge. We briefly refer to three different methodologies for measuring deployment:

- Technology flows measured by patent data: This method uses technology flow matrices based on patent classifications according to the industry/sector of origin and adoption to identify R&D flows. Patents are considered carriers of technological knowledge.
- Surveys of new technology use: These surveys measure the rate of adoption of new technologies, providing a snapshot of the technologies industries use at a particular point in time.
- Technology flows based on input-output (I-O) matrices: This method uses transactions across sectors for intermediate and investment goods to reflect R&D efforts.

In this study, we focused on contract research as form of knowledge deployment and the contract amounts as value appropriated to the transferred knowledge by the users. While this measure can help capture the economic value of such activities, it is important to recognize that RTOs have a broader impact resulting from the knowledge they can generate and the technologies that can be developed based on this knowledge[39]. The broader impact of RTOs through knowledge generation and technology development is certainly significant and it thus would warrant a study of its own.

Several methodologies are available for measuring the value of knowledge transfer. However, the empirical literature most commonly refers to a method based on the input-output approach using the 'technology multiplier'. This method was applied by Papaconstantinou et al. (1996) for 10 OECD countries and later refined, extended, and updated by Knell (2008) for 25 European countries, the United States, and Japan[40]. These studies rely on OECD data (input-output database and ANBERD database).

The technology multiplier indicates the relationship between total technology intensity and R&D intensity, or more specifically, between total embodied R&D and intramural R&D, considering both direct and indirect technology deployment in the region. The most recent estimate for the technology multiplier in the Eurozone is 1.98. This implies that for each euro of intramural R&D expenditure in the Eurozone, 1.98 euros of embodied technology is generated.

We used the above-mentioned technology multiplier to assess the value of the knowledge transfer of the RTOs through contract research. We applied the technology multiplier of the EU to all contracts as an average value for all involved countries (primarily the home countries of the RTOs, but also other EU countries as recipients) and aggregated the effects to estimate the total economic value created through technology transfer by RTOs. This multiplier methodology was developed at the country level, not the

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39 Roessner D., Manrique L. & Park J. (2010). The economic impact of engineering research centers: preliminary results of a pilot study. Journal of Technology Transfer, 35, 475–493. https://doi.org/10.1007/s10961-010-9163-x.

40 Knell (2008) is based on the methodology described in Papaconstantinou et al. (1996) but additionally accounts for potential duplications as described in Hauknes and Knell (2006). The study is in other words a refinement of the methodology of Papaconstantinou et al. (1996).

institutional level. Therefore, applying this multiplier to the technology transfer of an RTO yielded results that should be viewed as illustrative rather than definitive. The value of the multiplier has been validated in a workshop with RTOs and in an interview with an external expert, Magnus Gulbrandsen (Professor at the TIK Center for Technology, Innovation and Culture, Norway) during the previous version of this study[41]. The conclusion of that process was that the use of the value 1.98 remained justified and was considered a 'careful' estimate.

- Data

We started from the contract research revenues of the RTOs. These revenues could be considered as an indication of the willingness to pay of enterprises for access to the R&D of the RTOs. In line with the results of Knell (2008) we applied the multiplier of 1.98 for the EU to calculate the value of the technology transfer through contract research. We benchmarked the results with an analysis of the downstream interactions in input-output tables.

- Hypotheses for the analysis

Three assumptions are important to bear in mind:

  - The fact that the multiplier has been developed at country level.
  - The multiplier is not regularly updated (also due to the delays in availability of input-output tables) so applying it assumes that we do not expect large changes in the multiplier over time, in particular in recent years.
  - The use of one technology multiplier for the entire EU, while the main receivers are located in the home countries of the RTOs (Belgium, Denmark, Finland, France, Germany, The Netherlands, Norway, Spain, Sweden) and thus concentrated in Western and Northern Europe. In most of these countries, one might expect a higher technology multiplier thanks to a higher technology intensity.

2.1.4 Economic impact of the technological knowledge transfer

Knowledge transfer has an important economic value for the receiver. Furthermore, it generates in turn additional economic effects by filtering through of direct effects to suppliers and consumers (upstream). Estimating these economic effects demonstrates the importance of the technological knowledge transfer also from an economic point of view.

In our framework, the value of the technology transfer corresponded to the direct value added created by the contract research. This direct value added was then further translated into turnover and employment and finally into estimations of the indirect and induced effects. For this, the specific economic ratios calculated for the RTOs in the detailed economic analysis were applied:

  - Direct turnover knowledge transfer = direct value added knowledge transfer * (direct revenue RTOs/direct value added RTOs)
  - Direct FTE knowledge transfer = direct value added knowledge transfer * (direct FTE RTOs/direct value added RTOs)
  - For the three units (employment, turnover and value added):
    - Indirect effect knowledge transfer = direct effect knowledge transfer * (indirect effect RTOs/direct effect RTOs)
    - Induced effect knowledge transfer = (direct + indirect) effect knowledge transfer * [induced effect RTOs/ (direct + indirect) effect RTOs]

The effects based on this approach were further triangulated with an analysis of downstream interactions according to input-output tables. It is important to note that the input-output analysis captured only the monetary value of the research contracts; therefore, not the discounted present value of future potential unknown income streams that were due to the knowledge produced, the scientific value, environmental value, and societal benefits. The results of this analysis thus benchmarked the results of the technology multiplier based on Knell (2008).

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[41] See "Economic Footprint of 9 European RTOs in 2015-2016" (2018), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

- Data

The estimation of the value of contract research was available from the previous step. To calculate the direct turnover and value added, and to estimate the indirect and induced impact, the specific economic ratios of the RTOs were applied.

- Hypotheses for the analysis

By applying the RTO specific ratios, we assumed that the effects of knowledge transfer had similar upwards spillover effects as the RTO core activities. We thus assumed that the purchasing pattern of the receivers of the knowledge transfer and the profile of their employees (average wage and spending) were similar to the purchasing pattern and the profile of employees at the RTO.

For the implementation of the downstream input-output calculations, the underlying hypothesis was one of an economy with an excess demand (supply shortage). While this is a strong hypothesis for most of the sectors, for R&D this hypothesis is quite plausible as production is more knowledge & technology driven.

2.1.5 Fiscal return of the technological knowledge transfer

To calculate the fiscal return through the economic impact of the technological knowledge transfer, each type of impact is translated to its specific fiscal return, i.e. turnover to corporate taxes, value added to VAT, employment to social security contributions and wage taxes. For this, the specific fiscal return ratios calculated for the RTOs were applied:

  - Fiscal return from turnover knowledge transfer = turnover knowledge transfer * (fiscal return from turnover RTOs/total turnover RTOs)
  - Fiscal return from value added knowledge transfer = value added knowledge transfer * (fiscal return from value added RTOs/total value added RTOs)
  - Fiscal return from employment knowledge transfer = employment knowledge transfer * (fiscal return from employment RTOs/total employment RTOs)

- Data

The estimation of the economic effects of contract research was available from the previous step. To calculate the fiscal return stemming from each type of impact, the specific ratios of the RTOs were applied.

- Hypotheses for the analysis

By applying the RTO specific ratios, we assumed that the effects of knowledge transfer have similar fiscal returns mechanisms as the RTO core activities.

2.2 Results

Figure 23 provides an overview of the effect of contract research conducted by the RTOs in our sample.

Figure 23: Bilateral or collaborative contract research – overview

Public funded research

- 1.1 billion euro in 2021 and 1.2 billion euro in 2022
- In 2022, 68.4% of the funding comes from national sources and 30.0% from the European projects

Knowledge transfer through contract research

- 2.0 billion euro worth of contracts each year (of which 1.5 billion euro from Europe)
- Annual technological value creation of 3 billion euro

Effects of contract research

- 98 696 HC jobs (93 225 FTE) in 2021 and 104 453 HC jobs (98 663 FTE) in 2022
- Turnover of 15.1 billion euro in 2021 and of 16.1 billion euro in 2022
- Value added of 6.6 billion euro in 2021 and of 7.1 billion euro in 2022
- Fiscal and parafiscal return of 2.8 billion euro in 2021 and 3.1 billion euro in 2022

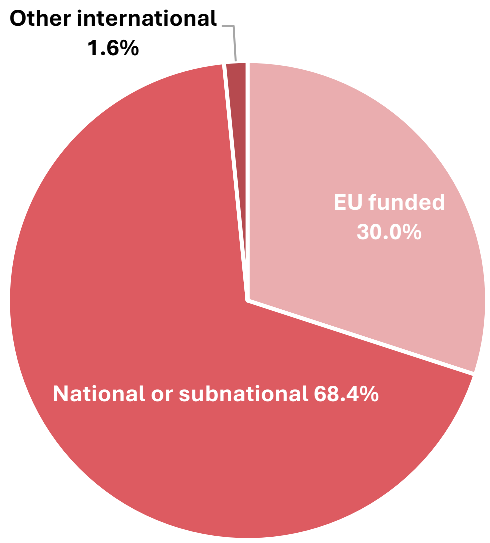
Source: IDEA Consult based on RTO data

In the case of the contracts, the value of the contract served as an indicator of the receiving partner's willingness to pay for the RTO's knowledge. By applying a technology multiplier to this value, the total technological impact of RTOs on the broader technological research community could be quantified. This value also provided a basis for estimating the broader economic impact and fiscal return of these activities on the overall economy.

2.2.1 Publicly funded research projects

Due to their scientific focus and resources, the 15 RTOs secured approximately 1.2 billion euro in public research funds annually, with 68% from national sources and 30% from European projects, mainly via Horizon 2020 or Horizon Europe. This highlighted EARTO members' strong involvement in European R&D Framework Programmes.

