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ERA Dashboard 2023

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Research and Innovation

ERA Dashboard 2023

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ERA Dashboard 2023

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EXECUTIVE SUMMARY

Within the framework of the ERA monitoring mechanism (EMM) this ERA Dashboard encompasses a set of indicators aiming to monitor progress of EU Member States and Associated Countries towards the ERA priorities.

The quantitative data is complemented by qualitative information compiled using mainly the OECD STIP Survey 2023 as well as national documents to accommodate the different individual national circumstances.

Purpose of the report

The ERA Dashboard report 2023 focuses on the following:

- Analysing the data on the main R&I indicators and key policy documents for the ERA, such as ERA Roadmaps and strategies.
- Assessing performance and progress of Member States and Associated Countries regarding the ERA priorities and sub-priorities of the Pact for R&I.
- Providing insights related to performance and progress of Member States and Associated Countries regarding other ERA-relevant initiatives and actions.

Key insights for ERA Priority 1: Deepening a truly functional internal market for knowledge

- From 2010 to 2021, most EU Member States increased their gross domestic expenditures on R&D (GERD), In comparison to 2011, Belgium, Greece, Poland, Austria, and Czechia experienced the most significant increases in their GERD values in 2020. Associated Countries also generally increased their R&D investments, with Iceland leading the way. Germany leads among the EU Member States with regard to government budget allocations for R&D (GBARD) as % of GDP. Belgium shows consistent growth in business R&D investments (BERD) as % of GDP, with similar positive trends in several Associated Countries: Norway, Iceland, Türkiye and Serbia.
- Open access publications were most common in the Netherlands, Hungary, Sweden (in EU-27), as well as in Norway, and Iceland (among Associated Countries).
- France and Germany excelled in European research infrastructure investments among EU Member states, with Norway standing out among Associated Countries. Concerning the share of national public R&D expenditure allocated to European research infrastructures based on 2022 data, Hungary, Romania, and Bulgaria exhibited high investment in research infrastructures, exceeding the EU average. Among the Associated Countries, Norway and Iceland have also demonstrated commitment to research infrastructures.
- The representation of women in academia has improved, especially in Romania, and the proportion of mixed-gender research publications is very high in Italy. Romania stands

out for the share of women in the 10% most cited publications, with Iceland and Serbia among Associated Countries making strides as well. Finland leads the women in digital index in the EU (2022), while the proportion of women among STEM doctoral graduates varies among countries.

- An upward trend has been noted regarding the share of foreign doctorate students as % of all doctorate students in the EU, with Luxembourg consistently standing out in this regard. Among Associated Countries, Iceland excels in attracting foreign doctoral students. As for the rate of new doctoral graduates per 1,000 inhabitants (aged 25-34), Slovenia excels, with Finland, Ireland, Sweden, and Denmark doing similarly well. In terms of job-to-job mobility of human resources in Science and Technology, Denmark stands out among Member States. Among Associated countries, Norway, Türkiye, Iceland, and Serbia exhibit positive trends.

- Growth in public-private co-publications has been observed, with Denmark, Luxembourg, Finland, Sweden, Austria and the Netherlands being top performers. Positive trends are evident in the number of PCT patent applications divided by GDP in million euros, with notable performances from Finland and Sweden. There is a visible enhancement in the share of innovating firms collaborating with higher education institutions/public research organisations (HEI/PRO) out of all innovative firms, with notable improvements from countries like Estonia and Ireland. Associated Countries like Türkiye and Serbia also show remarkable progress. The Netherlands and Sweden excel in both 'business enterprise researchers as a percentage of the national total' and “business enterprise researchers in full-time equivalent per thousand employment in industry”. Among Associated Countries, Türkiye shows significant growth in business sector research.

- Regarding the number of scientific publications among the 10% most cited publications worldwide the Netherlands, Luxembourg, Denmark stand out among EU-27, and Norway and Israel do the same among Associated Countries (2020). Concerning the academic freedom index, the EU Member States Czechia, Estonia, Belgium, Italy and Germany stand out, and among Associated Countries, Israel and Norway demonstrate a top performance.

- Considering the indicator international co-publications with non-EU partners per 1,000 researchers in the public sector: in 2022, EU Member States Cyprus, Denmark, Luxembourg, Sweden and Finland, and Associated Countries Iceland and Norway demonstrate a top performance. As regards the European and international co-patenting in EPO applications at national and EU level, there is a negative trend for the considered period 2010 to 2013.

Key insights for ERA Priority 2: Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society’s participation in the ERA

- In terms of the government budget allocations for R&D (GBARD) by NABS: Germany and France exhibit strong performance for all considered years. All Associated Countries for which data are available (Norway, Switzerland, Türkiye, Serbia and Iceland) figure below EU-27 average. Regarding R&I investments (transnational cooperation): Between 2010 and 2020, Belgium and Italy stand out as the best performing Member States. Among the Associated Countries, Norway finds itself above the EU average. Regarding environmentally related government R&D budget: for the considered period of 2010 – 2021, top performance at EU Member State level is noted in Lithuania, Poland and Belgium, whereas among the Associated Countries, Norway remains above the EU level.

Regarding national public and private investments between 2010 and 2020: significant positive evolutions since 2010 are seen for Germany, Austria and Denmark. Regarding patents on environment technologies: for the period 2010 – 2018, the EU Member States of Denmark, Germany, Austria and Cyprus display high performance (2018 and 2019). As for the Associated Countries, Norway is above the EU average (in 2018).

- In terms of the share of researchers receiving transferable skills training, in 2019, Romania, Malta and Hungary stand out from EU-27 average. Regarding the Associated Countries, data are only available for Iceland and Norway, which are both above the EU-27 average. As to the indicator number of innovative enterprises that co-operated on R&D+I with universities and HEIs, Germany stands out from the rest of the EU Member States. Among Associated Countries, Türkiye stands above the EU-27 average.

- With direct and indirect government support through R&D tax incentives as % of GDP at the EU-27 level, Austria, Belgium, and France consistently surpass the EU-27 average in the period 2010-2020. Although the Associated Countries demonstrate levels of government support below the EU-27 average, both Türkiye and Norway show growth trends.

- A substantial number of EU Member States demonstrate high levels of trust in science, with Greece and Germany doing exceptionally well. In the Associated Countries, a notable affirmation of science is evident, with Türkiye exemplifying this with a very high demonstration of trust.

Key insights for ERA Priority 3: Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union

- Most of the widening countries experience stagnation or even a slight decrease in total R&D expenditure (period 2011 to 2021). The indicator for Portugal and Cyprus grew, possibly related to the effectiveness of policies such as StartUp+ Portugal or Centro Ciencia LP.

- Both Member States and Associated Countries have initiatives supporting synergies between EU, national and regional funding programmes. The German Pact for Research and Innovation works as a joint exercise to boost R&D funding. Similarly, the Research and Science Fund of the Netherlands becomes a crucial initiative to increase R&I funding. In some other Member States, internationalisation is enhanced, for example through the Academy of Finland and Centro Ciencia LP in Portugal. In terms of specific programmes on synergies, Latvia's Guidelines for Science, Technology development, and Innovation is important. Associated Countries are also involved in this sub-priority through initiatives such as ISERD, an Israeli directorate for the communication with Europe and the European Framework programme.

- On increased collaborative links and the excellence-based integration of research-performing organisations from countries and outermost regions with lower R&I: the National Academic Infrastructure for Supercomputing in Sweden (NAISS) and the Estonian Research Infrastructure Roadmap, are important initiatives promoting collaboration within European R&I. Among the widening countries, Poland has a programme related to the European Funds for the Modern Economy Action Feng.01.01 Smart Path, with the aim of financing projects on innovation and internationalisation. Similarly, the Associated Countries have developed programmes towards increasing linkages among countries. An example includes the Marmara Research Centre which works with institutions like NATO or COST, becoming a key R&D institution in Türkiye to promote cooperation.

Key insights for ERA Priority 4: Advancing concerted research and innovation investments and reforms

- With regard to the share of public R&D expenditures financed by the private sector it has remained quite stable across the Member States from 2010 to 2020. In the case of the Associated Countries, Türkiye is the only country that has increased its value in the analysed period.

- Securing long-term research and innovation investment is measured through GBARD allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher. The highest values among the Member States are noted by Belgium and Italy, with the Associated Countries demonstrating a slight increase in the analysed period 2010 to 2020.

RÉSUMÉ EXÉCUTIF

Dans le cadre du mécanisme de suivi de l'EER (EMM), ce tableau de bord de l'EER comprend une série d'indicateurs visant à suivre les progrès des États membres de l'UE et des pays associés vers les objectifs de l'EER.

Les informations quantitatives recueillies auprès de différentes sources sont complétées par des informations qualitatives compilées à l'aide de l'enquête STIP de l'OCDE. De plus, le rapport intègre des informations tirées de documents nationaux afin d'expliquer pourquoi certains pays obtiennent de bons résultats en ce qui concerne les objectifs de l'EER.

Objet du rapport

Le rapport présente le point de départ de l'EER restructuré au niveau national en:

- Analysant les données sur les principaux indicateurs de R&I et les documents politiques clés pour l'EER, tels que les feuilles de route et les stratégies de l'EER.

- Évaluant les performances et les progrès des États membres et des pays associés en ce qui concerne les priorités et les sous-priorités de l'EER du Pacte pour la R&I.

- Fournissant des informations sur les performances et les progrès des États membres et des pays associés en ce qui concerne d'autres initiatives et actions pertinentes pour l'EER.

Informations clés sur la priorité 1 de l'EER : Approfondir un marché intérieur de la connaissance qui fonctionne réellement

- Entre 2010 et 2021, la plupart des États membres de l'UE ont augmenté leurs dépenses intérieures brutes de R&D (DIRD). Par rapport à 2011, la Belgique, la Grèce, la Pologne, l'Autriche et la Tchéquie ont connu les augmentations les plus importantes de leurs valeurs de DIRD en 2020. De même, tous les pays associés ont aussi généralement augmenté leurs investissements en R&D, l'Islande étant en tête. L'Allemagne est en tête des États membres de l'UE en ce qui concerne les crédits budgétaires publics pour la R&D (CBPRD) en % du PIB. La Belgique affiche une croissance constante des dépenses intérieures en R&D expérimental des entreprises (DIRDE) en % du PIB, avec des tendances positives similaires dans plusieurs pays associés : la Norvège, l'Islande, la Turquie et la Serbie.

- Les publications en accès ouvert étaient les plus courantes aux Pays-Bas, en Hongrie, en Suède (dans l'UE-27), ainsi qu'en Norvège et en Islande (parmi les pays associés).

- Parmi les États membres de l'UE, la France et l'Allemagne se sont distinguées par leurs investissements dans les infrastructures européennes de recherche, tandis que la Norvège s'est distinguée parmi les pays associés. En ce qui concerne la part des dépenses publiques nationales de R&D allouée aux infrastructures de recherche européennes sur la base des données de 2022, la Hongrie, la Roumanie et la Bulgarie ont fait preuve d'investissements élevés dans les infrastructures de recherche,

dépassant la moyenne de l'UE. Parmi les pays associés, la Norvège et l'Islande ont également fait preuve d'un engagement en faveur des infrastructures de recherche.

- La représentation des femmes dans le monde universitaire s'est améliorée, en particulier en Roumanie, et la proportion de publications de recherche d'auteurs mixtes est très élevée en Italie. La Roumanie se distingue aussi par la proportion de femmes dans les 10 % de publications les plus citées, l'Islande et la Serbie progressant également parmi les pays associés. La Finlande est en tête de l'indice des femmes dans le numérique dans l'UE (2022), tandis que la proportion de femmes parmi les titulaires d'un doctorat en STIM varie d'un pays à l'autre.

- Une tendance à la hausse a été observée en ce qui concerne la part des doctorants étrangers en % de l'ensemble des doctorants de l'UE, le Luxembourg se distinguant constamment à cet égard. Parmi les pays associés, l'Islande excelle à attirer les doctorants étrangers. En ce qui concerne le taux de nouveaux diplômés au niveau doctorat pour 1 000 habitants (âgés de 25 à 34 ans), la Slovénie excelle avec la Finlande, l'Irlande, la Suède et le Danemark observent des résultats similaires. En ce qui concerne la mobilité professionnelle des ressources humaines en science et technologie (RHST), le Danemark se démarque des autres États membres. Parmi les pays associés, la Norvège, la Turquie, l'Islande et la Serbie affichent des tendances positives.

- Une croissance des co-publications public-privé a été observée, avec le Danemark, le Luxembourg, la Finlande, la Suède, l'Autriche et le Pays-Bas affichants d'excellents résultats. Des tendances positives sont évidentes dans le nombre de demandes de brevets PCT divisé par le PIB en millions d'euros, avec des performances notables de la Finlande et de la Suède. La part des entreprises innovantes collaborant avec des universités ou établissements d'enseignement supérieur sur l'ensemble des entreprises innovantes est en nette progression, avec des améliorations notables dans des pays comme l'Estonie et l'Irlande. Des pays associés comme la Turquie et la Serbie affichent également des progrès remarquables. Les Pays-Bas et la Suède excellent à la fois dans le domaine des "chercheurs des entreprises en pourcentage du total national" et dans celui des "chercheurs en entreprise en équivalent temps-plein pour mille emplois dans l'industrie". Parmi les pays associés, la Turquie affiche une croissance significative de la recherche en entreprise.

- Concernant le nombre de publications scientifiques figurant parmi les 10 % de publications les plus citées dans le monde, les Pays-Bas, le Luxembourg et le Danemark se distinguent dans l'UE-27, et la Norvège et Israël font de même parmi les pays associés (2020). En ce qui concerne l'indice de liberté académique (*Academic Freedom Index*) parmi les Etats membres de l'UE, la Tchécoslovaquie, l'Estonie, la Belgique, l'Italie et l'Allemagne se distinguent, tandis que parmi les pays associés, l'Israël et la Norvège sont très performantes.

- A propos de l'indicateur des co-publications internationales avec des partenaires non-UE pour 1000 chercheurs dans le secteur public, en 2022, les États membres de l'UE de Chypre, le Danemark, le Luxembourg, la Suède et la Finlande, ainsi que les pays associés de l'Islande et la Norvège, affichent les meilleurs résultats. En ce qui concerne le brevetage en coopération européen et international dans les demandes de l'OEB au niveau national et de l'UE, une tendance négative est observée pour la période de 2010 à 2013.

Informations clés sur la priorité 2 de l'EER : Relever ensemble les défis de la transition écologique et de la transformation numérique ainsi que les autres défis qui ont une incidence sur la société, et accroître la participation de la société à l'EER.

- En ce qui concerne les crédits budgétaires de publics de R&D (CBPRD) par la NABS, l'Allemagne et la France affichent de bons résultats pour toutes les années considérées : L'Allemagne et la France affichent de bonnes performances pour toutes les années incluses. Tous les pays associés pour lesquels des données sont disponibles (Norvège, Suisse, Turquie, Serbie et Islande) sont en dessous de la moyenne de l'UE-27. Concernant le financement public national dans la R&D à l'échelon transnationale, la Belgique et l'Italie sont les États membres les plus performants entre 2010 et 2020. Parmi les pays associés, la Norvège se situe au-dessus de la moyenne de l'UE. En ce qui concerne le budget public de R&D consacrées à l'environnement, pour la période de 2010 à 2021, la Lituanie, la Pologne et la Belgique affichent les meilleurs résultats au niveau des États membres de l'UE, tandis que, parmi les pays associés, la Norvège se maintient au-dessus du niveau de l'UE. En ce qui concerne les investissements nationaux dans la R&D, à la fois publics et privés entre 2010 et 2020, des évolutions positives majeures sont observées en Allemagne, en Autriche, et au Danemark. A propos des brevets sur technologies liés à l'environnement pour la période entre 2010 et 2018, les États membres de l'UE que sont le Danemark, l'Allemagne et l'Autriche, et Chypre affichent des performances élevées (2018 et 2019). En ce qui concerne les pays associés, la Norvège performe au-dessus du niveau de l'UE (en 2018).

- En 2019, la Roumanie, Malte et la Hongrie se distinguent de la moyenne de l'UE-27 concernant la proportion des chercheurs bénéficiant d'une formation aux compétences transférables. En ce qui concerne les pays associés, les données ne sont disponibles que pour l'Islande et la Norvège, qui se situent toutes deux au-dessus de la moyenne de l'UE-27. Concernant l'indicateur du nombre d'entreprises innovantes ayant coopéré en matière de R&D et innovation avec des universités et des établissements d'enseignement supérieurs (EES), l'Allemagne se distingue des autres États membres de l'UE. Parmi les pays associés, la Turquie se situe au-dessus de la moyenne de l'UE-27.

- En ce qui concerne les financements publics directs et soutien indirect sous forme d'incitations fiscales à la R&D en % du PIB au niveau de l'UE-27, l'Autriche, la Belgique et la France dépassent systématiquement la moyenne de l'UE-27 au cours de la période 2010 à 2020. Bien que les pays associés affichent des niveaux de soutien public inférieurs à la moyenne de l'UE-27, la Turquie et la Norvège affichent des tendances à la croissance.

- Dans un nombre important d'États membres de l'UE, les niveaux de confiance dans la science sont élevés, la Grèce et l'Allemagne obtenant des résultats exceptionnels. Dans les pays associés, une remarquable confiance dans la science existe, exemplifié par la Turquie.

Informations clés sur la priorité 3 de l'EER : Améliorer l'accès à l'excellence en matière de recherche et d'innovation dans toute l'Union et renforcer les interconnexions entre les écosystèmes d'innovation dans l'ensemble de l'Union

- La plupart des pays dits « widening » connaissent une stagnation, voire une légère diminution des dépenses intérieures bruts de R&D expérimental (2011-2021). Les indicateurs du Portugal et de la Chypre ont augmenté, possiblement en raison de l'efficacité de politiques telles que StartUp+ Portugal ou le Centre Scientifique LP.

- Les États membres et les pays associés ont mis en place des initiatives visant à favoriser les synergies entre les programmes de financement européens, nationaux et régionaux. Le pacte allemand pour la recherche et l'innovation constitue un exercice commun pour stimuler le financement de R&I. De même, le fonds pour la recherche et la science des Pays-Bas est une initiative cruciale pour accroître le financement de la R&I. Dans d'autres États membres, l'internationalisation est renforcée par des institutions tels que l'Académie de Finlande et le Centre Scientifique LP au Portugal. En termes de programmes spécifiques sur les synergies, les lignes directrices pour la science, le développement technologique et l'innovation de la Lettonie sont importantes. Les pays associés sont également impliqués dans cette sous-priorité par le biais d'initiatives telles que l'ISERD, une institution israélienne pour la communication avec l'Europe et le programme-cadre européen.

- Concernant le renforcement des liens de collaboration et l'intégration fondée sur l'excellence des organismes de recherche des pays et régions ultrapériphériques dont le secteur R&I est plus faible, l'infrastructure académique nationale pour les supercalculateurs en Suède (NAISS) et la feuille de route estonienne sur les infrastructures de recherche sont deux initiatives importantes qui favorisent la collaboration dans le cadre de la R&I européenne. Parmi les pays dits « widening », la Pologne dispose du programme SMART, lié aux fonds européens pour l'économie moderne (FENG) action 01.01, dont l'objectif est de financer des projets liés à l'innovation et à l'internationalisation. De même, les pays associés ont développé des programmes visant à renforcer les liens entre les pays. Le centre de recherche de Marmara, par exemple, travaille avec des institutions telles que l'OTAN ou COST, devenant ainsi une institution de R&D clé en Turquie pour la promotion de la coopération.

Informations clés sur la priorité 4 de l'EER : Faire progresser les investissements et les réformes concertés dans la recherche et l'innovation

- En ce qui concerne la proportion des dépenses publiques de R&D financées par le secteur privé, elle est restée assez stable dans les États membres entre 2010 et 2020. Dans le cas des pays associés, la Turquie est le seul pays à avoir augmenté ses financements au cours de la période analysée.

- La garantie des investissements à long terme dans la recherche et l'innovation est mesurée par le CBPRD alloué aux programmes transnationaux à l'échelle de l'Europe, bilatéraux ou multilatéraux, par chercheur ETP. Les valeurs les plus élevées parmi les États membres sont enregistrées par la Belgique et l'Italie, les pays associés affichant une légère augmentation au cours de la période analysée entre 2010 à 2020.

1. Introduction

1.1. Overview of the purpose and content of the report

Following the 2021 Council Recommendations on the Pact for R&I, the need for an improved monitoring mechanism to track the progress of Member States and Associated Countries in achieving their goals within the European Research Area (ERA) was highlighted. In June 2022 the Commission presented the framework for a future ERA monitoring mechanism (EMM) to the Council of the EU.

The newly introduced EMM includes an ERA Dashboard that encompasses a comprehensive set of indicators, aiming to monitor the progress of countries towards the ERA objectives. The Dashboard will be instrumental in supporting the assessment of the progress made by Member States and Associated Countries[1]. ERA Dashboard data has also been used to analyse progress made in achieving the ERA priorities in the ERA monitoring EU-level report 2023[2].

This report analyses the ERA Dashboard indicators, highlighting strong performance in the EU-27 and the following Associated Countries: Armenia, Georgia, Iceland, Israel, Montenegro, Norway, Serbia, and Türkiye[3]. The report delves into the trends observed over the past decade across various indicators, identifying improvements made during the period from 2010 to 2022. The report also highlights challenges and limited progress witnessed in some countries. In order to help explain why certain countries consistently perform well on a given ERA indicator, this report utilises data from the OECD STIP Survey 2023[4] to shed light on significant initiatives launched by these countries. This approach allows us to contextualise the national landscape that may be influencing a country's success across the ERA Dashboard indicators. Further details at a country-level are provided in the ERA Country reports.

The following sub-section introduces the four ERA priority areas, followed by the methodological approach, and then a discussion of limitations and recommendations.

1.2. R&I landscape and the ERA priorities

To ensure a successful implementation of the ERA priorities, countries must demonstrate their commitment to investing in R&D activities. This commitment is often reflected in a progressive R&I landscape, where a significant portion of GDP is allocated to R&D activities. Having a notable share of researchers is also vital for a country's progress in terms of R&D.

In demonstrating their commitment to the new ERA, European countries have embraced the Pact for R&I. This initiative establishes four priority areas for collaborative efforts, presents ambitions for investments and reforms, and implements streamlined coordination and monitoring mechanisms. In alignment with these priority areas, there are 20 voluntary ERA Actions for the period of 2022 to 2024, that have been developed between the Commission

[1] European Commission, Directorate-General for Research and Innovation, (2022). A pact for research and innovation in Europe, Publications Office of the European Union. https://data.europa.eu/doi/10.2777/56361
[2] https://op.europa.eu/en/publication-detail/-/publication/5f91e877-88e5-11ee-99ba-01aa75ed71a1/language-en/format-PDF/source-296914217
[3] These Associated Countries have been selected based on available data and commitments to the ERA Actions.
[4] https://stip.oecd.org/stip

and the Council, with inputs from R&I stakeholders, not least the ERA Forum for Transition[5]. Member States and Associated Countries are encouraged to adopt and execute these ERA Actions to advance the ERA priorities[6]. The priorities, underlying sub-priorities[7], and associated ERA actions are outlined in Table 1.

Table 1. Overview of the ERA priorities, sub-priorities and associated ERA actions

Priority	Sub-priority	Affiliated ERA Action
Deepening a truly functioning internal market for knowledge	• Open science • Research infrastructures • Gender equality, equal opportunities for all and inclusiveness • Researchers' careers and mobility and research assessment and reward systems • Knowledge valorisation • Scientific leadership • Global engagement	1) Enable the open sharing of knowledge and the re-use of research outputs, including through the development of the European Open Science Cloud (EOSC) 2) Propose an EU copyright and data legislative and regulatory framework fit for research 3) Advance towards the reform of the Assessment System for research, researchers and institutions to improve their quality, performance and impact 4) Promote attractive and sustainable research careers, balanced talent circulation and international, transdisciplinary and inter-sectoral mobility across the ERA 5) Promote gender equality and foster inclusiveness, taking note of the Ljubljana declaration 6) Deepening the ERA through protecting academic freedom in Europe 7) Upgrade EU guidance for a better knowledge valorisation 8) Strengthen sustainability, accessibility and resilience of research infrastructures in the ERA

[5] https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&do=groupDetail.groupDetail&groupID=3755

[6] European Commission Directorate-General for Research and Innovation. (2021). European Research Area Policy Agenda, Overview of actions for the period 2022-2024. https://research-and-innovation.ec.europa.eu/system/files/2021-11/ec_rtd_era-policy-agenda-2021.pdf

[7] "Sub-priorities" are referred to in the Pact for R&I as "priority areas for joint action".

Priority	Sub-priority	Affiliated ERA Action
		9) Promote a positive environment and level playing field for international cooperation based on reciprocity
Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society's participation in the ERA	• Challenge-based ERA actions • Synergies with education and the European Skills Agenda • Synergies with sectorial policies and industrial policy, in order to boost innovation ecosystems • An active citizen and societal engagement in R&I in all its dimensions	10) Make EU R&I missions and partnerships key contributors to the ERA 11) An ERA for green energy transformation 12) Accelerate the green/digital transition of Europe's key industrial ecosystems 13) Empower Higher Education Institutions to develop in line with the ERA, and in synergy with the European Education Area 14) Bring Science closer to citizens
Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union	• More investment and reforms in countries and regions with lower R&I performance • Synergies between Union, national and regional funding programmes • Increased collaborative links and the excellence-based integration of research-performing organisations from countries and outermost regions with lower R&I performance into European scientific networks and innovation ecosystems, more balanced "brain calculation" within the ERA, appropriate skills and training for enhancing access to excellence	15) Build-up regional and national R&I ecosystems to improve regional/national excellence and competitiveness 16) Improve EU-wide access to excellence 17) Enhance the strategic capacity of Europe's public research performing organisations

Priority	Sub-priority	Affiliated ERA Action
Advancing concerted research and innovation investments and reforms	• Coordination of R&I investments • Support to prioritise and secure long-term R&I investments and policy reforms	18) Facilitate a national process or ERA policy vehicle preparation for identification of running or planned measures contributing to the implementation of ERA 19) Establish an efficient and effective ERA monitoring mechanism 20) Support to the prioritisation, coordination and direction of R&I investments and reforms

1.3. Scope of the ERA Dashboard

1.3.1. Quantitative data

The ERA Dashboard is a comprehensive monitoring tool comprised mainly of quantitative indicators. The ERA Dashboard indicators were proposed by a panel of experts within the framework of the study *Design of the new ERA Monitoring System* with 56 proposed indicators. Nonetheless, as explained further in this section, due to data limitations, the final number of indicators included in the ERA Dashboard has been narrowed down to 37 indicators.

