ERA LEARN

COUNTRY REPORT

Estonia

ERA-LEARN:
enabling systematic interaction with the P2P community

September 2022

Project no.	811171
Project acronym	ERA-LEARN
Project full title	Strengthening partnership programmes in Europe
Funding scheme	CSA
Start date of the project	July 1st, 2018
Duration	48 months
Deliverable D5.3	ERA-LEARN Country Report Estonia
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Date of deliverable	September 2022
Dissemination Level	Public

Table of contents

Introduction

ERA-LEARN Country Reports

This is the eighth in a series of ERA-LEARN Country Reports on participation in European R&I partnerships (henceforth referred to simply as 'Partnerships') that are being produced during the course of ERA-LEARN. The previous reports covered Poland, Austria, Spain, Belgium, Finland and Norway, and Germany and the next in the series will cover France[1].

The ERA-LEARN data used in this report mainly refer to public-to-public partnerships that were launched and supported under Horizon 2020. The analyses are based on the data available in the ERA-LEARN database by a cut-off date of May 2022. A number of provisos need to be made when interpreting these analyses. In the first instance, it should be noted that the ERA-LEARN database on Partnerships at the cut-off point was around 75% complete, as not all required information (especially project-related and financial data) had been fully updated by the partnerships. It is also important to emphasise that the data collected in terms of pre-call budget committed or actual investments in selected projects do not take into account differences across countries in the eligibility of certain expenses. In some countries, for example, only additional costs of a research project are eligible, while personnel costs are not. Furthermore, in-kind contributions made by funding organisations when participating in public R&I partnerships – which differ from country to country - are not usually considered national investments in partnerships, although this will possibly change under Horizon Europe.

The country reports provide an analysis of participation and try to explain the 'performance' of a country in public R&I Partnerships within the context of their own national and regional research and innovation systems. Data and analyses stemming from a variety of sources are thus drawn upon. These include the RIO (Research Innovation Observatory) country reports; EU Semester national reports; ERA Progress Reports; the European Innovation Scoreboard and Regional Innovation Scoreboard; Regional Innovation Monitor Plus; H2020 Country Reviews; OECD country reviews; OECD EUROSTAT statistics; special reports by the Policy Support facility; MLE (Mutual Learning Exercise) special reports and national reports on R&I data, policies and strategies.

[1] All the Country Reports are on the ERA-LEARN website https://www.era-learn.eu/documents/documents-listing (by inserting 'country report' in the search phrase).

The goal of the country reports is to provide an overall picture of a country's performance in terms of partnership participation, comparing this not only to EU14[2], EU13 and EU27 averages but also to the performance of a group of comparator countries with similar research and innovation profiles. In the case of Estonia, these are Latvia, Ireland, Slovenia and Norway. The hope is that these reports are useful not only for organisations within the country of interest, which may only have a fragmented picture of the situation but also for organisations in other countries that wish to learn the reasons underpinning the 'position' of a particular country and/or learn from the exemplary performance of other countries.

The Structure of This Report

The report commences with an overview of the Estonian research and innovation system in an international context, as an aid to understanding the environment in which partnership participation takes place. The key R&I funders and performers in Estonia are then identified and areas of R&I strength are described before an analysis of Estonia's research and innovation partnership participation patterns. An assessment of the strengths and weaknesses of Estonia's involvement in partnerships is then presented and the report concludes with a review of a topic of interest for Estonia, specifically, how the partnerships could contribute to the goals Estonia is trying to achieve in Horizon Europe.

Acknowledgements

We owe special thanks to officials from ETAG as well as to individual researchers that shared with us valuable insights, data and information about their experience of participating in public R&I Partnerships under H2020. Overall, 13 interviews were carried out[3] involving people from the following organisations:

- Ministry of Education and Research
- Ministry of Rural Affairs
- Estonian Research Council
- Enterprise Estonia
- University of Tartu
- Tallinn University of Technology
- Tallinn University
- University of Life Sciences

[2] As of 1 February 2020 with the withdrawal of the UK from the EU.

[3] Respecting GDPR rules, the names of the interviewees are not disclosed.

- Vetik OÜ

Special thanks are also due to the ERA-LEARN partner, Optimat, particularly Katrina Watson for supporting data elaboration, and the ERA-LEARN consortium for commenting on earlier versions of the report and helping to improve it.

Key Highlights

Within Horizon 2020 (2014-2020) Estonia has taken part in 51 public partnerships. This is comparable to Latvia and Slovenia with 48 and 43 partnerships respectively but is far lower than the two other comparator countries, Ireland (with 64 partnerships) and Norway (76). However, it exceeds the EU13 average (37) and is very close to the EU27 average (53). However, the country is reluctant to have a coordinator's role in any of the partnerships. The same stands for Latvia and Slovenia, while Ireland and Norway do have some presence as coordinators. (Table 1, Figure 1).

Of the total of 341 calls that partnerships launched in H2020, Estonian ministries and agencies took part in 99, similarly to research funders in Slovenia and higher than the EU13 average, but much less than the number of calls that organisations from Latvia, Ireland and Norway participated in. A slightly different picture emerges with regards to the number of supported projects. This is similar between Estonia and Latvia, while Slovenia's and Ireland's performance scales up and Norway leaves all comparator countries significantly behind. This can be explained by the smaller research communities in these two countries (researchers full-time equivalent - FTE, Table 1). Interestingly, although Estonia presents a much higher R&D intensity[4] than that of Latvia and Ireland, this does not seem to counteract the small number of supported projects (Table 1). This is further explored in the following sections of the report.

Table 1: Participation of Estonia and peer countries in H2020 public European R&I Partnerships including JPIs and selected R&I data

	EE	LV	SI	IE	NO	EU13 aver.	EU14 aver.	EU27 aver.
Number of partnerships	51	48	43	64	76	37	68	53
Partnership participations	55	54	45	74	83	42	115	80
Partnership coordinations				1	3	3	7	7
Number of calls	99	121	99	135	189	91	160	127
Supported projects	92(**)	91	179	207	618	137	708	433
Researchers (FTEs) ('000s – 2014-2020)	4.935	3.661	10.033	23.585	35.046			
R&D Intensity (% GDP-2020)	1.79	0.71	2.15	1.23	2.28			

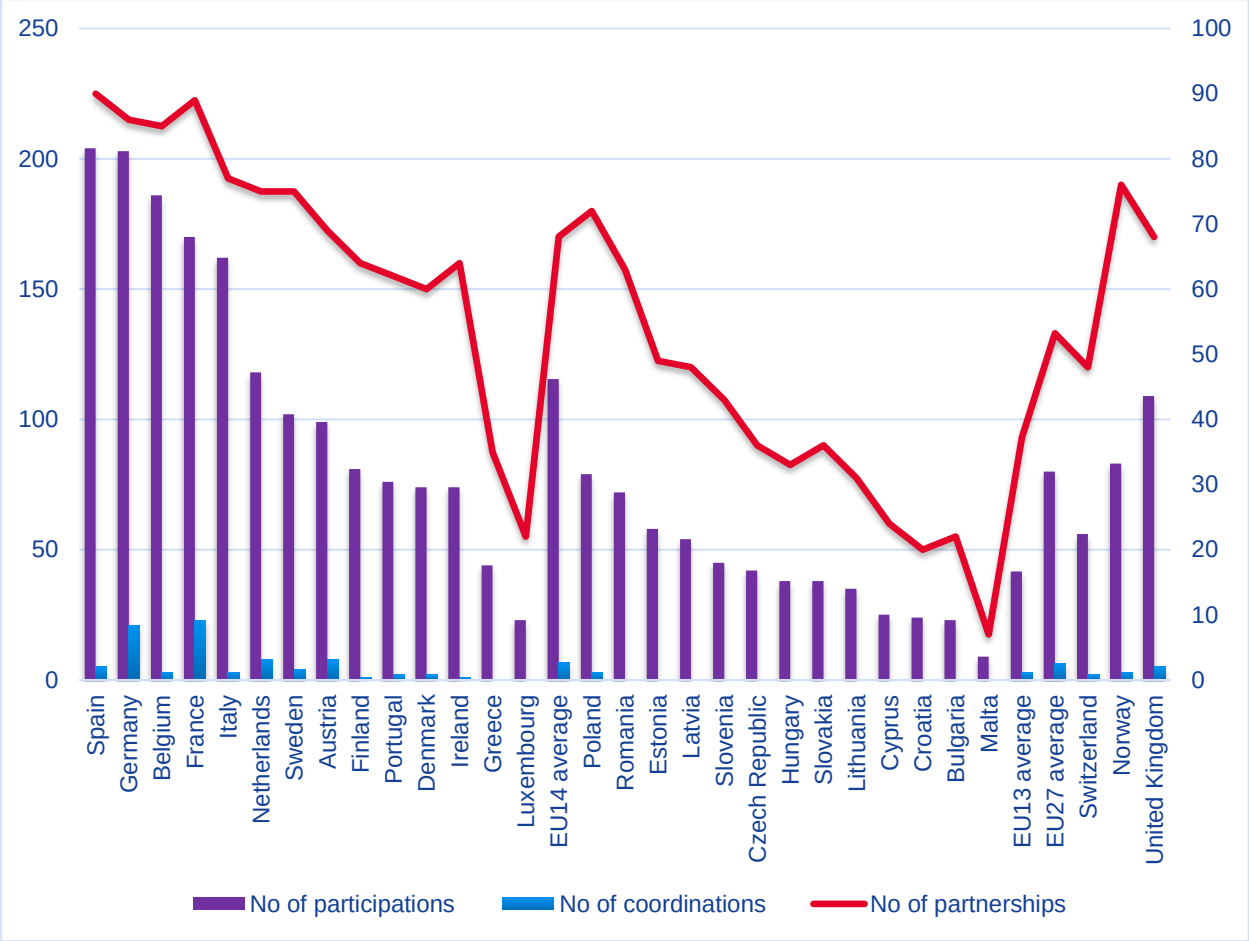
Source: ERA-LEARN database[5] (cut-off date May 2022); Eurostat; JPI data exclude the associated Cofund data

(*) Partnership coordinations: number of partnerships a specific country coordinates. Partnership participations: number of partnerships in which a specific country takes part as participant. Call participations: number of partnership calls in which a country takes part. (**) Based on ETAG and MEM data.

[4] i.e. Gross Domestic Expenditure (GERD) in R&D as share of Gross Domestic Product (GDP)

[5] These figures are actually higher considering that around 25-30% of the financial data of the H2020 P2Ps have still to be updated by the P2P networks in the ERA-LEARN database.

Figure 1: Participations and coordinations of Partnerships by country and number of Partnerships by country in H2020 (including JPIs)



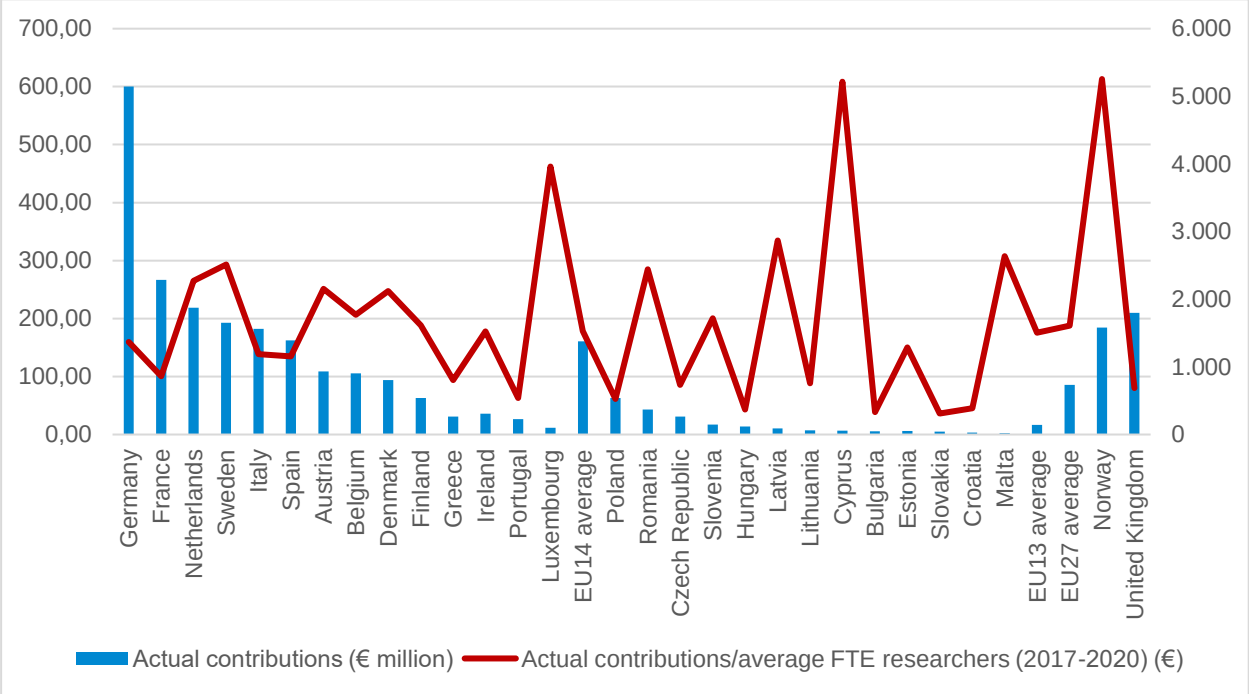
Source: ERA-LEARN database (cut-off date May 2022).
(*) Partnership coordinations: number of partnerships a specific country coordinates. Partnership participations: number of partnerships a specific country takes part as a participant. Total partnership participations: number of partnerships a specific country participates in with any role (i.e. coordinator, participant, observer, other).

Estonia's performance in relation to the actual funds spent to support national researchers in granted projects is rather low. It is the lowest among the comparator countries and ones of the lowest in the EU27. Based on the data of ETAG and MEM, Estonia spent around € 7.3 million in H2020, which is less than half the EU13 average. Latvia, the other country with a small research community in the comparator countries, spent € 10.5 million and Slovenia more than € 17 million. The European Commission's recommendation for Member States is to reach a 5% partnership co-financing level in the national RD budget by 2030, therefore, seems rather optimistic for Estonia Veemaa et al (2021).

According to the views of ministry and agency officials as well as of researchers that were interviewed, the funds allocated to partnerships (€ 100,000 per project and € 150,000 in case of undertaking the role of coordinator) are limited and need to be increased. There are discussions to increase the amount to € 150,000 under Horizon Europe, which is positively received by researchers. In addition, ministries have pledged to increase national co-funding to approx. €3 million per year during Horizon Europe Veemaa et al (2021).