Figure 24: Public funded research (share of funding, 2022)

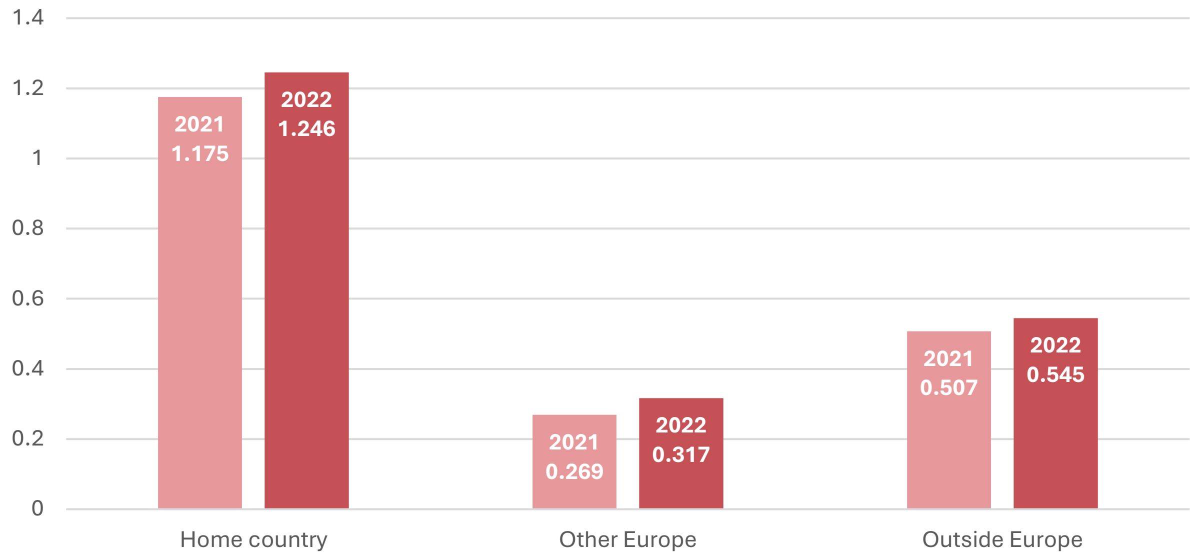


Source: IDEA Consult based on RTO data

2.2.2 Bilateral or collaborative contract research

The 15 RTOs participated in contracts for a total amount of 2.0 billion euro in 2021 and of 2.1 billion euro in 2022. On average, 60% corresponded to partners located in the home country of the RTO and another 15% from collaboration contracts with partners in other European countries. 30% of the budget from contract research in Europe stemmed from the manufacturing sector, 21% from the service activities sector, and 10% from the energy, water and waste sector. Around 16% stemmed from the public and education sector. These contracts corresponded to a direct knowledge transfer to the contract partner, which was of great scientific/technological interest to them. Their willingness to pay, approximated by the amount of the contract, could be considered a concrete estimate of the value for the receiving partner.

Figure 25: Bilateral of collaborative contract research (billion euro)



Source: IDEA Consult based on RTO data

2.2.3 Value of knowledge transfer through contract research

To estimate the value of the knowledge transfer to European partners, we started from the contract research revenues of the 15 RTOs in the EU27 and Norway, which amounted to around 1.5 billion euro each year. In line with the results of Knell (2008) we applied the multiplier of 1.98 for the EU to calculate the value of the technology transfer through contract research. The value of the RTOs' global technology transfer through contract research in Europe was then estimated at around 2.9 billion euro in 2021 and 3.1 billion euro in 2022.

Figure 26: Technological value of contract research (billion euro)

Source: IDEA Consult based on RTO data

In other studies, we also saw multipliers based on the return on investment principle, based on expert opinions or previous studies on business interaction with academia. The values for these multipliers are diverse and make comparison difficult. Many of the values we found in the literature were higher than the technology multiplier estimated in Knell (2008). An example was the multiplier used in the report by BiGGAR Economics for LERU on the economic contribution of 21 LERU universities (2015, update 2017)[42]. This was based on a previous evaluation of the Interface programme through Scottish Universities (2013) and found to be comparable to the value observed by PricewaterhouseCoopers[43] in their study for the Department of Business, Enterprise & Regulatory Reform (2009). The first study found that the direct return to investment for businesses to participate in the programme was 360%. The latter found that interventions in 'Science, R&D and innovation infrastructure' returned a cumulative GVA of 340% of the cost of the project at the businesses. While the 2015 BiGGAR study applied the value of 360%, the 2017 update applied the benchmark of 340%.

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[42] BiGGAR Economics (2015). Economic Contribution of the LERU Universities.
BiGGAR Economics (2017). The Economic Contribution of the LERU Universities in 2016.

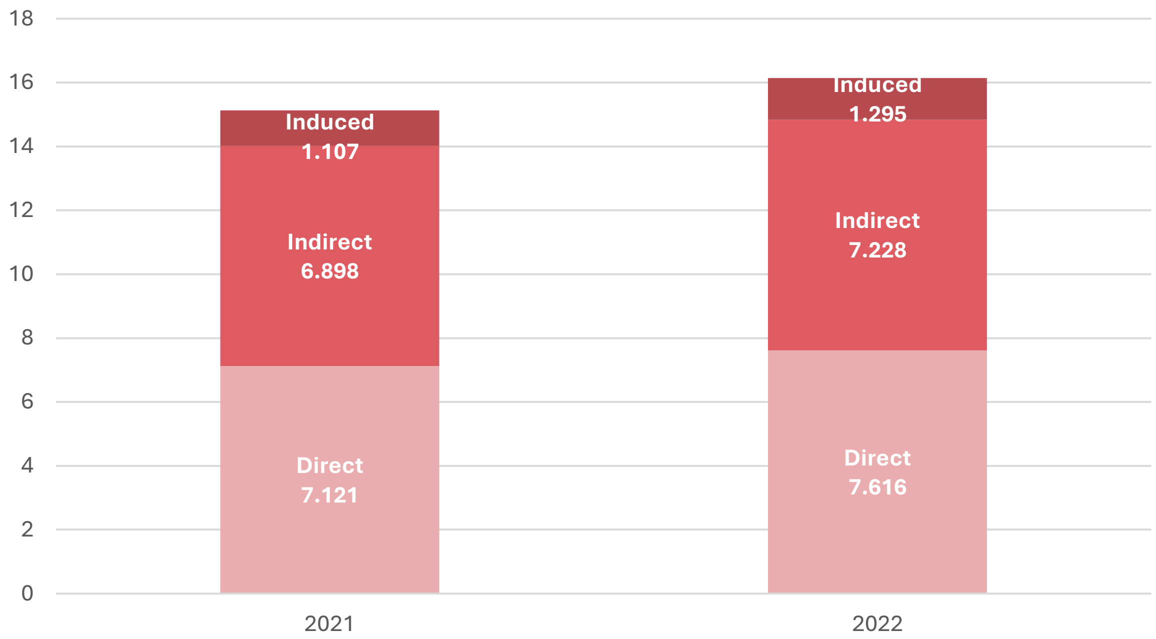
[43] PriceWaterhouseCoopers, Impact of RDA spending – National report – Volume 1 – Main Report, March 2009, DBERR.

2.2.4 Economic impact of the technological knowledge transfer

The value attributed to the knowledge transfer via contract research was demonstrated in the previous part. Applying the RTO specific economic rates, this value added was translated to estimate the economic importance of the contract research. This means that we translated the value of the knowledge transfer to turnover and employment according to the specific economic ratios that were calculated for the 15 RTOs[44].

The total turnover (direct, indirect and induced) that was created by means of knowledge transfer through contract research was estimated at around 15.1 billion euro in 2021 and around 16.1 billion euro in 2022. If we applied in the previous step the multiplier of 3.4 instead of 1.98, the total result would have been almost twice as high: a total turnover (direct, indirect and induced) of around 26.0 billion euro in 2021 and around 27.7 in 2022.

Figure 27: Total turnover effect (billion euro)

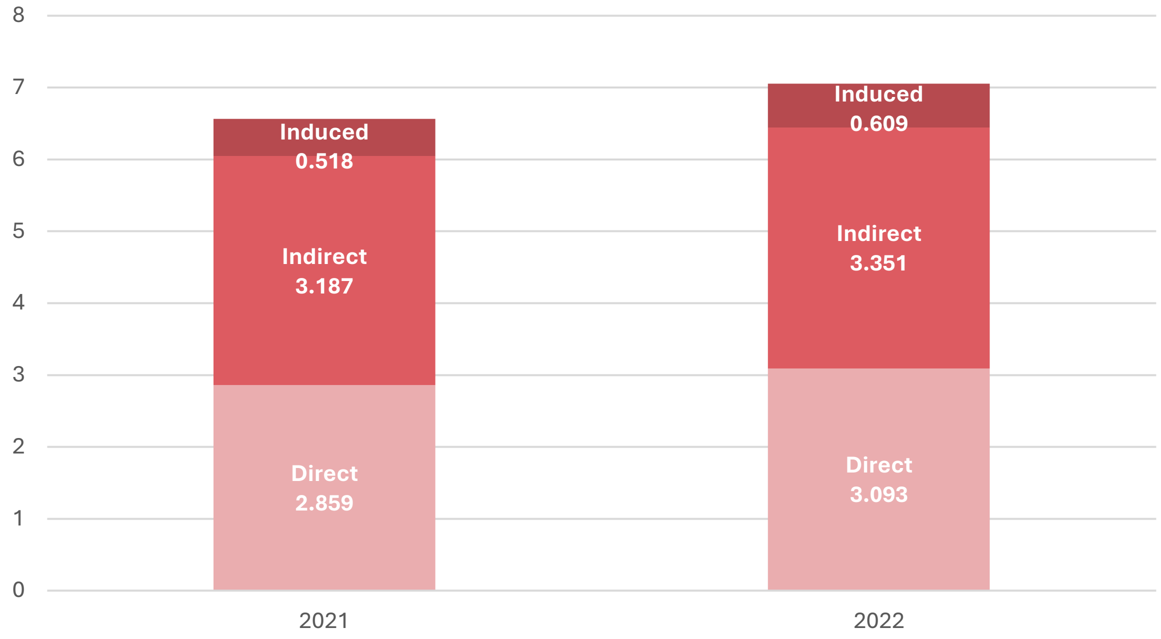


Source: IDEA Consult based on RTO data

The total value added (direct, indirect, and induced) generated through knowledge transfer via contract research was estimated at around 6.6 billion euros in 2021 and around 7.1 billion euros in 2022. With a multiplier of 3.4, the total value added would have nearly doubled, reaching 11.3 billion euros in 2021 and 12.1 billion euros in 2022.