A range of sources of information and databases have been explored to collect data for the available Dashboard indicators. Sources include, but are not limited to, Eurostat, OECD, MORE Survey, Science-Metrix or Women in Science (WiS) database. Due to the high volume of data to be collected and the required transformations to obtain some of the indicators, all data has been downloaded and organised per priority area. To facilitate analysis and ensure consistency, indicators data have been compiled under a single standardised database. More information on the methodology and data are available in the accompanying methodology report and the replication package.[8]

The final list of the 37 available indicators is summarised in Table 2. Each indicator is classified in terms of ERA priority and sub-priority and 13 of these indicators are shared with the ERA Scoreboard. For additional information about the sources of these indicators, please refer to Annex 1.

The ERA Dashboard, utilising the aforementioned indicators, encompasses data spanning from 2010 up to the most recent available data. In terms of its geographical scope, this monitoring tool extends beyond the 27 EU Member States and includes eight selected Associated Countries participating in the Horizon Europe programme. The Associated Countries are Armenia, Georgia, Iceland, Israel, Montenegro, Norway, Serbia, and Türkiye. The selection of these eight Associated Countries was based on a predefined set of criteria (e.g. data availability, commitment towards ERA) in collaboration with DG RTD.

[8] See https://european-research-area.ec.europa.eu

Table 2. Overview of indicators per ERA priority and sub-priority

General indicators		Indicator
R&I investments and landscape		1. Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP
		2. Government Budget Allocations for R&D (GBARD) as share of GDP
		3. Researchers (in full-time equivalent) per million inhabitants
		4.Business Enterprise expenditure on R&D (BERD) as a percentage of GDP
ERA Priority	**ERA Sub-priorities**	**Indicator**
ERA Priority 1: Deepening a truly functional internal market for knowledge	Open Science	5. Share of publications available in open access
	Research Infrastructures	8. Share of national public R&D expenditure committed to European research infrastructures
		9. Number of European research infrastructures in which a Member State or an Associated Country participates
	Gender equality, equal opportunities for all and inclusiveness	11. Share of women in grade A positions in HEIs
		12. Proportion of papers with mixed gender authorship
		13. Proportion of women in authorships of the top 10% most cited publications
		14. Women in Digital Index
		15. Proportion of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM)
	Researchers' careers and mobility and research assessment and reward systems	16. Share of foreign doctorate students as a percentage of all doctorate students
		17. New doctorate graduates per 1,000 inhabitants aged 25-34
		18. Job-to-job mobility of Human Resources in Science and Technology
	Knowledge valorisation	19. Share of public-private co-publications per million population
		20. Best practice examples and methodologies for knowledge valorisation
		22. Number of PCT patent applications divided by GDP in million Euros
		23. Share of innovating firms collaborating with higher education institutions or public/private research institutions
		25. Business enterprise researchers as percentage of national total
		26. Business enterprise researchers in full-time equivalent per thousand employment in industry
	Scientific leadership	27. Number of scientific publications among the top 10% most cited publications worldwide as a percentage of all publications
		28. Academic Freedom Index
	Global engagement	30. International co-publications with non-EU partners per 1,000 researchers
		31. European and international co-patenting in EPO applications at national and EU level

General indicators		Indicator
ERA Priority 2: Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society's participation in the ERA	Challenge-based ERA actions	33. Government budget allocations for R&D (GBARD) by NABS
		34. R&I investments (transnational cooperation): GBARD (EUR) allocated to Europewide transnational, bilateral or multilateral, public R&D programmes per FTE researcher in the public sector
		35. Environmentally related government R&D budget as percentage of total government R&D
		37. National public and private investments as suggested in the SET Plan progress report 2021
		38. OECD Patents on environnement technologies
	Synergies with education and the European Skills Agenda	39. Share of researchers receiving transferable skills training
		40. Innovative enterprises that co-operated on R&D+I with universities and HEIs
	Synergies with sectorial policies and industrial policy, in order to boost innovation ecosystem	41. Direct government support plus Indirect government support through R&D tax incentives as a percentage of GDP
	An active citizen and societal engagement in R&I in all its dimensions	48. Trust in Science
ERA Priority 3: Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union	More investments and reforms in countries and regions with lower R&I performance	49. Increase in total R&D expenditure in widening countries expressed as a percentage of GDP
ERA Priority 4: Advancing concerted research and innovation investments and reforms	Coordination of R&I investments	55. Share of public R&D expenditures financed by the private sector
	Support to prioritise and secure long-term R&I investments and policy reforms	56. Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher[9]

[9] This indicator is also included under sub-priority 2.1 Challenge-based ERA actions. The rationale behind its inclusion in both sub-priorities is the relevance to measure both sub-priorities, especially in light of the limited available indicators to measure sub-priority 4.1.

1.3.2. Qualitative data

The quantitative information collected via the ERA Dashboard is complemented by qualitative information compiled from the OECD STIP Survey 2023. This bi-annual survey collects qualitative and quantitative data on national science, technology and innovation (STI) policies. It covers a wide spectrum of STI policy areas, spanning various ministries and national agencies responsible for domains such as research, innovation, education, industry, environment, labour, finance/budget, among others. Consequently, the ERA Dashboard report incorporates key initiatives related to different ERA sub-priorities, at national level, as highlighted by the OECD STIP Survey. This additional qualitative perspective provides valuable context and depth to the monitoring process, especially regarding high performing countries.

In addition to the OECD STIP Survey, the report incorporates insights from national documents to further try to understand why certain countries do well with regard to the ERA objectives. Examples include key national strategies and plans targeting the whole R&I landscape, mainly key initiatives targeting core areas within R&I. As a result, the Dashboard report incorporates key information at the country level not only in quantitative terms but also qualitative, through important policies and initiatives.

1.4. Limitations on data collection and recommendations for future monitoring exercises

The primary obstacle encountered during the data collection process was the limited availability of data for several indicators. As a result, the initially proposed set of 56 Dashboard indicators had to be reduced to 37.

These challenges primarily revolved around the necessity for new survey data collection and the absence of publicly available data. Additionally, certain indicators had to be excluded due to the unavailability of data within the desired time frame and geographical units.

Data availability at the geographical level is particularly problematic in relation to Associated Countries. Since many sources of information collect data only at the EU-27 level, there are key constraints regarding available indicators for Associated Countries. As a result, the possibility to assess the progress and commitment of Associated Countries towards the ERA priorities is limited.

The identified limitations and challenges have revealed key areas for further improvement in data collection. A core need lies in ensuring all sub-priorities can be measured through quantitative indicators. Consequently, a key recommendation entails the identification of relevant and comparable indicators for sub-priorities 3.2 and 3.3[10]. Furthermore, progress towards all sub-priorities should not only be measured against quantitative indicators, but also through an adequate number of them. Therefore, the second recommendation focuses on the need to determine additional feasible, relevant and continuous indicators for sub-priorities with a limited number of indicators, such as sub-priorities 3.1, 4.1 or 4.2[11] with

[10] Sub-priority 3.2 refers to Synergies between Union, national and regional funding programmes and Sub-priority 3.3.to Increased collaborative links and excellence-based integration of research-performing organisations from countries with lower R&I performance.

[11] Sub-priority 3.1: More investments and reforms in countries and regions with lower research and innovation performance; Sub-priority 4.1: Support to prioritise and secure long-term research and innovation investments and policy reforms and Sub-priority 4.2: Coordination of research and innovation investments.

currently only one indicator. Overall, further efforts are required in relation to measuring quantitative progress towards priorities 3 and 4[12]. Finally, in order to ensure that indicators included in the ERA Dashboard accurately reflect the objectives of each sub-priority, it is recommended that indicators are scrutinised each year to include additional ones, if necessary, tailored to each sub-priority.

1.5. Structure of the report

To provide a comprehensive assessment, the analysis is conducted by ERA priority areas. Each priority is further classified into sub-priority areas, clearly defining their objectives. Each sub-priority presents an overview of the context, notable trends and the indicators included. Interactive maps are provided for each priority area, allowing for visualisation of the performance of Member States and Associated Countries.

For each sub-priority, trends observed across all underlying indicators over the past decade at the national level and compared to the EU average are discussed. The "notable trends" sections also incorporate key initiatives implemented by Member States and the eight Associated Countries covered in this report. Consequently, the ERA Dashboard report focuses on key advancements at the national level. For further insights on the EU as a whole, please refer to the EU-level Report 2023[13].

The report is complemented by two annexes that provide additional information to facilitate the understanding of the analysed trends. Annex 1 presents an overview of the available indicators included in the ERA Dashboard. In order to facilitate the analysis and to illustrate the progress, Annex 2 presents graphs developed for each indicator providing key visualisations employed in the analysis of the indicators. This annex is organised into 5 sections, corresponding to visualisations of R&I investments and landscape and the four defined ERA Priorities.

[12] ERA Priority 3: *Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union* and ERA Priority 4: *Advancing concerted research and innovation investments and reforms.*

[13] https://op.europa.eu/en/publication-detail/-/publication/5f91e877-88e5-11ee-99ba-01aa75ed71a1/language-en/format-PDF/source-296914217

2. R&D investment and landscape

2.1. Overview

Over recent decades, a primary objective of the European Union (EU) has been to promote increased investment in research to enhance the competitiveness of the EU. Sustainable growth is increasingly related to the capacity of regional economies to innovate and transform, adapting to an ever-changing and more competitive environment. This translates into a greater effort needed to create the ecosystems that encourage innovation, research, and entrepreneurship. Innovation is thus key to a range of Commission priorities, in particular the European Green Deal, an economy that works for people, and making Europe fit for the digital age.

The following section provides an analysis of the performance of Member States and Associated countries with respect to their R&I investment and researcher density. This analysis provides insights into government priorities concerning public R&D funding activities and the involvement of businesses in such endeavours. Additionally, this section assesses researcher density, serving as a proxy for the attractiveness of the research career path within a country and the level of encouragement for individuals to pursue research careers.

2.2. Notable trends

Key findings on R&D investment and landscape

In examining R&I landscape across European countries, there are varying levels of investment and researcher density. In terms of **Gross Domestic Expenditures on R&D (GERD)**, most EU Member States increased their GERD as a percentage of GDP. In comparison to 2011, Belgium, Greece, Poland, Austria, and Czechia experienced the most significant increases in their GERD values in 2020. Associated Countries also generally increased their R&D investments, with Iceland leading the way.

Between 2010 and 2021, EU-27 countries mostly witness a **decreasing trend in Government Budget Allocations for R&D (GBARD**) as a percentage of GDP, followed by a recent increase in the last couple of years. Germany consistently led with a GBARD rate above 1%, and Greece, Germany, Luxembourg, and Hungary had notable increases over the past decade. Among Associated Countries, Serbia, Iceland, and Norway portray positive GBARD trends, while Israel and Türkiye experienced declines.

In 2021, Sweden had the highest number of **researchers per million inhabitants** among EU Member States, followed by Finland and Denmark. Between 2010 and 2020, the EU-27 saw a steady increase in the number of researchers per million inhabitants, with significant improvements in Sweden, Belgium, the Netherlands, and Hungary. Among Associated Countries, Norway consistently performed well on this indicator, while Türkiye saw remarkable improvement.

The EU consistently shows a positive trend in **Business Enterprise Expenditure on R&D** as a percentage of GDP (BERD). Belgium had the highest increase in its BERD since 2016. Among Associated Countries, Norway, Iceland, Türkiye, and Serbia exhibited positive trends in BERD from 2010 to 2021, with Iceland having the highest increase.

The level of investment in research and development (R&D) within a country can serve as an indication of its dedication and commitment to advancing its research and innovation landscape. This section focuses on four indicators that gauge these efforts as summarised in Table 3.

Table 3. R&I investment indicators

Note: Annex A2.1 includes graphs illustrating the trend for all Member States and Associated Countries

Indicator
1. Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP
2. Government Budget Allocations for R&D (GBARD) as share of GDP
3. Researchers (in full-time equivalent) per million inhabitants
4. Business Enterprise Expenditure on R&D (BERD) as a percentage of GDP

Using the most recent data available, map 1 illustrates the scores of the EU-27 Member States and Associated Countries with respect to the indicators presented in Table 3. Additionally, the notable trends observed over the past 10 years are analysed per indicator to offer a comprehensive understanding of the evolving R&D landscape.

Map 1. R&D Landscape: Latest Data on Countries' Investment in Research and Development (R&D).

Sources: Eurostat, World Bank, UNESCO Institute for Statistics. Data is based on 2022 or the most recent available data.

Reset the map

R&I investment and landscape

- GERD as % of GDP
- GBARD as % of GDP
- Researchers (in full-time equivalent) per million inhabitants
- BERD as % of GDP

Gross Domestic Expenditures on R&D

In terms of R&I intensity, Sweden led among the EU Member States in 2021 with a **Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP** rate of 3.36%. Belgium (3.22%) and Austria (3.19%) also had strong performances. By contrast, six Member States allocated less than 1% of their GDP to R&D in 2021, namely Romania (0.47%), Malta (0.63%), Latvia (0.69%), Bulgaria (0.77%), Cyprus (0.87%), and Slovakia (0.93%).

In terms of trends over the last decade, approximately two-thirds of EU Member States reported higher R&I intensity in 2021 compared to 2010. However, some countries experienced notable declines in R&D intensity during this period, including Finland (-0.73 pp), Ireland (-0.53 pp), and Luxembourg (-0.4 pp).

Belgium (+1.16 pp), Greece (+0.85 pp), Poland (+0.72 pp), Austria (+0.46 pp), and Czechia (+0.67 pp) witnessed the most significant increases of GERD as a percentage of GDP between 2010 and 2021.

Between 2010 and 2021, all Associated Countries depict an upward trend in their GERD as a percentage of GDP. Compared to 2010, the most notable increase is witnessed in Iceland (+2.77 pp) and Israel (+1.51 pp). However, Armenia experiences a small decrease in their rate of GERD (-0.03 pp). The latest available data shows that Israel exhibited the strongest performance (5.44%) followed by Iceland (2.47%) and Norway (2.24%).

Government Budget Allocation for R&D

As for the **Government Budget Allocations for R&D (GBARD) as a % of GDP**, the evolution of the EU-27 between 2010 and 2021 shows a generally decreasing trend for the first eight years, followed by a recent increase in the last two years. Germany, Denmark, Finland, Austria, and Sweden consistently perform above the EU average. In 2021, Germany led among the EU Member States with a GBARD as % of GDP of 1.12%, thus being the only EU country with a GBARD rate higher than 1%.

Focusing on EU Member States performance between 2010 and 2021, we find that half of them show a rise in GBARD as % of GDP. Of all EU countries, Greece experienced the highest increase in GBARD (+0.55 pp), followed by Germany (+0.23 pp), Luxembourg (+0.14 pp) and Hungary (+0.10 pp).

Other countries experienced a decline in 2021 compared to 2010 such as Ireland (-0.27 pp). Finland (-0.21 pp), Portugal (-0.179 pp), and Spain (-0.154 pp).

The Associated Countries average performance for GBARD as % of GDP shows a minimal average increase of +0.03 pp. The associated country with the best GBARD performance is Serbia, with an increase in GBARD of +0.42 pp from 2010 to 2021, followed by Iceland (+0.25 pp) and Norway (+0.08 pp). Israel and Türkiye depict a decline in GBARD of approximately -0.07 percentage points.

Researcher density

In 2021 Sweden reported the most **Researchers in Full Time Equivalent (FTE)** with 9,640 researchers per million inhabitants, followed by Finland (7,871), and Denmark (7,708). Romania (995), Cyprus (1,813), and Malta (2,059), score below the EU-27 average of 4,481 researchers in FTE per million inhabitants.

Between 2010 and 2020, the EU-27 average performance has steadily increased with notable improvements in Sweden (+4467), Belgium (+2724), the Netherlands (+2387) and

Hungary (+2147). The following countries exhibited a slight increase in the number of researchers per million inhabitants: Malta (+642), Slovakia (+392), Latvia (+553), Spain (+355), and Romania (+21). Luxembourg witnessed a minor decrease in researcher density between 2010 and 2020 (-154).

As for the Associated Countries, Norway consistently has a strong performance with regard to researchers in FTE per million inhabitants with a value of 7,162 for 2021. Compared to 2010, Türkiye portrays a remarkable improvement in researcher density (+703), followed by Georgia (+343) and Serbia (+253). Iceland on the other hand experiences a decrease of -146 in 2021 compared to 2011.

Business Enterprise Expenditure on R&D

The EU witnesses a positive trend of **Business Enterprise Expenditure on R&D as a % of GDP (BERD)**, with a positive change of +0.27 pp from 2010 to 2021. Therefore, EU investment in BERD has been stable over the last decade. Eight EU Member States outperform the EU-27 BERD average across the 2010 decade (Belgium, Denmark, Germany, France, Austria, Slovenia, Finland and Sweden). Belgium is the country that shows the highest increase in its BERD since 2016.

In contrast, four EU Member States have experienced a decrease in their BERD as a percentage of GDP in the period 2010-2021 (Denmark, Ireland, Luxembourg and Finland). Nonetheless, except for Ireland, their relative BERD as a percentage of GDP compared to that of the EU is still higher over the decade. Other EU Member States exhibit lower scores than the EU average. Particularly, Cyprus consistently has a rather low BERD score with an average BERD value of 0.18% of GDP. Similarly, Bulgaria, Latvia, Lithuania, Malta, Slovakia, Poland, Greece, Spain and Romania, all have a BERD value below the EU average.

For Associated Countries, data on BERD is only available for Norway, Iceland, Türkiye and Serbia. All of these countries exhibit a positive trend from 2010 to 2021, with Iceland standing out with the highest increase of 0.7 percentage points in 2021 compared to 2010.

3. ERA Priority 1: Deepening a truly functional internal market for knowledge

ERA Priority 1 aims to strengthen the efficacy of an internal market for knowledge. This aim is achieved by establishing an open access scientific landscape, facilitating knowledge exchange and valorisation while fostering research infrastructures. Other objectives include creating motivating and attractive work environments for researchers, promoting gender equality, ensuring ample funding opportunities, and fostering academic freedom. Additionally, under this priority, active global engagement is encouraged, fostering collaboration with relevant stakeholders. By pursuing these goals, ERA Priority 1 seeks to drive progress, excellence, and inclusivity in European research and innovation.

This ERA priority is divided into seven sub-priorities to help outline the necessary changes needed to achieve a functional internal knowledge market:

- **Sub-priority 1.1 focuses on promoting open science** by fostering a culture of openness, supporting open access to publications and research data, and developing the necessary digital infrastructure.

- **Sub-priority 1.2 addresses research infrastructures** which focuses on expanding access, encouraging integration, and leveraging their potential for addressing global challenges.

- **Sub-priority 1.3 looks at gender equality, equal opportunities, and inclusiveness** to ensure fair and inclusive career paths, counter gender-based violence, monitor national policies, and eliminate inequities across various dimensions.

- **Sub-priority 1.4 is concerned with researchers' careers and mobility** and it focuses on providing supportive working conditions, diverse career paths, and equitable assessment practices that recognise quality, impact, open science, collaboration, and engagement.

- **Sub-priority 1.5 focuses on knowledge valorisation**, aiming to enhance cooperation, coordination, and access to research results and intellectual assets.

- **Sub-priority 1.6 is on scientific leadership** aiming to increase funding and support for fundamental and applied research.

- **Sub-priority 1.7 aims to foster global engagement** by developing a coherent strategy, promoting partnerships, and ensuring European scientific and innovation autonomy while upholding open economy principles.

Collectively, these goals contribute to advancing research excellence, inclusivity, collaboration, and the global impact of European research and innovation.

Using the most recent data available, the map below illustrates EU Member States and Associated Countries with respect to the indicators covered under this priority. In the following sub-sections, we will highlight key results of this priority area with respect to the underlying sub-priorities. To do so, an overview of each sub-priority goal will be presented. To assess the effectiveness of the said measures and their implementation, trends are analysed and compared with the EU trend over time.

Sources: DG RTD, ESFRI Roadmaps, Women in Science (WiS) database, Science-Metrix, Digital SB EC, Eurostat, Bibliometrics, OECD, Vdem, Own estimates. Data is based on 2022 or the most recent available data.

Map 2. Deepening a truly functional internal market for knowledge

Reset the map

Open science

- Open access scientific publications with digital object identifier (DOI) as % of total scientific publications with (DOI)

Research infrastructures

- Share of national public R&D expenditure committed to European research infrastructures
- N° of European RIs in which MS or AC participates

Gender equality, equal opportunities for all, and inclusiveness

- Share of women in grade A positions in higher education institutes
- Proportion of papers with mixed gender authorship
- Proportion of women in authorships of the 10% most cited publications
- Women in Digital Index
- Proportion of women among doctoral graduates by narrow fields fo STEM

Researchers' careers and mobility and research assessment and reward systems

- Share of foreign doctorate students as a percentage of all doctorate students
- New doctorate graduates per 1,000 inhabitants aged 25-34
- Job-to-job mobility of Human Resources in Science & Technology

Knowledge valorisation

- Share of public-private co-publications per million population
- Number of PCT patent applications divided by GDP in million Euros
- Share of innovating firms collaborating with HEI/ PRO out of all innovative firms
- Business enterprise researchers as % of national total
- Business enterprise researchers in full-time equivalent per thousand employment in industry

Scientific leadership

- Number of scientific publications among the top-10% most cited publications worldwide as a percentage of all publications
- Academic Freedom Index

Global engagement

- International co-publications with non-EU partners per 1,000 researchers (in full-time equivalent) in the public sector
- European and international co-patenting in EPO applications at national and EU level

3.1. Sub-priority 1.1: Open Science

3.1.1. Overview

Open Science represents a new paradigm for the scientific process based on principles of accessibility, collaboration, and transparency. This sub-priority aims to transform the culture of scientific research to be more open and inclusive, thereby accelerating discovery, reducing inefficiencies, and fostering a more robust and reliable scientific enterprise.

The main goals of this sub-priority involve: (1) Mainstreaming open access to scholarly publications and research data. This is grounded in the philosophy of “as open as possible, as closed as necessary”, recognising that while openness should be the norm, there may be exceptions for privacy, security, and intellectual property rights. (2) Facilitating the diffusion and uptake of open science principles and practices across the scientific community. This considers the variations across different disciplines and cultural differences, including multilingualism. (3) Enhancing open science skills among researchers, educators, and information professionals, is crucial for creating a culture that values and practices open science. (4) Further developing and integrating the digital infrastructure and services that underpin open science, such as data repositories, analytics tools, and collaborative platforms.

The Open Science sub-priority is closely linked to ERA Action 1, “Enable the open sharing of knowledge and the re-use of research outputs, including through the development of the European Open Science Cloud (EOSC)”, within the European Research Area. The ambition of ERA Action 1 is to provide European researchers, innovators, companies and citizens with an accessible, trusted and open distributed environment where they can publish, find and re-use each other’s data and tools for research, innovation and educational purposes, and access relevant services.

3.1.2. Notable trends

Key findings on Open science

Among the EU Member States, the Netherlands, Hungary and Sweden were the highest performers regarding the **share of publications available in open access**, in 2019. As per the OECD STIP Survey, the Netherlands' success could be attributed to a decade-long commitment, including the "National Plan Open Science" and the "Covenant Open Science". Hungary's strategic orientation towards research, guided by the National Open Science Advisory Board, and Sweden's robust approach, as reflected in its Research Bill, may also explain its high open-access output.

Despite challenges, notable efforts are made by countries such as Bulgaria, and Latvia, as recognised in the 2023 EOSC Catalogue of Best Practices. Bulgaria is acknowledged for promoting scientific publications via a National Open Science Programme and Latvia for integrating Open Science requirements in state-funded research, exemplifying substantial steps towards more accessible and collaborative scientific exploration.

Among Associated Countries, Norway and Iceland are the front-runners, with over half of their scientific publications in open access as of 2019. Norway's alignment with its national goals and open access guidelines, along with Iceland's investment in research infrastructures, are potentially central to their leading status in the open science domain.

Adopting and implementing open science principles within a country or an institution can be viewed as a measure of its commitment to enhancing transparency and collaboration in scientific research endeavours. Under this sub-priority, we analyse one indicator as presented in Table 4.

Table 4. Overview of the indicators for the ERA Dashboard 2023 under sub-priority Open Science

Note: Annex A2.2 includes graphs illustrating the trend for all Member States and Associated Countries over the last 10 years

Indicator
5. Share of publications available in open access

Publications available in open access

The **share of publications available in open access** is measured by the open access scientific publications with digital object identifier (DOI) as % of total scientific publications with (DOI). Data is available for 2010 and 2019, as sourced from DG RTD - SRIP 2022.

From 2010 to 2019, the EU-27's average share of public-private co-publications per million population rose from 33.9% to 39.2%, marking a 15.6% growth. In 2019, within the EU-27, the countries with the highest percentages of open-access scientific publications were the Netherlands (58.3%), Hungary (54.3%), and Sweden (52.9%), each achieving rates of over 50% in open science publications. Additionally, several EU Member States showcased high growth between 2010 and 2019. In terms of increase, during that nine-year period, Hungary had a +20 pp increase in the share of publications available in open access, followed by Sweden with +15 pp , then Austria and Finland with +14 pp .