When the contributions are normalised, the average amount spent per researcher is around € 1,500. This is the lowest in the comparator group of countries, only comparable to that of Ireland (€1,524). Slovenia spends around €1.718 while Latvia being fourth in rank in all EU27 countries reaches the amount of €2.868 per researcher. (Figure 2: Actual national contributions, in total (€ million) and per researcher FTE (average 2017-2020) (in €)Figure 2)

Figure 2: Actual national contributions, in total (€ million) and per researcher FTE (average 2017-2020) (in €)



Source: ERA-LEARN database (cut-off date June 2022)
(*) Actual contributions are the funds actually spent by each country to support their researchers in the granted projects.
(**) Actual contributions for each researcher are the total actual funds spent by a country divided by the number researchers in the country estimated in full-time equivalents (FTE). The average is for the years 2017-2020 based on EUROSTAT data.

Based on the available ERA-LEARN data, Estonian organisations are much less acting as coordinators in projects supported by partnerships than their counterparts in the comparator countries. In fact, Estonian organisations coordinate only 2% of the total projects they participate in, while Latvia rises to 15% which is even higher than the share reached by Slovenian and Irish organisations with 11% and 12% respectively. Norway is the leader in the group by taking the coordinator's role in almost 29% of the supported projects. Most of the coordinators are higher education institutes and public research organisations in Estonia, Latvia and Ireland. The exceptions are Norway and Slovenia where more than 60% are private entities (large enterprises including SMEs and R&D performing SMEs).

Overall, the impact of participating in R&I partnerships has been positive at various levels. At the policy level, taking part in the programme activities of partnerships has enabled the development and alignment of the thematic priorities for Estonia (and for the EU) with other Member States Veemaa et al (2021). It has also resulted in better national coordination among various ministries and agencies involved in R&D and developed new national-level structures for funding, e.g. the Estonian Environmental Investment Centre is planning a dedicated funding tool to co-fund partnerships (in the environmental field) (Country Fiche Estonia, BMR 2022). At the researchers' level, the opportunities offered for international collaboration are highly appreciated. The

networking and building of consortia that sometimes last even after the projects' lifetimes are valuable.

Estonia has a strong international profile compared to other EU13 countries and the expertise in certain areas, e.g. medical and health sciences, including personal medicine and genetics is widely acknowledged. It is common belief that there are challenges that cannot be tackled by any single country alone, and international collaboration is key especially for a country with a small research community like Estonia. It is also acknowledged that partnerships provide a valuable space for mutual policy learning and for shaping and aligning policies in relation to research and innovation, and thus strengthening the ERA.

1. Estonian Research and Innovation in an International Context

According to the OECD Estonia Economic Snapshot[6], Estonia managed to tackle the pandemic shock better than its peers thanks to a large, timely and effective policy response to mitigate the COVID-19 shock. This resulted in a GDP contracted by only 2.7% in 2020, while the implications of the second wave at the beginning of 2021 did not put the recovery on hold. Yet, after a robust expansion in GDP growth in 2021, this is now expected to slow to 1.3% in 2022 and 1.8% in 2023, owing to the war in Ukraine.

The great performance of the country in digital governance and innovation was one of the reasons that helped the country address better the sanitary and economic shock from the pandemic. Indeed, based on the European Innovation Scoreboard 2021[7], Estonia is a strong innovator with a particularly strong performance over time. The strong points of Estonia relate to Linkages, Innovators and Intellectual assets, with the top-3 performing indicators being Trademark applications, Innovative SMEs collaborating with others, and Non-R&D innovation expenditures. As the EIS 2021 report on Estonia mentions the improvements are mainly seen in indicators that have to do with innovation, in particular, product innovators (an almost fivefold increase from 10.2% to 48.9%) and business process innovators (an almost triple increase from 18.0% to 52.5%).

The country's gross expenditure in R&D (GERD) as a share of GDP is 1.79 (figure 3) which is greater than that of several EU13 countries as well as some EU14 countries like Greece, Ireland and Italy. In the comparator group of countries this performance is higher than that of Latvia and Ireland but less than Slovenia and Norway. A similar situation appears in relation to the business expenditure in R&D (BERD). The business R&D intensity in Estonia (0.98% of GDP in 2020) is relatively low compared to the EU27 average (1.44%), although it supersedes that of several EU14 countries including Ireland (0.91%), Italy (0.93%), Spain (0.78%) or Portugal (0.92). However, the target that at least two-thirds of the gross expenditure in R&D should come from the business sector is a rather long shot with the share of GERD funded by the business sector accounting only for 49% (2019 value).

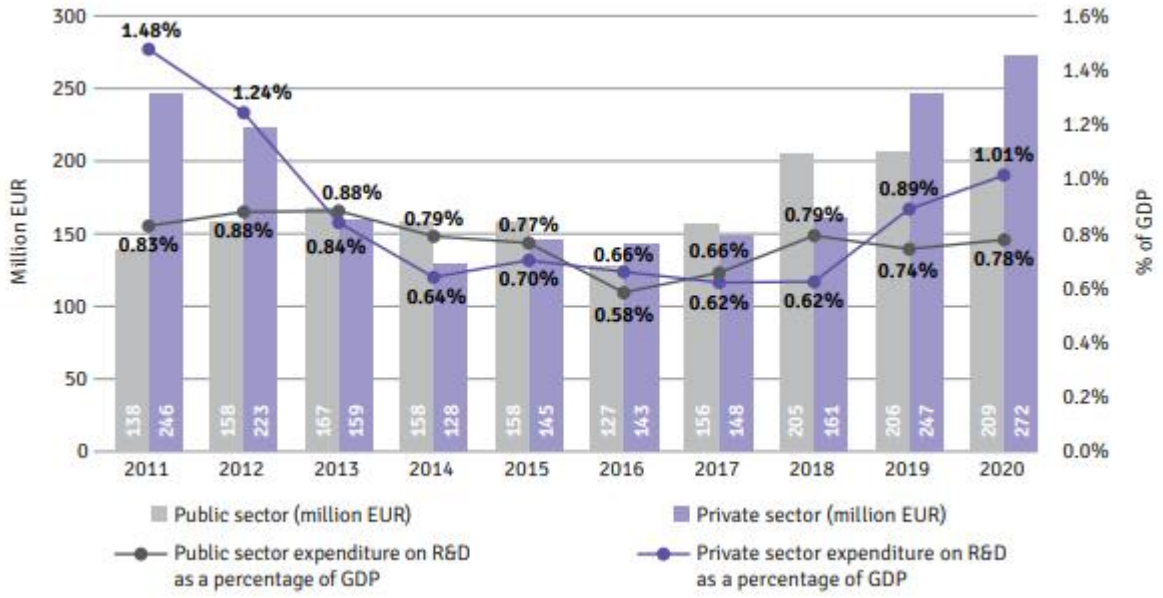
As stated in the ETAG's publication, Estonian Research 2022, the level of R&D expenditure in Estonia in the last five years has presented an upward trend, with the private sector showing a particular increase compared to the growth of public sector expenditure (including state and higher education institutions) is particularly positive. Private sector R&D investments have once again exceeded the volume of public sector investments since 2019. Public sector expenditure is still largely dependent on measures funded by the Structural Funds.[8]

[6] https://www.oecd.org/economy/estonia-economic-snapshot/

[7] https://ec.europa.eu/info/research-and-innovation/statistics/performance-indicators/european-innovation-scoreboard_en

[8] Estonian Research 2022, ETAG, Estonian_Research_2022.pdf (etag.ee)

Figure 3: Gross domestic expenditure on R&D in Estonia as a percentage of GDP from 2011 to 2020

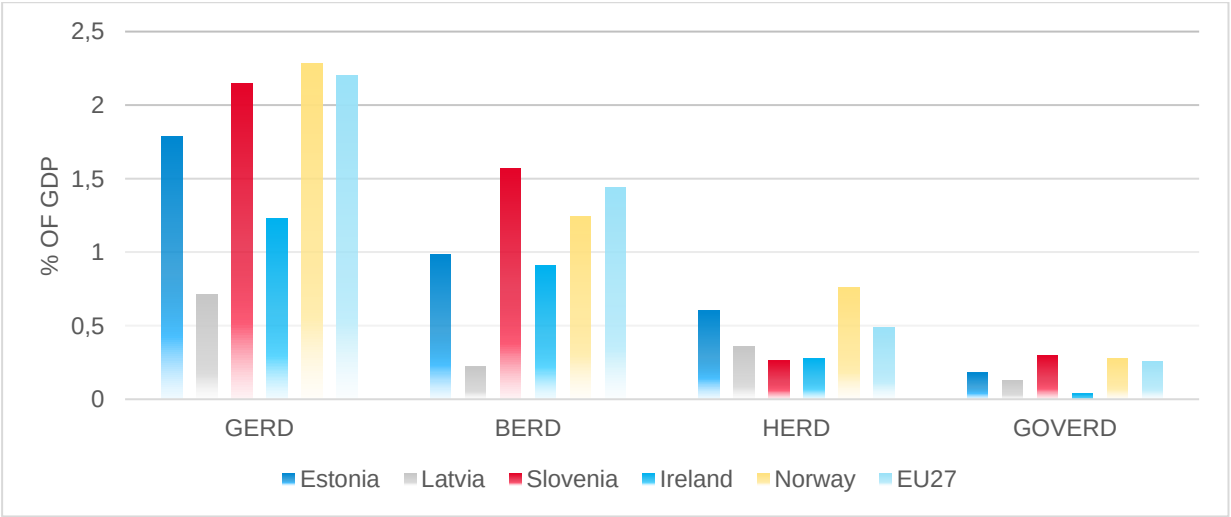


Source: Estonian Research 2022, p.13.

The expenditure of the Higher Education sector in R&D (HERD) as a share of GDP, however, is rather high, surpassing all benchmark countries as well as the EU27. The Estonian government sector also accounts for a part, although small, which however is larger than that of Latvia and Ireland. (Figure 4)

The priorities of the country concerning research and innovation are set in the Estonian Research and Development, Innovation and Entrepreneurship Strategy 2021-2035. These include digital solutions across all areas of life; health technologies and services; valorisation of local resources; smart and sustainable energy solutions; and a viable Estonian society, language and cultural space.

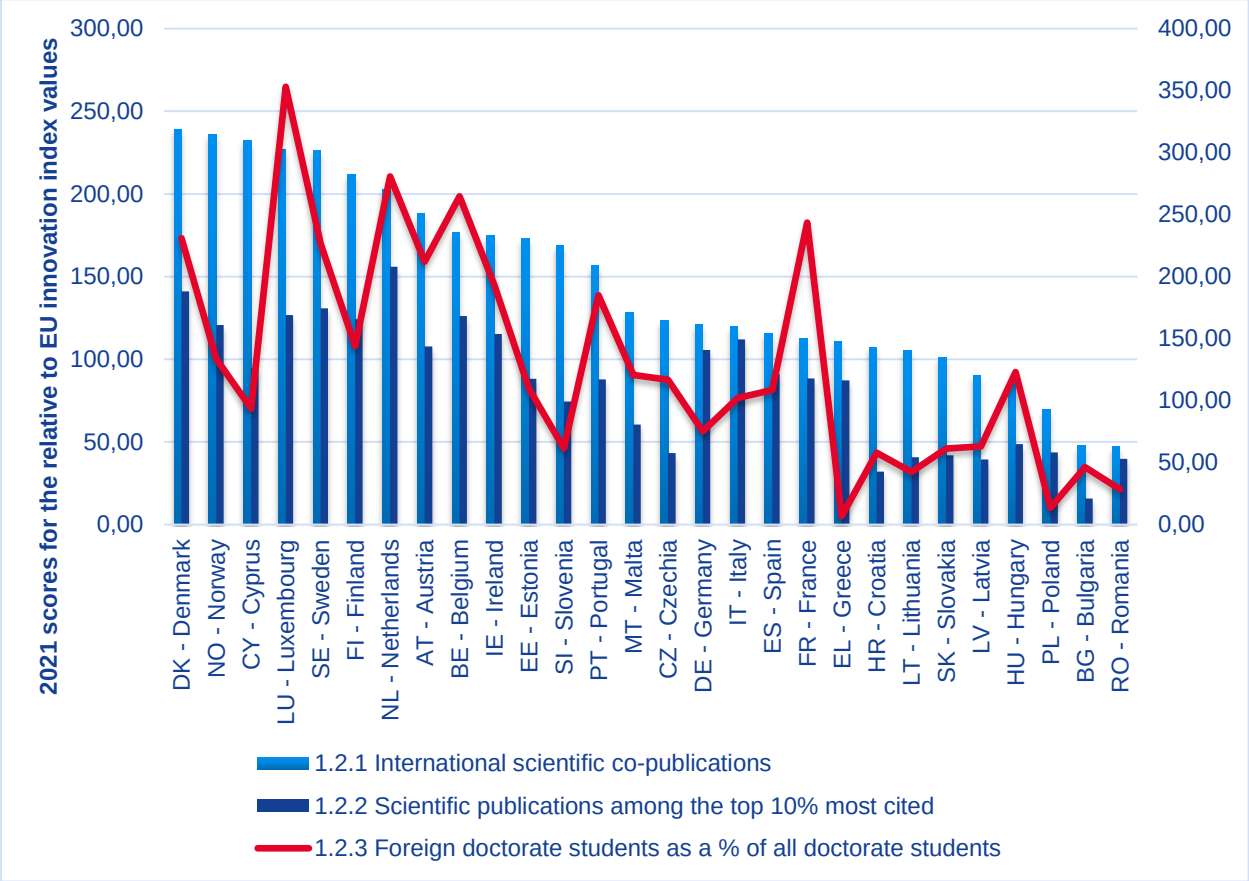
Figure 4: Main R&D indicators for Estonia and the comparator countries and EU27 averages (2020)



Source: OECD

The ‘attractiveness’ of the Estonian research system[9] is relatively medium in the European Innovation Scoreboard 2021. In detail, Estonia ranks 11th among the EU27 countries plus Norway concerning ‘international co-publications per million population’ but falls to the 15th place in terms of ‘scientific publications among the top 10% most cited’ and ‘foreign doctorate students as % of total doctorate students’ (Figure 5).