[44] The total value that is created directly by knowledge transfer is multiplied by the ratio "direct revenue over direct value added" to calculate the direct turnover of knowledge transfer from the RTOs. This direct turnover is then multiplied by the ratio "indirect turnover over direct revenue" to calculate the indirect turnover of the knowledge transfer from the RTOs. The induced turnover is then calculated as the "direct + indirect turnover" multiplied by the ratio "induced turnover over direct + indirect turnover."

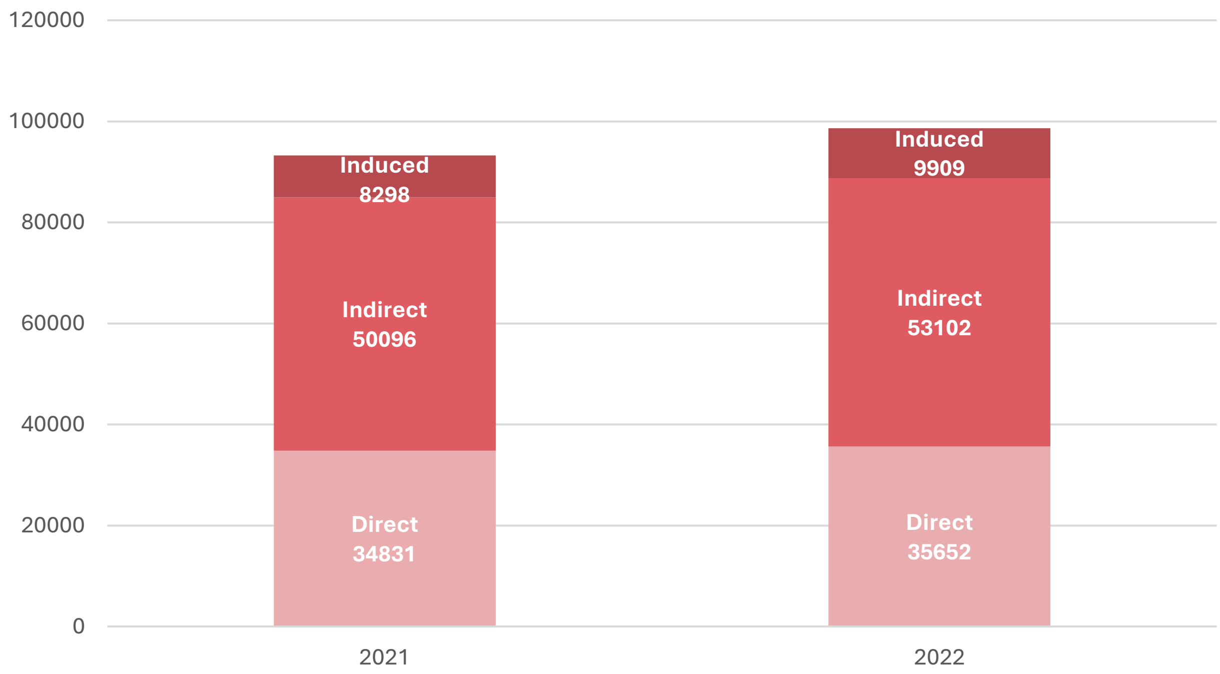
Figure 28: Total value added effect (billion euro)



Source: IDEA Consult based on RTO data

The total employment (direct, indirect and induced) that was created by means of knowledge transfer through contract research was estimated at around 93 225 FTE in 2021 and around 98 663 FTE in 2022. If we applied in the previous step the multiplier of 3.4 instead of 1.98, the total result would have been almost twice as high: a total employment (direct, indirect and induced) of around 160 083 FTE in 2021 and around 169 421 in 2022.

Figure 29: Total employment effect (FTE)



Source: IDEA Consult based on RTO data

2.2.5 Fiscal return of the technological knowledge transfer

The economic effects of the contract research of the RTOs also lead to fiscal and parafiscal flow-back towards the respective governments of the European countries where the RTOs generated economic effects. The total fiscal return of contract research in the 15 RTOs amounted to around 2.8 billion euro in 2021 and 3.1 billion euro in 2022.

The main component of these revenues were labour taxes: 1.6 billion euro in 2021 and 1.8 billion euro in 2022. Value added creation at the receivers and upstream in their value chain accounted for around 0.4 billion euro each year. Finally, the corporate tax generated each year over 0.8 billion euro of fiscal return. Applying in the previous steps the multiplier of 3.4 instead of 1.98 would have resulted in a total fiscal return of 4.8 billion euro in 2021 and 5.3 billion euro in 2022.

Figure 30: Total fiscal and parafiscal return (billion euro)

Source: IDEA Consult based on RTO data

2.2.6 Combined economic effects of the RTOs' contract research

Table 9 provides an aggregated view of the combined economic effects of the RTOs' contract research in 2022.

Table 9: Results from RTOs' contract research in 2022

	TURNOVER (B€)	VALUE ADDED (B€)	EMPLOYMENT (FTE)
Direct	7.616	3.093	35 652
Indirect	7.228	3.351	53 102
Induced	1.295	0.609	9 909
Total contract research	16.139	7.054	98 663
	Corporate tax	**VAT revenues**	**Wage tax and social security contributions**
Fiscal return (B€)	0.384	0.890	1.813

Source: IDEA Consult based on RTO data

2.2.7 Benchmark with analysis of downstream interactions in input-output tables

As explained in the methodological section 12.1.4 in Part 3 of this report, downstream interactions could also be analysed using input-output tables. This method offered additional insights into the economic outcomes of technological knowledge transfer. However, it is important to note that input-output analysis only reflected the monetary value of research contracts and did not account for:

- The discounted present value of potential future income streams from the generated knowledge,
- Scientific value
- Environmental value
- Societal benefits.

Therefore, it represented a lower bound of the actual effects. The analysis in the previous sections captured at least some of the technological and scientific impacts through the technology multiplier and would, therefore, yield higher results than those based solely on the monetary flows in the input-output analysis.

Given the over 1.5 billion euro of contracts in Europe each year, the downstream interactions through input-output tables resulted in an input multiplier of 1.85 for the 15 RTOs. This means that for each euro sold or contracted by the RTOs, another 0.85 euro could be sold by other sectors. In total, this implied an additional output of 1.4 billion euro in the European economy in 2022 (indirect) – on top of the almost 1.6 billion of contract research at the RTOs (direct). In other words, with the research services of the RTOs, the economy was able to generate another 1.4 billion euro turnover in the EU. However, the total of 3.0 billion euro was low compared to the value for turnover found in the analysis based on the technology multiplier. As explained above, the IO analysis captured only the monetary streams and not scientific or other impacts on contracts and sales and did not consider the discounted value of future potential output streams that may stem from the RTOs research findings[45].

[45] Assessing the latter is beyond the scope of this project and warrants a separate study given the wide range of potential outcomes and the difficulty to trace the contribution to a specific research output since building knowledge, discoveries, and innovations usually consists of combinations of know-how and research results, often in incremental manner.

3. Knowledge conversion: deep-tech spin-offs

Knowledge conversion refers to the process of converting scientific and technological knowledge to a format that allows for further commercialisation and a wider deployment within society.

The knowledge conversion process consists of three different phases:

- market intelligence
- go-to-market policy
- implementation

Once a number of potential areas for commercialisation have been explored (market intelligence phase), it is necessary to develop a clear vision on how the potential fields of knowledge application can be translated into specific products (go-to-market policy phase). The creation of spin-offs can be one option to translate technological knowledge into prototypes and marketable products. Also patents can be an efficient instrument. Finally, the integration of different forms of knowledge and the adoption of newly developed products can be enhanced by frequent interaction with stakeholders and the wider society. The implementation phase allows for the research projects to be evaluated within a specific context and stimulates the integration of new knowledge into the existing knowledge base.

In this study, we focused on spin-off creation to illustrate the importance of this kind of knowledge conversion flows also from an economic point of view. With their open-innovation business model, one of the core missions of RTOs is to transfer research and technology to the market with high impact for society. RTOs have many ways of doing so, one of which being the incubation, creation and development of spin-off companies: deep-tech start-ups. RTOs' spin-offs are based on RTOs' unique and differentiated knowledge and technology, often protected with strong IP or incorporated through human capital. They are an important instrument to translate their RTOs' R&I activities into commercial or industrial applications and leverage the economic added value of this knowledge. In this context, RTOs can be seen as facilitators of business development. They enhance the incubation of business opportunities by transforming innovative technological assets into investment-ready ventures with the potential of creating societal value. Many RTOs have their own ventures' strategy to support this process.