Focusing on Member States that perform well on this indicator in 2019, we find that the Netherlands has a long-standing commitment to open science, starting with introducing the

"Open Access Policy and Digital Preservation"[14] in 2011. Another significant step was the implementation of the "National Plan Open Science"[15] in 2017. Looking ahead, the "Ambition Document 'Open Science 2030 in the Netherlands'" released in 2022, coupled with the "Covenant Open Science and National Coordination Body Open Science"[16] in 2023, reinforces the Netherlands' leadership position in open science.

Similarly, Hungary's strong performance with regard to open science could be credited to its strategic approach towards research and innovation. The OECD STIP Survey[17] spotlights Hungary's National Digitalisation Strategy (2022-2030)[18] and the role of the National Open Science Advisory Board[19]. Having released its position paper in October 2021, the board reinforces Hungary's commitment to open science principles, looking to stimulate more comprehensive adoption across research and higher education establishments.

Sweden's high percentage of open-access scientific publications could symbolise its firm commitment to open access and research. From the Nordic Council of Ministers - Rules on Open Access[20] in 1946 to the updated national approach in the 2021 Research Bill[21], Sweden's dedication to this cause remains evident.

Austria's 42% growth (percentage increase) could be another exemplary model rooted in its commitment to broadening its research horizons. Instrumental in this drive are the Open Access Policy[22], the Research Infrastructure Action Plan 2030[23], and the Open Science Network Austria[24], among others.

With its 40% increase, between 2010 and 2019, Finland focuses on an open science coordination strategy established in 2018[25]. This coordination relies on the collaborative efforts of the research community, assuring a consolidated approach to improving research quality.

On the other end of the spectrum, Bulgaria, Romania and Latvia had a share of open-access scientific publications equivalent to 25.7%, 25.1%, and 28.9%, in 2019, respectively. Despite the challenges, these countries have made considerable efforts to promote open science. In addition, certain EU Member States – Bulgaria (-5 pp), Slovakia (-4 pp), Malta (-4 pp), Croatia

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[14] Royal Netherlands Academy of Arts and Sciences (KNAW). (2011). Open Access Policy and Digital Preservation. Available at: https://storage.knaw.nl/2023-08/open-access-and-digital-preservation-eng.pdf.
[15] van Wezenbeek, W., Touwen, H., Versteeg, A., & van Wesenbeeck, A. (2017). *Nationaal plan open science*. Ministerie van Onderwijs, Cultuur en Wetenschap. https://doi.org/10.4233/uuid:9e9fa82e-06c1-4d0d-9e20-5620259a6c65.
[16] Regieorgaan Open Science. (2023). Regieorgaan Open Science officially launched as Open Science NL. NWO. Available at: https://www.nwo.nl/nieuws/regieorgaan-open-science-officieel-van-start-onder-de-naam-open-science-nl.
[17] OECD. (2023). STIP Compass. Available at: https://stip.oecd.org/stip/.
[18] Miniszterelnöki Kabinetiroda. (2022). National Digitalisation Strategy 2021-2030. Available at: https://kormany.hu/dokumentumtar/nemzeti-digitalizacios-strategia-2022-2030.
[19] HUN-REN Hungarian Research Network - ELKH. (2023). National Position Paper on Open Science. Available at: https://hun-ren.hu/en/research/open-science.
[20] Nordic Council of Ministers. (1946). Rules on Open Access. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F3511.
[21] Utbildningsdepartementet. (2020). Research, freedom, future - knowledge and innovation for Sweden. Available at: https://www.regeringen.se/rattsliga-dokument/proposition/2020/12/forskning-frihet-framtid--kunskap-och-innovation-for-sverige/.
[22] Austrian Science Fund (FWF). (n.d.). Open Access Policy. Available at: https://www.fwf.ac.at/en/research-funding/open-access-policy.
[23] Federal Government of the Republic of Austria. (2020). RTI Strategy 2030: Strategy for Research, Technology and Innovation of the Austrian Federal Government. Available at: https://era.gv.at/public/documents/4489/RTI_Strategy_2030-1-1.pdf.
[24] Open Science Austria. (n.d.). Open Science Network Austria. Available at: https://www.osa-openscienceaustria.at/en/.
[25] National Open Science and Research Coordination. (2023, July 31). Coordination. Available at: https://avointiede.fi/en/coordination.

(-2 pp), and Latvia (-1 pp) saw a decrese in their share of publications available in open access between 2010-2019. Despite the challenges, these countries have made considerable efforts to promote open science. The EOSC Catalogue of Best Practices for 2023[26] features Bulgaria for its significant efforts in promoting scientific publications, especially in stimulating scientific publications and ensuring open access to scientific information through a National Open Science Programme[27].

The OECD STIP Survey acknowledges Romania's commitment to open science, underscored by its publication of a forward-looking White Paper on the Transition to Open Science 2023-2030[28]. This strategic paper outlines Romania's open science objectives and the concrete steps necessary to fulfil its vision by 2030.

Latvia's commitment to open science has also been acknowledged in the EOSC catalogue for incorporating Open Science requirements into its state-funded research programmes, reinforcing the region's collective move towards more accessible and collaborative scientific inquiry[29].

Although with a -4 pp reduction, Slovakia is mentioned in the same catalogue for its commitment to Open Science Training, offering courses covering a vast spectrum from open-access publishing to advocacy for Open Science.

Malta and Croatia have made significant steps despite reductions of -4 pp and -2 pp respectively in the share of publications in open access. Malta initiated a working group in 2022 to oversee its transformative National Open Access Policy, aiming for immediate Open Access by 2025. Croatia is pushing for a national open science cloud aligned with European standards and is launching the Research Information System of the Republic of Croatia (CroRIS)[30] by 2023. With a -2 pp decline, Latvia is recognised in the EOSC catalogue for integrating Open Science requirements in its publicly funded research initiatives.

Among the Associated Countries, Norway and Iceland had high figures in 2019, with 53.7% and 51.4% of the share of publications available in open access, respectively. Between 2010 and 2019, Norway showcased the most significant growth with 17 pp, and Iceland followed with a 10 pp increase. Norway's success could be tied to its 'National Goals and Guidelines for Open Access to Research Articles'[31] since 2017 and other open science directives. Iceland has emphasised research infrastructures support since 2013, co-financing equipment and rolling out a research information system for academic institutions.

On the other hand, Israel and Türkiye show room for improvement in open-access publishing, with Israel having 36.7% and Türkiye 29.8% of their scientific publications freely accessible. Türkiye is mentioned in the EOSC catalogue for its targeted approach to enhancing open science, with concerted efforts in expanding access to publications, improving data

[26] Thomas Neidenmark, Gareth O'Neill, & Istvan Karasz. (2023). EOSC Catalogue of Best Practices (Version V1). Zenodo. https://doi.org/10.5281/zenodo.7574165.
[27] Българския портал за отворена наука. (2023). National Open Science Programme. Available at: https://bpos.bg/.
[28] Open Science Knowledge Hub. (2023). White Paper on the Transition to Open Science 2023-2030. Available at: https://www.open-science.ro/cartea-alba-a-tranzitiei-catre-stiinta-deschisa-2023-2030.
[29] EIFL. (2022). The Latvian Open Science Strategy. Available at: https://www.eifl.net/news/latvian-open-science-strategy.
[30] EC-OECD. (2023). STIP Compass: International Database on Science, Technology and Innovation Policy (STIP). Draft of croatian plan for open science. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99996851.
[31] Regjeringen.no. (2017). National goals and guidelines for open access to research articles. Available at: https://www.regjeringen.no/en/dokumenter/national-goals-and-guidelines-for-open-access-to-research-articles/id2567591/.

management, developing research infrastructures, and strengthening skills through specialised training programmes.

Between 2010 and 2019, Montenegro reported a decrease of -9 pp, with Israel and Serbia recording -3 pp and -2 pp decreases respectively. However, it is noteworthy that despite these decreases, both Montenegro and Serbia remained above the EU-27 average regarding their share of public-private co-publications per million population.

While data for Armenia and Georgia remained unavailable during the assessment, these countries seem to be making significant strides in the broader scientific landscape. Georgia's Knowledge Hub[32] underscores its push for advanced scientific research and collaboration. In parallel, Armenia is gaining traction for its infrastructure development, reinforcing its dedication to strengthening research capabilities. These acknowledgements underline that countries could enhance their scientific environments even with data gaps.

3.2. Sub-priority 1.2: Research infrastructures

3.2.1. Overview

The sub-priority regarding research infrastructures is focused on the enhancement of accessibility, connection, and exploitation of both existing and newly established European and national research infrastructures, including e-infrastructures.

The main objectives encapsulated within this sub-priority include: (1) Developing further open access to existing and new research infrastructures across all scientific domains, aiming to foster a culture of transparency and collaboration. (2) Optimising the exploitation and integration of these research infrastructures, thereby creating a more synergistic and interconnected scientific community. (3) Better leveraging these infrastructures' integrated role within the knowledge and innovation ecosystem, harnessing their potential to tackle global challenges, fostering partnerships, pooling resources, and linking to the European Open Science Cloud (EOSC). (4) Diversifying funding sources for world-class research infrastructures and exploring innovative ways of funding transnational and virtual access. (5) Enhancing their interaction with technology infrastructures and industry to increase impact and strengthen sustainability, accessibility, and resilience.

The research infrastructures sub-priority is closely linked to ERA Action 8, “Strengthen sustainability, accessibility and resilience of research infrastructures in the ERA”, within the European Research Area. ERA Action 8 comprises a set of activities specifically aimed at strengthening the European research infrastructure ecosystem.

[32] Academia Europaea Tbilisi Knowledge Hub. (n.d.). Available at: https://www.aetbilisihub.org/.

3.2.2. Notable trends

Key findings on Research infrastructures

Generally, the availability and comparability of quantitative data regarding **investments in European research infrastructures (RIs)** across years remain limited. According to recent European Strategy Forum on Research Infrastructures reports, France, and Germany are often in the top EU-27 countries in terms of financial contribution to European RIs. Among the Associated Countries, Norway also shows significant involvement.

In terms of the **EOSC Catalogue of Best Practices contributing to the richness of RIs** across various sectors, Norway, Armenia and Georgia are also mentioned for introducing initiatives that help enhance the research infrastructures within Europe.

Concerning ***the share of national public R&D expenditure allocated to European research infrastructures*** based on 2022 data, Hungary, Romania, and Bulgaria exhibited high investment in research infrastructures exceeding the EU average. Notable initiatives include Hungary's National Research Infrastructure Roadmap, Romania's National Roadmap for Research Infrastructures, and Bulgaria's National Roadmap for Research Infrastructure 2020-2027, as described by the OECD STIP Survey.

Among the Associated Countries, Norway and Iceland have also demonstrate commitment to research infrastructures. Norway participates in the European Strategy Forum on Research Infrastructure and implements its National Financing Initiative for Research Infrastructures. Iceland, on the other hand, established the Infrastructure Fund and developed the Icelandic Roadmap for Research Infrastructures. These activities are detailed in the OECD STIP Survey.

The extent of investment in research infrastructures within a country can serve as a barometer of its dedication to cultivating a conducive environment for cutting-edge scientific investigations. This examination hinges on two principal indicators that serve to monitor these commitments.

Table 5. Overview of the indicators related to research infrastructures
Note: Annex A2.2 includes graphs illustrating the trend for all Member States and Associated Countries

Indicator
8. Share of national public R&D expenditure committed to European research infrastructures[33]
9. Number of European research infrastructures in which a Member State or an Associated Country participates (financially contributes to operations)

Investment in European research infrastructures

In this analysis, we examine the ***share of national public R&D expenditure allocated to European research infrastructures*** based on 2022 data from ESFRI. The focus is on 15 EU Member States and two Associated Countries, Iceland and Norway, using the EU average as a benchmark for comparison.

[33] R&D expenditures include government and higher education sector.

The EU average for this indicator in 2022 stood at 1.82%, a figure calculated considering the contributions of 15 EU Member States[34]. This average offers a reference point against which the efforts of individual countries can be measured. Among the Member States, Hungary, Romania, and Bulgaria showcased high figures, with shares of 4.73%, 3.87%, and 2.26%, respectively.

As revealed in the OECD STIP survey, Hungary's significant investment could be reflected in its strategic initiatives, such as the launch of the National Research Infrastructure Roadmap[35] in 2018, the Supporting the Use of International Research Infrastructures[36] scheme in 2019, and the Establishment of Centres of Competence[37].

Similarly, Romania demonstrated its commitment through several key measures, including the creation of the Romanian Committee for Research Infrastructures[38] in 2016, the National Roadmap For Research Infrastructures[39] in 2017, and the launch of *EERTIS - Engage In The European Research And Technology Infrastructure System*[40] in 2022.

Bulgaria's dedication was apparent in initiating the National Roadmap For Research Infrastructures 2020-2027[41] in 2017.

In contrast, countries such as Malta and Latvia presented different levels of engagement, with shares of 0.19% and 0.22%, respectively.

The OECD STIP survey points out Malta's involvement in BBMRI-ERIC, a European Research Infrastructure for Biobanking[42], and Latvia's start of the Structural Fund Activity for R&D Infrastructure[43] in 2016, underlining their approaches to research infrastructure.

The analysis also extends to Associated Countries, where Iceland and Norway recorded shares of 0.13% and 0.95%, respectively.

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[34] The calculation of the EU average is based on public R&D expenditures, including government and higher education sector contributions.
[35] National Research Infrastructure Roadmap. (2018). National Innovation Office Hungary. Available at: https://nkfih.gov.hu/english-2017/strategy-making-by-the/hungarian-research.
[36] Supporting the Use of International Research Infrastructures. (2019). National Innovation Office Hungary. Available at: https://nkfih.gov.hu/english/nrdi-fund/support-to-utilise-international-research-infrastructures-2019-126-nemz-ki/call-for-project-proposals-2019-216-nemz-ki.
[37] Establishment Of Centres Of Competence – Development of Research Infrastructures. (2019). National Innovation Office Hungary. Available at: https://nkfih.gov.hu/english/nrdi-fund/establishment-of-centres-of-competence-2019-131-kk/call-for-project-proposals-2019-131-kk.
[38] Romanian Committee for Research Infrastructures. (2016). Ministerul Cercetării, Inovării şi Digitalizării. Available at: https://www.old.research.gov.ro/ro/articol/4201/despre-ancsi-comunicare-comitetul-roman-pentru-infrastructuri-de-cercetare-a-realizat-raportul-de-strategie-privind-infrastructurile-de-cercetare-din-romania.
[39] National Roadmap For Research Infrastructures. (2017). Autoritatea Naţională pentru Cercetare Ştiinţifică. Available at: https://www.old.research.gov.ro/uploads/sistemul-de-cercetare/infrastructuri-de-cercetare/cric/romania-national-roadmap_2017.pdf.
[40] EERTIS - Engage In The European Research And Technology Infrastructure System. (2022). The Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI). Available at: https://eertis.eu/.
[41] National Roadmap For Research Infrastructures 2020-2027. (2017). European Commission. Available at: https://ec.europa.eu/research/infrastructures/pdf/roadmaps/bulgaria_national_roadmap_2017_en.pdf.
[42] Participation in BBMRI-ERIC (European Research Infrastructure for Biobanking). (2013). University of Malta. Available at: http://www.um.edu.mt/biobank.
[43] Structural Fund Activity: R&D Infrastructure for Smart Specialisation. (2016). Ministry of Education and Science (MoES; Izglītības un zinātnes ministrija). Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F16787.

Iceland's Infrastructure Fund[44], established in 2013, and its Icelandic Roadmap For Research Infrastructures[45], launched in 2021, as noted in the OECD STIP survey, could indicate its commitment to supporting varied research infrastructures.

Norway's long-term investment in research infrastructures is noted by its participation in the European Strategy Forum on Research Infrastructures[46] since 2006, its National Financing Initiative for Research Infrastructure[47] in 2010, and specific R&D infrastructure projects[48] in 2013.

Regarding the **number of European research infrastructures (RIs) in which a Member State or an Associated Country participates** (financially contributing to operations), the main data is available for 2021, and for 2016[49] and 2018[50] the data is supplemented with reports. It is essential to note that the data from 2021 cannot be directly compared with the figures from 2016 or 2018. Likewise, data from 2016 is not directly comparable to that of 2018 due to variations in the terminology used in the reports to classify countries.

Furthermore, comparing the absolute number of participations in RIs may not provide a meaningful analysis for countries that vary significantly in size. Therefore, it is crucial to be cautious when interpreting the data for this indicator, given the differences in size and capabilities of different countries.

As per the information sourced from the ESFRI catalogue[51], focusing on "landmarks" for 2021, the EU-27 average is 15.67. The EU-27 countries with a high performance were France, Italy, and Germany, with 37, 30, and 27 participations respectively. Their involvement in European RIs during that year suggests a strong emphasis on research and development at a national level.

On the other hand, Lithuania, Luxembourg, and Malta registered engagements with four, four, and two participations, respectively.

For the Associated Countries in 2021, Norway showed high investment levels, with 21 participations, and Israel's participation stood at nine. Iceland, Türkiye, and Serbia each participated in at least three RIs. No data was available for Armenia, Georgia and Montenegro, making it challenging to draw definitive conclusions for these countries.

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[44] Infrastructure Fund. (2013). Prime Minister's Office. Available at: http://eng.forsaetisraduneyti.is/science_and_technology_policy_council/funds/.
[45] Icelandic Roadmap for Research Infrastructures 2021. (2021). Ministry of Education, Science and Culture. Available at: https://www.rannis.is/media/innvidasjodur/Roadmap-to-Icelandic-infrastructure_August_2021.pdf.
[46] European Strategy Forum on Research Infrastructure. (2006). European Commission. Available at: https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures/esfri_en.
[47] National Financing Initiative For Research Infrastructure. (2010). The Research Council of Norway. Available at: https://www.forskningsradet.no/en/about-the-research-council/programmes/infrastruktur----nasjonal-satsing-pa-forskningsinfrastruktur/.
[48] Norway's specific R&D infrastructure projects and investments. (2013). Ministry of Education and Research (KD; Kunnskapsdepartementet), Ministry of Local Government and Modernisation (KMD; Kommunal- og moderniseringsdepartementet), Ministry of Trade, Industry and Fisheries (NFD; Nærings- og fiskeridepartementet). Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F25952.
[49] European Strategy Forum on Research Infrastructures. (2016). ESFRI Roadmap 2016 - Strategy Report on Research Infrastructures. ISBN: 978-0-9574402-4-1.
[50] European Strategy Forum on Research Infrastructures. (2018). ESFRI Roadmap 2018 - Strategy Report on Research Infrastructures. Available at: http://roadmap2018.esfri.eu/media/1049/roadmap18-part3.pdf.
[51] European Strategy Forum on Research Infrastructures. (2021). ESFRI Roadmap 2021: Projects & Landmarks. Available at: https://roadmap2021.esfri.eu/projects-and-landmarks/browse-the-catalogue/.

References from the 2016 and 2018 reports, namely the ESFRI Landmarks, enrich our understanding by listing specific countries coordinating in sectors such as energy, environment, health and food, and physical sciences engineering. France and Germany appear most frequently across different sectors in the 2016 and 2018 reports. France was consistently mentioned in the Energy, Environment, Health and Food, Physical Sciences & Engineering, and Social & Cultural Innovation sectors in 2016 and maintained a strong presence across various sectors in 2018. Germany is similarly prevalent across multiple sectors in both reports.

Norway, an Associated Country, also holds a notable position in the ESFRI Landmarks. In both reports, Norway is prominently mentioned in the Social and Cultural Innovation sectors, and in the 2018 report, it is also listed in the Energy sector.

The evaluation of progress in investment in European research infrastructures as a percentage of GDP is limited due to the absence of comparable data. However, the EOSC Catalogue of Best Practices for 2023 provides complementary insights, specifically in the section on 'Best Practices Targeting 'Infrastructure". This section encompasses 17 best practices from the EU-27 and nine from the Associated Countries. Notable contributions from Associated Countries include Armenia's focus on 'Infrastructure Development' and Georgia's emphasis on the 'Knowledge Hub'[52].

Additionally, best practices are highlighted from Norway, Serbia, and Türkiye, such as Norway's 'Big Data Infrastructure'[53] and 'FAIR Repository'[54], Serbia's 'Repository Model'[55] aiming at transparent access to research infrastructures, and Türkiye's initiatives like the 'Academic Archive (HARMAN)'[56] and 'Open Science Portal'[57]. These practices offer valuable insights into the diverse strategies adopted to support European research infrastructures.

Overall, there appears to be a significant variance in the level of participation and share of investment across both Member States and Associated Countries. This could be attributed to various factors, including differences in national research and development priorities, funding levels, or policy focus.

3.3. Sub-priority 1.3: Gender equality, equal opportunities for all and inclusiveness

3.3.1. Overview

The sub-priority is aiming to promote equal and inclusive career paths within the research field. It strives to create a supportive environment that upholds fairness and openness, while actively countering gender-based violence and sexual harassment to foster a safe and respectful research community. Monitoring and evaluating national gender equality policies and plans in research and innovation play a crucial role in ensuring progress and addressing

[52] Academia Europaea Tbilisi Knowledge Hub. (n.d.). Available at: https://www.aetbilisihub.org/.
[53] The Norwegian Language Bank. (n.d.). Resource Catalogue. Available at: https://www.nb.no/sprakbanken/en/resource-catalogue/.
[54] DataverseNO. (n.d.). Available at: https://dataverse.no/.
[55] Computer Centre of the University of Belgrade. (n.d.). Policy for Transparent Access to Research Infrastructures at the Computer Centre of the University of Belgrade: TRAP-RCUB IT solution and organisational model for the implementation of institutional or thematic repositories. Available at: https://repowiki.rcub.bg.ac.rs/index.php/Policy_for_Transparent_Access_to_Research_Infrastructures_at_the_Computer_Centre_of_the_University_of_Belgrade:_TRAP-RCUB_IT_solution_and_organizational_model_for_the_implementation_of_institutional_or_thematic_repositories.
[56] TÜBİTAK ULAKBİM. (n.d.). Harman. Available at: https://harman.ulakbim.gov.tr/index.
[57] TÜBİTAK ULAKBİM. (n.d.). Open Science Portal. Available at: https://portal.ulakbim.gov.tr/.

existing disparities. The sub-priority aims to eliminate inequalities, removing any bias related to gender, racial or ethnic origin, religion or belief, disability, age, or sexual orientation.

The "Gender equality, equal opportunities for all, and inclusiveness" sub-priority is closely linked to ERA Action 5, "Promote gender equality and foster inclusiveness, taking note of the Ljubljana Declaration", within the European Research Area. Recognising the significance of the Ljubljana Declaration, ERA Action 5 works towards reducing gender disparities, promoting gender balance in research, and ensuring equitable access to research and innovation opportunities.

3.3.2. Notable trends

Key findings on Gender equality, equal opportunities for all, and inclusiveness

European countries show differing levels of progress when it comes to gender equality and inclusiveness. The **share of women in grade A positions in HEIs** has notably improved, with approximately three-quarters of EU-27 countries demonstrating this positive trend. This trend was particularly evident in Romania, followed closely by Bulgaria, Slovenia, Latvia, and the Netherlands.

In terms of the **proportion of papers with mixed-gender authorship**, Italy consistently performs well in this regard, followed closely by Spain and the Netherlands. Among Associated Countries, Norway, Israel, and Iceland have made notable progress in gender diversity.

The **share of women in the top 10% most cited publications** varies, with Romania performing strongly. Among the Associated Countries, Iceland and Serbia have seen a consistent increase. In 2022, Finland tops the **Women in Digital Index** in the EU.

Regarding **the proportion of women among STEM doctoral graduates**, trends also vary. Some countries have maintained stability over the last decade, while others like Poland and Bulgaria have made substantial improvements.

Gender equality, equal opportunities for all, and inclusiveness are vital measures of a diverse and inclusive scientific community. These principles convey a commitment to creating a fair and supportive environment that empowers individuals from all backgrounds to contribute to scientific research. To assess this sub-priority, the following five key indicators have been considered.

Table 6. Overview of Gender-related indicators

Note: Annex A2.2 includes graphs illustrating the trend for all Member States and Associated Countries

Indicator
11. Share of women in grade A positions in HEIs
12. Proportion of papers with mixed gender authorship
13. Proportion of women in authorship, of the top 10% most cited publications
14. Women in digital Index
15. Proportion of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM)

Women in grade A positions

Regarding **the share of women in grade A positions in HEIs** the data from 2010 to 2018[58] suggest that the EU average gradually increased, with the percentage rising from 22.3% in 2010 to 27.2% in 2018. Romania showed substantial progress, increasing 15 percentage points in this period. Other countries like Bulgaria (+13.8 pp), Slovenia (+10.4 pp), Latvia (+9.2 pp), and the Netherlands (+9.2 pp) also made significant strides in bolstering women's representation.

Among EU Member States, Latvia (41.4%), Romania (40.6%), Lithuania (40.4%) and Bulgaria (39.7%) have demonstrated the highest performance in terms of the share of women in grade A positions in higher education institutions in 2018. These countries have made commendable efforts to address gender equality and promote women's representation in higher education leadership roles, surpassing the EU-27 average by more than 10 percentage points.

Focusing on Member States that perform well on this indicator, Lithuania exhibits a very high figure. According to the OECD STIP Survey, we can identify several national initiatives connected to ensure equal opportunities in Lithuanian research and higher education institutions and in the labour code. These efforts, spanning from 2014 to 2019, involve measures such as gender mainstreaming, promoting gender balance, and ensuring equal opportunities for women in senior research and decision-making positions. The responsible organisation for most of these initiatives is the Ministry of Education, Science and Sport, along with the State Labour Inspectorate and the Lithuanian Academy of Sciences. Furthermore, in 2016, a legal amendment was made to the Law on Science and Higher Education of the Republic of Lithuania, extending post-doctoral eligibility after childbirth, maternity, or parental leave.