Figure 5: EIS 2020 indicators for ‘Attractive research systems’



Source: European Innovation Scoreboard 2021. Elaborated using the data provided at https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis

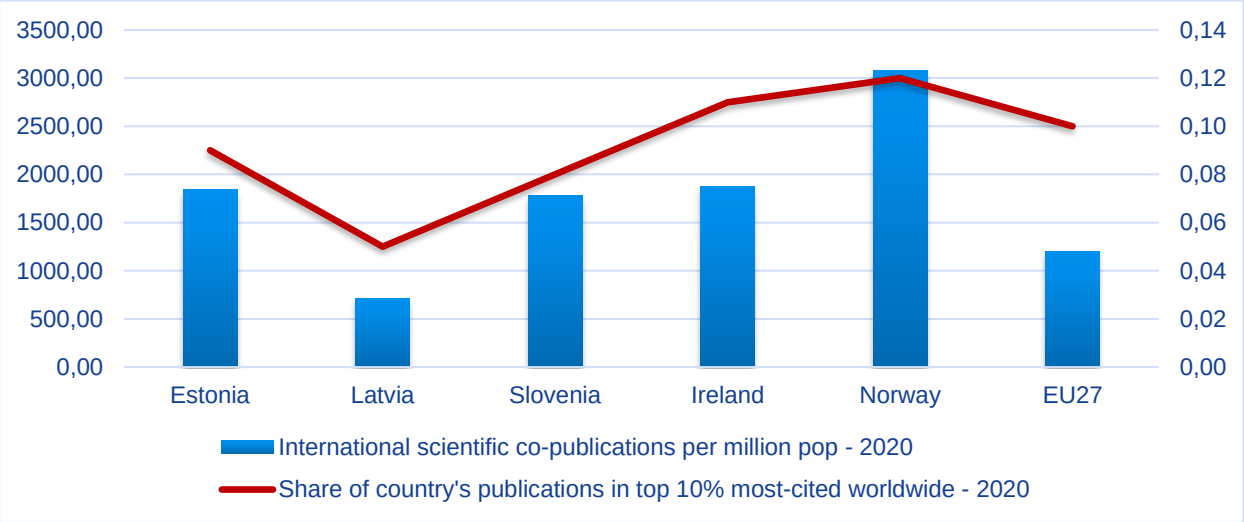
Compared to its peers, Estonia surpasses Latvia in all three indicators and holds a moderate position with Slovenia and Ireland in relation to international scientific co-publications. This is rather remarkable concerning the small research community of the country. The share of the country’s publications in the 10% most-cited ones worldwide is also good, comparable to that of Slovenia and Ireland and very close to the EU27 average (Figure 6). At the same time, in relation to the two other EU13 countries included in the benchmark group, Estonia presents the highest share of foreign doctoral students (17.29%) while not being that far away from the EU27 average (18.73%) or even Norway (21.07%). Indeed, based on Statistics Estonia, the number of foreign

[9] Attractive research systems includes three indicators and measures the international competitiveness of the science base by focusing on International scientific co-publications, Most cited publications, and Foreign doctorate students (EIS 2020 Methodology report.pdf); https://interactivetool.eu/EIS/EIS_2.html

researchers in non-profit institutional sectors has almost doubled between 2017 and 2021 (from 502 to 928).[10]

Research mobility support, including for incoming foreign researchers, was provided by Mobilitas Pluss programme[11]. This included support for ERA-Chairs, incoming postdoctoral researchers and top researchers. Although the programme is about to finish, the measures to attract foreigners paid off and the mobility support for incoming foreign researchers will continue in the new period (2012-2028).

Figure 6: EIS 2020 indicators for 'Attractive research systems' for Estonia and the comparator countries



Source: European Innovation Scoreboard 2021

The main strategic framework for the participation of Estonia in the H2020 has been the National RDI Strategy 2014-2020 "Knowledge-based Estonia" (approved by the Parliament in 2015). The strategy encompasses Article 185, JPIs, JTIs, KICs of the EIT, FET partnerships, objects on the roadmap of ESFRI, and ERA-NETs. The participation[12] in partnerships is regulated by the "Strategic Framework for Estonia's participation in the research, development and innovation partnerships of the EU". This document, which was adopted on 05.02.2015 by order of the Government of the Republic, lays out the principles and preconditions for participating in the research and development partnerships of the EU and enables the public sector's coordinated participation in H2020. It is renewed yearly or as needed.

In addition, joining with the Horizon Europe partnerships, missions, and in other international RDI initiatives is regulated "Strategic Framework for Estonia's participation in the international RDI initiatives EU" (adopted in on 31.08.2021 by Government's Research and Development

[10] https://andmed.stat.ee/en/stat/majandus__teadus-tehnoloogia-innovatsioon__teadus-ja-arendustegevus__teaduse-uldandmed/TD053/table/tableViewLayout2

[11] https://etag.ee/en/funding/mobility-funding/

[12] The participation framework indicates the participation and financial contributions by each partnership via each call (see the box in p.20), while the framework for joining the RDI initiatives regulates at strategic level which initiatives Estonia joins.

Council[13]). The Strategic Framework is part of the Research and Development, Innovation and Entrepreneurship Strategy 2021-2035, which places special emphasis on improving the position of Estonia in the EC Framework Programmes including partnerships to the level that Estonia becomes a leading country also taking the role of coordinator and/or initiator of Partnerships. At the same time, emphasis is placed to make Estonia an attractive pole for foreign researchers. Particularly, the vision for 2035 as defined in the Strategy specifies that…

> *(By 2035) ...Estonian researchers will have achieved outstanding results, will be valued partners in society for both enterprises and policymakers, and will be active and recognised participants in international knowledge networks. (RDIE Strategy 2021-2035)*

Relevant actions that have been set in this direction refer to supporting the participation of enterprises in international (CERN, ESA, etc.) and EU-wide partnerships and networks (action 1.6); creating incentives for research institutions, their support structures and researchers to take the lead in international networks, programmes and partnerships, including for cooperation with third countries (action 3.1); providing support for the preparation of collaborative research projects with external enterprises and for the export of research results, and develop the capacity of research teams to fulfill high-tech orders (Action 3.2); and continue to develop and monitor a strategic engagement plan to identify priorities and decision-making mechanisms for international research cooperation, in line with the RDIE focus areas (Action 3.3.).

Further strategic documents showing the strong emphasis placed by Estonia on internationalisation include the Estonian Research International Marketing Strategy 2016–2022[14] and the Internationalisation Strategy of Estonian Higher Education for 2015-2020[15].

Accordingly, the goals of Estonia for Horizon Europe as stated by ETAG officials are:

- *To maintain a high level of funding (measured per capita)*
- *To broaden participation – involve (besides universities and R&D institutions) more enterprises, non-profit societies, public-sector institutions, sectoral ministries, local governmental bodies, etc.*
- *To take leadership and coordinating role in project consortia*
- *To be successful in applying for calls in excellent science pillar*
- *To contribute to solving global societal challenges*

[13] https://www.riigikantselei.ee/en/supporting-government-and-prime-minister/councils-and-comittees/research-and-development-council

[14] https://www.etag.ee/wp-content/uploads/2015/11/Teadusagentuur_dokument_eng.pdf

[15] https://info.i-graduate.org/case_study/estonias-text-book-internationalisation-strategy

In summary, Estonia is a strong innovator with particularly strong performance over time and with an upward trend in the R&D expenditures mainly due to the private sector. The country also has a good standing compared to its peers in relation to international co-authorship and attractiveness of foreign researchers. Yet, the major feature that stands out is the strong commitment to internationalisation as demonstrated in the recent RDIE strategy and vision statement. Whereas, Estonia has yet to exploit the benefits of the European R&I partnerships to the full, it certainly enjoys the key factors and appropriate measures to make this possible in the future.

2. Who are the key R&I funders in Estonia?

The main body for the design, implementation and evaluation of R&D policy in Estonia is the Ministry of Education and Research (HTM). Policy design and support for innovation lie under the responsibility of the Ministry of Economic Affairs and Communication (MKM). At the operational level, both MKM and HTM have implementing agencies and intermediaries. The main implementing body under the MKM is the Enterprise Estonia Foundation, which is responsible for managing business support, innovation and technology programmes. The Ministry of Education and Research has two main agencies that among their other activities deliver funding and support. The Estonian Research Council (ETAG) was established in 2012 to concentrate the funding of R&D and achieve better functioning of the financing systems. ETAG is the main funding organisation for R&D, consolidating different grants and types of funding and giving research more visibility in society. Estonia's Education and Youth Board (HARNO)[16] administers schemes for improving mobility and marketing Estonian higher education and research abroad. HARNO also manages a range of programmes and support measures in the fields of lifelong learning and active labour market policies.

The Ministry of Education and Research was advised by the Research Policy Committee, and the Ministry of Economic Affairs and Communications was advised by the Innovation Policy Committee during the previous R&D Strategy period (until 2020) and during H2020. In the new R&D Strategy, HTM is advised by a joint RDIE steering committee.[17] The overall research strategy, which is based on the Research and Development Organisation Act is approved by the Parliament, and once a year the Parliament considers the Prime Minister's report on the execution of the strategy, as well as the state budget for research.[18] In preparing the R&D policy, the government is advised by the Research and Development Council[19], comprising four ministers and eleven members appointed by the government.

The new Horizon Europe partnerships are more strategic and ambitious and request larger financial commitments as well as an interdisciplinary approach to addressing research. This means that diverse research funders and ministries are well placed to get involved. A couple of years ago all the sectorial ministries were enabled by law to have their R&D budget and be responsible for spending it in their areas of interest. Yet, they are not as experienced in recognising opportunities and benefits of international collaboration, and efforts are still needed in this direction.

[16] https://harno.ee/en

[17] https://www.hm.ee/sites/default/files/estonian_rdi_strategy_2014-2020.pdf

[18] https://researchinestonia.eu/research-landscape/

[19] The Research and Development Council | Riigikantselei

The ministries that have mainly been involved in partnerships until now are the Ministry of Education and Research, whose funds are channelled through ETAG, and the Ministry of Rural Affairs, which is well connected internationally and even has a specific internationalisation strategy. Other relevant ministries with R&I budgets include the Ministry of Social Affairs, Ministry of Economic Affairs and Communication, and the Ministry of Environment. However, their involvement in partnerships has been limited, but this is expected to change in Horizon Europe. Overall, Estonian Ministries have committed around €27 million in Horizon Europe Partnerships and another €5.55 million is earmarked for the second wave of Horizon Europe Partnerships. Compared to the funds spent in H2020 partnerships that reach €7 million, this is a remarkable increase.

In Horizon Europe, the process of deciding on which partnerships to take part at country level[20] is based on the Framework for participating in international research, development and innovation initiatives, which is part of the RDIE strategic management and defines the fields of international R&D cooperation that are strategically important to Estonia. First, the candidate partnerships and any other R&D initiatives have to be aligned with the national priorities in the RDIE strategy, which has five focus areas as discussed earlier. Alternatively, they should be aligned with the national sectorial strategies (e.g. in agriculture, forestry, etc.). Thirdly, if they are not well aligned with the existing strategies either, then there should be good arguments in favour of participating in the partnership backed by interest and capacity expressed by the researchers. The opinion and interests of the research organisations are usually reported by email. Similar exercises of recording interest and capacity to take part in particular partnerships are also done by other ministries and the Ministry of Education and Research then consolidates the results. The level of the funds Estonia commits for each partnership is proposed by the ministries and taken by the government based on the advice of the Research and Development Council[21] (advisory council to the Prime Minister).

The new decision-making process followed for selecting which partnerships to join is described in the box below along with the selection criteria and preconditions that have to be ensured. A big change in this process was the creation of positions of scientific advisors[22] in the ministries, hired and trained by the ETAG. Their interaction with the research community and the policy community at the same time made it easier for the ministries to understand the needs of the researchers and the importance of the partnerships. At the same time, it helped break the silos among the ministries and supports evidence-based policy making.

[20] This applies only for those partnerships that need country commitment, i.e. mainly co-funded ones.

[21] The Research and Development Council | Riigikantselei

[22] Scientific advisers at the Ministries and the Government Office: RITA3 - Estonian Research Council (etag.ee)

Decision-making process in Estonia for participation in HEU RDI partnerships

1. **Estonian Research Council** consolidates and transmits information on EU RDI partnerships to the sectoral ministries, research institutions and Enterprise Estonia.

- Sectoral ministries make a selection based on the objectives and needs of their government areas. Ministries commit to cover entirely or partly the expenses arising from participation.
- Research institutions submit justified proposals and participation requests.
- For initiatives requiring the participation of enterprises, Enterprise Estonia submits consolidated proposals.

2. **Estonian Research Council** consolidates the proposals, draws up a proposal for Programme of Participation in view of the participation criteria and the available funding, and submits this proposal to the **Committee on Research Policy** for review.
3. **Committee on Research Policy** reviews the proposal for Programme of Participation drawn up by Estonian Research Council, advises on strategic selection, and adopts an advisory opinion on the Programme.
4. The Board of **Estonian Research Council** approves the Programme of Participation and ensures its availability to the public.

Selection criteria: Participation should

1. contribute to the tackling of socio-economic problems for which Estonia's own resources are insufficient and which require international cooperation in order to be solved;
2. further the objectives of the sectoral development plan, facilitates rapid development in the sector, drives further development or enables implementation changes with notable qualitative impact;
3. further the objectives related to the development of the society, economy and science, and facilitates capacity building of research and development institutions and institutions of higher education to serve the interests of the society and economy;
4. be necessary for the development of competencies and supports internationalisation and research excellence.

Preconditions for participation:

- Estonia has adequate capabilities and capacities (in academic, business and/or government sector) for successful participation in research and development partnerships of the EU;
- Generally, the precondition for joining the European Strategy Forum on Research Infrastructures (ESFRI) objects is that the research infrastructure is included on the list of the Estonian Research Infrastructure Roadmap;
- Initiatives that are aimed at coordinating the RDI activities between countries and require the availability of the relevant national action programme will be supported provided that the respective activity has been planned as part of research activities of the ministry responsible for the sector.

Involvement of different ministries (scientific advisors)

Scientific advisors at sectoral ministries help to engage ministries

- Participation in preparing the Programme of participation also helps the ministries to formulate their research priorities
- Ministries are encouraged to participate in partnerships – particularly ERA-NETs (incl. as co-funders with ETAG)
- Being involved in ERA-NET Cofunds is a stepping stone for ministries in international research cooperation and helps them to set longer-term research priorities
- This has enhanced ministries' involvement in coordinating H2020 actions and input into Estonian FP9 positions

Based on the interviews, a strong coordination structure is important with the authority to decide and make recommendations to the ministries if they seem to be missing opportunities. This issue is being discussed at the moment with a new law being developed on the organisation of the national R&I system, also addressing the creation of a high-level coordination structure.