3.1 Methodology

The number and size (in terms of FTE) of spin-off companies were reported as indication of the scale of knowledge conversion through this channel. The life cycle was reported as an indication of the strength in terms of commercialisation opportunities of RTOs' (bilateral or collaborative) research[46]. Both types of indicators were based on data delivered by the RTOs.

- Data

The input data was a list of spin-off companies from each RTO that were still active or were active at some point during the period 2021-2022, and their number of employees. Spin-offs were defined as those companies with direct links to the RTO, based on knowledge/technology of the RTO. This also means that for instance the exit of people who start their own company or licencing to entrepreneurs, were excluded here.

Most RTOs considered in this study reported data on employment in the spin-offs. However, data on FTE were not always available. In two cases, the head count figures were transposed into FTE by applying the FTE/HC rate of the RTOs, assuming that this rate is similar across spin-offs. In some cases, data for only one year was available. If the spin-off was indicated to be active in the second year as well, the number of FTE was taken equal in both years.

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[46] The analysis on the life cycle of spin-offs (survival rate, average time passed between start and end of activities) is based on all spin-offs whether or not still active in 2021 or 2022.

For 101 out of 393 spin-off companies, employment data were not available in 2021 nor 2022 (coverage of 74%) so their FTE values were set to zero. The limitation that information on FTEs was not available for all spin-offs in all years, resulted in the fact that the indicators are to be considered lower boundaries to the real effect.

- Hypotheses for the analysis

Where data were not available for one year, we have used the numbers for the second year – conditional upon the spin-off being active in that year as well. The assumption was that the employment in spin-off companies was more or less stable between 2021 and 2022, a reasonable assumption to make. As mentioned, in two cases the head count figures were transposed into FTE by applying the FTE/HC rate of the RTOs, thus assuming that this rate was similar across spin-offs.

3.1.1 Economic impact of spin-offs

Spin-offs not only have an important potential value added in terms of translating basic research into commercial applications. They also create new jobs and have a positive impact on economic growth, just like any other new company. This aspect was considered in the economic impact assessment of the spin-offs.

As mentioned before, we cannot simply add the impact of the spin-offs to the footprint of the RTOs (the founding organisation). First, not all accomplishments of these spin-offs could be attributed to the RTO. On the other hand, these spin-offs would not have existed without it. Therefore, we calculated their economic impact as an indication of the importance of this kind of knowledge conversion processes for the European economy.

To calculate the economic impact of the spin-offs (direct, indirect and induced) we used the same method as for the calculation of the economic impact of the RTOs core activities. However, less data was available, so we applied the specific economic ratios found in the detailed calculations for the RTOs:

- Direct turnover spin-offs = direct FTE spin-offs * (direct revenue RTOs/direct FTE RTOs)
- Direct value added spin-offs = direct FTE spin-offs * (direct value added RTOs/direct FTE RTOs)
- For the three units (employment, turnover and value added):
  - Indirect effect spin-offs = direct effect spin-offs * (indirect effect RTOs/direct effect RTOs)
- Induced effect spin-offs = (direct + indirect) effect spin-offs * [induced effect RTOs/ (direct + indirect) effect RTOs]

- Data

For the spin-offs, only the direct employed FTE were available. To calculate the direct turnover and value added, and to estimate the indirect and induced impact, the specific economic ratios of the RTOs were applied (see above).

- Hypotheses for the analysis

By applying the RTO specific ratios of turnover/FTE and value added/FTE in the direct economic impact assessment, we assumed that the spin-off had a similar activity profile as the RTO. Also, by applying the RTO rates of indirect and induced impact compared to direct impact, we assumed that the purchasing pattern of the spin-offs and the profile of the spin-off employees (average wage and spending) were the same as the purchasing pattern and the profile of employees at the RTO. We remarked that the economic effects of spin-offs cannot be fully attributed to the RTOs that supported their start-up.

3.1.2 Fiscal return of the spin-offs

To calculate the fiscal return of the spin-offs, each type of impact was translated to its specific fiscal return, i.e. turnover to corporate taxes, value added to VAT, employment to social security contributions and wage taxes. For this, the specific fiscal return ratios calculated for the RTOs were applied:

- Fiscal return from turnover knowledge transfer = turnover knowledge transfer * (fiscal return from turnover RTOs/total turnover RTOs)

    - Fiscal return from value added knowledge transfer = value added knowledge transfer * (fiscal return from value added RTOs/total value added RTOs)
    - Fiscal return from employment knowledge transfer = employment knowledge transfer * (fiscal return from employment RTOs/total employment RTOs)

- Data

The estimation of the economic impacts of spin-offs was available from the previous step. To calculate the fiscal return stemming from each type of impact, the specific ratios of the RTOs were applied (see above).

- Hypotheses for the analysis

By applying the RTO specific ratios, we assumed that the effects of knowledge transfer had similar fiscal returns as the RTO core activities. We remarked that the fiscal returns of spin-offs cannot be fully attributed to the RTOs that supported their start-up.

3.2 Results

Figure 31 provides an overview of the effect of RTOs' spin-offs in the economy and their basic characteristics.

Figure 31: Spin-offs – overview

Number of spin-offs

- 393 deep-tech spin-offs created by the RTOs

Effects

- 16 940 HC jobs (15 129 FTE) in 2021 and 18 917 HC jobs (16 826 FTE) in 2022
- Turnover of 2.5 billion euro in 2021 and of 2.8 billion euro in 2022 of turnover
- Value added of 1.1 billion euro in 2021 and of 1.2 billion euro in 2022
- Over 0.5 billion euro of fiscal and parafiscal return each year

Survival rate

- Considering all spin-offs whether or not still active in 2021 or 2022 (636), the survival rate in the first year was 98%. On average, the spin-offs of the RTOs were active for 9.7 years before they stopped or merged their activities.

Source: IDEA Consult based on RTO data

3.2.1 Economic impact of the spin-offs

The creation of spin-offs is an important way for research intensive organisations to translate their scientific research into commercial or industrial applications and leverage the economic added value of this knowledge. Also the human capital moving from the 'founding' organisation to the spin-off contributes to the availability and dispersion of highly qualified knowledge and skills to the local economy and related industries.

The scientific activities of 15 RTOs in this study have led to the creation of many valuable spin-off activities over the years. 393 of their spin-off companies are still active today[47] and employed 6 329 HC or 5 652 FTE in 2021 and 6 836 HC or 6 080 FTE in 2022. 92% of the spin-off and employment creation was concentrated in the RTOs' respective home countries. In 2022, the spin-offs' activities additionally generated around 9 056 HC (10 182 FTE) indirect positions in the European economy, as well as another 1 900 HC (1 690 FTE) induced positions.

[47] For data feasibility reasons, only spin-offs still active in 2021 and 2022 are included.

Table 10: Employment generated by spin-offs (FTE/HC)

Year	Direct FTE	Direct HC	Indirect FTE	Indirect HC	Induced FTE	Induced HC	Total FTE	Total HC
2021	5 652	6 329	8 130	9 103	1 347	1 508	15 129	16 940
2022	6 080	6 836	9 056	10 182	1 690	1 900	16 826	18 917

Source: IDEA Consult based on RTO data

Under the assumption that the spin-offs had a similar turnover per capita as the RTOs, the spin-offs' direct activities were good for an annual additional turnover of around 1.2 billion euro in Europe in 2021 and of around 1.3 billion euro in 2022. The spin-offs' activities have generated around 1.1 billion euro of turnover at the spin-offs' suppliers in 2021 and around 1.2 billion euro in 2022, and an induced turnover of around 0.2 billion euro was estimated for each year. Finally, the spin-offs direct activities have generated an annual additional value added of around 0.5 billion euro each year. An additional indirect and induced value added of around 0.6 billion euro in 2021 and of around 0.7 billion euro in 2021 was linked to the spin-off activities of the RTOs.

Table 11: Turnover and value added generated by spin-offs

Year	Year	Direct	Indirect	Induced	Total
Turnover	2021	1.156	1.119	0.180	2.455
	2022	1.299	1.233	0.221	2.753
Value added	2021	0.464	0.517	0.084	1.065
	2022	0.528	0.572	0.104	1.204

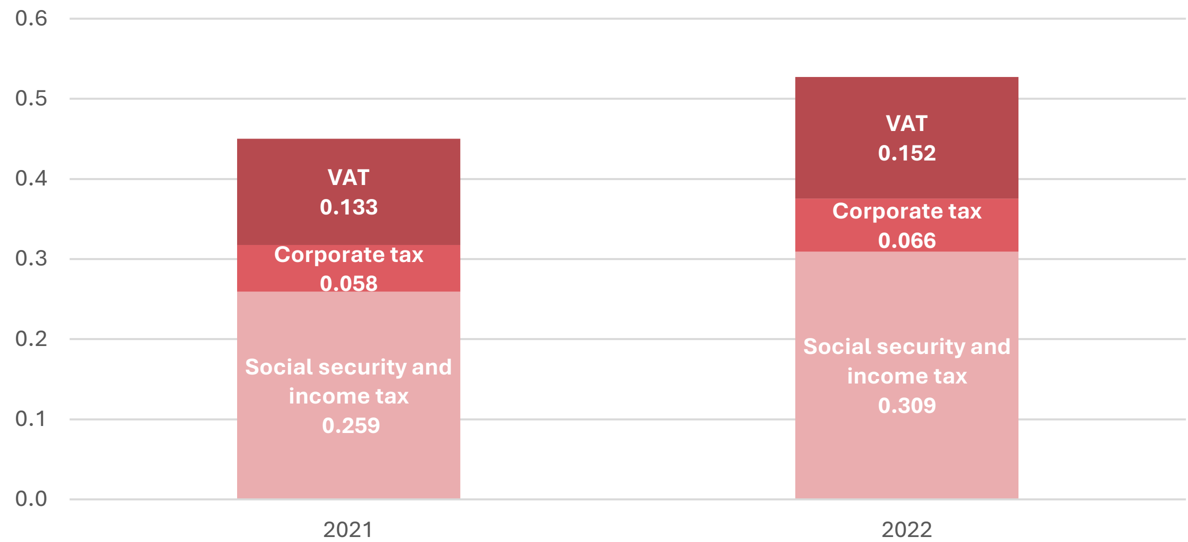
Source: IDEA Consult based on RTO data

3.2.2 Fiscal return of the spin-offs

Also the economic effects of the spin-off activities of the RTOs led to fiscal and parafiscal flow-back towards the respective governments of the European countries where the spin-offs were created and where their economic impact was situated. The total fiscal return of RTO spin-offs amounted to around 0.5 billion euro each year.