Similarly, Latvia's strong performance could be credited to its education strategy. The Ministry of Education and Science of Latvia established in 2017 the Law on Higher Education which provides a foundational framework for the administration of higher education institutions. This law emphasises the importance of evaluation and accreditation to encourage these institutions to unlock their full potential and uphold the quality of education offered.

Cyprus on the other hand, indicated a significant gap compared to the EU-27 average and showed a varying performance with the share of women in grade A positions fluctuating throughout the years from 9.7% in 2012 to 13.6% in 2018. Encouraging and supporting women's representation in leadership positions should be prioritised through targeted policies and initiatives. By implementing strategies that create equal opportunities for career advancement, these countries can foster a more inclusive and diverse higher education environment.

For the Associated Countries, although with several sporadic data points, there are some trends. Norway experienced an increase of eight percentage points, increasing from 22.9% in 2010 to 30.9% in 2018. Additionally, Israel has demonstrated progress in recent years (+5.7 pp), and Iceland has also done well (+2.1 pp). This positive trajectory indicates a commitment to enhancing gender diversity in higher education institutes. These countries can further strengthen these efforts by implementing comprehensive policies and initiatives that address gender disparities, promote mentorship programmes, and foster a supportive environment for women pursuing leadership positions.

[58] Only Croatia has available data for the year 2019.

Papers with mixed gender authorship

In a general sense, the EU has a consistently higher proportion of **papers with mixed gender authorship**. The EU-27 average spanned from 52.2% to 62.7% over the last decade (2010 to 2020), indicating a relatively positive overall trend in promoting gender diversity in research collaborations across European Union Member States.

Italy consistently demonstrates a strong performance in terms of the proportion of papers with mixed gender authorship reaching a percentage of 71.3% in 2020. The Netherlands and Spain were also among the best EU-27 performing countries, with a share of 66.9% and 66.1%, respectively. On the other hand, Malta recorded lower percentages compared to other countries, with percentages ranging from 32.7% in 2010 to 49.4% in 2020. Although it is relatively low in comparison, there is a slight progress with several fluctuations which might convey a resolve to enhance gender inclusivity in research authorship.

Focusing on Italy, several initiatives may contribute to its good performance. According to the OECD STIP Survey, Italy established the Italian National Code of Equal Opportunities[59] in 2006, which relates to ERA action 5. The framework aimed to regulate and promote gender parity across all sectors of society. Aligned with EU directives, the National Code and subsequent laws address equal treatment and opportunities in employment matters.

Similarly, the Netherlands demonstrates an effort to achieve mixed-gender authorship in academia. According to the OECD STIP Survey, the Netherlands Organisation for Scientific Research (NWO) together with the Ministry of Education, Culture and Science implemented the Aspasia Programme back in 1999[60]. The programme supports women in academia, providing grants for career progression to associate and full professor positions. Moreover, the Athena Award by NWO, starting from 2015, recognises exceptional female scientists with a PhD earned less than ten years ago. It aims to highlight their achievements and inspire early-career researchers[61].

Overall, up until 2020, Belgium, Denmark, Germany, France, Finland, and Sweden have shown a consistent upward trend over the years while Croatia, Czechia, Estonia, Latvia, Lithuania, Slovakia, and Slovenia have experienced fluctuations in their proportions of mixed gender authorship. Austria, Bulgaria, Greece, Hungary, the Netherlands, Poland, and Portugal have maintained relatively stable proportions of mixed gender authorship over the last 10 years.

Among the Associated Countries, we see varying patterns. Iceland showcased a consistent upward trend, starting at 51.2% in 2010 and reaching a peak of 62.3% in 2020 (+ 11.1 pp). Likewise, Norway showed a gradual increase, reaching 56.8% in 2020 (+ 9 pp), Serbia reached 69.5% (+ 8.6 pp) while Montenegro reached 46.8% (+ 7.1 pp). Armenia displayed a modest growth in the proportion of papers with mixed gender authorship, recording a figure of 44.3% in 2020, increasing only one percentage point. This highlights the necessity for targeted initiatives to promote gender diversity in authorship.

Authorship of women in most cited publications

Between 2010 and 2018, the European Union has been seeing a steady increase of the **proportion of women in authorships of the 10% most cited publications**. The latest

[59] EIGE. Gender Equality in Academia and Research - GEAR tool, available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/italy
[60] Netherlands Organisation for Scientific Research (NWO). Aspasia, available at: https://www.nwo.nl/en/researchprogrammes/aspasia
[61] Netherlands Organisation for Scientific Research (NWO). Athena Award, available at: http://www.nwo.nl/en/funding/our-funding-instruments/cw/athena/athena-award.html

available EU average in 2018, stands at 32.6%, indicating a modest increase of 4.6 percentage points from 2010.

Among the Member States, the highest proportion of women in authorships of the 10% most cited publications is observed in Romania, with a score of 46.1%. This figure surpasses the EU-27 average by a margin of 13.5 percentage points. Lithuania (44.8%), Croatia (42.4%) and Bulgaria (42.1%) also demonstrate higher representation of women, surpassing the EU by 10 percentage points on average.

Belgium (31.9%) and Denmark (31%) closely follow the 2018 EU-27 average, showing consistent performance. On the other hand, Malta has the lowest proportion of women in authorships, with only 22.2% of women involved. This value is 10.4 percentage points below the EU-27 average. Similarly, countries such as Luxembourg (25%), Germany (26.1%), Cyprus (27.1%) and Austria (27.7%) fall below the average, reflecting the need for improvements.

As for the Associated Countries, trends highlight both progress and disparities in gender representation among the top-cited publications in different countries. From 2010 to 2018, the proportion of women authorship in the 10% most cited publications in Norway ranged from 30.2% to 33.7%, showing relative stability over eight years. For Armenia, this indicator varied between its lowest of 11.6% in 2015 to its highest of 35.7% in 2018, indicating significant changes over the same period. Georgia portrayed variation with 31.3% in 2010, a peak at 52.4% in 2015 and a decrease to 23% by 2018. As for Iceland (+8.9 pp) and Serbia (+5.6 pp), this indicator increases steadily. The data exhibited significant fluctuations for Montenegro, with a low of 1% in 2012 and a high of 53.6% in 2016.

Iceland's good performance on this indicator could be attributed to its commitment to achieving equal rights for women and men. Drawing from the OECD STIP Survey, the Act on Equal Status and Equal Rights of Women and Men, established in 2008, reinforces the nation's enduring dedication to gender equality, a commitment that dates to 1976. This legislation is crafted to champion equal opportunities and standing for individuals of all genders throughout society.[62]

Similarly, according to the OECD STIP Survey, Serbia established the Law on Gender Equality aiming to create equal opportunities and protect against discrimination based on sex and gender. A strategy for gender equality spanning from 2021 to 2030 emphasises achieving a gender-equal society in Serbia, with a focus on bridging gender gaps and promoting sustainable development[63].

Women in digital sector

Based on the only available dataset from **the Women in Digital Index** which is from 2022, Finland stands out as the highest-performing Member State in the EU. With a score of 80.4, the country significantly surpasses the EU-27 average of 54.9, indicating a strong participation of women in the digital sector. This high score reflects Finland's commitment to gender equality and inclusion in the digital field, as well as its efforts to provide opportunities and support for women's participation in the digital economy.

[62] Government of Iceland. (n.d.). Act on Equal Status and Equal Rights Irrespective of Gender, available at: https://www.government.is/library/04-Legislation/Act%20on%20Equal%20Status%20and%20Equal%20Rights%20Irrespective%20of%20Gender.pdf

[63] Government of Serbia. (2022). National Strategy for Gender Equality 2021-2030, available at: https://www.rodnaravnopravnost.gov.rs/sites/default/files/2022-03/National%20Strategy%20for%20GE%202021-2030.pdf

On the other hand, Romania exhibits a low figure with a score of 35.8. By tackling the challenge presented by a low value of this indicator, Romania can strive towards achieving gender equality and providing greater access to digital opportunities for women across the country.

The data suggests variations across Member States in terms of women's participation in the digital domain. High scores are observed in Ireland (74.9), the Netherlands (71.9) and Sweden (71.2). Conversely, countries such as, Bulgaria, and Poland show lower scores of 36.1 and 45.5 respectively, suggesting a need for more focused efforts to bridge the gender gap and improve women's representation in the digital economy.

Regarding Finland's good performance, while the OECD STIP Survey does not outline specific policies for women in digital in Finland, the country has taken measures under ERA Action 5 to promote equality across sectors. The Domestic Ownership Programme, initiated in 2020 by the Ministry of Economic Affairs and Employment, aims to generate economic growth and job opportunities. Its primary goal is to bolster and diversify ownership in Finnish companies, with a focus on women, private investors, entrepreneurs, and businesses of all sizes and ages[64].

Focusing on Italy, the OECD STIP Survey data shows that Ireland implemented the Athena Swan Initiative in 2020, which tackles gender-related concerns pertaining to advancements in R&I through a series of measures[65]. As part of its efforts in line with ERA Action 5, the Higher Education Authority (HEA) is initiating its call for submissions to the Gender Equality Enhancement Fund for 2023[66].

Data is not available for the Associated Countries Armenia, Georgia, Iceland, Israel, Montenegro, Norway, Serbia, and Türkiye.

Gender Representation among STEM doctoral graduates

The last indicator for this sub-priority is on the **proportion of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM)**. Overall, the EU average for the proportion of women among doctoral graduates in narrow fields of STEM remains relatively stable over the years. From 2013 to 2020, it experienced a slight decrease from 37.8% to 37.3%.

Poland and Bulgaria have a high proportion of women among doctoral graduates, with figures of 50.4% and 50.1% respectively in 2020. On the other hand, Luxembourg and Malta have a lower proportion of women among doctoral graduates. In Luxembourg, the percentage fluctuates between 29.4% in 2013 to 24.5% in 2020, while in Malta, it decreases from 44.4% to 30.0% in the same period. These countries face challenges in achieving gender parity in STEM doctoral education.

As indicated by the OECD STIP Survey, the implementation of Bulgaria's Law on Higher Education[67] in 2017, could potentially have influenced the performance of this indicator. The law focuses on evaluation and accreditation to encourage these institutions to develop their potential and maintain the quality of education offered. The objectives include preparing

[64] Ministry of Economic Affairs and Employment. (2020). New Programme to Strengthen Finnish Ownership in Companies. Available at: https://tem.fi/en/-/new-programme-to-strengthen-finnish-ownership-in-companies
[65] Department of Enterprise, Trade and Employment (2015). Innovation 2020. Available at: https://www.djei.ie/en/Publications/Innovation-2020.html
[66] Higher Education Authority. (2021). Gender Equality Enhancement Fund 2023. Available at: https://hea.ie/policy/gender/gender-equality-enhancement-fund2021/
[67] Ministry of Education and Science of Bulgaria. (2016). National Qualifications Framework for Lifelong Learning. https://lll.mon.bg/uploaded_files/zkn_visseto_obr_01.03.2016_EN.pdf

highly qualified specialists beyond secondary education, fostering scientific and cultural development, and identifying research-focused institutions for increased funding.

As for Poland, in 2019 the Ministry of Education and Science introduced a policy allowing PhD students to take an equivalent of maternity or parental leave while still receiving their scholarship. The initiative aims to support doctoral training for individuals with parental responsibilities and promote equal opportunities, particularly for women[68].

Other EU Member States, including Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Spain and Sweden, present relatively stable ratios with fluctuations within a moderate range over 10 years (2010-2020).

Iceland as an Associated Country has shown mixed numbers going from 44.7% (2013) to 60.0% (2014) and subsequently stabilising at 47.8% in 2020. Türkiye has also demonstrated a relatively stable trend, with percentages going from 44.6% (2014) to 43.5% (2020). Serbia has made progress, with percentages increasing from 42.2% (2014) to 53.9% (2020).

3.4. Sub-priority 1.4: Researchers' careers and mobility and research assessment and reward systems

3.4.1. Overview

By addressing barriers, biases, and enhancing evaluation systems, this sub-priority aims to establish a framework that enables researchers to thrive, contribute to scientific advancements, and receive equitable recognition for their work. It is tightly linked with the ERA Action 3 "Advance towards the reform of the Assessment System for research, researchers and institutions to improve their quality, performance and impact" and ERA Action 4 "Promote attractive research careers, talent circulation and mobility". ERA Action 3 seeks to advance towards a reform of the research assessment and reward system, aiming to assess the quality, performance, and impact of research and researchers using more suitable criteria and procedures. ERA Action 4 works towards strengthening research careers in Europe and making them more attractive for EU and international research talents.

It encompasses key objectives which are mainly to give attention to early and mid-stage researchers, creating inclusive working conditions, equipping researchers with necessary skills, providing diverse career paths, addressing an imbalanced circulation of researchers, and building upon existing programmes such as the Marie-Skłodowska-Curie Actions[69]. This is to ensure continuity and consistency as well as enhance research assessment systems. Through this comprehensive approach, the sub-priority seeks to empower researchers, improve their career prospects, and foster an environment of excellence and fairness in research and innovation.

[68] EIGE. Gender Equality in Academia and Research - GEAR tool, available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/poland?language_content_entity=en

[69] European Commission. Marie Skłodowska-Curie Actions, available at: https://marie-sklodowska-curie-actions.ec.europa.eu/

3.4.2. Notable trends

Key findings on researchers' careers and mobility and research assessment and reward systems

Over the last decade, a discernible positive shift has been observed when examining researchers' careers and mobility and the systems for assessing and rewarding research. An upward trend is observed regarding the **share of foreign doctorate students as a percentage of all doctorate students** across the EU-27. Luxembourg exhibits high figures in this regard. Among Associated Countries, Iceland excels in attracting foreign doctoral students, demonstrating an upward trajectory.

Regarding the rate of **new doctoral graduates per 1,000 inhabitants (aged 25-34)**, Slovenia consistently performs well. Finland, Ireland, Sweden, and Denmark closely follow, surpassing the EU-27 average.

In terms of **job-to-job mobility of human resources in Science and Technology**, a steady increase has been observed in the EU-27 average. Denmark demonstrates a strong performance, displaying a consistent upward trajectory. Among Associated countries, Norway, Türkiye, Iceland, and Serbia exhibit positive trends, indicative of a dynamic and evolving scientific labour market.

The research environment in a country plays a crucial role in determining the quality and impact of its scientific endeavours. This sub-priority highlights the dedication to cultivate ideal conditions and create an environment conducive to fostering capacities that empower researchers and enable ground-breaking advancements in scientific knowledge. The three following indicators serve as a measure for the evaluation.

Table 7. Overview of indicators measuring researchers' mobility
Note: Annex 2.2 includes graphs illustrating the trend for all Member States and Associated Countries

Indicator
16. Share of foreign doctorate students as a percentage of all doctorate students
17. New doctorate graduates per 1,000 inhabitants aged 25-34
18. Job-to-job mobility of human resources in Science and Technology

Foreign doctorate students

When examining **the share of foreign doctorate students as a percentage of all doctorate students** from 2013 to 2020, Luxembourg consistently demonstrates a strong performance. Luxembourg reported 89% of doctoral students as foreign in 2020 which increased from 84.1% in 2013. This indicates an attractive and welcoming environment for international students pursuing doctoral studies in Luxembourg.

Luxembourg's positive performance may be credited to the implementation of several national initiatives aimed at bolstering its international research community, as detailed in the OECD STIP Survey. In 2008, the PEARL initiative[70] was launched with funding from the National Research Fund (FNR; Fonds National de la Recherche). This initiative serves to provide financial backing to research institutions in Luxembourg, enabling them to attract

[70] Luxembourg National Research Fund. PEARL Attracting Leading Researchers from abroad to Luxembourg, available at: https://www.fnr.lu/funding-instruments/pearl/

established and internationally recognised researchers from abroad. In parallel, the AFR-PPP Programme, also established in 2008 and supported by the FNR, extends its assistance to PhD and postdoc researchers, regardless of their nationality. The programme aims to foster cooperation between Luxembourg-based companies involved in R&D and both local and international public research institutions[71].

Several Member States have experienced notable improvements in their share of foreign doctorate students over the years. Estonia, for instance, has seen a significant increase from 7.2% in 2013 to 25.6% in 2020. Similarly, Malta has risen from 7.7% in 2013 to 35.1% in 2020.

On the other hand, Bulgaria shows lower figures on the share of foreign doctorate students, with a gradual rise from 4% in 2013 to 8.6% in 2020. This result suggests there is still potential for further improvement in attracting a larger proportion of international students to pursue doctoral studies in the country. By continuing to enhance its offerings and promoting its strengths as a destination for advanced academic pursuits, Bulgaria can further increase its attractiveness to international students.

Croatia, Greece, Italy, Lithuania and Romania displayed limited progress in the share of foreign doctorate students. Each of these countries experienced a relatively small increase, with all of them recording growth rates below 3.8 percentage points between 2013 and 2020.

Overall, at an EU level, from 2015 to 2020 one can observe an increase in the share of foreign doctorate students from 16.3% to 23.3%. This demonstrates collective efforts to foster international collaborations and create a more diverse research community within the European Union.

Among the Associated Countries, Iceland demonstrates a notable performance in attracting foreign doctorate students. From 2013 to 2020, Iceland saw a significant upward trend, with the percentage of foreign doctorate students more than doubling from 19.8% to 41.7%. Norway has maintained a relatively stable share of foreign doctorate students, that is hovering around the 20% mark throughout the years. On the other hand, Türkiye and Serbia have experienced modest growth in the proportion of foreign doctorate students. In 2020, Türkiye reached 6.7% (+2.2 pp) while Serbia reached 7.3% (+2.4 pp).

New doctorate graduates

As for the **new doctorate graduates per 1,000 inhabitants (aged 25-34)**, focusing on the EU-27, Slovenia consistently performs well in this category. From 2013 to 2021, it experienced fluctuations but maintained a relatively high level, ranging from 0.7 to 3.4 new doctorate graduates per 1,000 inhabitants.

The good performance of this indicator could be linked with Slovenia implementing a comprehensive range of initiatives to bolster new doctorate positions, according to the OECD STIP Survey. Among the total initiatives, the following are noteworthy: The “Young Researchers Programme,”[72] initiated in 1985, offers fixed-term employment contracts and grants for mentoring institutions, nurturing highly qualified personnel and rejuvenating and enabling the inflow of fresh ideas into research groups. The “Participation in the Fulbright Program”[73] has been fostering international mobility for Slovenian doctoral students and post-

[71] Luxembourg National Research Fund. Industrial Fellowships, available at: https://www.fnr.lu/funding-instruments/industrial-fellowships/
[72] See: http://www.arrs.si/sl/stabilno/
[73] Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia. Co-financing of Research Mobility of US Citizens in Slovenia Within the Fulbright Programme, available at: https://www.srips-rs.si/en/scholarships/cofinancing-scientific-research-mobility/fulbright-scholarships

doctoral researchers since 1993, providing opportunities for research exchanges with the United States.

The "Financing of Doctoral and Post-Doctoral Studies at European University Institute"[74] offers fully funded scholarships, supporting early-career researchers in fields such as economics, law, history, and social sciences. Additionally, the "Eligibility of Foreigners to Young Researchers Programme" since 2006 has extended funding eligibility to international young researchers. Lastly, the "Slovenian National Supercomputing Network (SLING)" consortium[75], established in 2009, focuses on developing grid networks and managing advanced computing infrastructure, ensuring access to high-performance computing resources.

Overall, in terms of new doctorate graduates per 1,000 inhabitants, Finland, Ireland, Sweden and Denmark consistently performed above the EU average throughout the eight-year period, indicating a strong focus on advanced academic degrees. Denmark and Sweden show a steady flow of new doctorate graduates, with Denmark ranging from 1 to 1.4 and Sweden ranging from 1 to 1.5 new doctorate graduates per 1,000 inhabitants.

Other Member States like Belgium, Czechia, Estonia, France, Croatia, Latvia, Lithuania, Poland, and Italy were relatively consistent in their numbers. Spain and Luxembourg showcased fluctuating patterns, while Slovakia and Romania experienced slight decreases during the same period.

The trend varied among several Associated Countries as well. In Iceland, there were fluctuations in the number of new doctorate graduates, going from 0.5 in 2013 to 0.8 in 2021. The trend showed a slight increase from 2013 to 2014, followed by a temporary decline until 2016, before gradually rising again. In contrast, Norway exhibited a relatively stable pattern, with numbers ranging from 0.8 to 1 throughout the period. Serbia demonstrated a gradual increase in the number of new doctorate graduates per 1,000 inhabitants, starting at 0.3 in 2013 and reaching 0.6 in 2017, with some fluctuations in subsequent years. Türkiye remained at 0.1 throughout that period (2015-2021).

Job-to-job mobility of human resources in science and technology

In terms of **job-to-job mobility of human resources in science and technology**, the EU average experienced a gradual increase starting at 5.5% in 2010 and increasing to 6.8% by 2020. Denmark demonstrates a notable performance in terms of job-to-job mobility in the field of human resources in science and technology. It displays an upward trend from 9.3% in 2010, to a peak of 11.6% in 2017 and finally 10.7% in 2020.

The OECD STIP Survey notes that Danish STEM-focused strategies and programmes were established, which could explain the good performance of this indicator. For instance, the Danish E-Infrastructure Cooperation[76] (2012) serves as the national service provider for digital research infrastructure, ensuring researchers at Danish universities have access to state-of-the-art resources. The Open Science Policy[77] (2014) emphasises open access, research integrity, and data management to enhance the transparency and effectiveness of research. The Technology Pact[78] (2018) aims to increase the number of students pursuing

[74] Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia. Scholarships for Doctoral Studies at the EUI, available at: https://www.srips-rs.si/en/scholarships/ad-futura-scholarships/programmes-for-promoting-mobility-abroad/scholarships-for-doctoral-studies-at-the-eui
[75] Slovenian National Supercomputing Network, available at: https://www.sling.si/sling /
[76] Danish E-Infrastructure Cooperation, available at: www.deic.dk
[77] Ministry of Higher Education and Science. The Danish Code of Conduct for Research Integrity, available at: https://ufm.dk/en/publications/2014/the-danish-code-of-conduct-for-research-integrity?searchterm=Research%20integrity
[78] The Technology Pact, available at: https://www.teknologipagten.dk/

STEM subjects by 20% through collaborative efforts among various ministries. Lastly, the Strategy 2.0 for Danish involvement in the European Spallation Source[79] (2020) focuses on establishing leading research environments in materials technology and driving innovation for a green transition.

Belgium, Czechia, Greece, Hungary, Italy, Poland, Portugal, Slovakia, and Spain demonstrate relatively stable mobility rates, with fluctuations within a moderate range over the years. For example, Belgium went from 5.8% in 2010 to 6.5% in 2020, Czechia from 5% in 2010 to 4.3% in 2020, and Spain from 5.2% in 2010 to 6.9% in 2020. On the other hand, Romania has the lowest percentage with a mobility rate starting at 2.2% in 2010, experiencing minimal fluctuation over the years, ranging from 1.4% to 2.2% with the latest data being 1.4% (2020).

Across the Associated Countries, while the availability of data varies, we can observe a mix of stable, increasing trends. Norway and Türkiye exhibit consistent high levels going respectively from 8.6% (2010) to 9.2% (2020) and 6.2% (2010) to 7.1% (2020). Iceland has shown consistent increase of rates from 7.9% in 2010 to 8.9% in 2020. Similarly, Serbia shows a gradual increase from 3% in 2010 to 5.7% in 2020. Although the rates are comparatively lower than some other Associated Countries, the upward trend indicates a growing openness to career transitions and movement within the Science & Technology field in Serbia. The positive trends in Norway, Türkiye, Iceland, and Serbia indicate a dynamic and evolving scientific labour market, fostering professional growth and collaboration.

3.5. Sub-priority 1.5: Knowledge valorisation

3.5.1. Overview

The Knowledge Valorisation sub-priority under the ERA is centred on translating research and innovation into tangible societal and economic benefits. The main goals of this sub-priority are: (1) Enhancing cooperation and establishing robust linkages between R&I actors to convert knowledge into practical applications effectively. (2) Coordinating policies and programmes at Union, national, and regional levels to create a conducive environment for knowledge valorisation. This coordination extends to establishing R&I-friendly regulatory and policy support frameworks. (3) Improving the uptake of and access to research results, upskilling efforts, and intellectual asset management. This objective is about maximising the impact of research results by ensuring they are effectively utilised and protected.

The knowledge valorisation sub-priority is closely linked to ERA Action 7, “Upgrade EU guidance for a better knowledge valorisation”, within the European Research Area (ERA). ERA Action 7 aims to achieve a common line on measures and policy instruments for improving knowledge sharing and valorisation in Europe. In addition, Codes of Practice will guide R&I practitioners on how to implement some aspects of knowledge valorisation, such as smart intellectual property management and standardisation for knowledge uptake.

[79] Ministry of Higher Education and Science. ESS as a Driver for Future Growth - Strategy for the Danish ESS Effort 2.0, available at: https://ufm.dk/publikationer/2020/ess-som-drivkraft-for-fremtidens-vaekst-strategi-for-den-danske-ess-indsats-2.0

3.5.2. Notable trends

Key findings on knowledge valorisation

Over the last decade, Denmark, Finland and Sweden demonstrated strong performance in terms of **collaborations between public and private research entities.** In terms **of best practices for knowledge valorisation**, notable examples emerge from Belgium, Italy, and Spain. These examples emphasise intellectual property protection and knowledge transfer skills, with international collaborations underscoring Europe's knowledge valorisation efforts.

Similarly, positive trends are generally observed for the EU-27 in the **number of PCT patent applications.** Notable performances were seen from Finland and Sweden, despite some decreases, with Latvia, Portugal, and Bulgaria, among others, showing encouraging increases in innovation capacity relative to economic output.