Furthermore, to secure sufficient national funding for ERA-NET participation, the Estonian Research Council in cooperation with the Ministry of Education and Research developed a new co-funding model engaging both the ETAG and sectorial Ministries. For ERA-NET topics that overlap with national priorities, the Estonian Research Council offers co-funding provided that the sectoral ministry also allocates funding to the specific ERA-NET. The specific co-funding model has been quite successful and was considered good practice in the MLE exercise on alignment[23]. Yet, a key challenge has been that budget allocations for RDI vary considerably across ministries. Consequently, in some ERA-NET topics, there is hardly any national budget available. Another issue is how to set clear funding shares between the ministry, the Estonian Research Council and the EU for each ERA-NET call.

Based on the ERA-LEARN data, the most active funding agencies in participating in public R&I partnerships include:

- Estonian Research Council (ETAG) under the Ministry of Education and Research (HTM)
- The Ministry of Rural Affairs (MEM)
- Enterprise Estonia under the Ministry of Economic Affairs and Communication (MKN)[24]

These organisations are presented below including insights from conducted interviews.

[23] https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/mle-alignment-and-interoperability-national-research-programmes

[24] All the mentioned organisations were contacted with a request for an interview – the Ministry of Economic Affairs and Communication did not respond. However, Enterprise Estonia responded which is the main agency for managing participation in partnerships, thus providing insights about the perspective of MKN as well.

2.1. Ministry of Education and Research (HTM)

The Ministry of Education and Research together with the scientific advisers at sectoral ministries and with the Estonian Research Council coordinate the country's international participations. As presented earlier, each ministry has a particular budget line including also ESIF and national funds. This budget is also covering R&I expenses and, thus participation in partnerships and other international collaborative initiatives in R&I.

Based on HTM officials, until now it was believed that the Ministry of Education and Research should primarily cover the country's participation in international and intersectoral initiatives, and the sectorial ministries have not been coordinating their support to participation in R&D partnerships in a coherent manner. In addition, synergies were limited across the various strategies of the ministries. This is now slowly changing while understanding is also improving at the sectorial ministries on what constitutes relevant R&I activities to support.

Besides being responsible for the RDI strategy of the country and coordination its international participation, HTM is also financially supporting the training and networking of researchers through seminars and events organised by ETAG where researchers can increase their capacity and knowledge on how to find partners, where to look for information, etc. This is done through support measures under the Mobilitas programme managed and implemented by ETAG[25]. These activities are crucial in helping Estonian researchers build the capacities and knowledge needed to improve their performance in international R&I activities.

Participating in partnerships has several positive impacts. It helps raise the excellence level and international standing of Estonian researchers, as well as the prestige of Estonian research.

> *"As a small country, we cannot achieve excellence in research being limited within our borders. If we want researchers to master their research fields, we need to support them to be more visible and gain from counterparts at the international level. If the researchers are more visible and our institutes are more attractive, then the country itself also benefits having more power in discussions and being considered more in decisions." (HTM officials)*

A possible negative effect relates to the danger of brain drain. Therefore, improving the attractiveness of the Estonian universities and institutions, which is simultaneously being addressed by Estonia, is very important.

Additionally, Estonia has to face financial challenges in further strengthening its international position. As a small country the level of available resources for R&I are limited (Table 2). Only a couple of years ago it was decided to spend 1% of GDP in R&I. The use of ESIF in funding

[25] Mobilitas Pluss - Estonian Research Council (etag.ee)

participation in partnerships has also been limited due to the restrictions in using ESIF or ERDF funds in ERA-NET co-funded calls. It is encouraging that in Horizon Europe this possibility is being more effectively addressed at the EC level.

Table 2: Types of R&D funds available in Estonia (2016-2022)

	Volume (mln EUR)							Proportion (%)						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Grants	37,9	39,4	40,2	40,6	42,7	46,3	52,3	29%	29%	27%	24%	24%	23%	24%
Baseline funding	13,9	16,9	26,9	39,1	42,5	46,3	52,3	11%	12%	18%	23%	24%	23%	24%
ESIF Funds	63,6	63,4	62,7	74,9	70,4	66,4	57,9	48%	47%	42%	44%	40%	33%	26%
Others	16,4	16,2	21,2	16,4	19,4	43,7	56,2	12%	12%	14%	10%	11%	22%	26%
Total:	132	136	151	171	175	203	219	100	100	100	100	100	100	100

Source: HTM

On the positive side. The new landscape seems to be much more streamlined and clearer. There are less partnerships and although they are larger as structures, the overlap is less and thus expressing interest and deciding where to take part is easier.

REPUBLIC OF ESTONIA
MINISTRY OF RURAL AFFAIRS

2.2. Ministry of Rural Affairs (MEM)

MEM officials state that it is widely acknowledged that international collaboration offers many possibilities.

> *"The networking achieved is very important and this is beneficial for both researchers but for policy-makers and civil servants. The researchers improve their capabilities and benefit from access to knowledge and research infrastructures. The civil servants update their knowledge of developments at the European level, and of the development plans and strategies of other countries. This is important." (MEM officials)*

The ERA-NETs that MEM takes part in need to be aligned with the national priorities in the agri-food sector. The ERA-NET with the longest presence of Estonian researchers has been CORE ORGANIC. Another area of great attraction to Estonian researchers is sustainable natural resources management and increased value added from the agriculture and food sectors. The ERA-NETs with the highest success rates (=<50%) are SUSFOOD 2, SusCrop, AGRI-FOOD and ICRAD. (Table 3)

Table 3: Estonian participation in partnerships under H2020 (2014-2020) managed by MEM

Partnership calls	pre-proposals with Estonian participation	Full-proposals with Estonian participation	Granted projects with Estonian particip	Success rate (no projects/ full-proposals)	National budget committed by agency	Actual agency budget spent in granted projects
ERA-NET Cofund FACCE Surplus	6	6	2	33.33%	300,000	195,000
ERA-NET Cofund SusAn	0	0	0		100,000	0
ERA-NET Cofund SusAn, ERA-GAS, ICT-Agri joint call	1	1	0	0.00%	100,000	0
ERA-NET Cofund SusAn, SusCrop, ERA-GAS, ICT-Agri	3	3	1	33.33%	100,000	100,000
ERA-NET CORE ORGANIC Cofund	11	10	2	20.00%	200,000	198,100
ERA-NET CORE ORGANIC Cofund and SUSFOOD2 joint call	3	1	0	0.00%	100,000	0
ERA-NET SUSFOOD2	6	2	1	50.00%	100,000	86,644
ERA-NET SUSFOOD2 and FOSC joint call		4	0	0.00%	100,000	0
ERA-NET Cofund SusCrop	17	6	3	50.00%	200,000	230,638
ERA-NET Cofund SusCrop and JPI FACCE joint call	3				100,000	
ERA-Net ICT-Agri-Food	5	3	2	66.67%	100,000	100,000

ERA-Net BlueBio	3	3	ongoing		100,000	
ERA-Net ICRAD	4	2	1	50.00%	100,000	90,100
Grant Total	62	41	12	29.27%	1,700,000	1,000,482

Source: elaboration of MEM data

MEM enjoys good collaboration with other research funders in Estonia, e.g. ETAG and other sectoral ministries. Evidently, in Horizon Europe partnerships, this cooperation will be further intensified. Communication with the research community in the agro-food area is regular. Researchers are invited to provide views on strategies and development plans. Yet, the choices are limited by the level of available resources.

> *"We have to carefully decide where to put money on and whether it'll be national or international programmes, we need to strike a balance there." (MEM officials)*

The research community is small, and thus not many applications are submitted in each call. Yet, the researchers need to be more encouraged to take the lead role in research projects. This will be further facilitated with higher funding for the projects and efforts to increase the experience of project management for researchers.

> "*When Estonian researchers take the leaders' role in projects they become trend-setters of the latest evolutions and state-of-the-art in their area and this can also help Estonia as a country by bringing in their knowledge about the future in their field. (MEM officials)*

In this regard, MEM organises seminars where researchers come together with advisory services and civil servants. In these seminars, results of finished ERA-NET projects are presented, views are shared of positive and negative impacts, researchers that took up the role of coordinator share their experiences to encourage others to follow their example, and topics of interest of researchers are also discussed. Calls for proposals are advertised once launched via direct emails to relevant research institutes and departments of the universities, as well as social media.

The interest is high and the benefits are much appreciated both by researchers and policy-makers. The creation of networks between researchers and between civil servants is valuable as is the experience gained in managing participation in partnerships.

> *"There are good examples of joint calls where our experience in ERA-NETs proved to be useful. Such a case was the joint call with Finland on cross border European Innovation Partnership operational groups under the Rural Development Plans support measure in the Common Agricultural Policy. We had to synchronise the timing, regulations, etc and the experience in ERA-NETs proved very useful… Close co-operation also helps to keep us updated on sectoral developments, which is a good starting point for local policy-makers (especially ministries), for example in drawing up national strategies…." (MEM officials)*

International scientific cooperation has increased Estonian researchers' capacity through the possibility to exchange data, and research infrastructure, and improve knowledge and competencies.

"Researchers say that they increase their contacts abroad through the partnership projects and get into ways to do new research. This is highly appreciated by them. They see international collaboration as a starting point to have more projects in new topics and find new colleagues." (MEM officials)

However, the funds allocated to international collaboration are limited. MEM funds research projects (national and international) under the applied research programmes (Table 4). Until now, around one proposal per call has been funded (max €100,000 for partners,), although there might have been more highly ranked proposals. If ETAG is also a funder in a call it also funds one or two additional proposals (with up to €150,000 if the Estonian project partner takes the lead role). The plan for 2022 is to allocate 2.6 million for research projects; less than 500,000 of those will be available for international collaboration.

Table 4: Programmes funded by the state budget and managed by MEM between 2012-2020 (€)

Year	RUP		SORT	GR	Sum
	including ERA-Net projects	including National projects			
2014	69,833	1,038,853	557,947	191,416	1,858,049
2015	220,887	671,845	557,947	241,416	1,692,095
2016	279,000	717,516	557,947	250,197	1,804,660
2017	300,296	615,362	557,947	253,817	1,727,422
2018	305,109	498,427	657,947	272,917	1,734,400
2019	184,862	625,612	1,130,737	401,606	2,342,817
2020	236,722	712,204	1,130,738	401,600	2,481,264

Source: MEM
RUP - programme "Applied Research and Development in Agriculture in 2015-2021" and its previous programme. The programme funds national projects and ERA-Net projects.
SORT - "National Programme for Plant Breeding from 2009-2019" and "Plant Breeding Programme 2020-2030".
GR - "Collection and Conservation of Plant Genetic Resources for Food and Agriculture in 2014-2020"

The application and reporting processes are kept simple and the efforts that need to be put by coordinators/researchers are minimum. Proposals are submitted to the call secretariat and the funder only conducts an eligibility check. For project reporting, it is required to submit a copy of the reporting that is submitted to ERA-NETs. The only additional task asked by MEM is a short description of the progress at the end of each year, which is needed to help MEM officials to monitor the projects.

Under Horizon Europe, Estonia has chosen to take part in all new partnerships under Cluster 6. MEM is interested in "Rescuing biodiversity to safeguard life on Earth", "Blue Economy", "Accelerating farming systems transition: agro-ecology living labs and research infrastructures", "Animal health: Fighting infectious diseases", "Safe and Sustainable Food System for People, Planet & Climate", "Circular bio-based Europe: Sustainable, inclusive and circular bio-based solutions", "Agriculture of Data". In Cluster 1 MEM is interested in the partnerships "Chemicals risk assessment" and "One Health / Antimicrobial Resistance". Efforts need to be oriented towards encouraging researchers to take up a more leading role and to more effectively address the challenge of finding the right balance in the support of national and international programmes. At the same time, it is important to keep the management burden as low as possible on the side of the partnerships.

2.3. Estonian Research Council (ETAG)

Until now, the main Estonian partner in European partnerships has been the Estonian Research Council (ETAG). ETAG advises the sectoral ministries on which partnerships to join, coordinates the whole process of decision-making and also consolidates and monitors participation by collecting and analysing relevant data.

ETAG and its predecessors have been funding research projects in partnerships as early as 2006 and have successfully used ESIF in additional calls through the Mobilitas Plus program. On average, ETAG contributes 100,000 - 150,000 euros to each joint call, which covers the costs of the Estonian participants in the project consortium. The usual case is that one project is funded per call, although there have been cases where more than one project was funded (Veemaa, et al. 2021) mainly due to the EU top-up funding as stated by ETAG officials.

Based on ETAG data, the calls where Estonian participants have been most successful in H2020 partnerships (=<50% success rate, Table 5) are under the partnerships Blue Bioeconomy, ICT-AGRI-FOOD, SusCrop, FLAG-ERA II, ERA-MIN3, ENUTC, ERA-CVD, and JPIAMR. This confirms the interest and excellence of Estonian researchers in the areas of sustainable agriculture, aquatic resources, raw materials but also urban transformations, and health. These areas are reflected in the broader priorities set in the national strategy for research, development, innovation, and entrepreneurship. In total, ETAG invested € 6.3 million to support granted projects under H2020 partnerships.