More than half of these revenues stemmed from labour taxes: around 259 million euro in 2021 and 309 million euro in 2022. The value added creation at the spin-offs and upstream in their value chain generated 133 million euro in 2021 and 152 million euro in 2022. The corporate tax resulted in 58 million euro of fiscal return in 2021 and 66 million euro in 2022.

Figure 32: Fiscal and parafiscal return of spin-offs (billion euro)



Source: IDEA Consult based on RTO data

3.2.3 Combined economic effects of the RTOs' spin-offs

Table 12 provides a concise overview of the effects of the activities of the RTOs' spin-offs in 2022.

Table 12: Results from the activities of the RTOs' spin-offs in 2022

	TURNOVER (B€)	VALUE ADDED (B€)	EMPLOYMENT (FTE)
Direct	1.299	0.528	6 080
Indirect	1.233	0.572	9 056
Induced	0.221	0.104	1 690
Total spin-offs activities	2.753	1.204	16 826
	Corporate tax	**VAT revenues**	**Wage tax and social security contributions**
Fiscal return (B€)	0.066	0.152	0.309

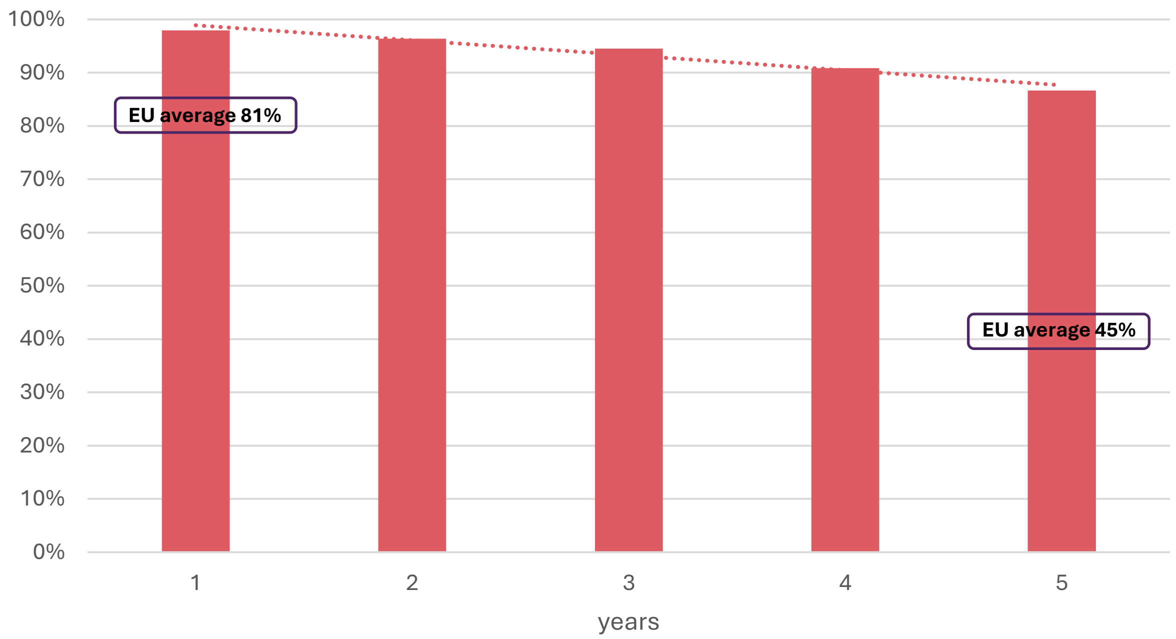
Source: IDEA Consult based on RTO data

3.2.4 Survival rate of the RTOs' spin-offs

Fourteen RTOs reported on 636 spin-offs. The oldest spin-off in the list was created in 1978, the youngest in 2023. 47% were created in the last ten years. Of the 636 spin-offs, 478 are still active today and 158 have either ended their activities (142) or have been merged with another company (16). On average, the spin-offs of the RTOs were active for 9.7 years before they stopped or merged their activities.

The survival rate in the first year was 98% - taken over all spin-offs in the entire period. The Eurostat indicator on the survival rates of companies at EU27 level in 2018 was 81% after 1 year and 45% after 5 years[48]. Similar values can be observed in the US, with a survival rate of 81% after 1 year and 54% after 5 years[49]. These values were all considerably lower than the values found for the spin-offs of the RTOs.

Figure 33: Survival rate of RTOs' spin-offs

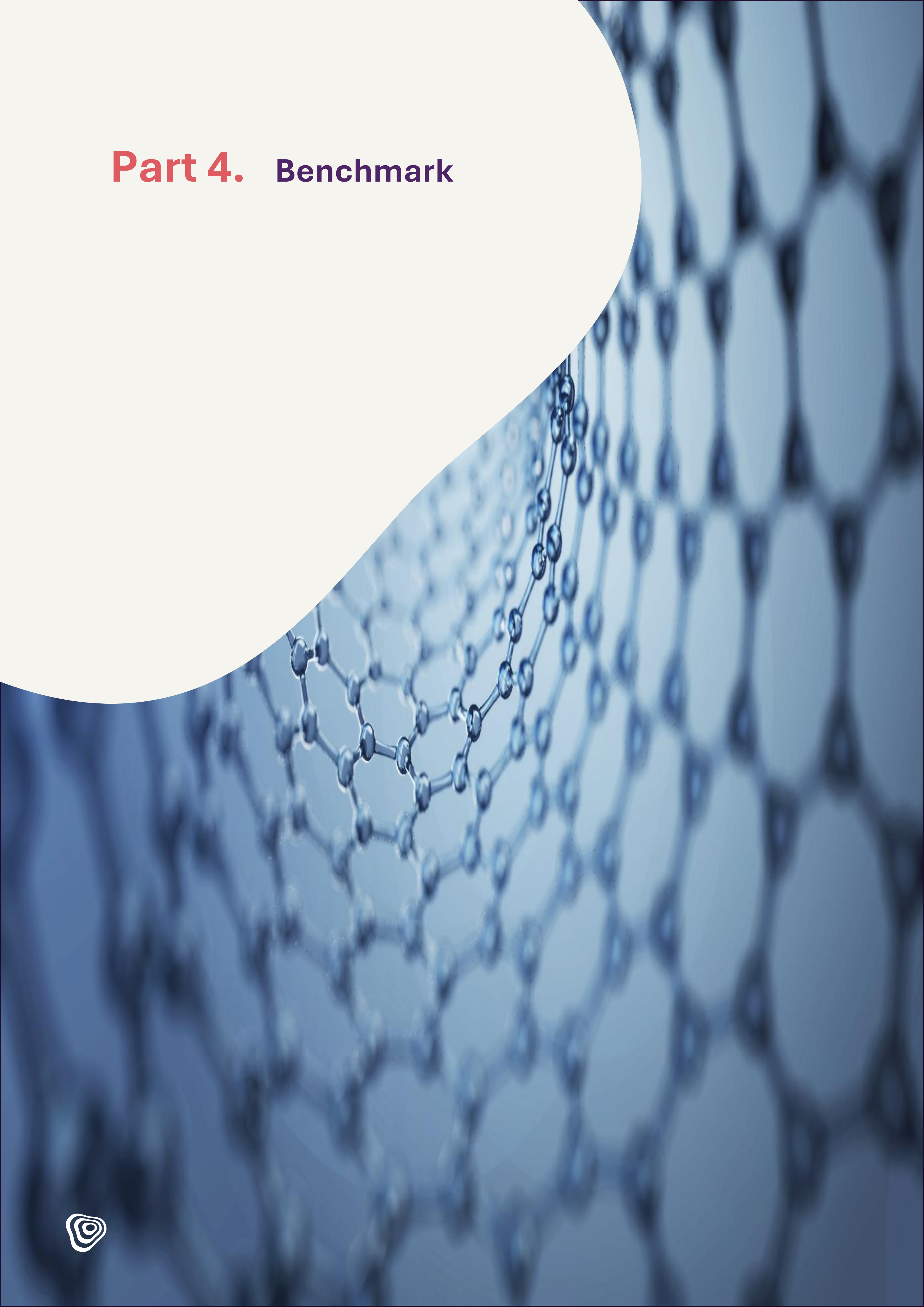


Source: IDEA Consult based on RTO data

[48] Eurostat (online data code : bd_9bd_sz_cl_r2)

[49] Bureau of Labor Statistics (https://www.bls.gov/bdm/us_age_naics_00_table7.txt)