There is also a visible enhancement in the **share of innovating firms collaborating with Higher Education Institutions/Public Research Organisations (HEI/PRO)**, with notable improvements from Estonia and Ireland. Associated Countries Türkiye and Serbia also show remarkable progress, enhancing the overall picture of cooperation in driving innovation across Europe.

The EU-27 has seen an upward trend in business sector research, with the **share of enterprise researchers as a percentage of the national total** increasing over the past decade. Similarly, there is growth in business enterprise researchers in FTE within the industry. The Netherlands and Sweden excel in both **'business enterprise researchers as a percentage of the national total**' and **'business enterprise researchers in FTE per thousand in employment'**, reflecting their substantial R&D investment in the private sector. Among Associated Countries, Türkiye shows significant growth in business sector research. Norway also demonstrates a rise in full-time equivalent enterprise researchers, indicating a commitment to industry-linked R&D.

The degree of emphasis placed on knowledge valorisation in a country or institution can be considered as a potential metric of its commitment to leveraging academic research for socio-economic development and innovation. This analysis focuses on six key indicators that are indicative of these pursuits.

Table 8. Overview of the indicators on knowledge valorisation
Note: Annex A2.2 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
19. Share of public-private co-publications
20. Best practice examples and methodologies for knowledge valorisation
22. Number of PCT Patent applications
23. Share of innovating firms collaborating with higher education institutions or public/private research institutions
25. Business enterprise researchers as % of national total
26. Business enterprise researchers in full-time equivalent per thousand employments in industry

Public-private co-publications

The data highlights key trends in the **share of public-private co-publications per million population** among the EU-27 from 2011 to 2015. It provides an insightful glimpse into the varying levels of collaboration between public and private research entities across different regions. The EU-27 average witnessed a modest increase of 48 units per million population from 2011 to 2021.

The top performers in 2021 were Denmark, Luxembourg, Finland, Sweden, Austria, and the Netherlands, exemplifying a robust collaboration between public and private research entities. For both 2011 and 2021, Denmark boasted the highest figures, at 402.29 and 698.97 units per million population, respectively. Similarly, Sweden (with 317.88 in 2010 and 498.78 in 2015) and Finland (with 367.98 in 2010 and 499.48 in 2015) exhibited strong and consistent performances. These numbers highlight the Nordic region's excellence in fostering productive public-private research collaborations.

As per the OECD STIP Survey, specific initiatives may have been instrumental in promoting these collaborations among top-performing countries. Denmark's "Innovation Fund Denmark"[80] (2014) has been a funding source for research and innovation projects between universities and companies. Sweden's "Innovation Partnership Programmes"[81] (2016) encourages collaborative solutions to global challenges, fostering innovation and commercial viability through government and business partnerships. Finland's "Co-innovation Fund"[82] (2018) facilitates the collaborative development of innovative knowledge and solutions between companies and research organisations, enhancing the basis for international business activities.

In terms of absolute growth, measured in units per million population, Luxembourg made the most significant progress, by increasing its share from 169.97 in 2011 to 537.24 in 2021, thus demonstrating a notable increase of 367 units per million population. This growth could have been explained by the initiatives such as the AFR-PPP Programme[83] initiated in 2008, and the Industrial Partnership Block Grant[84]. These programmes, mentioned in the OECD STIP Survey, were designed to foster cooperation between Luxembourg-based companies active in R&D and public research institutions within the country.

Cyprus and Austria also made significant strides, with respective increases of 244 and 231 units per million population. These countries continue showing a commitment to fostering collaborations between public and private research entities, Cyprus focusing on efficient public funding use and private investment increase through its National R&I Strategy 2030[85], and Austria enhancing science-industry cooperation and technology transfer through programmes like COMET[86]. These strategic actions could improve their public-private research collaborations, likely influencing their rise in research co-publications per million population.

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[80] Innovation Fund Denmark. (2014). Available at: https://innovationsfonden.dk/en.
[81] Government Offices of Sweden. (2016). Innovation partnership programmes–mobilising new ways to meet societal challenges. Available at: https://www.government.se/articles/2016/07/innovation-partnership-programmes–mobilising-new-ways-to-meet-societal-challenges/.
[82] Business Finland. (2018). Co-Innovation. Available at: https://www.businessfinland.fi/en/for-finnish-customers/services/funding/cooperation-between-companies-and-research-organizations/co-innovation.
[83] FNR - Luxembourg National Research Fund. (2018). Industrial Fellowships (formerly AFR-PPP). Available at: https://www.fnr.lu/funding-instruments/industrial-fellowships/.
[84] FNR - Luxembourg National Research Fund. (n.d.). IPBG - Industrial Partnership Block Grants. Available at: https://www.fnr.lu/funding-instruments/ipbg/.
[85] National Board of Research and Innovation. (n.d.). National R&I Strategy. Available at: https://www.nbri.gov.cy/strategy-plan/national-ri-strategy/.
[86] Austrian Research Promotion Agency (FFG). (n.d.). COMET – Competence Centers for Excellent Technologies. Available at: https://www.ffg.at/en/comet/programme.

Latvia's trajectory in public-private co-publications over the decade is admirable. In 2011, Latvia's performance was considerably below the EU average, being at 28.92 units. However, by 2021, Latvia exhibited a remarkable progress, elevating its position to 135.22 units, surpassing the EU average. This signifies a momentous transformation in Latvia's collaborative research engagement landscape, reflecting enhanced synergy between the public and private sectors in scientific explorations and innovations.

The OECD STIP Survey suggests several strategic initiatives that could have been instrumental in facilitating this advancement. Key among these is Latvia's "Smart Specialisation Strategy - RIS3"[87] (2014), a strategy aimed at transitioning the economy towards higher added value and productivity sectors, as well as more efficient resource utilisation. This strategy fosters sectors of future growth enriched with high-value products and services. Complemented by other initiatives such as the "Structural Fund Activity: R&D Infrastructure for Smart Specialisation"[88] (2016) and "Fundamental and Applied Research Projects"[89] (2018), Latvia's strategy collectively aims to support institutional capacities, optimise research resources, and enhance collaborative research and innovation engagements. These strategies and initiatives underpin Latvia's commendable trajectory in public-private co-publications.

Despite these positive trends, France, Romania, and Bulgaria show modest increases, thereby indicating potential avenues for strengthening the synergy between public and private research sectors. France's growth was relatively modest, with a rise from 117.22 to 150.78 units per million population, an increase of just 33.56 units. Similarly, Romania and Bulgaria exhibited only slight growth of 31 and 28 units per million population, indicating potential areas for further stimulation of public-private research partnerships.

Although there is no specific data available on the share of public-private co-publications per million population for Associated Countries, various initiatives reported in the OECD STIP survey suggest active efforts to boost this indicator through collaborative programmes that likely contribute to their collective research output and innovations. Israel, through the Magnet Consortium[90], established in 2000, encourages collaborative R&D by funding groups of companies and research institutions working on joint technology projects. Complementing this, Israel has engaged with the European Framework Programme since 2016 to foster stronger scientific and industrial partnerships with Europe.

In Montenegro, the 2020 launch of the Science and Technology Park marks an effort to merge innovative, scientific, entrepreneurial, and economic capacities, supporting academia-business collaboration as prescribed by the S3 Strategy[91], with the ultimate goal of nurturing innovative start-ups.

Norway's Industrial PhD Scheme[92], initiated in 2008, targets the enhancement of research within the business sector by promoting academia-industry collaborations and facilitating

[87] Ministry of Education and Science of the Republic of Latvia. (2014). Smart Specialisation Strategy (RIS3). Available at: https://www.izm.gov.lv/en/smart-specialisation-strategy-ris3.
[88] Ministry of Education and Science of the Republic of Latvia. (2016). R&D Infrastructure for Smart Specialisation. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F16787.
[89] Latvijas Zinātnes padome. (2018). Fundamental and Applied Research. Available at: https://www.lzp.gov.lv/en/fundamental-and-applied-research.
[90] Israel Innovation Authority. (2000). MAGNET Consortiums. Available at: https://innovationisrael.org.il/en/program/magnet-consortiums.
[91] Ministry of Science of Montenegro. (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available at: https://s3platform.jrc.ec.europa.eu/montenegro.
[92] Research Council of Norway. (2008). Industrial Ph.D. scheme – Doctoral projects in industry. Available at: https://www.forskningsradet.no/en/apply-for-funding/funding-from-the-research-council/industrial-ph.d.-scheme--doctoral-projects-in-industry/.

doctoral research by company employees, thereby acting as a conduit between the two realms.

Serbia has been fostering joint initiatives between research organisations and the private sector through a collaborative grant scheme[93] since 2016, providing a financial impetus for shared innovation projects.

Türkiye introduced the Digital Innovation and Collaboration Platform[94] in 2022, aiming to synergise efforts across public institutions, industry, and academia within artificial intelligence, data science, and robotics to drive economic and technological advancements through innovative national projects.

Best knowledge valorisation practices

The **Best Practice Examples and Methodologies for Knowledge Valorisation** is a qualitative indicator reflecting European efforts to harness research results for societal and economic benefits. This indicator does not involve numerical measurements; instead, it focuses on collating and assessing strategies, tools, and methodologies that have successfully turned research into practical, beneficial outcomes.

The repository for this indicator is a rich collection of 111 best practices, illustrative examples from real-world experience, and relevant policies that support knowledge valorisation[95]. Information, provided by stakeholders themselves, ranges across various valorisation channels and themes. Valorisation channels involve academia, industry or SMEs, public authorities, intermediaries, and a wider societal ecosystem. The themes cover climate action, democratic change, digital age, health, and others of a horizontal nature.

The EU reports 27 best practices, demonstrating a multifaceted approach to knowledge valorisation. Belgium leads among individual countries with 17 practices, followed by Italy and Spain with 13 each. Among these, several stand out. Belgium's University of Hasselt utilises Intellectual Property Panels[96] for securing research protection. Italy offers a Master's programme focusing on Intellectual Property Valorisation[97], equipping participants with requisite managerial skills. Spain's Academia Innovation Enhancer programme[98] reinforces the knowledge transfer skills of junior researchers.

Some of these practices are collaborations involving more than one country, emphasising the international and cooperative nature of knowledge valorisation in Europe.

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[93] Innovation Fund. (2016). Collaborative Grant Scheme Programme. Available at: http://www.inovacionifond.rs/cms/files//psnp-dokumentacija/CGS_Program_Grant%20Manual_v1.2_%28English%29.pdf.

[94] Digital Transformation Office of the Presidency of Türkiye. (2022). Türkiye Digital Innovation and Collaboration Platform. Available at: https://cbddo.gov.tr/projeler/diib/.

[95] European Commission, Research and Innovation. (n.d.). Repository of Best Practices. Available at: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository.

[96] Research and Innovation Repository of Best Practices. (2023). Intellectual Property Panel at University Hasselt. Available at: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/intellectual-property-panel-university-hasselt.

[97] Research and Innovation Repository of Best Practices. (2023). Master in Intellectual Property Valorisation for Knowledge Exchange & Impact. Available at: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/master-intellectual-property-valorisation-knowledge-exchange-impact.

[98] Research and Innovation Repository of Best Practices. (2022). Academia Innovation Enhancer. Available at: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/academia-innovation-enhancer.

The Netherlands and Germany have reported many best practices, with 12 and 10, respectively. Portugal, Austria, and France each reported eight best practices, while Czechia, Finland, Ireland, and Slovenia reported six. Denmark and Lithuania have four best practices, and Latvia, Luxembourg, and Sweden reported three. Countries including Croatia, Cyprus, and Greece have each contributed two best practices.

Estonia, Hungary, Malta, Poland, Romania, Slovakia, and Serbia (as an Associated Country) each have one best practice, while, Bulgaria has not reported any best practices. These practices and methodologies reflect a concerted European effort to harness research for the greater good.

In addition to the existing repository information for this indicator, the EOSC Catalogue of Best Practices 2023 provides enriched data, showcasing additional contributions from the EU-27 and Associated Countries. For instance, Türkiye is prominently featured with nine best practices, followed by Norway with six, while Armenia and Georgia each have one notable contribution listed in the catalogue. These entries illustrate the varied yet significant contributions these countries have made to the field of best practices in research and innovation.

PCT patent applications

In terms of the **number of Patent Cooperation Treaty (PCT) applications,** the data provided highlights key trends in the ratio of PCT patent applications divided by GDP in million EUR among EU-27 and Associated Countries from 2010 to 2015. This indicator offers insights into the level of innovation concerning each country's economic output.

For the EU-27, there was a slight decrease of approximately -10.3% in this indicator from 2010 to 2015. This suggests that the rate of patent applications relative to GDP across these 27 countries declined slightly during this period. When analysing the data for individual EU-27 countries, Finland and Sweden showed the highest ratios in 2010 and 2015, despite a decrease over this five-year period of approximately -26.7% and -7.5%, respectively. Germany followed closely behind these countries, exhibiting high ratios, despite a decrease over these five years of approximately 17.3%.

The OECD STIP Survey indicates that the initiatives in Finland, Sweden, and Germany may play a significant role in each country's successful patent application rates relative to their economic output. In Finland, the 2022 Comprehensive Reform of Patent Legislation[99] is likely a strategic move to promote the country's patenting activity by making the legal processes more conducive to protecting innovations, which could, in turn, have a positive impact on the number of PCT patent applications when measured against the country's GDP.

Sweden's long-term investment in incubators since 2000 and the subsequent introduction of Innovation Offices[100] in 2013, alongside the 2016 Model for Commercialisation of Assets in Companies[101], collectively build a robust framework for nurturing innovations from the research stage to the market. Such a supportive ecosystem is conducive to high levels of patenting activity, contributing to Sweden's PCT patent applications.

[99] Ministry of Economic Affairs and Employment of Finland. (2022). The national intellectual property rights strategy of Finland. Available at: https://ec.europa.eu/research-and-innovation/sites/default/files/kvp/files/kvp-national-ip-rights.pdf.
[100] Swedish Agency for Innovation Systems. (2013). Innovation Offices. Available at: https://www.vinnova.se/en/.
[101] Swedish Agency for Innovation Systems. (2016). Model for Commercialisation of Assets in Companies. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F15842.

Germany's WIPANO programme[102], active since 2016, bundles various funding and support mechanisms for patenting and commercialisation endeavours, including innovative research standardisation. This approach facilitates translating research into patentable inventions, potentially enhancing the number of German PCT patent applications per million euros of GDP.

Despite facing challenges in achieving higher ratios in specific years, Lithuania, Greece, and Romania are making commendable progress in fostering innovation and research development, as highlighted by the OECD STIP Survey. Lithuania has launched the "InnoPatent"[103] initiative, a significant move to encourage companies to register designs and patents at the international level for their R&D&I activity results, showcasing a strategic approach towards global competitiveness.

Greece has instituted the "Patent Box Tax Exemption" since 2010 to support R&D investment within the business sector. This initiative also aims to enhance research results by acquiring international patents and optimising the exploitation of these acquired patents. These measures underscore a proactive and strategic commitment by these countries to foster innovation, enhance global competitiveness, and promote research and development.

In terms of progression, between 2010 and 2015, Latvia (63.5%), Portugal (61.6%), Bulgaria (61%), Poland (59.7%), Czechia (52.6%), Malta (51.5%), Greece (48.1%), Romania (35.5%), the Netherlands (17%), Italy (12.1%), Slovakia (6.7%), and France (2.1%) experienced an increase in their ratios, indicating growth in their innovative capacity relative to their GDP. In contrast, between 2010 and 2015, Estonia (-64.6%), Slovenia (-42.6%), Croatia (-34.7%), Finland (-26.7%), Germany (-17.3%), Belgium (-15.2%), Ireland (-12.7%), Lithuania (-11.2%), Sweden (-7.5%), Austria (-6.5%), Spain (-6.5%), Hungary (-5.4%), and Denmark (-1.3%) saw a decrease in their ratios over the same period, suggesting that their level of patent applications relative to GDP decreased.

Regarding the Associated Countries, Israel had the highest ratios in both 2010 and 2015, despite a slight decrease of approximately -17.5%. This performance may have been supported by initiatives such as the Israel Patents Law 1967[104] and the Ideation Incentive Program 2001[105]. The latter facilitates a broad spectrum of support for potential start-ups, ranging from legal assistance in patent registration to prototype development and product showcasing in trade fairs, thus nurturing a conducive environment for innovation.

Norway and Iceland experienced a decrease of -17.5% and -5.5%, respectively. On the other hand, despite having ratios below the EU-27 average, Türkiye showed a positive trend, with an approximate growth of 44.3% from 2010 to 2015. Data for Serbia, Georgia, Armenia, and Montenegro was unavailable, making assessing their performance or progress challenging. However, the OECD STIP Survey provides insight into Serbia's endeavours to enhance its innovation landscape. Initiatives such as the "Programme for the Cooperation of Serbian Science with Diaspora"[106], launched in 2019, aim to strengthen knowledge exchange and collaboration, facilitating joint research, publications, and patent development. Additionally, Serbia's adoption of patent law in 2011 further underscores its commitment to legal

[102] Innovation - Beratung - Förderung. (2020). WIPANO-Richtlinie 2020-2023. Available: https://www.innovation-beratung-foerderung.de/INNO/Navigation/DE/Home/home.html.
[103] Agency for Science, Innovation and Technology. (2019). Protection of industrial property rights (InnoPatent). Available at: https://mita.lrv.lt/en/national-r-d-programmes/innopatent.
[104] World Intellectual Property Organization. (1968). Israel Patents Law, 5727-1967. Available at: https://www.wipo.int/wipolex/en/legislation/details/2364.
[105] Israel Innovation Authority. (2001). Ideation Incentive Programme. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F5301.
[106] Science Fund of the Republic of Serbia. (2019). The Serbian Science and Diaspora Collaboration Programme. Available at: https://fondzanauku.gov.rs/the-serbian-science-and-diaspora-collaboration-program/?lang=en.

frameworks that safeguard and promote inventions, evidencing a structured approach to supporting innovation.

The data for the indicator "Number of PCT patent applications divided by GDP in million euros" illustrates a diverse landscape among the EU-27 and Associated Countries. While some countries consistently demonstrate a high level of innovation relative to their economic output, others show room for growth in this area. Furthermore, the data reflects a dynamic innovation environment, with several countries increasing their innovation capacity relative to GDP between 2010 and 2015 while others experienced a decline.

Firms' collaboration with educational and public organisations

The collaboration between innovative firm and research institutions is measured by the **share of innovating firms collaborating with Higher Education Institutions/Public Research Organisations (HEI/PRO) out of all innovative firms** from 2010 to 2020 for the EU-27 and Associated Countries. This indicator shows a positive trend for the EU-27 as a whole, with a substantial increase in the EU-27 average from 10.91% in 2010 to 13.27% in 2020. This suggests that, over this decade, innovative firms in the EU-27 have developed a growing propensity to collaborate with HEIs or PROs.

While all countries showed varying levels of this indicator, several displayed remarkable performances. Estonia, for instance, experienced a significant increase from 8.24% to 14.91% over the 10-year period (2010-2020), indicating a growing trend of collaboration between firms and HEIs/PROs. Ireland showed the most dramatic rise in this indicator, from 10.49% to 23.04%, suggesting a vibrant synergy between academia and industry in this country.

Finland is the leading country where innovative firms collaborate most with HEI/PROs, despite a decrease from 34.68% to 24.57% between 2010 and 2020. Austria is closely behind, showing growth in collaborations, increasing from 20.50% to 23.19% in the same period. Other countries, such as Belgium, Germany and Sweden, also exhibited commendable growth in this area.

The OECD STIP Survey highlights ongoing initiatives that may support this positive trajectory. Estonia, through the Programme RITA[107] since 2015, aims to strengthen sectoral R&D, enhancing the innovative capacity of the country. Ireland, with strategies like the "Development of Next National Research and Innovation Strategy"[108] (2021) and the introduction of the "National Challenge Fund"[109] (2022), fosters multi-sectoral collaboration, encouraging a holistic approach that involves government departments, enterprises, and the academic research community in promoting innovation and addressing national challenges.

Despite demonstrating a relatively modest performance in 2010, several countries showed notable improvements over the decade, signalling their potential for future growth. For instance, Italy's percentage rose from 4.64% to 9.91%, Romania's from 2.79% to 7.59%, and Malta's from 3.31% to 8.14%. These countries present encouraging signs of increasing synergies between industry and academia.

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[107] Estonian Research Council. (2015). RITA – Support for sectoral R&D. Available at: https://www.etag.ee/wp-content/uploads/2022/03/Lopparuanne_RITA-mojuanaluus-1.pdf.
[108] Department of Further and Higher Education, Research, Innovation and Science. (2021). National Research And Innovation Strategy 2021 to 2027: Consultation Paper. Available at: https://www.gov.ie/en/publication/a526a-national-research-and-innovation-strategy-2021-to-2027-consultation-paper/.
[109] Department of Further and Higher Education, Research, Innovation and Science. (2022). National Challenge Fund. Available at: https://www.gov.ie/en/press-release/c41f6-65-million-fund-for-green-transition-and-digital-transformation-announced-by-minister-harris/.

On the other hand, Cyprus and Slovakia experienced a slight dip over the decade, -65.2% and -39%, respectively, suggesting potential areas for improvement in fostering collaboration between firms and HEIs/PROs.

In terms of the Associated Countries, data is limited. Data for several Associated Countries is unavailable, making it difficult to assess trends in these countries. However, among the ones with available data, Türkiye showed a substantial increase from 5.15% in 2010 to 15.87% in 2020, indicating a significant rise in the propensity for innovative firms to collaborate with HEIs/PROs. Serbia also showed a considerable increase from 14.86% to 16.90% in 2020.

Overall, this analysis illustrates a generally positive trend among EU-27 and the available Associated Countries in fostering collaboration between innovative firms and HEIs/PROs. While the data presents variability across countries, it also highlights the potential for growth and the importance of such partnerships in driving innovation.

Enterprise researchers

The EU-27 data indicate an overall upward trend on **the business enterprise researchers as % of the national total**, moving from 47.24% in 2010 to 55.28% in 2020. This shows an increased share of researchers in the business sector compared to other industries, suggesting an increase in private-sector investment in research and development.

While having different initial values, several countries have shown a significant increase in this indicator, highlighting a trend towards more research being performed by the business sector. For instance, Poland offers the most remarkable increase, from 18.18% to 50.83%, a jump of over 32 percentage points, coming closer to the EU-27 average, indicating a remarkable research shift to the business sector over the decade.

Sweden, the Netherlands and Austria are the top performers in this indicator in 2020, with 71.84%, 69.13% and 63.30%, respectively. However, on the other side of the spectrum, Latvia, Slovakia and Greece might have faced challenges in increasing the share of researchers in the business sector compared to other industries. In addition, some countries displayed a reduction in this measure. Luxembourg, for instance, witnessed a decrease from 55.87% to 37.61%, signalling a relative shift of research away from the business sector. Denmark also witnessed a minor decline.

Türkiye, an Associated Country, showed a substantial increase in this indicator, moving from 39.39% to 64.92%, indicating a significant growth in business sector research over this period. Data for Iceland is somewhat limited, available only for the years 2011, 2013, 2015, and 2017. Notably, there was a slight fluctuation observed in the value of business enterprise researchers as a percentage of the national total, with a recorded 46.94% in 2011, followed by a modest decrease to 42.73% in 2017.

For a number of countries – Bulgaria, Croatia, Cyprus, Malta, Romania, Armenia, Georgia, Israel, Serbia, and Montenegro – the data is not available, making it difficult to draw any conclusions from these countries.

Despite the variance across countries, the overall trend points towards an increased role of business enterprise researchers in the national total, reflecting an increased focus on research and development within the private sector. This trend has significant implications for innovation and economic growth as it may lead to more industry-relevant research, commercialisation of research outcomes, and increased competitiveness.

The research and development (R&D) capacity within the business sector of an industry is estimated with the indicator **business enterprise researchers in FTE per thousand**

employment in industry. For the EU-27 as a whole, the data indicates an overall upward trend, with the metric increasing from 4.38 in 2010 to 6.89 in 2020.

Some countries have demonstrated significant growth in this indicator, suggesting an expansion of research activity within the industry. Sweden showed the most significant increase, from 10.24 to 17.20. This considerable increase signifies a substantial enhancement in research activity within the Swedish industrial sector over the decade.

In 2010, the Netherlands had fewer business enterprise researchers in FTE per thousand employees compared to the EU-27 average. However, by 2020, there was a notable increase in the Netherlands, from 4.25 to 10.30. This improvement positioned the Netherlands well above the EU-27 average.

There are two countries that performed well on both indicators: the Netherlands and Sweden. Their robust performance may be corroborated by policies and programmes highlighted in the OECD STIP survey. For the Netherlands, strategies such as the "Enterprise Policy - 'To the Top'"[110] since 2011 and "SME Innovation Support Top Sectors"[111] since 2013 have been instrumental. The "Enterprise Policy" is a modern combination of industrial and innovation policies, fostering a collaborative, cross-sectoral approach towards innovation in nine key sectors. Concurrently, the "SME Innovation Support Top Sectors" initiative promotes Small and Medium Enterprises (SMEs) participation in sectoral innovation efforts, facilitating collaborative R&D projects, feasibility studies, and networking opportunities.

Sweden's strong performance is potentially strengthened by programmes such as the "Environment-Driven Business Development Programme"[112] established in 2009 and the "INCUBATORS"[113] initiative since 2000. These programmes are tailored to support researchers and entrepreneurs in cultivating, developing, and commercialising innovative business projects, illustrating a comprehensive approach to fostering innovation and research in the business sector.

Austria, Belgium, France, Germany and Ireland have increased their respective numbers by approximately two to five. This suggests that these countries have enhanced research intensity within their industrial sectors. Conversely, Luxembourg experienced a decrease from 5.16 to 3.05, which suggests a relative decline in research activity within the industrial sector.