Table 5: Estonian participation in partnerships under H2020 (2014-2020) managed by ETAG

Partnership calls	pre-proposals with Estonian participation	Full-proposals with Estonian participation	Granted projects with Estonian particip	Success rate (no projects/full-proposals)	National budget committed by agency	Actual agency budget spent in granted projects
BiodivERsA3	16	16	4	25.00%	100,000	200,000
BiodivScen	14	14	1	7.14%	100,000	78,493
BiodivClim	22	8	1	12.50%	100,000	89,863
BiodivRestore	16	10	1	10.00%	100,000	83,612
WaterWorks2014	8	8	1	12.50%	25,000	23,082
WaterWorks2017	8	6	2	33.33%	100,000	100,000
AquaticPollutants	9	4	0	0.00%	100,000	0
OCEAN JPI Microplastics	6	6	2	33.33%	100,000	150,000
Blue Bioeconomy	6	3	3	100.00%	300,000	280,000

ICT-AGRI-FOOD	3	2	1	50.00%	100,000	90,909
ICT-AGRI-FOOD, SusCrop, SusAn, ERA-GAS	3	2	2	100.00%	100,000	94,000
SusCrop	17	6	4	66.67%	200,000	174,286
ERA CoBioTech	9	7	2	28.57%	300,000	107,818
EURONANOMED III	41	15	4	26.67%	800,000	396,450
FLAG-ERA II	4	4	3	75.00%	200,000	150,000
FLAG-ERA III	5	3	0	0.00%	200,000	0
CHIST-ERA III	4	3	1	33.33%	250,000	239,927
CHIST-ERA IV	4	5	2	40.00%	100,000	130,000
QuantERA II	3	3	1	33.33%	150,000	104,717
ERA-MIN 3	4	2	2	100.00%	100,000	120,000
M-ERA.NET 2	35	22	5	22.73%	700,000	647,000
M-ERA.NET 3	16	5	1	20.00%	100,000	100,000
ENUTC	17	2	2	100.00%	100,000	100,000
TRANSCAN-2	45	15	5	33.33%	800,000	489,120
TRANSCAN-3	2	1	0	0.00%	100,000	0
ERA-CVD	6	4	4	100.00%	600,000	480,614
ERA PerMed	12	4	1	25.00%	200,000	100,000
JPIAMR-Action	6	2	1	50.00%	100,000	68 650
NEURON Cofund2	6	3	1	33.33%	100,000	100,000
HERA JPR UP	53	11	1	9.09%	53,000	62,428
HERA-JRP-PS	23	10	1	10.00%	100,000	139,037
NORFACE WSF	23	3	1	33.33%	50,000	50,000
NORFACE DIAL	7	3	1	33.33%	150,000	150,000
NORFACE Governance	8	0	0		96,000	0
GENDER-NET	12	5	1	20.00%	50,000	42,143
ERA-NET RUS Plus	104	71	18	25.35%	850,000	1,208,775
Grand Total	577	288	80	27.78%	7,674,000	6,282,274

Source: elaboration of ETAG data

Based on ETAG officials, participating in transnational R&I partnerships is of utmost importance for a small country. This gives access to additional knowledge that enhances research quality. It also increases visibility in the international R&I arena. At the same time, each country needs to make its contribution to dealing with societal challenges that cross national borders. Yet, the choices until now have not been as strategic concerning which areas/call topics are addressed, but the current position is still that choices should be diverse and cover many disciplines. As a result, the overall budget is thinly spread across many topics. The available budget per joint call during H2020 (€ 100,000) has also been limited. This has now increased to €150,000 in Horizon Europe but remains limited.

ETAG has also been successful in increasing the participation activity of Estonian target groups due to effective communication and international networking activities (Veemaa, et al. 2021) Indeed as explained by ETAG officials, being the NCP also puts ETAG in the right place for disseminating information and raising awareness for the funding opportunities through info days and call advertisements. ETAG also helps applicants with partner searches and provides clarifications about calls and advice to potential beneficiaries. Furthermore, they changed their rules to also support other types of beneficiaries, besides universities and research organisations, such as enterprises, in ERA-NETs. The dissemination of project results is another area where they place special attention.

> *"New or alternative ways of dissemination (like exhibitions instead of academic conferences) should be used to bring science results closer to citizens." (ETAG officials)*

ETAG procedures make sure that any extra burden put on researchers in relation to application and project reporting is minimum. In particular, the central application process for the partnerships is accepted which is only accompanied by an eligibility check. Project reporting is very simple and is also accepted in either English or Estonian.

As reported in the interviews with ETAG officials, the impact of participation in partnerships has been positive at various levels. At the policy level, ministries have become more engaged and have started collaborating more with each other. On the financial side, clearly, the access to EU top-up funding has resulted in funding more projects. At the researchers' level, partnerships help to build international networks that lead to sometimes long-lasting collaborations. The perception of ETAG officials is that the interest from the research community in partnership calls is rather high. A lot of proposals are submitted and not many of them are ineligible. Thus, the capacity exists in terms of time and resources and the success rates are also good, depending on the subject and level of competition. As a side-effect of participation, Estonian researchers consider ERA-NETs are a stepping stone in terms of getting the necessary experience and getting involved in networking before trying to enter larger projects and consortia in H2020. Yet, it is true that not many Estonian organisations become coordinators of projects, despite the incentive that project coordinators could apply for €150,000 in H2020 while project participants could apply for €100,000. More capacity for research administrators needs to be built. Some universities, like the University of Tartu and Tallinn University of Technology, have grant offices that help researchers in administering research projects, but this is not the case for all of them.

Estonia has also been quite successful in using ESIF for partnership calls that received no EU co-funding. However, when ESIF is used the investments need to be made in areas compatible with the S3 priorities and although these are quite broad they may not always be in line with the call topics of the partnerships. The use of ESIF is an area that needs immediate action. During H2020 the use of ESIF was allowed only in the non-cofunded calls. Considering that around 50% of the R&I national budget in Estonia comes from ESIF this is a serious limitation. This needs to be rectified in Horizon Europe. Another aspect to address in increasing the use of ESIF is how to align the focus areas of the ESIF/S3 strategies with those of the partnership calls.

2.4. Enterprise Estonia (EAS)

Enterprise Estonia is the executive agency under the Ministry of Economic Affairs and Communication and is involved in EUROSTARS. The major motivation is the international dimension of EUROSTARS that enables the building of deep cooperation with companies in other countries. Estonia stopped co-funding EUROSTARS for some years, but it started again a couple of years ago. In this period the awareness and interest of companies in EUROSTARS have increased, although EUROSTARS is not suitable for companies without any international cooperation capabilities.

Yet, the performance of Estonian businesses in EUROSTARS is rather limited mainly due to the small size of companies and low capability and contacts in international collaboration, the relatively low level of business R&I investments, and the difficulties in setting up an international project in terms of language and finding partners.

Estonia has created a special budget line for EUROSTARS to support national participation that allocates €300,000 maximum per project. Through this budget line, EAS funds around 2 projects per call, and there are usually two calls in a year. Thus, the funds to be allocated per year are €1.2 million maximum, but there can be variations from one year to another. There have been no cases where a project did not go ahead because of a lack of funds on the Estonian side. In Horizon 2020 a total of 38 full proposals were submitted, of which 2 have been approved, 4 are in the second phase of evaluation and 3 more are not confirmed yet.

Table 6: Estonian participation in partnerships under H2020 (2014-2020) in EUROSTARS

	Full-proposals with Estonian participation	Number of projects granted with Estonian participation	National budget committed by agency	Actual agency budget spent (after selection of proposals)
EUROSTARS				
Call 2 - 15	19	2	600.000	585.896
Call 3-1	8	3 (not confirmed)[22]	600.000	ca 600000*(not confirmed)[26]
Call 3-2	11	4 (not confirmed)[23]	600.000	Ca 450000 (not confirmed)[27]

Source: EAS

Based on EAS officials, companies participating in EUROSTARS highly appreciate the benefits of international collaboration, including the contacts and the networks created and accessing different competencies that are not found in-house. The collaborations built are strong and

[26] Three projects are approved by Eureka, two projects are already financed, and one submitted, so the final amount cannot yet be confirmed.

[27] Three projects approved by Eureka, (one of them by a university thus not supported by EAS which provides funding only for SMEs). Two other projects also submitted to EAS for funding.

usually, last beyond the life of the project. The impact goes beyond the joint project, i.e. companies improve their knowledge about foreign markets, even though this may not be the primary aim of the joint project.

> *"EUROSTARS enables synchronisation of public funding for international projects. EUROSTARS sounds attractive and less bureaucratic overall. It is also relatively flexible; as partners with no public funding may self-fund their part." (EAS officials)*

Participation in EUROSTARS shows that Estonian businesses are strong in biotech and IT but also in healthcare, e-commerce, and energy. These areas reflect the national priorities overall. In EUROSTARS there is a collaboration between Estonian businesses and counterparts in certain countries like the Scandinavian countries, but EUROSTARS is also an effective channel for finding partners that are not geographically nearby.

EUROSTARS is deemed an important instrument for Estonian businesses.

> *"It is most crucial to encourage companies to join these networks. It takes some time to build trust and build networks of partners and having such instruments makes it much easier. The more companies have such experience the more they can encourage others." (EAS officials)*

Of the new Horizon Europe partnerships, EAS has just joined the Key Digital Technologies partnership that has a narrower focus than EUROSTARS and will support larger projects.

Estonia enters Horizon Europe with a strong coordination mechanism managed by sectoral ministries and ETAG, backed by a sound decision-making framework, and with a successful track record in increasing participation of Estonian researchers in the EC framework programmes including the R&I partnerships. Estonia takes part in partnerships for a number of reasons, i.e. to offer the researchers the benefits for transnational/international collaboration, to collaborate/align with other countries in developing policies and strategies in areas of strategic importance for the EU, as well as to contribute to driving developments and create the necessary critical mass in certain areas of interest. The policy exchange and learning enabled is much appreciated.

3. Who are the key R&I performers in Estonia?

Research and development activities are carried out by both public sector (primarily universities) and private sector research institutions. There are six public universities that have successfully passed external evaluation[28], where research in a specific field is assessed based on international criteria: the University of Tartu, Tallinn University of Technology (TalTech), Tallinn University, the Estonian University of Life Sciences, the Estonian Academy of Music and Theatre, and the Estonian Academy of Arts. Of those, the most active ones in R&I partnerships are the University of Tartu and TalTech briefly presented in the following sections.

Public R&D institutions acting within the area of responsibility of the Estonian Ministry of Education and Research include the Estonian Literary Museum and the Institute of the Estonian Language; the National Institute for Health Development within the area of responsibility of the Ministry of Social Affairs; the Estonian National Museum within the area of responsibility of the Ministry of Culture; and the Estonian Crop Research Institute within the area of responsibility of the Ministry of Rural Affairs. In addition, there is the National Institute of Chemical Physics and Biophysics which operates pursuant to its own separate act, and the Under and Tuglas Literature Centre which acts under the Estonian Academy of Sciences. On the private side, there are eight research institutions that have successfully passed evaluation: AS Cybernetica, OÜ Protobios, OÜ BioCC, AS Tervisetehnoloogiate Arenduskeskus (Competence Centre on Health Technologies), AS Toidu- ja Fermentatsioonitehnoloogia Arenduskeskus (Centre of Food and Fermentation Technologies), OÜ STACC, OÜ Icosagen Cell Factory, and AS Metrosert, the Central Office of Metrology in Estonia. Only one private university, the Estonian Business School, has passed the evaluation.[29]

Based on Statistics Estonia, in 2020, the R&D expenditure in non-profit institutional sectors (higher education, government and non-profit private sectors) was €243m, increased by 50% since 2017[30], although this increase is not clearly visible in the evolution of HERD nor GOVERD intensity over time (Figure 7). Taken together, the higher education sector together with the government sector perform around 43% of the gross expenditure in R&D.

Yet, it is the business enterprise sector that accounts for the majority of GERD performance, (55%), similarly to Norway, but much less than the other comparator countries (Slovenia or Ireland with 73%) or the EU27 average (65%). (Annex, Main R&I indicators) The R&D expenditure in the business enterprise sector reaches €287 million, marking an increase of 84% since 2017[31]. This seems to be what is driving the upward trend in GERD intensity in Figure 7.

[28] R&D Evaluation. Estonian Research Council. https://www.etag.ee/en/activities/rd-evaluation

[29] Estonian Research 2022, ETAG, Estonian_Research_2022.pdf (etag.ee)

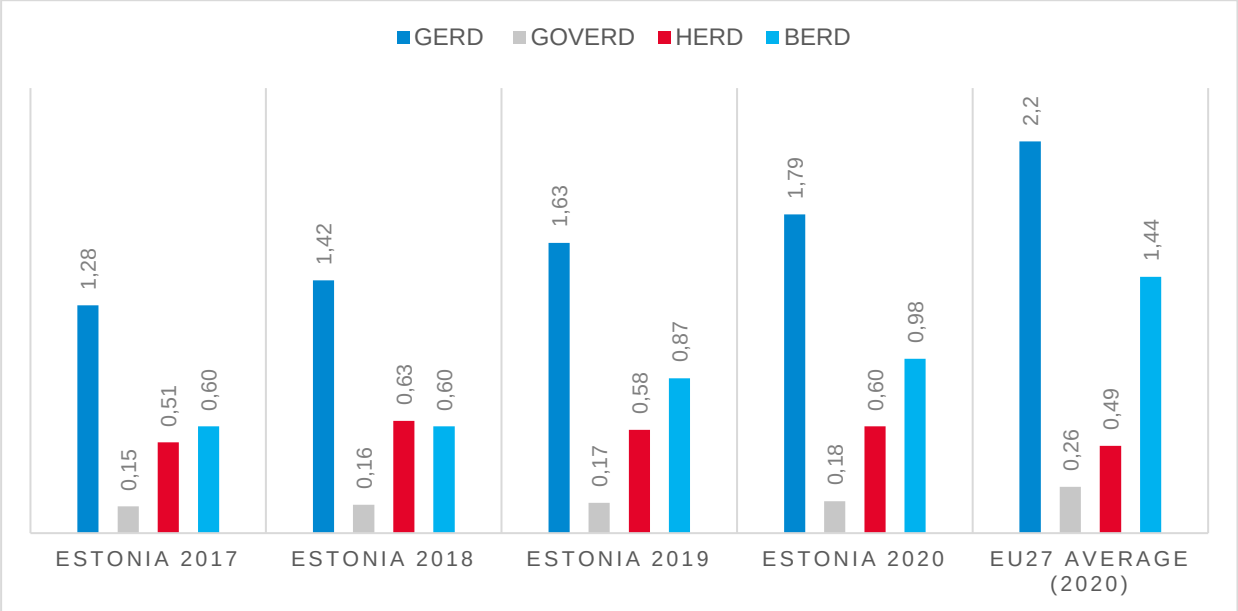
[30] https://andmed.stat.ee/en/stat

[31] https://andmed.stat.ee/en/stat/majandus__teadus-tehnoloogia-innovatsioon__teadus-ja-arendustegevus__teaduse-uldandmed/TD050/table/tableViewLayout2

The structure of the Estonian economy is dominated by small and medium-sized low-tech companies with limited demand or engagement, in research and innovation activities. Private sector R&D is largely performed by larger companies. Indeed, two of the most important challenges facing the Estonian E&I system relate to the low pace of the business sector in engaging in R&I activities: 'Addressing the asymmetry between the public and the private R&I efforts' and 'Promoting private investment in R&I by addressing the low pace of technological upgrading in industry' (RIO Country Report Estonia 2017). The bulk of R&I is carried out in the IT and manufacturing sectors, particularly in the 'manufacture of computer, electronic and optical products' domain, as well as 'manufacture of wood, paper, printing and reproduction'.