Part 4. Benchmark



Throughout the report, we have guided the reader to interpret the results in the right context and to look for comparable benchmarks. Points of attention are:

- **The scope of the economic footprint**. This study included the direct, indirect and induced economic effect of RTO core activities, and the economic effects of knowledge transfer through outflow of staff, contracts and spin-offs. It however excluded other types of impacts such as:
  - Catalytic impact: The presence of the RTOs in Europe is an important element in the location and collaboration decisions of many enterprises. The role of the RTOs in the international research landscape and the overall ecosystem can also be part of a catalytic impact assessment. The attractiveness and specialisation of a region in a specific field, combined with the technological and scientific cooperation of RTOs with both universities and industry, further supports regional (smart) specialisation.
  - Human capital impact: Through employment, training and interaction with higher education, the RTOs are expected to have a positive impact on the development of human research capacity in Europe.
  - Societal impact: The societal impact refers to the role an RTO plays in supporting and informing the society at large through education, communication, interaction with the broader public, but also by addressing the societal challenges through research.
  - Tourist impact: RTOs organise events, trainings, conferences that attract local but also international visitors to their region, who in turn make consumptions in hotels, restaurants, transport, etc. in the region.
- **The parameters and assumptions specific to the methodology. Two elements in our methodology affected the results compared to other existing studies. They were both applied in the spirit of 'careful' estimations (to avoid overestimations or duplications) and thus added to the accuracy and robustness of the results.**
  - In the economic footprint analysis, we compared the situation 'as is' with the situation that the RTOs would have not been active. We thereby assumed that employees (direct and indirect) would have been unemployed if the RTOs did not exist. The additional effect of an RTO was thus the difference between employment and unemployment of the direct and indirect employees. In this situation, we assumed that the unemployed would have received an unemployment benefit, so that their income would have not decreased to 0. Many other impact studies[50] in the field did assume that the unemployed had zero income if the RTO did not employ them, leading to an overestimation of the additional effects of the RTOs.
  - For the translation of contract research to the value added for the receivers, we applied the Knell (2008) technology multiplier, considerably lower than the parameter used in e.g. the BiGGAR Economics study for this purpose. The impact of this parameter on the results was shown throughout the report. For reasons of robustness (the Knell (2008) indicator has been calculated based on input-output methodology) and carefulness, we preferred to apply the Knell (2008) indicator in our final results. The value of the technology multiplier has also been validated through a workshop and discussion with RTOs and an external expert for the previous version of the economic footprint[51] in order to assess whether the value was expected to have evolved over time since 2008. All experts agreed to the continued use of the value 1.98, considering it as a 'careful' estimate.

Comparing the results of this study with other studies could be difficult as the type of organisations analysed is generally different. Nevertheless, the methodology did not differ (that much) from the study from BiGGAR Economics on the indirect impact of 23 LERU Universities located in 12 countries (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland and the UK)

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[50] For example, the study of the Economic Contribution of the LERU Universities by BiGGAR Economics (2015, update 2017) does not mention a correction for unemployment benefits.

[51] See "Economic Footprint of 9 European RTOs in 2015-2016" (2018), IDEA Consult. http://www.earto.eu/fileadmin/content/02_Events/EARTO_Economic_Footprint_Study/EARTO_Economic_Footprint_Report_-_final.pdf.

throughout Europe[52]. In that study, they found an indirect employment multiplier (in methodology comparable to the indirect impact calculated for the 15 EARTO members) of 1.74 compared to the 2.77 of the RTOs in 2022. While the comparison can only be made on this type of effect due to the different scope of the study, it could be indicative of the relatively higher indirect employment impact of RTOs, highlighting the significant role they played in job creation compared to other organisations.

52 BiGGAR Economics (2017). The Economic Contribution of the LERU Universities in 2016. The 2015 study included 21 universities in 10 countries, cf. BiGGAR Economics (2015). Economic Contribution of the LERU Universities.

Part 5. Summary and conclusions

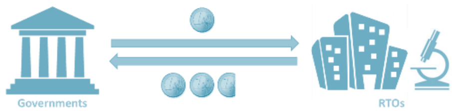
The analysis in this report focused on the economic footprint of 15 European RTOs, members of the European Association of Research and Technology Organisations (EARTO). Data has been gathered from the following RTOs: AIT (AT), CEA (FR), DTI (DK), Eurecat (ES), imec (BE), INESC TEC (PT), JSI (SI), NIC (SI), RISE (SE), SINTEF (NO), Tecnalia (ES), TNO (NL), Tyndall (IE), VITO (BE), VTT (FI).

For 2022, the analysis showed that:

- **Around 245 000 jobs (HC) or 230 000 FTEs were created in the European economy that could be linked to the activities of the RTOs included in this footprint, corresponding to a total turnover of around 37.7 billion euro and a total value added of around 16.5 billion euro. The fiscal return added up to around 6.6 billion euro (core activities, contract research, spin-off activities), of which around 3 billion euro stemmed from the RTOs' core activities.**
    - **Core Activities:** almost 122 000 jobs (HC) or 115 000 FTEs in Europe stemmed from the core activities of 15 RTOs, corresponding to a total additional turnover of 18.8 billion euro and a value added of around 8.2 billion. This also led to 3 billion euro of fiscal and parafiscal return to governments.
    - **Contract Research:** around 2 billion euro worth of contracts (of which 1.5 billion euro in Europe) resulted in an annual technological value creation of 3 billion euro (directly). This in turn translated into an additional 104 000 jobs (HC) or 99 000 FTEs, a turnover of 16.1 billion euro, and an added value of 7.1 billion euro in the European economy. Furthermore, it resulted in 3.1 billion euro of fiscal and parafiscal return to governments. Publicly funded research projects are treated separately in this study as they prioritize foundational knowledge creation and long-term societal and economic growth over immediate government benefits.
    - **Spin-off Activities:** 393 spin-offs created by the RTOs and active at some point during the period 2021-2022 resulted in almost 19 000 jobs (HC) or 17 000 FTEs, 2.8 billion euro turnover and 1.2 billion euro value added for the European economy. In addition, their activities led to over 0.5 billion euro of fiscal and parafiscal return to governments. Considering all spin-offs whether or not still active in 2021 or 2022 (636), the survival rate in the first year was 98%. On average, the spin-offs of the RTOs were active for 9.7 years before they stopped or merged their activities.

- **For each job in RTOs, almost 5 jobs were created elsewhere in the European economy (on top of the 1 direct job in the RTO)** either at the suppliers of the RTOs and further upstream, or in the broader economy, thanks to the economic activity of the employees of both the RTOs and their suppliers, and especially thanks to the effects of knowledge transfer through contract research and spin-offs.

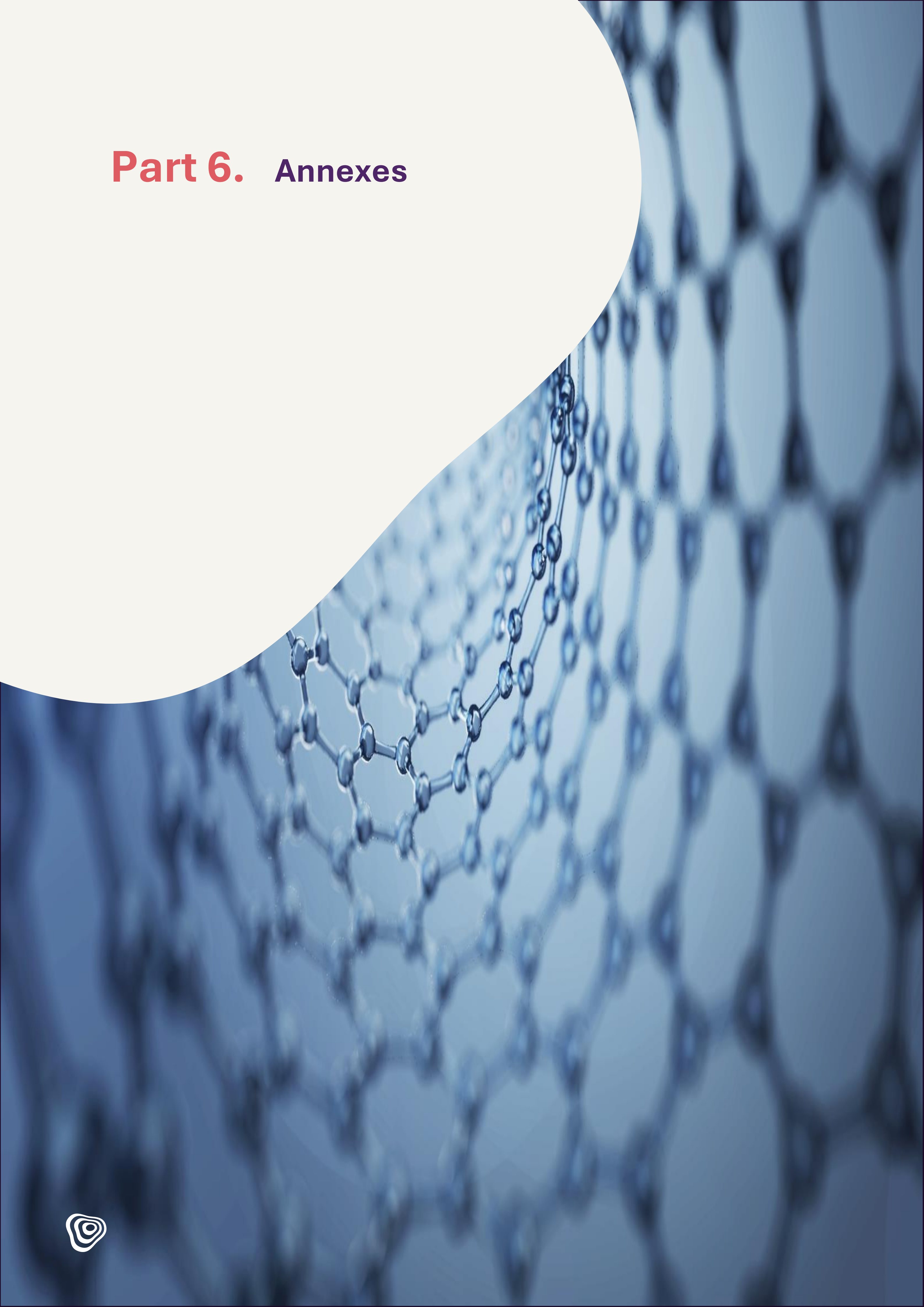
- The operational grants[53] received by RTOs, were earned back by national governments through fiscal return mechanisms. **For each euro invested in the form of operational grants, more than 2 euro flew back to the national governments.** In other words, 228% of the amount spent on operational grants for RTOs returned to governments through fiscal revenues, which signifies that the investments made by national governments in RTOs are generating additional economic benefits beyond the initial expenditure, contributing positively to the broader economy.