Among the Associated Countries, Norway saw a notable increase in the number of full-time equivalent (FTE) business enterprise researchers per thousand industry employments, rising from 7.70 in 2010 to 10.66 in 2020. For Iceland, the data is less comprehensive, available only for specific years (2011, 2013, 2015, 2017). Within this period, there was variability in the number of FTE business enterprise researchers per thousand industry employments, starting at 9.38 in 2011 and decreasing to 6.16 by 2017. Türkiye, despite potential challenges, exhibited growth in this metric, with an increase from 1.34 in 2010 to 4.62 in 2020, showing a positive trend in the engagement of researchers in the industry.

[110] Ministerie van Economische Zaken en Klimaat. (2011). Bedrijvenbeleid in beeld. Available at: https://www.bedrijvenbeleidinbeeld.nl/.
[111] Netherlands Enterprise Agency. (2013). SME Innovation Support Top Sectors. Rijksdienst voor Ondernemend Nederland. Available at: https://www.rvo.nl/subsidies-financiering/mit.
[112] Swedish Agency for Innovation Systems. (2019). Environment-Driven Business Development Programme. Available at: https://www.rvo.nl/subsidies-financiering/mit.
[113] Vinnova. (n.d.). Inkubationsstöd. Available at: https://www.vinnova.se/e/inkubationsstod/.

3.6. Sub-priority 1.6: Scientific leadership

3.6.1. Overview

The Scientific leadership sub-priority specifically aims at boosting both capacities and funding for bottom-up fundamental and applied research. It is particularly linked to ERA Action 6 “Deepening the ERA through protecting academic freedom in Europe”. Ensuring and enhancing academic freedom plays a pivotal role in the production of quality, collaborative and transparent scientific outputs.

3.6.2. Notable trends

Key findings on scientific leadership

The average trend both at EU level and for the Associated Countries in terms of the **number of scientific publications among the top 10% most cited publications worldwide as a percentage of all publications** was mildly negative over the period of 2010 to 2020. In 2020, Member States such as the Netherlands, Luxembourg and Denmark, and Associated Countries such as Norway and Israel demonstrate high values for this indicator.

In terms of the **Academic Freedom Index (AFi),** the average trend both at EU level and for the Associated Countries was lightly negative over the period of 2010 to 2022. Nevertheless, Member States Czechia, Estonia, Belgium, Italy and Germany, and Associated Countries Israel and Norway demonstrate high figures for this indicator.

The type of research environment and promotion of scientific production in a given country has a direct effect on its quality and level of impact. The analysis in this sub-section comprises two indicators (Table 9) that reflect the commitment to the pursuit of the ideal conditions for boosting capacities and funding for bottom-up fundamental and applied research.

Table 9. Overview of the indicators relevant to the Scientific leadership
Note: Annex 2.2 includes graphs illustrating the trend for all Member States and Associated Countries

Indicator
27. Number of scientific publications among the top-10% most cited publications worldwide as a percentage of all publications
28. Academic Freedom Index (AFi)

Top cited scientific publications

Data for the indicator **number of scientific publications among the top 10% most cited publications worldwide as a percentage of all publications** are available for the period between 2010 and 2020, showing variations in performance across different countries and years.

Focusing on the EU-27 Member States, in 2020, the Netherlands has 13.94 % of their total scientific publications included in the top-10% most cited publications worldwide. In fact, the Netherlands consistently achieved high figures throughout the decade, although it has seen a decrease since 2010. In 2020, Luxembourg (12.78 %), Denmark (12.24 %) and Italy (12.18 %) follow the Netherlands, in that order.

Luxembourg's situation for this indicator shows more variation, while Denmark consistently displayed high values throughout the years, indicating good research output and impact on the scientific community. Although Italy has a lower figure in 2010, it has seen an increase of +1.88 pp in 2020, when compared to the beginning of the decade.

According to the OECD STIP Survey, the Netherlands has relevant national initiatives connected to ERA Action 6 dating as far back as 1953[114], denoting its historical efforts channelled into promoting quality R&D activities. This signalled that the priority shown at government level might explain this Member State's consistent good performance regarding this indicator. Some other initiatives have been put in place between 1953 and 2015, the year when a regulation on grants of the Netherlands Organisation for Scientific Research was implemented. It fosters free online access to scientific publications by offering diverse subsidy instruments to support it. This leads to greater visibility of scientific publications as well as more citations and might also have contributed to the trend observed for the Netherlands.

Similarly, Denmark has also been implementing and joining relevant initiatives since 1985, such as the EUREKA[115], as well as funding instruments for open access scientific production. These are available through the 'Open Science' policy initiative[116], implemented in 2014 with a budget allocation of EUR 1 to 5 million, and Denmark's national strategy for open access[117], implemented in 2018. Equally, Luxembourg has adhered to the 'National ERA Roadmap'[118] initiative in 2017, which, among other objectives, sets out to develop a common national open access strategy. This is of particular relevance to the analysed indicator. Finally, regarding Italy, a vast array of initiatives have been implemented by this Member State since 1955, of which one is of greater relevance. Like Denmark, Italy also joined the EUREKA initiative, allocating, however, a larger budget of EUR 500 million per year[119].

On the other hand, among the EU-27 countries in 2020, Bulgaria (2.44%), Slovakia (4.45%), Croatia (4.82%), and Latvia (4.99%) showed relatively low values when compared to the EU-27 average (9.82 %). This trend is consistent throughout the decade. It is noteworthy that while these countries have areas for improvement, Slovakia, Croatia and Latvia have shown positive developments since 2010, with increases of +1.56 pp, +1.93 pp and +3.57 pp, respectively. By contrast, Bulgaria experienced a slight decrease of -0.69 percentage points.

Concerning the Associated Countries, Norway (10.90 %) and Iceland (10.70 %) performed well in 2020, representing the only countries with figures higher than the EU-27 average. While Norway produced very stable values in scientific output since 2010, Iceland's is more variable, being placed above the EU-27 average only in six out of the 10 years. Armenia (2.12 %), Georgia (3.69 %) and Montenegro (4.24 %) have low figures, nevertheless exhibiting a positive evolution since 2010, of +1.05 pp, +0.41 pp and +1.46 pp, respectively. This signals the effort in improving the quality and impact of their scientific output.

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[114] Innovation Attaché Network, with an estimated budget expenditure range per year of EUR 5 to 20 M. Netherlands Innovation Network. (2023). About the innovation network. Available at: https://netherlandsinnovation.nl/about-us/

[115] Publicly-funded, intergovernmental network, involving over 46 countries and the EU Commission, connecting small and large industry, research institutes and universities, aiming at enhancing European competitiveness. Its annual budget ranges from EUR 5 to 20 million. EUREKA. (2023). Eureka: About us. Available at: https://www.eurekanetwork.org/

[116] EC-OECD (2023), STIP Compass: International Database on Science, Technology and Innovation Policy (STIP), edition November 2, 2023, https://stip.oecd.org

[117] Danish Agency for Science and Higher Education. (2018). Denmark's National Strategy for Open Access. Denmark. https://ufm.dk/en/

[118] Luxembourg Ministère de l'Enseignement Supérieur et de la Recherche. (2018). Luxembourg National ERA Roadmap. Available at: https://era.gv.at/public/documents/3480/LuxNatERARoadmap2018.pdf

[119] EC-OECD (2023), STIP Compass: International Database on Science, Technology and Innovation Policy (STIP), edition November 7, 2023 (https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F4367)

Academic freedom

In terms of the level of academic freedom in each country, the available data show notable trends in the **Academic Freedom Index (AFi)** across Member States and Associated Countries.

In 2022, the EU-27 country with the highest AFi value was Czechia (0.98), closely followed by Estonia (0.97), Belgium (0.97), Italy (0.97), Germany (0.96) and Luxembourg (0.96). These six countries have higher figures than the 2022 AFi average value of the EU-27 (0.89). They have also consistently maintained high AFi values, displaying little (in the case of Czechia, Estonia, Belgium, Italy and Germany) or no variation (in the case of Luxembourg) since 2010.

Contrary to the other five countries mentioned, Czechia exhibited a positive evolution throughout the decade, registering a slight increase of +2.8% from 2010 to 2022, up to be the country with the highest figure for this indicator, while originally starting out in sixteenth position.

Focusing on the evolution of this indicator for Czechia, the protection of several aspects of academic freedom in this Member State is ensured by legislative and institutional foundations, namely the Higher Education Act, amended in 2017[120]. Acts 4 and 6 offer legal guarantee for academic freedom in research, teaching, learning and choice of study, as well as cover some other important conditions, including institutional autonomy of internal organisation or financial management.

The Prague Declaration was renewed in 2021[121], strengthening the importance of principles such as academic freedom, self-governance, autonomy and freedom of research and teaching. The Charles University in Prague is one of the signatories of this declaration, and also a committed defender of the autonomy of institutions from power and political structures, as evidenced in its strategic plan for 2021-2025, similarly to many other Czech HEIs[122]. This recent conjuncture of heightened prioritisation of several aspects of academic freedom could possibly explain the substantial increase in performance observed for this Member State, between 2021 and 2022, regarding the AFi.

Estonia, Italy and Germany also include the legal protection of academic freedom in their respective constitutions, the latter in each states' higher education legislation[123].

Regarding Member States for which lower values are observed, Hungary has an AFi value of 0.34, followed by Poland, with 0.71. Hungary has shown low AFi values and little variation over the years.

When analysing the evolution of all EU-27 Member States through 2010 to 2022, most countries have shown a negative evolution, that, in significant cases, ranges from -51.7% (Hungary) to -0.63% (Slovakia). However, Czechia (see above) and France (+0.55%) displayed a positive evolution. Most notably, it is Austria that upheld high AFi values from 2010 (0.98) to 2021 (0.95), then dropping to 0.88 in 2022, i.e. just below the EU-27 average value for 2022.

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[120] Czech Ministry of Education, Youth and Spors. (2017). The Higher Education Act (Act No. 111/1998 Coll). https://www.msmt.cz/areas-of-work/tertiary-education/the-higher-education-act

[121] Charles University. (2021). Message from the Heart of Europe (Prague Declaration II). Available at: https://www.coimbra-group.eu/wp-content/uploads/Prague-Declaration_2021_final_for-printing-.pdf

[122] European Parliament. (2023). The impact of the COVID-19 pandemic on the EU's external. Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/740231/EPRS_STU(2023)740231_EN.pdf

[123] European Parliament. (2023). The impact of the COVID-19 pandemic on the EU's external. Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/740231/EPRS_STU(2023)740231_EN.pdf

Among the Associated Countries, the trends vary. Israel, Norway and Iceland have consistently exhibited high AFi values, never below 0.90, indicating the robust protection of academic freedom. Israel exhibits the highest AFi value for 2022 (0.93) and together with Norway (0.92) and Iceland (0.92), these countries have values above the EU-27 average for 2022. Both Israel and Iceland show a slight and not very significant negative evolution from 2010 to 2022, while Norway's AFi remains static throughout the decade.

Türkiye has a relatively low value of 0.08, which is the result of a negative evolution since 2010. As for the remaining Associated Countries, Armenia (0.71) and Serbia (0.78) have values closer to the EU-27 AFi average (0.89).

Overall, the Associated Countries display varying progress throughout the decade. It should be highlighted that for Montenegro and Georgia a substantial increase in in their AFi values is observed, between 2010 and 2022, with positive evolutions of +34.3% and +11.1%, respectively, increasingly approaching the average AFi value of the EU-27.

3.7. Sub-priority 1.7: Global engagement

3.7.1. Overview

The EU's strategic autonomy and leadership is promoted and safeguarded by upholding shared values and principles, including high ethical standards, academic freedom and human rights, in international research and innovation (R&I) collaborations. This entails promoting multilateralism based on established rules, fostering mutual openness, and aligning bilateral R&I relations with European interests and values to safeguard the EU's strategic autonomy.

In line with this mission, the Global engagement sub-priority aims to: (1) develop a coherent global engagement strategy and common tools, promoting shared European values and principles for R&I in terms of international cooperation and capitalising on the attractiveness of research in the Union; (2) promote a level playing field and reciprocity based on fundamental values; (3) enhance R&I partnerships and strengthen, broaden and deepen collaboration with third countries and regional organisations; and (4) ensure the Union's scientific and innovation strategic autonomy while preserving an open economy.

This sub-priority is linked to ERA Action 9 "Promote a positive environment and level playing field for international cooperation based on reciprocity" and is being endorsed by the proposal and implementation of many policy initiatives.

3.7.2. Notable trends

Key findings on global engagement

With respect to **international co-publications with non-EU partners per 1,000 researchers in the public sector,** the average trend at EU level (both with only non-EU partners and all foreign partners) is positive over the period of 2010 to 2022. The overall trend for the Associated Countries is also positive. In 2022, Member States Cyprus, Denmark, Luxembourg, Sweden and Finland, and Associated Countries Iceland and Norway demonstrate high values for this indicator.

The trend throughout the considered period of 2010 to 2013, both at EU level and for the Associated Countries with respect to **European and international co-patenting in EPO applications at national and EU level** displays an overall negative evolution.

The achievement of a Union's scientific and innovation strategic autonomy that promotes shared European values and principles for R&I in terms of international cooperation relies on

the joint effort from every involved country. This sub-section comprises the analysis of two indicators (Table 10) that provide an insightful measure of the level of commitment to this pursuit from each targeted country.

Table 10. Overview of the indicators relevant to Global engagement
Note: Annex A2.2 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
30. International co-publications with non-EU partners per 1,000 researchers in the public sector
31. European and international co-patenting in EPO applications at national and EU level

International co-publications

In terms of the **international co-publications with non-EU partners per 1,000 researchers in the public sector**, for the EU, this indicator measures the number of scientific co-publications per 1,000 researchers with at least one co-author from a non-EU country. For the individual countries, the indicator is more broadly defined by including co-publications with at least one co-author in any foreign country (including an EU country), as data limited to non-EU countries are not available[124]. When isolating EU-27 average values concerning only co-publications with at least one co-author from a non-EU country, an increase from 217.4, in 2010, to 358.7, in 2021, is observed.

At Member State level, Cyprus shows the highest figure of the EU Member States, with a total of 3,743.8 co-publications, in 2022. Cyprus has seen a consistent and significant increase in the number of co-publications since 2011, namely +2,676.8 co-publications per 1,000 researchers.

Following Cyprus, Denmark (3,698.4), Luxembourg (3,495.5), Sweden (2,975.9) and Finland (2,776.6) also show high values in 2022, surpassing the EU-27 average value of 1,279.0. All five countries displayed a consistent positive evolution since 2010, with high levels of collaboration with foreign partners, indicating their strong international research networks and engagement.

As an example of its efforts employed towards international cooperation, particularly with non-EU partners, Cyprus is a founding member of SESAME, the “Middle East’s first major international research centre”, including Egypt, Jordan, Israel, Pakistan, Iran, Türkiye and the Palestinian Authority as participating members. It officially opened in 2017 and, as an intergovernmental scientific and technological centre of excellence open to all scientists from the Middle East and elsewhere, it aims at promoting scientific, technical, and economic development of the region, and strengthening collaboration in science[125].

On the other hand, some EU-27 countries with low values in 2022 were Romania (395.2), Bulgaria (404.7), Poland (591.7) and Hungary (757.4). These countries have low numbers of international co-publications per 1,000 researchers in the public sector, suggesting a potential need for increased collaboration and engagement with foreign partners. However, it should be noted that all four countries display a positive evolution since 2010.

[124] The average values for the EU-27 used for comparison with individual countries differ from those included in the ERA EU level report. Such differences are due to the fact that, in this report, analysis is conducted at country level, for which data are only available concerning co-publications with at least one co-author in any foreign country, as opposed to only non-EU countries.
[125] SESAME.(2020). What is Sesame. Available at: https://www.sesame.org.jo/

Based on the available data, Iceland and Norway consistently perform well in international co-publications with foreign partners, showing higher values when comparing to the EU-27 average, throughout the whole decade. In 2022, they were the only countries to have higher values than the EU-27 average (1,279.0), with the following numbers: 4,348.2 (Iceland) and 3,358.2 (Norway).

Regarding values of collaboration with foreign partners that are lower than the EU-27 average, in 2022, Serbia and Montenegro's figures were 697.2 and 736.6 co-publications per 1,000 researchers, respectively. For the same year, Türkiye follows these two countries with 203.1 co-publications, preceded by Armenia (256.1) and Georgia (269.8), denoting a challenge to improve engagement and collaboration with researchers from outside the EU.

European and international co-patenting

With respect to **European and international co-patenting in EPO applications at national and EU level**, the available data cover the period comprised between 2010 and 2013. When analysing this indicator for EU-27 countries, 17 of them show a negative evolution. Germany, for instance, shows a negative evolution of -4,742 co-patents compared to 2010.

Some EU-27 countries showing growth between 2010 and 2013 include Latvia (+ 43), Poland (+31), Portugal (+27), Malta (+23), Greece (+14), Bulgaria (+12), Cyprus (+10), Czechia (+6), Lithuania (+4) and Romania (+2). However, the variation is not big.

The data available for the Associated Countries only refers to Israel, Norway, Türkiye and Iceland. According to the latest data available from 2013, the following figures are observed: Israel with 749, Norway with 339, Türkiye with 276 and Iceland with 29 European and international co-patents in EPO applications. Furthermore, these values are consistently observed throughout the four years, showing very little variation. The evolution on this indicator for Israel, Norway and Türkiye is negative during this period, corresponding to -139, -125 and -165 co-patents, respectively. It was not possible to analyse Georgia, Armenia, Serbia and Montenegro's performance on this indicator, as there are no available data for these countries.

4. ERA Priority 2: Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society's participation in the ERA

ERA Priority 2 aims at taking up together the green transition and digital transformation and other challenges with impact on society and increasing society's participation in the ERA. This priority focuses on enhancing an alignment between R&I and societal challenges by further engaging citizens and societal actors and promoting the accomplishment of the green and digital transition, core current societal challenges. The ERA Policy Agenda envisages the attainment of this priority through five voluntary ERA actions to which Member States and Associated Countries commit.

This priority comprises four sub-priorities:

- **The first sub-priority, challenge-based ERA actions**, focuses on the role of R&I to address core challenges in the current society and R&I landscape.

- **The second and third sub-priorities, synergies with education and the European Skills Agenda and synergies with sectorial policies and industrial policy**, in order to boost innovation ecosystems respectively, focuses on building synergies across core areas and stakeholders involved in the R&I process.

- **The last sub-priority ensures active citizen and societal engagement in R&I** in all its dimensions, ensuring alignment across society and R&I.

Using the most recent data available, the following map illustrates the scores of the EU-27 Member States and Associated Countries with respect to the indicators covered under this priority. Additionally, throughout the section, we analyse notable trends observed over the past 10 years per each indicator to offer a comprehensive understanding of the evolving R&D landscape. Additionally, the following sub-sections will analyse key results of each sub-priority.

Sources: Eurostat, SETS Database, OECD, MORE survey, IES 2023, Own Estimates. Data is based on 2022 or the most recent available data.

Map 3. Taking up together the green transition and digital transformation

Reset the map

Challenge-based ERA actions

- GBARD by NABS (Environment)
- GBARD by NABS (Transport, teleco & other infrastructure)
- GBARD by NABS (Energy)
- R&I investments (transnational cooperation) GBARD (EUR) allocated to Europewide transnational bilateral or multilateral public R&D programmes per FTE researcher in the pub
- Environmentally related government R&D budget as a percentage of total government R&D
- National public and private investments as suggested in the SET Plan progress report 2021
- OECD Patents on environment technologies

Synergies with education and the European Skills Agenda

- Share of researchers receiving transferable skills training
- Innovative enterprises that co-operated on R&D+I with universities and HEIs

Synergies with sectorial policies and industrial policy

- Direct government support and Indirect government support through R&D tax incentives as a percentage of GDP

An active citizen and societal engagement in R&I in all its dimensions

- Trust in Science

4.1. Sub-priority 2.1: Challenge-based ERA actions

4.1.1. Overview

Collaboration with all relevant stakeholders, including Member States, third countries, regions and local entities, will enable fostering R&I-based solutions and mitigate future risks hindering Europe's green transition and digital transformation goals. The challenge-based ERA actions aim to encourage such collaboration through (1) addressing new and persistent challenges comprehensively through close coordination, co-design, cooperation, data sharing and joint funding; (2) addressing new and persistent challenges comprehensively by building on the contribution of the full spectrum of disciplines; (3) introducing sectorial policies to address new and persistent challenges, bringing together the Member States and the Commission, including regions and local entities, as well as third countries, R&I stakeholders and industry and (4) directing R&I investments and reforms towards speeding up the green transition and digital transformation[126].

Particularly, this ERA sub-priority is closely related with ERA Action 10 "Make EU R&I missions and partnerships key contributors to the ERA" and ERA Action 11 "An ERA for green energy transformation".

[126] Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

4.1.2. Notable Trends

Key findings on challenge-based ERA actions

For the time frame of 2010-2021, the average **Government Budget Allocations for R&D (GBARD) by NABS** for the socio-economic objectives have increased at EU level. The same is true for the overall trend of the Associated Countries, with the exception of spending on energy. Germany and France consistently perform well on socio-economic objectives. All Associated Countries for which data are available (Norway, Switzerland, Türkiye, Serbia and Iceland) have figures that are lower than EU-27 average.

Between 2010 and 2020, the EU level trend of **R&I Investments (transnational cooperation)** shows a negative evolution, whereas the trend for the Associated Countries was positive. Belgium and Italy show high figures among Member States for the whole period. Regarding the Associated Countries, Norway is above the EU-27 average.

In terms of **environmentally related government R&D budget** for the period of 2010 – 2021, the EU-27 trend reflects a negative evolution. Similarly, when considering the last available comparable data for Associated Countries (Israel, Iceland, Norway and Türkiye), the trend is also negative. At Member State level, Lithuania, Poland and Belgium perform well. Considering the Associated Countries, Norway has values higher than the EU-27 average.

As for the **national public and private investments** between 2010 and 2020, the overall EU level trend shows an increase in performance. Significant positive evolutions since 2010 are seen for Germany, Austria and Denmark.

Patents on environment technologies between 2010 and 2018, show a stagnant trend at the EU level. At Member State level, Denmark, Germany and Austria display high figures in 2018 and 2019, together with Cyprus. As for the Associated Countries, the observed trend for the 2010-2019 period is negative. However, Norway's value is higher than the EU-27 average in 2018.

The progress towards addressing core challenges through collaboration across the R&I landscape, particularly in relation to digital and green transition, becomes crucial to understand progress in the ERA. This section focuses on five indicators that gauge these efforts:

Table 11. Overview of the indicators related to the Challenge-based ERA actions
Note: Annex A2.3 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
33. Government budget allocations for R&D (GBARD) by NABS
34. R&I Investments (transnational cooperation): R&I investments (transnational cooperation): GBARD (EUR) allocated to Europewide transnational, bilateral or multilateral, public R&D programmes per FTE researcher in the public sector
35. Environmentally related government R&D budget as percentage of total government R&D
37. National public and private investments as suggested in the SET Plan progress report 2021
38. OECD Patents on environment technologies

Government budget allocation for R&D

The first indicator measures the **government budget allocations for R&D (GBARD) by NABS**. Government budget allocations for R&D (GBARD) are all provisions allocated to R&D in central, regional and local government. It covers government-financed R&D performed in government establishments but also in the other three national sectors (business enterprise (BES), private non-profit (PNP), higher education (HES)) and international organisations. They refer to budget provisions, not to actual expenditure.

The GBARD is broken down according to the nomenclature for the analysis and comparison of scientific programmes and budgets (NABS 2007) classification system. This indicator covers the socio-economic objectives related to this sub-priority which entail the following themes: environment; energy; transport, telecommunication, and other infrastructure.

For this indicator, data are available for the years 2010 to 2021.The average GBARD for the three objectives at EU level has increased in this period. The greatest increase can be seen in energy, with 41% rise, followed by an increase in environment of approximately 34%. The trend followed by transport, telecommunication and other infrastructure shows a decline followed by stagnation and a recent increase to EUR 133.25 million by 2021, with a significant drop seen between 2010 and 2011.

At Member State level, the majority of countries follow the EU trend for environment, energy and transport, telecommunication and other infrastructure. Nonetheless, for GBARD in environment, in 2021, Germany (EUR 1256.3 million) and France (EUR 511.2 million) have the highest values compared to the EU-27 average, while Lithuania (EUR 0.51 million) and Bulgaria (EUR 0.52 million) show figures that are lower than the EU-27 average. The value for Germany increased approximately 98% from 2010 to 2021.

With respect to both energy and transport, telecommunication and other infrastructure, Germany and France show values higher than the EU-27 average throughout the 2010-2021 period.

According to the OECD STIP Survey, Germany stands out regarding the number of initiatives implemented related to the objectives it excels in, mentioned above. Relevant initiatives, particularly connected to the energy objective, and a few also connected to the transport, telecommunication, and other infrastructures, have been put forward since 2016, especially promoting hydrogen production, use and the development of its related technology.

Some examples with the highest budget allocation include the National Innovation Programme for Hydrogen and Fuel Cell Technology[127] implemented in 2016 (EUR 50 to 100 million per year), the National Hydrogen Strategy[128] (more than EUR 500 million per year), the Research for Sustainability (FONA) Strategy[129] (more than EUR 500 million per year) and the Flagship Projects on Hydrogen[130] (EUR 100 to 500 million per year), all of these implemented in 2020.

France shows the same pattern of investment, also in what concerns hydrogen related initiatives. The highest budget allocations are seen in initiatives such as the Institutes for

[127] NOW. (2023). Hydrogen and fuel cell. Available at: https://www.now-gmbh.de/en/
[128] German Federal Ministry for Economic Affairs and Climate Action. (2023). The National Hydrogen Strategy. Available at: https://www.bmwk.de/
[129] Federal Ministry of Education and Research. (2023). 'Research for Sustainability' (FONA) Strategy. Available at: https://www.bmbf.de/
[130] Federal Ministry of Education and Research. (2023). Hydrogen Flagship Projects. Available at: https://www.wasserstoff-leitprojekte.de/home

Energy Transition[131] (EUR 20 to 50 million per year) implemented in 2010, the French Green Hydrogen Plan[132] (more than EUR 500 million per year) and the Investment on Clean Aircraft Technologies[133] (EUR 100 to 500 million per year), both implemented in 2020, and France's 2030 Investment Plan[134] (more than EUR 500 million per year) implemented in 2021, which include key objectives connected to the analysed indicator.