Although the private sector R&I efforts need a boost, interestingly, the share of HERD funded by the business sector is similar to the EU17 average (7.17%) leaving behind all comparator countries except Slovenia (8.57%). In fact, Estonia's score (7.89) places the country in the 5th rank in all EU27.

Figure 7: Evolution of R&D expenditure in Estonia as share of GDP



Source: OECD; GERD: Gross domestic Expenditure in R&D, BERD: GOVERD: Government Expenditure in R&D, HERD: Higher education

Performance in H2020

Based on the data available in the H2020 dashboard, Estonia accounts for almost 6% of the signed grants in H2020 and 2,1% of the total EU net contributions. However, these scores only leave behind Latvia in the benchmark countries, but Estonia's success rate in the H2020 is significant surpassing also that of Slovenia. (Table 7).

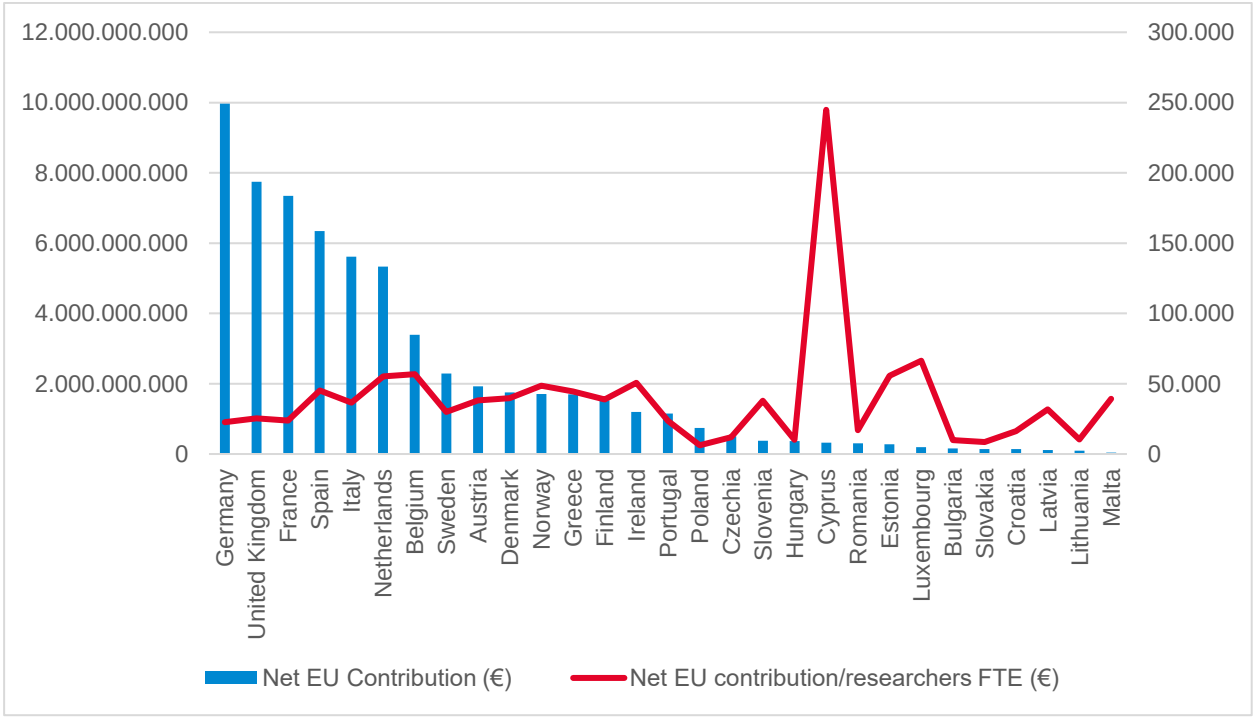
Table 7: Key features of H2020 participation for Estonia and the benchmark countries

	EU NET Contribution[32] (€ million)	Signed grants	Participations	Success rate
Estonia	274.3	698	896	16,23
Latvia	116.4	433	538	16,07
Slovenia	379.4	1013	1475	13,98
Ireland	1190	2149	2935	17,22
Norway	1700	2033	3216	18,07
Total H2020	67620	35381	176701	14,13
Estonia's % in total H2020	*0,17%*	*1,22%*	*0,30%*	

Source: Author's elaboration based on the H2020 data provided on https://ec.europa.eu/research/horizon2020/index.cfm?pg=country-profiles

The figure below shows the distribution of the EU net contribution per EU Member State in H2020. Dividing the EU net contribution by the number of researchers (in full-time equivalents) in each country a different picture emerges. Leaving aside Cyprus, Estonia belongs to the top countries (together with Netherlands, Belgium and Ireland) that received between €50,000 – 55,000 per researcher, next to Luxembourg with €65,000.

Figure 8: EU Net Contributions per country and EU Net Contribution divided by researchers FTE in H2020



Source: H2020 data (June 2022)

The evolution of Estonia's performance in H2020 has been remarkable considering that in 2014 the EU contribution to the Estonian beneficiaries were slightly over € 7million and this figure multiplied more than seven times by 2020. (Table 8)

[32] Funding received by the projects' participants after deduction of their linked third parties funding.

Table 8: European Commission financial contribution to Estonia (€) 2014-2020

	EU financial contribution (euros)	Participations in the selection
2014	7.260.099	42
2015	43.829.631	135
2016	17.280.973	81
2017	23.787.203	108
2018	45.834.877	120
2019	49.616.723	145
2020	51.397.775	167

Source: eCORDA, cut-off date 05.01.2021 (extraction date 08.02.2021).
**The table includes the EU contribution of all projects which have signed grant agreements; together with applications with positive grant decision (not necessarily signed grant agreements) the financial contribution would be larger.*

Based on the latest Report on Estonia's performance in H2020 prepared by ETAG in 2021[33], most participations in H2020 are by universities and R&D institutions. The most successful universities have been the University of Tartu, Tallinn University of Technology, Tallinn University and the Estonian University of Life Sciences. Yet, a number of research-intensive companies and municipalities are also significant in terms of their share in projects' budgets (Table 7). At the same time, the analysis confirms that small projects also play an important role. Thus, ETAG's report concludes that, on the one hand, the number of projects should be increased and, on the other, efforts should be made to increase the budgets of the funding organizations by encouraging potential project beneficiaries to take a more responsible role in project consortia.

Table 9: European Commission contribution to top 20 Estonian participants in H2020 (enterprises marked violet) by 31.12.2020

Nr.	Organisation (ENG)	Number of participations	EU financial contribution (€)
1	University of Tartu	154	62.709.216
2	Tallinn Technical University	74	35.279.743
3	Tallinn University	31	12.951.924
4	Graanul Biotech OÜ	2	10.743.939
5	Estonian University of Life Sciences	27	10.451.965
6	Tartu City Government	3	5.916.734
7	Guardtime OÜ	11	5.516.110
8	Estonian Research Council	49	4.197.152
9	National Institute of Chemical Physics and Biophysics	8	3.294.890
10	Cybernetica AS	9	3.112.824
11	Optofluid Technologies OÜ	2	2.873.952
12	Skeleton Technologies OÜ	3	2.756.263
13	Elcogen AS	6	2.725.725
14	ANF Development OÜ	2	2.683.806
15	Institute of Baltic Studies	8	2.575.870

[33] Report on Estonia's performance in H2020: https://www.etag.ee/wp-content/uploads/2021/06/ETAG_Horisont-2020.pdf (in Estonian)

16	Civitta Eesti AS	12	2.551.081
17	Biotatec OÜ	2	2.353.468
18	Lixea OÜ	1	2.318.663
19	Ministry of Economic Affairs and Communication	8	2.042.529
20	Tallinn City Government	7	1.921.704

Source: eCORDA, cut-off date 05.01.2021

How are they doing in partnerships' projects?

Based on ETAG and MEM data, Estonian organisations took part in 92 projects supported by public R&I Partnerships in H2020, with a cumulative budget of approximately € 10 million (total cost of projects). As discussed earlier, the number of projects with Estonian participation is relatively low compared to the benchmark countries (Table 1). This can partly be explained by the small research community. Yet, Estonia also presents a much higher R&D intensity[34] than that of Latvia and Ireland, which does not seem to counteract the small number of supported projects. It seems that the budget made available overall limits Estonia's participation to one project per call and the limited funds allocated per project diminish the ability to fully exploit the opportunities offered by the partnerships. Based on ETAG officials, the limited funds per project may also make Estonian applicants unattractive to project consortia.

At the same time, Estonian organisations rarely take up the role of coordinator in project consortia. Indeed, based on Veemaa et al (2021)[35], Estonian applicants were relatively active in taking part in partnership calls for proposals in H2020 (present in >10% final proposals), but very seldom had they the role of coordinator (<2%). On average, 47% of calls for proposals during Horizon 2020 resulted in the financing of at least one project with Estonia's participation. The Estonian success rate in proposals submitted for partnerships' support in H2020 was 22%. This is significant considering that the overall success rate in H2020 regular calls was 14% at the time of the specific study, although the EU average in partnerships was even higher (29%).

Overall experience

According to Veemaa et al (2021), participation in partnerships had a positive impact on the national research community. Based on the researchers' views, it increased the critical mass of researchers and improved research quality in priority research fields, getting Estonian researchers in international networks of cooperation, improving the quality of the Estonian RD system infrastructure and providing access to European joint RD infrastructure.

Similar views were repeated during the interviews carried out for the preparation of the report.

> *"ERA-NETs in general are very good. Their value lies in the possibilities they offer to establish fruitful collaboration with other researchers in other countries. ERA-NETs*

[34] i.e. Gross Domestic Expenditure (GERD) in R&D as share of Gross Domestic Product (GDP)

[35] Veemaa, J., Mulk, V., Nõmmela, K., Sepp, V. (2021). Analysis of the impact and effectiveness of the partnerships coordinated by the Estonian Research Council and assessment of the implementation of the participatory plan process. RITA 4: Monitoring of R&D&I policy. Final report. University of Tartu (in Estonian). The objective of the survey was to evaluate the performance and impact of participation in European RD partnerships under the Seventh Framework Programme (FP7) (period 2007-2013) and Horizon 2020 (period 2014-2020) coordinated by the Estonian Research Council (ETAG)

enabled the University to build connections with counterparts we wanted. We are very glad we had this opportunity." (beneficiary in ERA-CAPS)

"The real value of the ERA-NET projects was that we could publish very good papers, had close professional relationships with other Universities – we could host PhD and MSc students, who then were awarded degrees from both universities. We also started two other projects with them and participate together in other programmes/ proposals. Building a close and long-lasting collaboration is very important." (beneficiary in CORE-ORGNIC II and C-IPM)

"The value of the ERA-NET is that it allows you to make lots of connections with researchers in other countries and the quality of scientific work that you can do with them. The project gives us the resources to prove our concept and make it sustainable and scalable." (beneficiary in BlueBio Cofund)

Project beneficiaries appreciated the well-organised and straightforward procedures for applying and the acceptance of the English proposal by the Estonian ministries and agencies, although the reporting procedure followed by MEM was considered more rigid and bureaucratic than the one applied by ETAG. Yet, availability and support by both organisations were appreciated.

"We are confident that if we need any support from ETAG or MEM we'll be able to get it. There is good communication" (beneficiary in ICT-AGRI)

"ETAG has similar procedures to follow for all the projects they fund and they try to make it simple for scientists. This enables us to concentrate on the call rather than learning how to apply." (beneficiary in BlueBio Cofund)

They also felt that the smaller size of the projects (4-5 partners) allowed actual collaboration among each other and efficient running of the projects. Some good practices were also highlighted.

"A good practice was that HERA had a launch event where about 20 projects with similar structures and features could meet – this was very good but these connections need to be nurtured further. Something for ETAG to do, e.g. bring together all similar projects and push for collaboration within Estonia." (beneficiary in HERA)

"It was a good decision to take some time at the beginning to learn each other's language – this took 6 months but we're happy now we had this launching period." (beneficiary in ICT-AGRI)

Researchers were less satisfied with the limited funds allocated per project (€100,000 and up to €150,000 for coordinators only by ETAG) and certain obligations imposed when the funding came from the ministries rather than ETAG. For instance, a 20% VAT reduction was applied in the case of ministerial funds, which only worsened the financial situation. Accordingly, researchers welcomed the on-going discussions to increase the funding per project to €150,000.

The limited funding of the projects deterred some from taking up the leading role, while sudden and uncommunicated budgetary cuts caused problems in the project implementation in other cases. The limited duration of the projects was also criticised.

"We should have been the leaders but the funds were not enough." (beneficiary in BlueBio Cofund)

"(These) budgetary cuts caused changes in the work-plan, dropping some key activities/roles … and compromising our participation in these two projects. …However, we decided to stay …and the rest of the experience being very positive and both projects being extremely successful in terms of research delivery and outputs (i.e. papers published in peer-reviewed journals)..." (beneficiary in BONUS FP7)

"This is three years, which may be short to achieve something in science – it should be at least four years to allow also for proper experimentation and dissemination" (beneficiary in BONUS FP7)

Added value of partnerships

When compared to other programmes supporting trans/international research collaboration, researchers marked the easier administrative procedures, and the broadly set call topics in partnerships, which compared to the H2020 very specific themes, allow the emergence of research ideas in a more bottom-up approach. The added value of the partnerships is even higher for Estonia as there are no national/bilateral programmes supporting trans/international research collaboration.

"Compared to H2020, ERA-NETs are easier to apply for and manage. They are not as big as H2020 and the bureaucracy is much smaller. The fact that in ERA-NETs, partners have their own funding organisations to deal with makes the coordinators' life easier but, on other hand, it can also make life more difficult as there are always some national arrangements that are different across countries, which you cannot affect as coordinator (e.g. how to reallocate travel budget that was not spent due to Covid-19 restrictions). Other than that, the experience is quite similar to other international projects." (beneficiary in ICT-AGRI)

In addition, there are pros and cons about the size of the projects in partnerships as compared to FP or Horizon programmes.