This should be interpreted as a lower boundary to the total economic leverage effect, which would consider all other types of impact (technological, societal, tourism, human capital development, etc.). Indeed, the focus of the study was on another crucial aspect: the 'economic footprint' left by their business activities in society – an impact that is less known and documented.

53 Operational grants are defined as the revenue received directly from government in the form of (non-competed) block or base funding which can be flexibly used by the RTO.

Part 6. Annexes



Annex 1. Sample of 15 RTOs

15 of EARTO's member RTOs have participated in this study. They are listed in the table below and the next paragraphs provide a short description of each RTO's main activities.

Table 13: RTOs in the scope of the study

RTO	RTO Full name	Country
AIT	Austrian Institute of Technology	Austria
CEA	Commissariat à l'Énergie Atomique et aux Énergies Alternatives	France
DTI	Danish Technological Institute	Denmark
Eurecat	Eurecat, Centre Tecnològic de Catalunya	Spain
imec	Interuniversitair Micro-Elektronica Centrum	Belgium
INESC TEC	Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência	Portugal
JSI	Jožef Stefan Institute	Slovenia
NIC	Kemijski Inštitut	Slovenia
RISE	RISE Research Institutes of Sweden	Sweden
SINTEF	SINTEF	Norway
Tecnalia	Tecnalia Research & Innovation	Spain
TNO	Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek	The Netherlands
Tyndall	Tyndall National Institute	Ireland
VITO	Vlaamse Instelling voor Technologisch Onderzoek	Belgium
VTT	VTT Technical Research Centre of Finland Ltd	Finland

Source: IDEA Consult

- **AIT (Austria)**

Focusing on the key infrastructure topics of the future since 1959, the Austrian Institute of Technology (AIT) has been leading the Austrian innovation system and has played a key role in Europe. As a national and international network node at the interface of science and industry AIT enables innovation through its scientific-technological expertise, market experience, tight customer relationships and high quality research infrastructure.

AIT provides research and technological development to realize basic innovations for the next generation of infrastructure related technologies in the fields of Energy, Transport Technologies, Health & Bioresources, Digital Safety & Security, Vision, Automation & Control and Technology Experience. These technological research areas are supplemented by the competence in the area of Innovation Systems & Policy.

- **CEA (France)**

CEA is the French Alternative Energies and Atomic Energy Commission (Commissariat à l'énergie atomique et aux énergies alternatives). It is a public body established in October 1945 by General de Gaulle.

Thanks to its strong roots in fundamental research, CEA is able to provide tangible solutions to meet their needs in four key fields: low-carbon energy (nuclear and renewable), digital technology, technology for medicine of the future, defence and national security.

CEA has adopted a very unique approach in the research and innovation sector, based on 5 pillars: its historical role in France's defence and national security strategy, its ground-breaking strategy in research and innovation through its study of the atom, its capacity to handle projects from the fundamental discovery of a concept through to its development, its strong support of start-ups that drive the development of breakthrough innovations, and its local presence in different regions, its open-minded approach, and its cooperative spirit.

Relying on its renowned expertise, CEA is actively involved in setting up collaboration agreements with its various academic and industrial partners or within many European research infrastructures. CEA is also strongly involved in education and training in particular for the nuclear engineering with the INSTN institute. Considered an expert in its core skills, CEA is fully integrated into the European research area (ERA) and continues to be a growing presence in the international arena. It also performs sovereign missions entrusted to it by the State. It supports the deployment of French companies internationally.

Since 2015-2016, CEA has reorganized its civil research operations with one focusing on low carbon energies (nuclear and renewable), one on digital and electronics technologies and one on fundamental research also leading the health and medicine programs.

- **DTI (Denmark)**

The Danish Technological Institute (DTI) is an independent and non-profit research and development institute. Since 1906 DTI has worked to promote the application of technological advances, for the benefit of both the individual business and the continued development, growth, and prosperity of society as a whole.

The Institute participates in development projects, which are of use to society in close collaboration with leading research and educational institutions both in Denmark and abroad. On top of this, the Institute carries out consultancy and standardisation services, which contribute to a dynamic and harmonious development of society.

Their most important task is to ensure that new knowledge and technology quickly can be converted into value for customers in the form of new or improved products, materials, processes, methods and organisational structures. DTI works together with new and existing companies, either individually or in groups, on ways to enhance technological and management restructuring and efficiency, across a broad range of industries as well as in leading edge sectors. This takes place in line with interdisciplinary and highly relevant societal drivers: digital transformation, green conversion, the circular economy and growth, productivity, and innovation capacity.

- **Eurecat (Spain)**

Eurecat is a leading technology centre in Catalonia, Spain, established in 2015 through the merger of 5 RTOs, each with over 20 years of experience. The creation of Eurecat aimed to consolidate expertise and resources to become a key player in applied research, innovation, and technology transfer.

Eurecat plays a crucial role as a bridge between research and the business world, providing companies and organizations with advanced technological solutions to meet their innovation challenges. Its activities encompass applied research, innovation, high-tech consultancy, specialized training, and the orchestration of innovation ecosystems. By integrating multidisciplinary and multi-technological capabilities, Eurecat addresses complex business challenges in a comprehensive and sustainable manner.

The centre operates across various sectors, including digital & experience industries, green cities & industries, manufacturing, mobility, and wellness industries. Eurecat is actively involved in European and international research projects, contributing to global technological advancements. Additionally, it focuses on knowledge dissemination and upskilling, offering tailored training programs to ensure that professionals are equipped to handle the latest technologies. Through these efforts, Eurecat significantly contributes to the growth of a knowledge-based economy, fostering innovation and competitiveness in the industries it serves.

- **Imec (Belgium)**

In 1984 the Flemish Government set up a program in the field of microelectronics with the goal to strengthen the microelectronics industry in Flanders. The decision was inspired by the strategic importance of microelectronics for the industry, and by the major investments required to keep up with developments in this field. This program included setting up a laboratory for advanced research in microelectronics (imec), a semiconductor foundry (former Alcatel Microelectronics, now STMicroelectronics and AMI Semiconductor), and a training program for VLSI design engineers. The latter is now fully integrated in the imec activities.

Today, imec is a world-leading innovation hub in nanoelectronics & digital technologies and has the objective of maximizing societal impact by creating smart, sustainable solutions that enhance quality of life. They leverage their scientific knowledge with the innovative power of their global partnerships in ICT, healthcare and energy. Imec delivers industry-relevant technology solutions. In a unique high-tech environment, their international top-talent is committed to providing the building blocks for a better life in a sustainable environment.

In September 2016, imec merged with another Flemish research centre, iMinds. Imec's broadened research and collaboration offering makes it a unique and world-class research centre in the field of nanoelectronics, excelling in software and ICT expertise. The broadened innovation centre which operates under the imec name uses this knowledge to develop disruptive technologies and solutions in application areas such as health, smart cities and mobility, agrifood, industry 5.0, lifelong learning and data- and telecom.

- **INESC TEC (Portugal)**

INESC TEC is a private non-profit research association founded in 1999 and dedicated to scientific research and technological development, technology transfer, advanced consulting and training, and pre-incubation of new technology-based companies.

The mission of INESC TEC is to achieve advancement in science and technology and to enable science-based innovation through the transfer of new knowledge and technologies to industry, services and public administration. As an institution operating at the interface of the academic and business worlds, bringing closer together academia, companies, public administration, and society, INESC TEC typically applies the knowledge and results generated as part of its research in technology transfer projects, seeking value creation and immediate social relevance.

Research and innovation are conducted across 13 specialized R&D Centres, each focused on specific scientific and technological areas. INESC TEC's research is structured into eight broad scientific domains: Artificial Intelligence, Bioengineering, Communications, Computer Science, Photonics, Power and Energy Systems, Robotics, and Systems Engineering. The Scientific Domains structure the institute's research competences and challenges, facilitating strategic thinking, trajectory monitoring, and science communication.

- **JSI (Slovenia)**

The Jožef Stefan Institute (JSI) is the leading Slovenian scientific research institute, covering a broad spectrum of basic and applied research. The Institute was founded in 1949 at a time when scientific research was expanding rapidly throughout the world. Initially established as an institute for Physics within the Slovenian Academy of Sciences and Arts, it is today involved in a wide variety of fields of both scientific and economic interest.