Considering the Associated Countries, for which data are available, in 2021, Norway, Türkiye, Serbia and Iceland's figures are lower than the EU-27 average for all three objectives.

R&I Investments (transnational cooperation)

The second indicator measures the **GBARD (EUR) allocated to Europewide transnational, bilateral or multilateral, public R&D programmes per FTE researcher in the public sector**.

The data for this indicator are available for the period between 2010 and 2020, for which the EU-27 average GBARD depicts a negative trend (-7.6%). Regarding EU Member States, Belgium had a high value of EUR 3,918.10 million, in 2020. Together with Italy, it consistently performs well throughout the decade. Italy shows an increase of EUR + EUR 55.70 million, and Belgium displays a negative trend (EUR -488.47 million), for the period of 2010 to 2020. Luxembourg follows in 2020 (EUR 3,567.69 million) with a significant increase since 2010 (EUR 2,902.20 million).

As a possible explanation for why some Member States perform well, it can be seen that, in 2015, Belgium implemented the 'Urban Europe'[135] initiative, with an annual budget allocation of EUR 1 to 5 million. This tool allows European countries and stakeholders to work together on a voluntary basis and align their national interests to support European cities facing new challenges. As for Italy, the debut of its participation in the European Strategy Forum on Research Infrastructures[136], in 2010, with a yearly budget allocation of EUR 1 to 5 million, allows the qualification of its own research infrastructures by opening them to international access and by participating in the pan-European networks of Research Infrastructures.

In 2020, Bulgaria (EUR 139.43 million), Hungary (EUR 153.00 million) and Portugal (EUR 283.23 million) are Member States showing low figures, although Bulgaria and Hungary show a positive evolution since 2010, of EUR +82.55 million and EUR +104.48 million, respectively. Nevertheless, there is still room for improvement in the budget allocation for R&D at government level. There is no data available for France, hence it was not possible to evaluate its performance.

When considering the Associated Countries, only data for Norway are available for this indicator, with a figure higher than the EU-27 average in 2020, with a government allocation of EUR 2,075.13 million for R&D.

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[131] INES. (2023). INES.2S - French Institute of Energy Transition. Available at: https://www.ines-solaire.org/en/ines-2s/

[132] Direction Générale des Entreprises. (2023). Stratégie nationale pour le développement de l'hydrogène décarboné en France. Available at: https://www.entreprises.gouv.fr/

[133] OECD STIP COMPASS. (2023) Policy initiatives France: Investment on Clean Aircraft Technologies. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99994872

[134] Ministère de L'économie des Finances et de la Souveraineté Industrielle et Numérique. (2023). France 2030: un plan d'investissement pour la France. Available at: https://www.economie.gouv.fr/

[135] Urban Europe. (2023). Introduction to JPI Urban Europe. Available at: https://jpi-urbaneurope.eu/about/intro/

[136] ESFRI. (2023). European Strategy Forum on Research Infrastructures. Available at: https://www.esfri.eu/

Environmentally related government spending

The indicator **environmentally related government R&D budget, percentage of total government R&D budget** shows stagnation over the period 2010-2021 at the EU level, with a peak in 2015 at 3.17%, dropping to 2.70% in 2021. At Member State level, in 2021, Latvia displays the highest percentage of environmentally related government spending (9.38%), followed by Slovenia (5.33%) and Ireland (4.67%).

The OECD STIP Survey includes some initiatives connected to this indicator for the three countries. The Latvian National Energy and Climate Plan[137], implemented in 2021, constitutes an important environmental government investment, although no information on annual allocated budget is available.

In Slovenia, some initiatives such as the Slovenian Environmental Public Fund[138], implemented in 1993 (no information on yearly allocated budget), the Strategic Research and Innovation Partnership – Network for The Transition To Circular Economy[139], implemented in 2015, the Deep Demonstration of a Circular, Regenerative and Low-Carbon Economy initiative[140], implemented in 2019 (both with an annual budget allocation inferior to EUR 1 million), and the Integrated National Energy and Climate Plan[141], implemented in 2021 (for which the annual available budget is unknown), indicate its prioritisation in environmentally related government spending.

In Ireland, the National Challenge Fund[142] can be classified as somewhat relevant, with an annual budget allocation of EUR 5 to 20 million, characterised by some environmentally relevant objectives.

Regarding Member States, in 2021, Lithuania (0.29%), Poland (0.60%) and Belgium (0.65%) have figures that are lower than EU-27 average. These values show a low weight of environmentally related government R&D spending, when compared to other categories.

Out of the eight Associated Countries covered, data on environmentally related government R&D budget is available only for Iceland, Israel, Norway and Türkiye. Norway closely follows the EU-27 average throughout the period 2010-2021 and begins to show higher figures in 2019, ultimately reaching 2.7% in 2021. On the other hand, Türkiye, Israel and Iceland's environmental budgets remain below the EU-27 average, with 0.29% (2021), 0.74% (2020) and 0% (2019) environmentally related government spending, respectively.

National public and private investment in R&I

The indicator **national public and private investments as suggested in the SET Plan progress report 2021** shows a positive evolution between 2010 and 2020 (EUR +65.7 million) at EU-27 level, for which the average value is EUR 890.6 million in 2020. It is important to note that this indicator is an absolute measure, which means that comparisons across Member States may not be appropriate due to varying budgetary contexts and scales.

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[137] Ministry of Economics of the Republic of Latvia. (2023). National Energy and Climate Plan for 2021-2030. Available at: https://www.em.gov.lv/en/
[138] Eco Fund. (2023). Slovenian Environmental Public Fund (Eco Fund). Available at: https://www.ekosklad.si/
[139] Smart Specialisation Platform. (2020). Strategic Research and Innovation Partnership on Circular Economy. European Commission. Available at: https://s3platform.jrc.ec.europa.eu/en
[140] European Institute of Innovation & Technology. (2020). Slovenia adopts EIT Climate-KIC circular economy proposal. Available at: https://eit.europa.eu/
[141] European Commission. (2020). Integrated National Energy and Climate Plan of The Republic of Slovenia. Available at: https://energy.ec.europa.eu/system/files/2020-06/si_final_necp_main_en_0.pdf
[142] Science Foundation Ireland. (2017). Exploring opportunities with the National Challenge Fund. Available at: https://www.sfi.ie/

For the considered period, Germany shows a positive evolution, with a significant increase of EUR +2,173.4 million. Additionally, Austria (EUR +472.4 million) and Denmark (EUR +387.4 million) display a positive evolution between 2010 and 2020.

According to the OECD STIP Survey, relevant initiatives implemented by Germany related to public investment in energy related R&I are characterised by large budget allocations, some of them surpassing EUR 500 million. Examples of these are the National Innovation Programme for Hydrogen and Fuel Cell Technology, the Flagship Projects on Hydrogen, or the National Hydrogen Strategy, also mentioned for indicator 'Government budget allocation for R&D'. This array of initiatives for which there is a large budget allocation might explain Germany's significant positive evolution.

Also, for Austria several initiatives dating as far back as 1997 are found in the OECD STIP Survey, related to this indicator. Two of them are of particular relevance, given the large budget allocation per year (EUR 100 to 500 million): Domestic Funds for the Environment[143] and Climate and Energy Fund[144], both enabling the funding for business R&D and Innovation. The same is observed for Denmark, for which many initiatives have been implemented since 1973. Notably, the following two have the highest yearly budget allocations and focus both on public and private funding and acceleration of R&D and Innovation: Energy Technology Development and Demonstration Programme[145] and Strategy for Investments in Green Research, Technology and Innovation[146].

Member States such as Italy (EUR -824.0 million), the Netherlands (EUR -372.7 million) and Spain (EUR -226.6 million) have decreased their values of investment since 2010.

There is no data available for this indicator for any of the Associated Countries.

Patents on environment technologies

The last available indicator for this sub-priority measures OECD **Patents on environment technologies**, for which data are available for the period between 2010 and 2019, inclusive, at Member State level, and between 2010 and 2018 for the EU-27 average. The trend at the EU level marks a small decrease from 14 (2010) to approximately 13 (2018) patents. Therefore, the EU average on OECD patents on environment technologies shows overall stagnation.

At Member State level, the development of the trends for this indicator during the time frame is overall varied. In 2018, five countries registered a higher number of patents than the EU-27 average: Denmark with 24 (decreasing to 22 in 2019); Germany with 15 (decreasing to 13 in 2019); Austria with 14 (the same as in 2019) and Slovakia with 14, (decreasing to 12 in 2019). Notably, Cyprus has increased the number of patents from two in 2015 to 17, in 2019. The highest number of patents on environment technologies is registered for Malta in 2016 (49 patents).

The OECD STIP Survey shows some initiatives, for example, implemented by Denmark which might affect its performance related to this indicator. The Energy Technology

[143] KPC. (2022). Domestic Funds for the Environment. Available at: https://www.umweltfoerderung.at/
[144] Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology, Republic of Austria. (2023). Climate and Energy Fund. Available at: https://www.bmk.gv.at/en/topics/climate-environment/climate-protection/climate-energy-fund.html
[145] Danish Energy Agency. (2023). The Energy Technology Development and Demonstration Programme. Available at: www.eudp.dk
[146] Ministry of Higher Education and Science. (2020). Green solutions of the future - Strategy for investments in green research, technology, and innovation. Available at: https://ufm.dk/en/publications/2020/green-solutions-of-the-future-strategy-for-investments-in-green-research-technology-and-innovation

Development and Demonstration Programme[147], implemented in 2007, is a grant-based programme that supports the development and demonstration of new and innovative energy technologies, counting on a yearly budget allocation of EUR 50 to 100 million. Also relevant is the Green Development and Demonstration Programme[148], implemented in 2010, which supports innovative projects that simultaneously promote green and economically sustainable development in the entire food sector in Denmark, sustained by a budget of EUR 20 to 50 million, annually.

Similarly, Austria has also implemented initiatives of some relevance for its performance in this indicator, both with budget allocations of EUR 5 to 20 million per year. Those are the 'City of tomorrow'[149] project, implemented in 2013, and the 'Energy Research Programme'[150], implemented in 2014. Both initiatives promote the transition to a zero-carbon economy through cleaner and more efficient energy use, by developing (not only but also) innovative environmental technologies.

Countries for which there is room for improvement are Croatia (three patents) and Estonia (three patents), as they also exhibiting a negative evolution since 2010 (-7 and -22, respectively).

Regarding the Associated Countries, in 2019, Norway performs well, with 14 patents, as well as Serbia, with eight. For the same year, for Israel, six patents can be noted. Data are not available for 2019 for Georgia, Montenegro and EU-27 average. Hence, comparison with the latter is only possible for 2018. Additionally, data are also not available for 2018 for Montenegro and Iceland. For that year, however, Armenia (18), Georgia (18), Serbia (16) and Norway (13) have values that are higher that EU-27 average, while Türkiye (seven) and Israel (six), have values that are lower.

4.2. Sub-priority 2.2: Synergies with education and the European Skills Agenda

4.2.1. Overview

R&I and higher education are key drivers of innovation, knowledge creation, diffusion and use. Therefore, through the defined ERA Actions one expects to achieve more modern, inclusive and future-oriented higher education institutions, integrated in the R&I systems. As defined in the Council Recommendation on a Pact for Research and Innovation in Europe[151], interventions focus on (1) equipping researchers with all the skills required by the labour market and for upskilling and reskilling through targeted training; (2) the transition of the higher education system towards higher cooperation, inclusion, excellence and digitisation guided and supported with relevant stakeholders, with further development of the 'European University' initiative supported in a concerted manner at Union and national level; (3) development, support and exploiting synergies between the ERA and the European Higher Education Area, in particular through higher education institutions and research infrastructure, including e-infrastructure, mutually reinforcing open science and open education policies, as well as the EIT KICs.

[147] Ministry of Climate, Energy and Utilities. (2023). Energy Technology Development and Demonstration Program. Available at: https://ens.dk/en/
[148] Ministry of Food, Agriculture and Fisheries. (2023). Green Development and Demonstration Programme. ISBN: 978-87-7120-287-8. Available at: https://lbst.dk/
[149] Open4innovation. (2023). City of Tomorrow. Available at: https://nachhaltigwirtschaften.at/en/sdz/
[150] FFG. (2022). Energy Research. Available at: https://www.ffg.at/2022-Ausschreibung-Energieforschung
[151] Council Recommendation. (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

This sub-priority is closely related to ERA Action 13 “Empower Higher Education Institutions to develop in line with the ERA, and in synergy with the European Education Area”.

4.2.2. Notable trends

Key findings on synergies with education and the European Skills Agenda

The EU average of the **share of researchers receiving transferable skills training** between 2016 and 2019 portrays a slightly negative trend. In 2019, Romania, Malta and Hungary perform well with an above average share. Regarding the Associated Countries, data are only available for Iceland and Norway, which have values that are both higher than the EU-27 average.

As for the **number of innovative enterprises that co-operated on R&D+I with universities and HEIs enterprises,** no trend analysis is possible since data are only available for 2020. For that year, the highest number can be found for Germany, which is however the biggest EU Member State. With regards to Associated Countries, Türkiye has a figure higher than the EU-27 average.

The need for more modern, inclusive and future-oriented higher education institutions, further integrated in the R&I systems is a crucial area of the ERA. The following table presents an overview of available indicators to measure this sub-priority.

Table 12. Overview of the indicators related to synergies with education and the European Skills Agenda

Note: Annex A2.3 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
39. Share of researchers receiving transferable skills training
40. Innovative enterprises that co-operated on R&D+I with universities and HEIs

Transferable skills training

The indicator on the **share of researchers receiving transferable skills training** is only available for the years of 2016 and 2019[152]. It measures the promotion of relevant skills across researchers from higher education institutions. At the EU level, there has been a decrease of three percentage points from 2016 to 2019 from 49.5% to 46.3%.

At Member State level, between both years, the trends are variable: countries like Austria or Romania have experienced a considerable increase between 2016 and 2019 of more than 40 percentage points; other countries have witnessed a steep decline (such as Greece and Bulgaria) of 50 and 35 percentage points respectively; while other countries, including Lithuania, Portugal or Belgium, have stagnated over the considered period. In 2019, Romania, Malta and Hungary stand out from the EU-27 average with the share of researchers receiving transferable skills training being 89.4%, 80.3% and 72.8%, respectively.

[152] Data only available for these years. European Commission. (2021). MORE4. doi: 10.2777/645537. Available at: https://www.more-4.eu/

Bulgaria (31%), Luxembourg (32.7%) and Germany (35.1%) display lower values for this indicator, showing room for improvement, while also depicting a decrease when comparing to 2016 values.

Regarding the Associated Countries, data are only available for Iceland and Norway, which are both placed above the EU-27 average, with a share of 70.5% and 50.9%. Norway has, however, registered a decrease from 72% in 2016.

Cooperation between innovative enterprises and research organisations

A key indicator to gain further insights on the progress towards this sub-priority is the **number of innovative enterprises that co-operated on R&D+I with universities and HEIs**. Data for this indicator are only available for 2020, where the EU average lies at 1,506 innovative enterprises cooperating with the higher education sector.

At Member State level, Germany shows the highest figure with 14,593 innovative enterprises. It is followed by Italy (5,265) and France (3,090). Given that this indicator is measured in absolute numbers, comparison across countries may not be appropriate due to differences in size and other national characteristics.

Focusing on Germany, where there is a notable presence of innovative enterprises, we can identify several initiatives that potentially contribute to its figures. According to findings from the OECD STIP Survey, Germany initiated the Pact for Research and Innovation[153], in 2005. This pact is a joint effort of the Federal Government and the Länder to increase R&D funding of major Programme Related Investments as well as the German Research Foundation, which is the major third-party funding organisation for HEIs, which can surpass EUR 500 million a year. In turn, the increase in funding and the reliable planning framework enables these organisations to achieve defined research policy goals. Also relevant is the Research Fab Microelectronics Germany[154], implemented in 2017, which aims to advance future microelectronics and provide access to high-technology for partners and customers from academia and industry as a one-stop-shop for technologies and systems, counting on an annual budget allocation of EUR 50 to 100 million. These are two examples that might be connected to the outstanding performance of Germany concerning this indicator.

In the case of Italy, the 'Italian Strategy for Hydrogen Research'[155] (no information on budget), starting from 2020, aligns with this indicator, as it sets out (amongst other objectives) to be in synergy with the initiatives of Italian industry and local administrations, in order to increase the transfer of research results. No initiatives of particular relevance were found for France.

With regard to Associated Countries, data are only available for Norway and Türkiye. The latter Associated Country registered 4,106 innovative enterprises, and Norway registered 624 enterprises.

[153] Helmholtz Association. (2023). Joint Initiative for Research and Innovation. Available at: https://www.helmholtz.de/en/about-us/structure-and-governance/joint-initiative-for-innovation-and-research/
[154] Fraunhofer-Gesellschaft. (2023). Research Fab Microelectronics Germany. Available at: https://www.fraunhofer.de/en/
[155] Ministero dell'Università e della Ricerca. (2020). Strategia Italiana Ricerca Idrogeno. Available at: https://www.miur.gov.it/documents/20182/2312362/Prime.indicazioniSIRI.pdf/

4.3. Sub-priority 2.3: Synergies with sectorial policies and industrial policy, in order to boost innovation ecosystems

4.3.1. Overview

Close collaboration and engagement of industry becomes essential to improving competitiveness of R&I systems across the ERA. This entails fostering collaboration and developing sectoral policies and programmes that support the development of breakthrough and incremental innovations across the EU. As mentioned in the Council Recommendation on a Pact for Research and Innovation in Europe[156], this entails technology infrastructures, higher education institutions, the European Innovation Council, Horizon Europe partnerships, including EIT KICs, Industrial Alliances, important projects of common European interest, Joint Cluster Initiatives, thematic smart specialisation platforms, and common industrial technology roadmaps. This sub-priority also envisages the identification of specific priority areas to help align public and private investments.

In the advancement of this sub-priority, activities under ERA Action 12 "Accelerate the green/digital transition of Europe's key industrial ecosystems", will be crucial to better link European R&I and industrial policy accelerating industrial up-take or results and, consequently, increasing competitiveness.

4.3.2. Notable trends

Key findings on synergies with sectorial policies and industrial policy

In the pursuit of enhancing innovation ecosystems through synergies with sectorial and industrial policies, the European countries have shown progress. When looking at **direct and indirect government support through R&D tax incentives as a percentage of GDP** at the EU-27 level, a notable increase is observed from 2010 to 2020. Notably, Austria, Belgium, and France consistently surpass the EU-27 average in this regard. Among these counties, France shows the highest levels, despite the modest advancements made during the last decade. Regarding the Associated Countries, overall, they demonstrate levels of government support below the EU-27 average. However, both Türkiye and Norway have shown growth trends over time.

The following table presents an overview of available indicators to measure this sub-priority. The indicator aims to measure progress towards further development, support and exploitation of synergies between the ERA cross-sectorial policies and the updated industrial strategy.

Table 13. Overview of the indicators related to synergies with sectorial policies and industrial policy, in order to boost innovation

Note: Annex A2.3 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
41. Direct government support plus Indirect government support through R&D tax incentives as a percentage of GDP

[156]European Union. (2021). Regulation (EU) 2021/2122 of the European Parliament and of the Council of 22 November 2021, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

Relevant tax incentives

The only indicator within this sub-priority is the **Direct government support plus Indirect government support through R&D tax incentives as a percentage of GDP**. Public financing of R&D sector is deployed via two channels, direct and indirect support. Direct funding is delivered through instruments including grants or public procurement, while indirect support is provided through the tax system. In this case, this indicator measures both types of support as a percentage of GDP. Performance at the EU level shows an increase from 0.150 in 2010 to 0.182 in 2020.

Austria, Belgium, and France are the EU Member States that have consistently higher shares than the EU-27 average between 2010 and 2020. Particularly, France shows the highest levels, despite the limited progress over the covered period. Regarding the evolution of Member States from 2010 to 2020, Austria, Poland and Portugal show the highest increase within EU-27 Member States with values of +0.13 pp, +0.13 pp and +0.18 pp respectively. On the other hand, Croatia exhibits a decrease with a drop of -0.14 pp. Many countries, like Latvia or Bulgaria, show stagnation between 2010 and 2020.

France's positive performance could be attributed to various national initiatives identified in the OECD STIP Survey that contribute to creating a conducive environment for R&D, in line with ERA Action 12. For instance, Club Galaxie (2001)[157] forges an ecosystem in Occitanie to spur innovation and entrepreneurship in the space sector. Aerospace Valley[158] (2005) leads as a prominent European competitiveness cluster, fostering collaborative R&D projects and supporting member companies. ASTech Paris Region[159] (2007) unites over 300 key players in aeronautics and space, striving to bolster European leadership in these domains. Lastly, the France 2030 Investment Plan[160] (2021) targets strategic investments across industries, with a special emphasis on emerging actors and decarbonisation. The plan encompasses the entire value chain of industries to allow historical sectors to catch up while also helping to develop the competitiveness of industries and technologies of the future.

Likewise, Austria has fostered innovation ecosystems through several initiatives potentially influencing the positive performance of the indicator. According to the OECD STIP Survey, the AplusB Scale up programme[161] (2016 - 2027) enhances the start-up ecosystem by offering services like coaching, funding, and networking. The ERA NAP 2.9 Green and Digital Transition of Key Industrial Ecosystems initiative[162] (2022 - 2025) focuses on compiling expertise in industrial technology roadmaps and aligning Austrian interests at the European level. Moreover, initiatives such as Digital and Key Technologies[163] (2022) and Space and Aviation Technologies[164] (2022) prioritise aligning technologies with climate protection, strengthening innovation, and promoting green and digital transformations in manufacturing and aviation. In relation to the Associated Countries, information is available for six out of the eight covered Associated Countries: Iceland, Israel, Montenegro, Norway, Serbia and Türkiye. Regarding their evolution over time, Türkiye and Norway show an increase of 0.10 and 0.13, respectively, from 2010 to 2020. Iceland, Montenegro and Serbia show limited progress, while Israel has experienced a slight decrease.

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157 See: https://www.club-galaxie.com/
158 See: https://www.aerospace-valley.com/
159 See: https://www.pole-astech.org/web/site/index.php?section=home&lang=en
160 Ministre de l'Économie, des Finances et de la Souveraineté industrielle et numérique. (2023). France 2030: un plan d'investissement pour la France, available at: https://www.economie.gouv.fr/france-2030
161 Austrian Federal Promotion Bank. AplusB Scale-up, available at: https://www.aws.at/aws-aplusb-scale-up/
162 Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, available at: https://www.bmk.gv.at/themen/innovation/schwerpunkte.html
163 Austrian Research Promotion Agency (FFG). (n.d.). Available at: https://www.ffg.at/#term-2
164 Austrian Research Promotion Agency (FFG). (n.d.). A at: https://www.ffg.at/#term-4

4.4. Sub-priority 2.4: An active citizen and societal engagement in R&I in all its dimensions

4.4.1. Overview

The engagement of citizens, local communities and civil society lies at the core of the new ERA to achieve greater societal impact and increased trust in science. The engagement of citizens and societal actors within R&I at all stages becomes crucial to ensure larger impact of R&I as well as higher alignment with societal needs and challenges. The commitment towards this sub-priority through diverse interventions will increase the awareness of the benefits and impact of R&I in people's daily lives and increase the acceptance and affordability of new solutions by making R&I more relevant for society.

Within this sub-priority, it is envisaged to promote citizens' and societal actors' engagement through science communication activities. Additionally, this sub-priority also entails the adoption of a greater diversity of collaboration, design and implementation approaches that allows their effective engagement and contribution to research but also to R&I policies[165]. The goals of this sub-priority go hand in hand with ERA Action 14 "Bring Science closer to citizens".

4.4.2. Notable trends

Key findings on active citizen and societal engagement in R&I in all its dimension

A substantial number of EU Member States demonstrate high levels of **trust in science**, with citizens recognising the significance of scientific knowledge in societal advancement. This trust is notably high in Greece and Germany. Targeted initiatives such as Greece's "Athens Science Festival" and Germany's "Funding Initiative for Citizen Science" could have been essential in fostering this trust, encouraging societal participation and enhancing public engagement with science and technology.

In the Associated Countries, a notable affirmation of science is evident. Türkiye exemplifies this with an extraordinary demonstration of trust. Strategic initiatives such as the "Tubitak Science Centres," as highlighted by the OECD STIP Survey, emphasise Türkiye's commitment to promoting scientific curiosity and technological adaptability within society.

The level of societal and citizen engagement in R&I in all its dimensions within a country serves to analyse how trustworthy scientific work is perceived within the population and how advancements in this field impact social development. It also helps to align R&I processes and results with societal challenges and needs. This section analyses these considerations by means of the indicator presented in Table 14.

Table 14. Overview of the indicators related to active citizen and societal engagement in R&I in all its dimensions
Note: Annex A2.3 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
48. Trust in science

[165] Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe (OJ L 431 02.12.2021, p. 1, ELI: http://data.europa.eu/eli/reco/2021/2122/oj).

Trust in science

As ERA aims to promote citizens' engagement, the level of citizen trust in science is a crucial factor to gauge within sub-priority 2.4. The indicator **trust in science** has been calculated based on Eurobarometer data for the year for which data is available, i.e. 2021[166]. Among the questions asked to citizens, topics such as science's influence in society, its utility for problem-solving and its contribution to the future of younger generations were covered. Horizon Europe (2021-2027) intends to reinforce the interactions between the scientific community and society in terms of R&D by mobilising citizens' direct participation in the production of scientific knowledge[167].