"If compared to FP projects, these are usually much bigger projects – many more partners and tasks are more focused on a certain partner. As a result, communication was not always so easy and fast compared to ERA-NET projects. In ERA-NET projects we could have prompt short meetings very easily and this was important for the experiments – communication was more flexible and user-friendly…. Larger projects give you more opportunities to meet different partners and establish collaboration links. The amount of money is a little bit bigger, but the workload is very intensive. The advantage of EU-funded projects is that they are usually longer than ERA-NET projects. For example, H2020 lasts six years and this sets the stage for planning and designing high quality long-term experiments." (beneficiary in CORE-ORGANIC II and C-IPM)

"This kind of smaller projects are easier to apply and to obtain. We also applied for H2020 but we didn't get it ... It is difficult to compare ERA-NET and H2020. Once the consortium becomes very large, it is hard to get everyone on the same page, to get as

engaged; more communication is needed. Otherwise, there isn't much difference. Financial reporting seems to be more difficult in H2020." (beneficiary in BlueBio Cofund)

Key factor for success

The experience of the Estonian beneficiaries in partnerships clearly highlights the importance of excellence in research that can translate to a good research idea, goals that are grounded and realistic within the short time given, and a clearly agreed operational work plan with setting out tasks and responsibilities among partners. Excellent and engaged partners are also key – interviews noted that consortiums are built based on personal networks and networks of colleagues rather than using partner search functions although these might also prove useful in some cases. Experienced administrative support from within the participating institution is also crucial and this can help Estonian researchers take up the role of coordinator in projects. The two-stage evaluation process was also appreciated where relevant.

> *"…talking, discussing, re-confirming is extremely important as is establishing consensus; regular meetings too – although not possible in the case of COVID-19, physical meetings are always more beneficial than remote meetings. ... Be a demanding coordinator in the good sense is also key…Prior knowledge of people that you are working with is very helpful – this way you already know what they are capable of." (beneficiary in BONUS)*

> *"Being confident that the core partners are up to the job and they can pull things through when something happens is also key. This is true, especially for larger projects…The two-stage evaluation (first submission in January and second in July) allowed us to have many meetings in between to clarify the concept and the methodology. In H2020 proposals where the task description can only be 2-3 lines it is very important to achieve a common understanding of what is there in the proposal. Reading the call very carefully is also important." (beneficiary in ICT-AGRI)*

Less bureaucracy and hurdles are important as are good communication and management skills. Overall, Estonian beneficiaries that were interviewed agreed that *"even though the funds are small, partnerships like ERA-NETs are valuable to help establish collaboration with counterparts abroad. We are very glad Estonia takes part in these partnerships."* (beneficiary in ERA-CAPS)

3.1. Tallin University of Technology (TalTech)

The importance of international collaboration is a given for researchers who are very active in forming their own networks. As TalTech officials stated, more than 60% of the publications from researchers in TalTech are with foreign counterparts. Counterparts usually come from Germany, UK, Finland, Sweden, USA, Italy, France, Russia but also non-European countries like India.

Based on TalTech officials, participation in partnerships is beneficial for Estonian researchers, who value the benefits of international collaboration irrespectively of where the funds come from (partnerships or Horizon 2020). Yet, there are several inhibiting factors that limit the level of participation. The administrative resources available in ministries and agencies to manage Estonian participation are limited. At the same time, choices need to be made and there are not enough resources/capacity to keep fully abreast of all developments in the partnership landscape so as to make well-informed decisions. Opportunities may also be missed in the case where high-quality projects do not go ahead due to a lack of money or high competition.

A clear strategy for choosing which partnership to join, besides the official criteria, never existed. This is especially true for the less experienced ministries. The situation has improved now with more research funds being available also in the sectorial ministries. The thematic exercises done in the context of the new national R&D strategy to develop thematic roadmaps may also include partnerships as a means to achieve the national objectives.

The role of Grant Offices in universities is significant in raising awareness of researchers about existing funding opportunities and assisting them in applications and project reporting procedures. The experience of Grant Office in TalTech is that it is difficult for researchers to understand the European funding and partnership landscape.

> *"They need explanations on the different calls for proposals, the different conditions for funding, etc. In addition, we're really putting effort to keep track of the developments in the area. It is crucial to have clear information about the partnerships – how they work, what the researchers need to do – maybe a one-stop structure would be helpful." (TalTech officials)*

The universities collaborate with the scientific advisers in each sectorial ministry and are usually consulted by the HTM on the level of interest of researchers in the call topics. The experience of the TalTech officers is overall positive, while efforts are still needed to help exploit their full potential.

> *"Partnerships should be more strategically planned, better run and the risks/obstacles especially for smaller countries should be better acknowledged." (TalTech officials)*

3.2. University of Tartu

Based on officials from the University of Tartu, the readiness of Estonian researchers in international collaboration is high in general. Around 70-80% of publications are with foreign co-authors. Since the restoration of the Estonian democracy in 1991, Estonian researchers started collaborating with the Nordic countries but also Western European countries such as Germany, France, Netherlands and the UK. The co-publication patterns show that most collaborations are with Western EU countries.

According to University of Tartu officials, the University of Tartu is among the 1% most cited universities in 13 out of 22 disciplines in the world. The university covers a wide range of disciplines and has achieved high quality in many of them, including clinical medicine, biology, ecology, genetics. The university is also hosting the national bio-bank including samples of 20% of the population. This is an important infrastructure both in the national as well as international levels. The university has been able to double its research budget in the past 2 years due to the increased direct funding and more national and EU grants, and it has been able to attract top talents - 17 of the researchers are among the 1% most cited researchers globally[36]. Tartu university is also the institute that researchers like to work in when they return to Estonia. This is due to the modern R&D infrastructure which has been improved in recent years. Efforts are also made in reforming doctoral programmes to attract younger researchers.

The Grant Office of University of Tartu helps researchers take part in collaborative research programmes covering all funding opportunities (national, ESIF and international). It also provides support to all applicants and grant holders. However, the project management responsibility lies with the principal investigators and the individuals with project management experience that are situated at the relevant institutes/departments of the university.

To provide effective support and advice to researchers, it is crucial to have an overview of the funding opportunities and respective calls for proposals. The Ministry of Education and Research and ETAG highly contributed to this by creating an overview of the partnerships and the funds available from all the ministries[37]. This information is now renewed annually and is very useful to understand and communicate the available opportunities to the research community.

Based on the interviews that Grant Office officials conducted with researchers, the experience of applying and participating in a partnership-supported project is relatively easy and the benefits are well appreciated.

> *"The primary benefit is networking at a pan-European level – similarly to H2020 calls. Partnerships provide regular opportunities for long-term cooperation. The extra funding for research is also another benefit but national funds need to be larger to allow for ambitious projects. Yet, the ERA-NETs have been quite important for networking and getting access to other networks and larger calls" (University of Tartu officials)*

[36] Highly cited researchers and research fields | University of Tartu (ut.ee)

[37] EL partnerluste osaluskava - Eesti Teadusagentuur (etag.ee) (in Estonian)

Yet, Estonian researchers rarely take the coordinating role in a project (5% or less) because the administrative burden is high, and sometimes it is better for well-established institutions to take the lead. In addition, the Estonian funds made available for each project (typically €100,000-150,000 over three years) are very limited to adequately cover the resources needed for the coordination tasks.

Comparing public partnerships to other types of partnerships, the experience of Grant Office officials has been that some instruments like the EIT KICs and industry-led partnerships require more coordination and networking before the call. The University of Tartu takes part in EIT-KICs in health, manufacturing, and urban mobility. In EIT-KICs the setting/rules are more complicated. In addition, the TRLs needed for proposals are much higher than in ERA-NETs and this makes the participation of universities more difficult. In EIT-KICs, the university co-invests by paying the annual membership fee. This provides access to funds that reach approximately five times more our membership fee (e.g., for the three KICs, an annual investment of € 190,000 for membership fees provides access to around € 1million in total budget for calls). Another benefit is the opportunity to realise some educational activities. Fifteen percent of the support provided by EIT is allocated to MSc programmes and doctoral schools, allowing activities such as exchange visits between universities.

Regarding the future, university officials consider that the best choices for the university would be the following partnership types in order of priority:

1. The Co-funded partnerships, which are based on national funding and target research in specific areas. In this case it is important to have adequate national funds (increased from the current levels) and find the right consortia to take part in.
2. The EIT-KICs, which require more networking, and engagement in different platforms and events to be visible, but offer a long-term cooperation environment, including also industry.
3. Then the Co-programmed partnerships, which have no national co-funding, but are more inclusive accepting also non-profit organisations as participants, and have many specific work groups and stakeholder involvement tools.
4. The Institutionalised ones, which support larger projects (€10-30+ million) and are led by industry, with high TRL levels and scale. Based on the current national co-funding rules, Estonian companies need to be contracted in these partnership projects and the universities can only be sub-contractors. However, this is expected to change, as the Ministry of Education and Research has also foreseen some co-funds for university participation in these partnerships.

The lessons learnt from the gained experience until now as expressed by the Tartu University officials is that while excellence and capacity of researchers is a major factor for success in international collaboration, communication and adequate resources are also key.

> *"We need to get the right info to the right person at the right time. EE is involved in so many partnerships that it is difficult to explain all different procedures in the best way to researchers; having enough resources for this task is also key. The challenge for researchers is to find time to prepare proposals and find the right partners to collaborate." (Tartu University officials)*

Estonian researchers appreciate the benefits of collaboration and networking at European / international level offered by the partnerships, although the limited funds made available per project may deter them from fully exploiting the opportunities offered. Partnerships present a clear added value for Estonia, a country that lacks national (bilateral) alternatives supporting international research collaboration. The small-scale consortia and the broadly defined call topics are much appreciated. Besides the drawbacks mentioned, the partnerships are valued as an important instrument complementing other European initiatives (FP and Horizon programmes).

4. In which R&I areas is Estonia strong?

As discussed earlier, Estonia's national priorities in research and innovation, as documented in the Estonian Research and Development, Innovation and Entrepreneurship Strategy 2021-2035, are:

- digital solutions across all areas of life;
- health technologies and services;
- valorisation of local resources;
- smart and sustainable energy solutions;
- viable Estonian society, language and cultural space

Based on the latest ETAG´s report 'Estonian Research 2022'[38], the areas where Estonian researchers excel in, as measured by the share of articles in the top-10 most cited, are: other humanities and veterinary sciences (25% each), health science (17%) and clinical medicine and biological sciences (15% each). Interestingly, the areas where the highest share of internationally co-authored papers are found present differences with nanotechnology and industrial biotechnologies sitting on top (83% and 77% respectively), followed by material engineering (75%), biological sciences (74%), clinical medicine (73%), earth and related environmental sciences (71%), and environmental biotechnology and health sciences (70% each).

Participation in H2020 reflects these strengths and priorities. Besides ERA Chairs and Marie Sklodowska-Curie actions, the areas that received the largest shares of net EU contribution include food, energy, ICT, health, security and climate action. (Figure 9)

Figure 9: Net EU Contribution (€ million) in H2020 for Estonia per thematic area

[38] Estonian_Research_2022.pdf (etag.ee)

Source: Report on Estonia's performance in H2020: https://www.etag.ee/wp-content/uploads/2021/06/ETAG_Horisont-2020.pdf (in Estonian)

The high interest of Estonian researchers in the above areas is repeated in the case of H2020 partnerships (Table 10). Additionally, the H2020 partnerships seem to be sources of funds in more specialised areas where Estonian researchers are also successful in areas like 'nanotech, biotech and advanced manufacturing'.

Table 10: Distribution of funding under the different H2020 instruments (P2Ps, JUs, cPPPs and other H2020 projects, i.e. CSAs, RIAs, IAs, etc.) across thematic priorities

Thematic priorities	P2Ps projects	JUs projects	cPPPs projects
Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, Biotechnology	23,15%	1,61%	0,00%
Climate action, environment, resource efficiency and raw materials	18,47%	0,00%	0,00%
Europe in a changing world - inclusive, innovative and reflective Societies (incl. secure societies - cPPPs)	3,15%	0,00%	28,49%
Food security, sustainable agriculture and forestry, marine and maritime and inland water research	26,59%	76,93%	
Future and Emerging Technologies	0,00%		0,00%
Health, demographic change and wellbeing	28,65%	10,54%	
Information and Communication Technologies		4,59%	67,83%
Secure, clean and efficient energy	0,00%	2,44%	3,68%
Smart, green and integrated transport	0,00%	3,88%	
	100,00%	100,00%	100,00%

Source: Biennial Monitoring Report 2022 – Country Fiche Estonia; ERA-LEARN database (cut-off date June 2021) based on actual national contributions for P2Ps; eCORDA based on net EU contribution; Values are calculated as the share of investments of the specific instrument in the specific theme in the total investments under the specific instrument

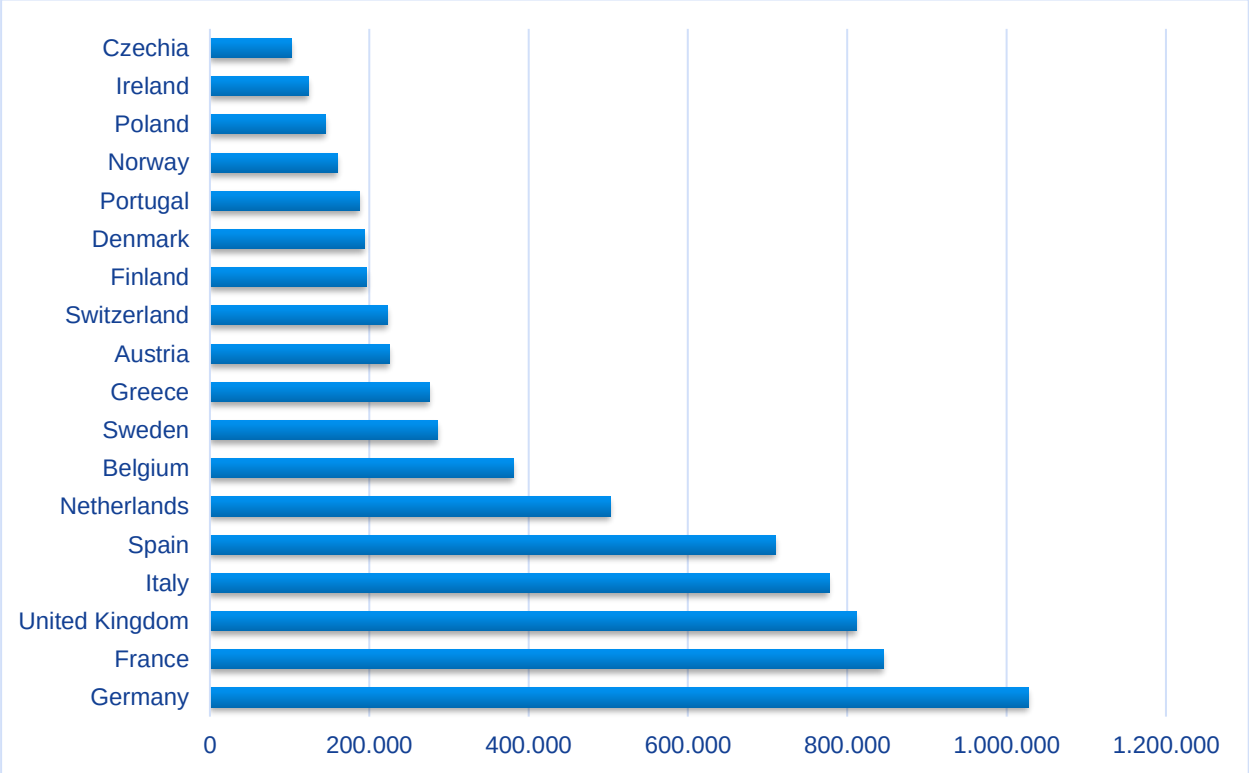
Estonia's participation in partnerships in H2020 reflects the national priorities such as ICT, food and health followed by climate change and resource scarcity. At the same time, partnerships show that the interest of Estonian researchers also lies in more specialized areas like nanotech, advance manufacturing, and biotechnology.