The institute comprises 28 research departments and several centres, covering a broad range of expertise in natural sciences, life sciences, and engineering. The subjects concern production and control technologies, communication and computer technologies, knowledge technologies, biotechnologies, new materials, environmental technologies, nanotechnologies, and nuclear engineering.

The mission of the Jožef Stefan Institute is the accumulation and dissemination of knowledge at the frontiers of natural science and technology to the benefit of society at large through the pursuit of education, learning, research, and development of high technology at the highest international levels of excellence. In addition to its research activities, JSI plays a vital role in fostering collaboration between academia, industry, and government, ensuring that scientific advancements translate into practical applications that drive innovation and contribute to economic growth.

- **NIC (Slovenia)**

The Kemijski Inštitut (National Institute of Chemistry) was established in 1946 and has the goal of pushing the boundaries of science with cutting-edge research and modern and innovative solutions.

The institute is a scientifically excellent, established, and breakthrough research institution in the European area. With its top-notch research, it enriches the world's treasury of knowledge and contributes to solving the most pressing social issues, including health, sustainable energy, climate change, circular economy, and safe food. The Institute sets challenging goals that push the boundaries of science and create new values. It successfully transfers knowledge to the industrial environment, supporting the long-term integration of science into societal development.

The Institute joins international multidisciplinary research networks and connects with the best global research institutions, groups, and individuals, enhancing its scientific excellence. It also strives to be an open learning space for young researchers. Through a wide variety of projects, along with material and moral support, it creates a stimulating environment where young researchers can develop their curiosity and exercise their research creativity. This approach ensures that the profession remains embedded in the lives of future generations.

- **RISE (Sweden)**

RISE Research Institutes of Sweden is a Swedish state-owned research institute that collaborates with universities, industry and the public sector.

The mission of RISE is to strive for sustainable growth in Sweden by strengthening the competitiveness and capacity for renewal of Swedish industry, as well as promoting the innovative development of society as a whole. The overarching goal for RISE is to be internationally competitive and facilitate sustainable growth in Sweden by strengthening competitiveness and innovation in industry as well as to promote innovation and ability in the public sector to contribute to solutions to societal challenges in collaboration with industry.

The organization is divided into five specialized divisions: Bioeconomy and Health which focuses on process engineering, drug development, and material design for biorefineries and various industries like agriculture and packaging; Built Environment with expertise in energy, infrastructure, construction, and innovation management, including market certification services; Digital Systems which specializes in electronics, ICT, software development, and digitalization solutions for diverse sectors; Materials and Production which covers corrosion, chemistry, biology, and mechanics, aiding in the development of products and materials for textiles, polymers, and metals; Safety and Transport with expertise in vehicle reliability, maritime safety, transport electrification, and fire safety, with a focus on measurement technology and inspections.

- **SINTEF (Norway)**

SINTEF is a large independent not-for-profit research organisation based in Norway, founded in 1950. Over the last 75 years, SINTEF has created value and innovation through knowledge generation and development of technological solutions that are brought into practical use.

Today, SINTEF is a broadly based, multidisciplinary research organisation with international top-level expertise in technology, and additional competence in medicine and the social sciences. As an R&D partner, SINTEF contributes to societal benefits, value creation and increased competitiveness within the public and private sectors. SINTEF also develops and runs research infrastructure, create new products and start-ups, and contributes to society via thought leadership.

SINTEF applies a multidisciplinary approach in a wide range of projects, from small test and verification projects and expertise evaluations to multinational research programmes with several partners. SINTEF collaborates with leading universities, companies, institutes, industry clusters, start-ups and authorities. Their work often involves developing projects that attract public funding for their clients, ensuring a broad and impactful reach in their research and innovation efforts.

- **Tecnalia (Spain)**

Tecnalia Research & Innovation is the leading private, non-profit and independent applied research and technology organisation in Spain and a centre of international excellence, a benchmark in Europe and a member of the Basque Research and Technology Alliance.

Tecnalia collaborates with companies and institutions to improve their competitiveness, people’s quality of life and achieve sustainable growth. Tecnalia works with an increasingly strategic business relationship model based on trust, collaboration, and a shared technological approach, whereby their main scopes of action are smart manufacturing, digital transformation, energy transition, sustainable mobility, health and food, urban ecosystem and circular economy.

Tecnalia conducts R&D on: Health, Ageing & Quality of Life, Sustainable Development and Renewable Energies, Information & Communication Technologies, Transport & Mobility, Industrial Systems and Processes, Innovation & Competitiveness, Natural Resources.

- **TNO (The Netherlands)**

TNO, the Netherlands Organisation for Applied Scientific Research, was founded by law in 1932 to enable business and government to apply knowledge. As an organisation regulated by public law, they are independent: not part of any government, university or company.

TNO connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society in a sustainable way. TNO aims to achieve this by performing two core tasks (roles). The first is to support the Dutch government in carrying out statutory government tasks in the public interest. TNO’s second core task is to strengthen the earning power of the Dutch economy and increase employment.

To maximize its impact, TNO emphasizes the importance of a robust knowledge base, keeping abreast of scientific and technological trends, and focusing on practical applications of scientific insights. Key strategies include a deep understanding of client and partner contexts, and collaboration to effectively bring products and services to market.

TNO supports small and medium enterprises (SMEs) by leveraging its technical expertise and national resources. The organization prioritizes speed and agility in a competitive innovation landscape and concentrates its efforts on four main themes—safety, health, sustainability, and digitalisation.

- **Tyndall (Ireland)**

Tyndall is Ireland’s national Information and Communications Technology (ICT) research centre and Ireland's largest Research and Technology Organisation. Tyndall is a joint venture between University College Cork (UCC) and the Department of Further & Higher Education, Research, Innovation & Science (D/FHERIS) of the Irish Government.

Tyndall is home to a multidisciplinary research community of over 600 people of 52 nationalities, including over 150 postgraduate students. With a network of over 200 industry partners and customers worldwide, Tyndall is focused on delivering real impact from excellent research with a clear strategy to create employment and build critical mass within the international technology space.

Tyndall’s focus is deep-tech, delivering fundamental research outcomes in science and engineering across nano-electronics and photonics. It collaborates with a global network of industry and academic partners to transform research into products in its core market areas of ICT, energy, digital health, agri-food and the environment, and to deliver human and economic impact from excellence in research.

- **VITO (Belgium)**

VITO, Vlaamse Instelling voor Technologisch Onderzoek, is an independent Flemish research organisation that provides scientific advice and technological innovations that facilitate the transition to a sustainable society, and this in the areas of energy, chemistry, materials, health and land use.

The mission of VITO is to accelerate the transition to a sustainable world, to de-risk innovation for businesses and to strengthen the economic and societal fabric of Flanders, with interdisciplinary research and large-scale pilot installations.

The main focus areas of VITO are creating an economy based on sustainable raw materials, in which circularity, bio-economy, water and energy are the main themes; creating solutions that allow for the best possible anticipation of the challenges associated with climate change and other crises; ensuring a sustainable living environment for citizens.

- **VTT (Finland)**

VTT Technical Research Centre of Finland, is a fully state-owned, not-for-profit company with a specific service mandate, VTT is part of Finland's innovation system, and operates under the mandate of the Ministry of Economic Affairs and Employment.

By its public mandate, VTT has a strong societal role. They engage in active cooperation between stakeholders (companies, universities and colleges, research institutes, research funding agencies, ministries, municipal and regional administration) in order to foster regular information flows and a common vision of Finland’s priority areas. They work in close collaboration with industry and highlights the renewal of industrial value chains and sustainable competitiveness in Finland and Europe.

VTT’s research, development and innovation activities are divided into three business areas in which they develop solutions for companies and society. More specifically, VTT develops carbon-neutral solutions for energy, transport, and hydrogen, creates sustainable products and materials through advanced biotechnology and industrial processes, and advances digital technologies including microelectronics and quantum technology to foster a safe, connected society.

Annex 2. Data coverage and quality

Table 14: Data coverage and quality (2021-2022)

	AIT	CEA	DTI	Eurecat	imec	INESC TEC	JSI	NIC	RISE	SINTEF	Tecnalia	TNO	Tyndall	VITO	VTT
Employment	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Turnover	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Costs	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Operational grant	x	x	No operational grants	x	x	No operational grants	x	x	x	x	x	x	x	x	x
Purchases	x	x (aggregate sector distribution for international purchases)	x	x	x	x	x	x	x	x (aggregate sector distribution for international purchases)	x	x	x (aggregate sector distribution)	x	x
Investments in infrastructure	x	x	x	x	X	NA	Total	NA	NA	X	x	x	x	x	x
Government funded research	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Contract research	X	x	x	x	x (aggregate sector distribution)	x	x	x	x	x (aggregate sector distribution for international contract research)	x	x	x (aggregate sector distribution)	x	x
Spin-offs	x	x (only head count)	No spin-offs	x	x	x	x	x	Only list spin-offs	Only headcount 2022	x	Only headcount 2022	x	x	x
Life expectancy of spin-offs	X	x	No spin-offs	x	x	x	NA	x	NA	x	x	x	x	x	x
Outflow of staff	Total, S&T staff, geography and destination sector	Total only	NA	Total, S&T staff, geography and destination sector	Total only	Total, S&T staff, geography and destination sector	Total, S&T staff, geography and destination sector	Total, S&T staff, geography and destination sector	NA	S&T staff, geography and destination sector	Total, S&T staff, geography and destination sector	Total and S&T staff	Total, S&T staff, geography and destination sector	Total and S&T staff	Total, geography and destination sector

Source: IDEA Consult

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