5. With whom does Estonia collaborate in R&I and why?

Based on the study carried out by Veemaa, et al. (2021), the countries participating in the same partnerships as Estonia are predominantly European countries (74%), of which 72% are EU Member States and 28% are non-EU countries. Estonia funding agencies and ministries have mostly participated in partnerships with counterparts in the following EU Member States: France, Germany, Belgium and Spain. Among the neighbouring countries, Estonia has had joint partnerships with Sweden (74%), Finland (71%), Latvia (55%) and Lithuania (47%).

Regarding collaboration among researchers at project level, a similar situation emerges. In successful projects, Estonian researchers collaborate with researchers mostly coming from Germany, France, UK, Italy, Spain as well as Netherlands and Belgium. Interestingly, neighbouring researchers from Sweden and Finland come lower in the rank, whereas Latvia and Lithuania are not included at all in the list of more than 100,000 collaboration links. Other smaller countries like Austria and Greece appear with not negligible number of links. (Figure 10).

Figure 10: Top collaborators of Estonian researchers under Horizon 2020 projects (including P2Ps, JUs, *cPPPs, and other H2020 projects* – above 100,000 collaboration links



Source: eCorda – Horizon 2020 Dashboard

Based on officials from the Ministry of Education and Research, collaborations depend both on where the excellence lies in the specific field as well as historical links. There are historical links with the Baltic states as well as Russia, which have stopped now because of the war with Ukraine. Specific links with certain countries depend on the field of interest, e.g., there is collaboration with Finland concerning educational research given their excellence in the area. There is a considerable collaboration with Sweden as well as Spain and the UK, and the latter has not changed due to Brexit.

Officials in the Ministry of Rural Affairs specify that collaborations mostly depend on earlier networks and contacts. This may also depend on which countries Estonian researchers have studied and these are usually Finland, Denmark, and other Scandinavian countries. In the field of agri-food, Estonian researchers collaborate mostly with Italy, Poland, Finland, Germany, France, Sweden as well as Turkey, i.e., countries with strong agri-food sectors and available funds to support research in this area.

Officers in TalTech highlight that based on the publication records of researchers from the TalTech, the main collaborator countries include Germany, UK, Finland, Sweden, France and Italy as well as USA, Russia and India. In 2016 TalTech started its tenureship programme and during the extensive recruiting a number of professors came from third countries, that keep on co-author papers with counterparts in their home countries (India, Pakistan, Iran, etc.).

The interviews with the University of Tartu revealed that based on the co-publication statistics, most collaborations are with the Nordic States and other Western EU countries such as Germany, France, Netherlands and the UK, especially after the restoration of the Estonian democracy in 1991. Collaboration with the other Baltic States is not as strong due to the small research communities in these countries which makes it harder to find areas of overlap. Yet, last year the collaboration with Latvia and Lithuania improved mainly due to the increasing excellence level in these countries.

With regards to EUROSTARS, collaborations reflect the business relations/networks and the geographical closeness to local enterprises. Thus, there is certainly collaboration with the Scandinavian countries, but EUROSTARS is also a good channel for finding partners that are geographically further. (Official from Enterprise Estonia)

Driven by their prior successful collaboration experiences and their personal networks and depending on where excellence lies in particular research fields, Estonian researchers partner with counterparts from a wide range of countries including the Nordic States as well as the most active in both H2020 and European R&I Partnerships (Germany, France, Netherlands, Spain, Italy and the UK). Co-publication links also extend to non-EU countries, which might have been the result of extending the tenureship programme in universities (TalTech).

6. What are Estonia's S&W in relation to participation in European R&I Partnerships?

Strengths

— The quality and openness of the Estonian science base are increasing year on year.[39]

— Among higher education and research organisations and innovation intermediaries, research quality is often good and researchers are reasonably well integrated into international networks.[40]

— Good practice processes for governance and co-funding: explicit and codified criteria for decision-making with regards to participation in partnerships; Scientific Counsellors in Ministries, co-funding model between ministries and ETAG.[41]

— Commitment to ensuring political support to the importance of RDI in national policy and the 1% target for government spending on R&D, and maintaining at least the same level in the future.[42]

— Strong and developing research teams, and research institutions (including universities, and regional competence centres), with state-of-the-art working environments, including high-quality research infrastructure.[43]

Weaknesses[44]

— The potential of international R&D cooperation has not been fully exploited.
— Not that attractive researcher's career (scarcity of PhD holders, small research teams often uncertain funding for research and not well-developed career paths for researchers); Brain-drain of researchers.
— No consensus in Estonia's RDIE policy on which major future directions and challenges Estonia should focus on, where to develop its strengths, and which future challenges should be the focus of joint RDI and enterprise efforts.
— Lack of critical mass of researchers and engineers in many fields.

[39] https://www.hm.ee/sites/default/files/taie_arengukava_lisad_15.07.2021_211109a_en_final.pdf

[40] European Commission 2019 Peer Review of the Estonian R&I system Final Report H2020 PSF

[41] European Commission. 2017. Mutual Learning Exercise Alignment and Interoperability Of National Research Programmes National Coordination Final Report H2020 PSF.

[42] Estonian Research and Development, Innovation and Entrepreneurship (RDIE) Strategy 2021—2035

[43] Ibid.

[44] Based on Estonian Research and Development, Innovation and Entrepreneurship (RDIE) Strategy 2021—2035 and Annexes

- International research cooperation is not sufficiently focused thematically and more strategic choices are needed for more effective engagement.
- Estonian researchers are not very active as consortium builders and project coordinators.
- Infrastructure not used to its full potential when participating in international research.
- No clear criteria and decision-making mechanisms to support research cooperation with third countries.

7. Country-specific focus areas for Estonia: Achieving the national targets for Horizon Europe through the European R&I Partnerships

Estonia has set five goals for Horizon Europe; out of these, four are directly relevant to partnerships:

- *To contribute to solving global societal challenges*
- *To broaden participation – besides universities and R&D institutions, involve more enterprises, non-profit associations, public-sector institutions, sectoral ministries, local governmental bodies, etc.*
- *To take leadership by getting the role of coordinator in project consortia*
- *To maintain high levels of funding for research and innovation (measured per capita)*

As a very small country, Estonia clearly recognizes the high value of EU and international collaboration – it would be impossible to solve societal challenges and maintain research excellence without cooperating with other countries simply due to the lack of a critical mass. Transnational calls and competitive funding on an international scale enhance both collaboration links and scientific excellence.

Since Horizon 2020, Estonia's strategy has been to strengthen national coordination and to strengthen the involvement of the sectoral Ministries and their responsibility in the respective fields of research policy and priority setting. This led to establishing the position of scientific advisors at the Ministries, setting up national research funding schemes and procedures in collaboration with the Ministries, as well as encouraging the Ministries to participate as research funding organisations in transnational funding opportunities such as Horizon 2020 ERA-NET calls. The European Commission’s initiative to engage Member States’ ministries in the strategic planning and co-financing of the EU partnerships is a perfect continuation of the national process.

A current challenge is that while the awareness of the sectoral Ministries about the partnerships has been rather moderate, the willingness to contribute financially has stayed quite modest. Estonia's contribution to the EU partnerships has been one of the lowest in the EU27 and less than half of the EU13 average. Hopefully, during Horizon Europe the size of the budget dedicated to partnerships will increase, especially thanks to the strategic planning process and the European Commission’s encouragement for the Member States' authorities to express a clearer commitment.

Estonian applicants have been performing exceptionally well in the 'regular calls' of the EC Framework Programmes which are very competitive. In partnership (ERA-NET and similar) calls, however, their potential has not been exploited to a full extent. Only one or two projects with Estonian partners could be funded per call. Now that several Estonian organizations (ETAG as well as the sectoral Ministries) are involved as funders in most partnerships the number of funded projects will hopefully rise. Still, as long as the budget per project remains quite low, the Estonian partners might appear unattractive as project partners. The low budget also hinders the readiness and willingness to become a project coordinator. Additional measures are needed to support

specifically the coordinating role, both in financial as well as administrative terms. Another obstacle to taking the coordinator's role in transnational research projects is the lack of administrative support provided by research institutions. By now, only the largest universities have grant offices that provide support to researchers, and this was much appreciated by the interviewees.

Identifying these obstacles is an important step to tackling them. One of Estonia's support measures in the new national RDIE strategy aims to strengthen administrative support in research institutions. Discussions are also ongoing about raising the funds made available per project as well as raising awareness about the opportunities offered by European partnerships and supporting the Estonian researchers to further improve their international standing in the European R&I scene and beyond.

Annex

Main indicators for P2Ps in H2020 (*)	Estonia	Latvia	Slovenia	Ireland	Norway	EU14 average H2020	EU13 average H2020	EU27 AVERAGE
Total actual investments in P2P partnership calls (€ m)	7.3	10.5	17.2	35.9	184.2	150	16.5	82.6
Number of funding organisations participating in P2Ps	10	9	9	15	14	25	9	17
Number of P2P calls with specific country participation	99	121	99	135	189	160	91	127
Number of full-proposals submitted to P2P calls (***)								
Number of eligible proposals submitted to P2P calls (***)								
Success rate (funded/full-proposals) (***)								
Number of projects funded under P2P calls	92 (**)	91	179	207	618	708	137	433
Number of total project participations from country	49	38	136	168	569	696	108	413
Total costs of project participation (€)	9.767.091	18.732.342	35.918.609	51.354.824	397.107.198	176.637.495	20.360.045	188.071.898
Total requested EC funding (€)	9.172.991	15.578.194	21.761.773	39.470.860	214.313.094	153.755.242	16.291.570	101.392.797

Source: ERA-LEARN database (cut-off date May-June 2022), Estimated missing data 25-30%; (**) Based on ETAG and MEM data. (***) Data to be collected by the networks in the future.

Main R&I indicators	Estonia				Latvia	Slovenia	Ireland	Norway	EU 27 average
	2017	2018	2019	2020	2020	2020	2020	2020	2020
GERD (as % of GDP)	1.28	1.42	1.63	1.79	0.71	2.15	1.23	2.28	2.2
Percentage of GERD funded by the business sector	43.57	40.83	49.11	..	24.28 (2019)	61.51 (2019)	62.78 (2019)	43.23 (2019)	58.31 (2019)
Percentage of GERD funded by government	40.19	42.79	37.23	..	35.40 (2019)	24.72 (2019)	22.61 (2019)	46.97 (2019)	29.83 (2019)
Percentage of GERD funded by rest of the world	14.97	14.65	13.3	..	38.63 (2019)	13.27 (2019)	13.35 (2019)	8.22 (2019)	9.62 (2019)
Percentage of GERD performed by the business sector	47.19	42.35	53.31	54.95	30.93	73,31	73,80	54,33	65,49
Percentage of GERD performed by higher education	39,63	44,54	35,28	33,58	50,24	12,23	22,61	33,23	22,03
Percentage of GERD performed by government	11,76	11,43	10,25	9,83	18,83	13,76	3,59	12,44	11,68
GOVERD (% of GDP)	0,15	0,16	0,17	0,18	0,13	0,30	0,04	0,28	0,26
percentage of GOVERD financed by the business sector	1,76	1,65	2,07	..	11,65 (2019)	5,87 (2019)	2,73 (2019)	6,78 (2019)	7,52 (2019)
HERD (as % of GDP)	0,51	0,63	0,58	0,60	0,36	0,26	0,28	0,76	0,49
percentage of HERD financed by the business sector	5,84	6,88	7,89	..	4,58 (2019)	8,57 (2019)	3,89 (2019)	2,35 (2019)	7,17 (2019)
BERD (% of GDP)	0,60	0,60	0,87	0,98	0,22	1,57	0,91	1,24	1,44
percentage of BERD fudned by the business sector	86,83	88,22	86,34	..	74,46 (2019)	80,81 (2019)	82.99 (2019)	78,42 (2019)	84,25 (2019)
percentage of BERD fudned by government	4,41	5,74	5,37	..	3,7 (2019)	7,68 (2019)	3,51 (2019)	10,01 (2019)	5,25 (2019)
percentage of BERD funded by rest of the world	8,72	5,92	8,26	..	21,83 (2019)	11,46 (2019)	13,5 (2019)	11,54 (2019)	10.30 (2019)
Total national public funding to transnationally coordinated R&D (€ million)	:	2,600	5,300	6,540	4,400	12,675	25,500	102,035	
Total researchers (full-time equivalent)	4.674	4.968	4.995	5.102	4.072	10.254	23.549	36.316	1.892.436
International scientific co-publications per million pop	1341,24	1400,84	1553,29	1844,78	709,24	1776,84	1877,56	3074,94	1204,00
Share of country's publications in top 10% most-cited worldwide	0,08	0,09	0,08	0,09	0,05	0,08	0,11	0,12	0,10
PCT patent applications EIS 2020	1,29	0,93	1,29	1,56	0,77	2,39	1,68	3,00	2.96
ERC grantees by country per call year (2020)	1	1	1			1	4	7	

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