According to available data, trust in science across the EU is relatively low, with less than 50% of citizens having faith in science and considering it a knowledgeable and verifiable source of information. This suggests that a significant proportion of European citizens are sceptical or, at least, unsure about the credibility of scientific knowledge. Belgium, France, Germany, Luxembourg, and Slovakia perform below the EU average in terms of trust in science as less than a 40% of the population express faith in it. Data hence suggests a remarkable lack of confidence in the scientific community within these countries.

In evaluating trust in science across the EU, it is evident that a significant portion of Member States surpass the EU average. 16 out of the 27 Member States exhibit above-average trust, viewing science as a credible and verifiable source of information. In particular, 10 of these countries have achieved a level where over 50% of their citizens express substantial trust in science. These countries include Bulgaria, Cyprus, Estonia, Greece, Hungary, Ireland, Lithuania, Malta, Portugal, and Spain.

Cyprus and Spain are the countries whose population's trust in science is the highest within the EU, surpassing the 60% threshold. The OECD STIP Survey highlights key initiatives that likely contribute to this trust. In Cyprus, the "Citizen Science"[168], "Researchers Night"[169] and "Science at Home"[170] could have fostered scientific curiosity and public engagement. For Spain, the "Programme for the promotion of scientific culture and innovation"[171] and the "Scientific information and news service"[172] could have played significant roles in promoting societal participation and collaboration with the scientific community, enhancing overall public confidence in scientific research and innovation.

For Associated Countries, Serbia and Montenegro display trust in science levels close to the EU average and they differ from this value by less than five percentage points. Türkiye, Norway and Iceland citizens display higher faith in science than the EU average. Türkiye, in particular, registers the highest trust in science levels among Associated Countries, with almost 80% of its population trusting scientifically produced knowledge. This trust level may be attributed to various strategic initiatives aimed at enhancing societal engagement and fostering innovation in research.

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[166] European Commission, Directorate-General for Communication. (2021). Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology (v1.00) [Data set]. Available at: http://data.europa.eu/88u/dataset/S2237_95_2_516_ENG.

[167] European Commission. (2021). Commission proposes a Path to the Digital Decade to deliver the EU's digital transformation by 2030. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4645.

[168] Citizen Science. (2010). Available at: *https://www.avcr.cz/en/public/Citizen-Science/*.

[169] Researchers' Night. (2023). Available at: *https://www.research.org.cy/en/rtdi-culture/ern/*.

[170] Science at Home. (2020). Available at: *https://www.avcr.cz/cs/pro-verejnost/veda-na-doma/index.html*.

[171] Spanish Foundation for Science and Technology. (2007). Programme for the promotion of scientific culture and innovation. Available at: *https://www.convocatoria.fecyt.es/Publico/index.aspx*.

[172] Spanish Foundation for Science and Technology. (2008). Scientific information and news service . Available at: *agenciasinc https://www.agenciasinc.es/*.

Overall, data shows varying levels of trust in science across the European Union and Associated Countries, with the latter displaying higher scores given that none of the Associated Countries underperforms with regard to the EU average. While some EU Member States struggle with lower levels of trust, hence underscoring the value of science, others demonstrate more confidence in scientific knowledge and its impact on society. Understanding these differences is thus essential for the creation of informative policies on the value of scientific knowledge aimed at boosting citizens' engagement with science and to strengthen popular confidence in this sense.

5. ERA Priority 3: Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union

ERA Priority 3 aims at enhancing access to research and innovation excellence across the Union and to strengthen interconnections between innovation ecosystems across the Union. The ERA Policy Agenda 2022-2024[173] defines three voluntary actions towards which EU Member States and Associated Countries can commit to further advance this priority. The core objective relies on the promotion of an inclusive approach in R&I, engaging all relevant stakeholders, particularly those located in R&I systems with lower performance as well as promoting synergies across funding schemes to enhance R&I across the ERA.

As part of this priority three different sub-priorities are developed:

- **Sub-priority 3.1 focuses on investments and reforms in countries and regions with lower R&I performance.** The disparities across countries in the EU is evidenced by the divergent R&I performance as illustrated by the European Innovation Scoreboard[174]. As a result, a core priority relies in the advancement of comprehensive reforms and funding schemes to boost widening countries performance in order to achieve convergence at the EU level, reducing regional disparities.

- **Sub-priority 3.2 focuses on synergies between Union, national and regional funding programmes.** In line with the previous sub-priority, enhancing synergies across the whole EU landscape at the different geographical levels (national, regional, etc.) will enable to further promote excellence across the EU, increasing interconnections and collaboration.

- **Sub-priority 3.3 concentrates on increasing collaborative links and on the excellence-based integration of Research Performing Organisations (RPOs) from countries with lower R&I performance** into European scientific networks and innovation ecosystems, a more balanced "brain circulation" within the ERA, as well as appropriate skills and training for enhancing access to excellence.

Using the most recent data available, the following map illustrates the scores of the EU-27 and Associated Countries with respect to the one indicator covered under this priority. Additionally, throughout the section, we analyse notable trends observed over the years to offer a comprehensive understanding of the evolving R&D landscape. Additionally, the following sub-sections will analyse key results of each sub-priority.

[173] European Commission Directorate-General for Research and Innovation. (2021). European Research Area Policy Agenda, Overview of actions for the period 2022-2024. https://research-and-innovation.ec.europa.eu/system/files/2021-11/ec_rtd_era-policy-agenda-2021.pdf

[174] European Commission. (2022). European Innovation Scoreboard https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

Map 4. Enhancing access to research and innovation excellence

More investments and reforms in countries and regions with lower R&I performance

Increase in total R&D expenditure, expressed as a percentage of GDP (in percentage points)

Sources: Own calculations using Eurostat data. Data is based on 2022 or the most recent available data.

5.1. Sub-priority 3.1: More investments and reforms in countries and regions with lower R&I performance

5.1.1. Overview

Persisting fragmentation and lack of cohesion between countries with divergent R&I performance hinders the growth of Europe's knowledge society and its capacity to address existing and future societal, industrial, and environmental challenges. Therefore, effective mobilisation of EU and national funding for R&I investment, in combination with support and assistance to engage in the necessary R&I reforms, is necessary.

There is a disparity across countries and regions in the EU in the field of R&I. On the basis of this imbalance, there is a strong need to mobilise research, innovation and technological capacities in countries with low participation rates in FP7 and H2020 projects, which are called "widening countries". More and better links with all relevant R&I actors, particularly in widening countries, are needed to boost R&I performance and excellence across the ERA. Therefore, the EU's R&I system needs to promote a more inclusive approach in which all can participate and from which all can benefit.

The promotion of inclusiveness across the ERA, along with promoting investments in widening countries is also enhanced through ERA Action 16. Improve EU-wide access to excellence. Under this field, core initiatives have been developed towards the goals of this sub-priority. At a national level, the Member States and Associated Countries present different policies supporting this idea.

5.1.2. Notable trends

Key findings on more investments and reforms in countries and regions with lower R&I performance

In terms of the **increase in total R&D expenditure**, most widening countries follow a similar trend between 2011 and 2021, experiencing stagnation and generally showing a slight decrease. Although Estonia and Slovenia experienced a decrease in the first years of the analysis, since 2014 and 2018 respectively, they remain stable. On the other hand, Portugal and Cyprus experience a relatively high increase in total R&D spending, potentially explained by the effectiveness of policies such as StartUp+ Portugal or Centro Ciencia LP in the case of Portugal, and Centre for Excellence in Cyprus.

To promote and ensure comprehensive development of R&I across Europe, it is necessary to engage all countries within the EU. Consequently, strengthening countries with lower R&I performance through investments and reforms becomes essential. For measuring progress in relation to this sub-priority, one available indicator is presented in the following table and analysed in further detail in this section.

Table 15. Overview of the indicators related to more investments and reforms in countries and regions with lower R&I performance
Note: Annex A2.4 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
49. Increase in total R&D expenditure, expressed as a percentage of GDP

Change in R&D expenditures

This indicator measures the increase in total R&D expenditure as a percentage of GDP in widening countries, represented in Figure 36 in Annex 2. It captures widening countries financial efforts devoted to R&D in order to assess progress and convergence with non-widening countries. Data shows that, except for 2014, 2016 and 2021, there has been an increase in R&D expenditure in widening countries. Nonetheless, as illustrated under Annex A2.4, the growth rate has diminished from an increase of 0.13 in 2011 to 0.01 in 2021. Future recent data will be crucial to see if the negative tendency continues and, hence, more efforts are needed.

Information at the country level helps to identify national trends. The vast majority of widening countries follow the overall downward trend, with a general trough in 2016. As illustrated in the Annex A2.4, national trends of widening countries show great divergence and fluctuations. Particularly, Estonia and Slovenia show upward and downward trends, highlighting the volatility of the increase in R&D expenditure.

The high values illustrated by Portugal can be potentially explained through the initiatives that the country has carried out in this regard. **Startup+ Portugal**[175] and **Centro Ciencia LP**[176] focus on the emerging challenges that require cooperation and synergies among institutions. Here, the **Scientific Technological Cooperation Agreements between FCT and Fundacao "La Caixa"** [177] is also key for the long-term plan regarding innovation, research and development activities. Cyprus follows a similar trend, and according to the OECD STIP Survey, the results might be encouraged by **CIENS**[178], the Centre for Excellence in Research and Innovation of Cyprus. Many universities of the country are part of this initiative that aims to support transfer of knowledge and empower the Cypriot R&I environment.

[175] `About Startup Portugal´ StartUp Portugal, available at https://startupportugal.com/about/
[176] `Background and mission´ CienciaLP, available at https://www.ciencialp.pt/en/centro-ciencia-lp-english/#background
[177] Iberian Initiatives on research and innovation´ FCT, available at https://former.fct.pt/apoios/cooptrans/fundacaolacaixa/index.phtml.en
[178] CIENS (n.d.) Centre of Excellence. https://www.cyens.org.cy/en-gb/

5.2. Sub-priority 3.2: Synergies between Union, national and regional funding programmes

Key findings on Synergies between Union, national and regional funding programmes

While there is no available quantitative data relevant to ERA Sub-priority 3.2, there are noteworthy initiatives introduced by both Member States and Associated Countries that will help to advance the sub-priority's goal to create better synergies.

The German *Pakt für Forschung und Innovation* (Pact for Research and Innovation) works as a joint exercise to increase R&D funding. Similarly, the Research and Science Funds of the Netherlands is a crucial initiative to boost R&I funding. Internationalisation is also enhanced through the Academy of Finland and Centro Ciencia LP in Portugal. Lastly, it is important to look at the specific programmes on synergies such as Latvia´s Guidelines for Science, Technology development, and Innovation. These guidelines are key for managing the activities in the R&I environment in accordance with the European standards and create synergies across EU and national funds.

Moreover, Associated Countries have also shown commitment towards this sub-priority through initiatives such as ISERD, an Israeli directorate for the communication with Europe and the European Framework programme.

The world is facing systemic challenges such as climate change or the digital transformation. In this sense, it is important to find harmony within the international community to address and overcome them, as synergies among them would increase effectiveness and are likely to strengthen the system both at EU and national levels. As highlighted in the Council Recommendation on a Pact for Research and Innovation[179] in Europe, synergies across funding programmes at the EU, national and regional level must be conducted by the principles defined by the Recommendation itself. It is essential that those synergies are enhanced, promoted and implemented in accordance with the basic guidelines internationally established through the cohesion policy and the Resilience and Recovery Facility among others.

Sub-priority 3.2 focuses on synergies between EU, national and regional funding programmes and cannot be measured at this stage through available indicators. Nonetheless, key initiatives at the EU level but, overall, at national level provide key insights on the development and progress towards this action.

At the EU level, the main initiative in this regard is Horizon Europe[180], which is considered an essential funding instrument for research and innovation. In addition, there are also cooperation-oriented common actions such as the Conference on Synergies in the Research and Innovation Funding in Europe[181] (Prague in 2022) that approached the promotion and management of synergies R&I, evidencing the necessity of capitalising on the full capacity of investments and promoting the right policies in the area.

[179] European Commission, Directorate-General for Research and Innovation. (2021). Proposal for a COUNCIL RECOMMENDATION on a Pact for Research and Innovation in Europe. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2021:407:FIN#:~:text=The%20Pact%20for%20Research%20and%20Innovation%20in%20Europe,the%20vision%20and%20objectives%20of%20the%20new%20ERA.

[180] European Commission. (n.d.). Horizon Europe. Available at: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en

[181] European Regions Research and Innovation Network (ERRIN). Available at: https://errin.eu/events/czech-presidency-conference-synergies-research-and-innovation-funding-europe

The ERA Dashboard report is focused on analysing the performance at a country level. Having invested more than EUR 500 million, Germany developed the *Pakt für Forschung und Innovation*[182] (Pact for Research and Innovation) as a joint exercise to increase R&D funding of the main Programme Related Investments (PRIs) and the German Research Foundation. The Pact works around five main policy goals; (a) Promote dynamic development, (b) Strengthening transfer in business and society, (c) Deepen networking, (d) Attract and retain the best minds, and (e) Strengthening infrastructures for research[183].

The Netherlands has also worked towards an increase in funds with the establishment of the Research and Science Funds[184], through which the government will invest EUR 5 billion in HEIs. This plan aims to improve student support and labour market connections, while promoting talent and research.

The Academy of Finland[185] dedicated to promoting internationalisation of Finnish knowledge, promoted a joint initiative with the Finnish Ministry for Foreign Affairs known as DEVELOP2[186]. It is aligned to the UN Agenda 2030, and finances research related to current challenges and global development issues, especially in developing areas.

Centro Ciencia LP[187] is a policy developed through an agreement between UNESCO and the government of Portugal as an instrument to boost cooperation among the Portuguese-speaking countries while appealing for the Strategic Plan by UNESCO for Multilateral Cooperation in Science, Technology and Higher Education. In this sense, this joint project entails different ERA actions by focusing on strengthening abilities, knowledge sharing and the development of a regional, national, and international network.

The Associated Countries have also become involved in this sub-priority, as the bilateral agreements on co-operation in science and technology that Norway has carried out in the last years, to consolidate international relations and to open targeted programmes relevant for the economy, society and research institutions of Norway[188]. Israel has ISERD[189], a directorate for the communication with Europe and the European Framework programme for the development of scientific collaboration and innovation activity.

As previously mentioned, developing synergies in accordance with the international guidelines is key for the sub-priority's effectiveness. For this reason, most countries count on a specific initiative setting a basis within the area at the national level. Latvia's Guidelines for Science, Technology Development, and Innovation for the period 2021 – 2027[190] determine the activities and management of areas related to digitalisation and innovation. It is developed also to allocate the resources obtained from the state, EU funds, and other financial supporters with the aim of achieving the country's objectives at the national level.

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[182]Pakt für Forschung und Innovation. (2023). Available at: https://www.bmbf.de/bmbf/de/forschung/das-wissenschaftssystem/pakt-fuer-forschung-und-innovation/pakt-fuer-forschung-und-innovation_node.html
[183] Ibid
[184] Government of the Netherlands. (2022). Available at: https://www.government.nl/latest/news/2022/04/14/government-earmarks-%E2%82%AC5-billion-for-sustainable-economic-growth-and-future-prosperity
[185]Research Council of Finland. (n.d). Available at: https://www.aka.fi/en/research-funding/programmes-and-other-funding-schemes/academy-programmes/development-research--develop-2-20232026/
[186] Ibid
[187] Centro Ciência LP. (n.d). Available at: https://www.ciencialp.pt/en/centro-ciencia-lp-english/#background
[188]Government of Norway. (2022). Available at: https://www.regjeringen.no/en/topics/education/innsikt/internasjonalt-kunnskapssamarbeid/forskningssamarbeid/bilateralt-forskningssamarbeid/id2414374/
[189] Israel-Europe Research & Innovation Directorate. (n.d.). Available at: https://www.innovationisrael.org.il/ISERD/contentpage/about-us
[190] Republic of Latvia. (2021). Regarding Guidelines for Science, Technology Development, and Innovation. Available at: https://likumi.lv/ta/en/en/id/322468

Croatia has also developed the National Guidelines for Knowledge and Technology Transfer[191] to comment and provide recommendations to technology transfer offices (TTOs) and investigation managers. It mainly covers technological and transfer programmes involved in the innovation system of the country.

5.3. Sub-priority 3.3: Increased collaborative links and the excellence-based integration of research-performing organisations from countries and outermost regions with lower R&I performance into European scientific networks and innovation ecosystems, more balanced "brain calculation" within the ERA, appropriate skills and training for enhancing access to excellence

Key findings on increased collaborative links and the excellence-based integration of research-performing organisations

Currently, there are no quantitative indicators measuring progress on enhancing collaboration, integration, and skills in countries with lower capabilities within European scientific networks and innovation ecosystems. Nonetheless, there are certain national policies that help shed light on the commitment of Member States and Associated Countries towards this sub-priority.

The National Academic Infrastructure for Supercomputing in Sweden (NAISS) and the Estonian Research Infrastructure Roadmap, are important initiatives promoting collaboration within European R&I. Among the widening countries, Poland has a programme related to the European Funds for the Modern Economy Action Feng.01.01 Smart Path, with the aim of financing projects surrounding innovation and internationalisation. In addition, there are also initiatives focused on infrastructures, as the Czech Roadmap and the support to utilise international research Hungarian infrastructures towards international collaboration.

Similarly, Associated Countries have developed relevant notable programmes such as the Marmara Research Centre which works with institutions like NATO or COST, becoming a key R&D institution in Türkiye to promote cooperation.

The European Union connects countries to develop a common network for strengthening scientific, innovative, and research instruments. Considered one of the main concerns of the European Research Area, common knowledge can enhance the national policies and R&D system and therefore, it is important to improve collaboration with different national organisations. Specifically, cooperation with countries with lower R&I performance is highlighted in the scope of increasing productivity and excellence.

There are no indicators for this sub-priority. Nevertheless, there are crucial initiatives at the EU level but especially across EU Member States and Associated Countries that promote this priority and are worth-mentioning as successful examples.

[191] OECP STIP Survey. (2023). National Guidelines for knowledge and technlogy transfer. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99996926

In terms of communication and cooperation within the European countries, Multilateral Dialogue on Values and Principles for International Cooperation in Research and Innovation[192] and Eureka[193] become crucial at the EU level.

At a national level, the Member States have developed their own policies in order to support such collaboration principles. The National Academic Infrastructure for Supercomputing in Sweden (NAISS) [194] is a new organisation for data sources, storage, and high-level technology in the country. Although it acts independently, it is connected to the Linköping University and funded by the Swedish Research Council and aims to improve and spread the Swedish digital transformation.

The Estonian Research Infrastructure Roadmap[195] works as a strategic programme for research infrastructures and investigation. It works as an intake for future decisions and manages the arrangement of strategies on research infrastructures.

Focusing on widening countries, the Czech Roadmap of Large Research Infrastructure[196] is a strategy that has been updated three times since it was published in 2010. The last version has shaped the large research infrastructures agenda, both in terms of funding and management. It also appeals to the internationalisation of the infrastructures assessment in order to enhance the role of the Czech Republic in R&D international fields.

In Hungary, initiatives such as the *Support to utilise international research infrastructures* work towards international collaboration particularly aim at encouraging Hungarian researchers to use the resources proposed by the international research infrastructures (RIs)[197].

Poland has developed relevant initiatives within this context such as the *European Funds for the Modern Economy Action Feng.01.01 Smart Path*[198]. The programme is planned for 2021-2027 and provides support to projects related to innovation, research infrastructures, sustainable enterprises, and internationalisation, and following not only ERA Priority 3 but also promoting actions from Priorities 1 and 2.

Associated Countries are also involved in the collaborative network and have national programmes themselves in this regard. An example is the Marmara Research Centre and the International Programmes[199] which work with institutions like NATO or COST. It is one of the main R&D leaders in Türkiye and aims to operate at a worldwide level, therefore constituting an important cooperation instrument.

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[192] Multilateral dialogue on values and principles (n.d.) European Commission. https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/europe-world/international-cooperation/multilateral-dialogue-values-and-principles_en

[193] Eureka (n. d.) Eureka Network. https://www.eurekanetwork.org/why-eureka/

[194] National Academic Infrastructure for Supercomputing in Sweden (NAISS) (n.d.) NAISS. https://www.naiss.se/#:~:text=The%20National%20Academic%20Infrastructure%20for%20Supercomputing%20in%20Sweden,acts%20independently%20with%20a%20national%20perspective%20and%20responsibility.

[195] Estonian Research Infrastructure Roadmap 2019 (2019). Estonian Research Council. https://etag.ee/wp-content/uploads/2019/06/ETAg_Research_Infrastructure_Roadmap_2019.pdf

[196] Roadmap of Large Research Infrastructures of the Czech Republic (2023). Ministry of Education, Youth and Sports of the Czech Republic. https://www.vyzkumne-infrastruktury.cz/en/roadmap-of-large-research-infrastructures-of-the-czech-republic/

[197] Support to utilise international research infrastructures (2019). National Research, Development and Innovation Offce of Hungary. https://nkfih.gov.hu/english/nrdi-fund/support-to-utilise-international-research-infrastructures-2019-126-nemz-ki/call-for-project-proposals-2019-216-nemz-ki

[198] European Funds for the Modern Economy Action Feng.01.01. Smart Path (2021). STIP OECD. https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99997185

[199] Marmara Research Center (n.d.). MAM Tubitak. https://mam.tubitak.gov.tr/en/kurumsal/who-we-are-0

6. ERA Priority 4: Advancing concerted research and innovation investments and reforms

ERA Priority 4 pursues the advancement of concerted research and innovation investments and reforms and defines voluntary actions towards which EU Member States and Associated Countries can commit to improve their compromises with said priority. Under ERA Priority 4, the objective is to enhance the capability and effectiveness of R&I across Member States and Associated Countries in both the national and the EU regional policy areas. With the goal of seizing shared opportunities, this priority emphasises the importance of coordination and synergy in R&I programmes among Member States and Associated Countries.

In order to analyse the advancement of concrete R&I investments and reforms, two sub-priorities which break down the overall priority 4 objective are identified:

- First, **sub-priority 4.1 focuses on the coordination of research and innovation investments**. One of the key objectives of the EU during the past decades has been to raise investment levels on R&D in order to increase the EU market potential and stimulate its competitiveness. The EU recognises the importance of having a leading role in promoting R&I programmes, and hence, it aims at encouraging partnerships with the private sector, through plans such as the Global Approach to Research and Innovation. For the digital shift, the private sector is crucial for an effective progress of R&D in the EU as it will be linked to tactical EU actions with the objective of increasing the number of key strategic fields[200].

- **Sub-priority 4.2 seeks support to prioritise and secure long-term R&I investments and policy reforms**. Through the Pact for Research and Innovation in Europe, the EU will prioritise investments in R&D by allocating national and regional resources and giving priority to public spending while acknowledging the importance of the private sector. Such valorisation efforts to secure long-term investment impacts on society are directly linked to this priority. Investments and policy reforms are needed to ensure that R&I products are transformed into sustainable outputs[201]. For this, the government expenditure on transnational and bilateral R&I programmes provides an overview on how much the public-private partnership potential for R&I investments is being exploited.

Using the most recent data available, the following map illustrates the scores of the EU-27 and Associated Countries with respect to the two indicators covered under this priority. In the following sub-sections, we will highlight key results of this priority area with respect to its underlying sub-priorities. To do so, an overview of each sub-priority goal will be presented accounting for the policy initiatives that have been done at the national level. To assess the effectiveness of said measures and their implementation, notable trends are analysed and compared with the EU trend across time by using ERA Dashboard indicators.

[200] R&D expenditure (2023). Eurostat. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_expenditure&oldid=551418
[201] EU valorisation policy: making research results work for society (n. d.). European Commission. https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/eu-valorisation-policy_en

Map 5. Advancing concerted research and innovation investments and reforms

Reset the map

Coordination of R&I investments

Share of public R&D expenditures financed by the private sector

Support to prioritise and secure long-term R&I investments and policy reforms

Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher

Source: Eurostat. Data is based on 2022 or the most recent available data.

6.1. Sub-priority 4.1: Coordination of research and innovation investments

6.1.1. Overview

An important consideration in determining the governmental support of R&D is the extent to which the private sector finances public R&D investment. Some benefits of public investment are their large impact on society not restricting it to clients of a specific sector. This source of leverage between public and private funding is the objective of sub-priority 4.1[202].

An OECD study on the impact of public investment in private companies found that active government endorsement of research and development conducted by the private sector enhances business-financed innovation. The returns generated by said investments have an impact on how much the private sector contributes to public R&D funding[203]. Since there is a need to monitor such figures, one should pursue the objective of ERA Action 19, which establishes the need to create an efficient and effective ERA monitoring mechanism.

According to the Council Recommendation on a Pact for Research and Innovation in Europe[204], the interventions in this area should focus on: (1) Fostering the interoperability of systems and implementing the lessons learned and good practices from joint programmes developed in European research infrastructures, and by supporting the coordinated funding of these programmes with a lookout to strengthen the ERA Agenda. Thus, EU Member States work closely together to maximise ERA impacts for the benefit of European R&D systems; (2) Coordinating R&I investments by assisting in the selection and implementation of integrated policy reforms that intend to boost the ERA Agenda at all EU governance levels while maximising their positive impact on science innovation systems and (3) Nurturing the interoperability of R&D systems following best practices of other EU joint programmes and EU research infrastructures.

With a budget of a EUR 95.5 billion, Horizon Europe is the primary financing programme for R&D in the EU. With respect to private sector partnerships, it includes a novel and ambitious partnership strategy which intends to have support from the private sector. In addition, the EU willingness to evaluate the impact of private sector funding has been evidenced by the EU R&D Scoreboard[205], an initiative which intends to identify the key players in several industries and the trend of private sector investment.

At the national level, an example of coordination includes the monitoring and evaluation system for the Spanish Strategy of Science, Technology and Innovation (EECTI 2021-2027), developed by the Spanish Government in order to perform an annual analysis based on a

[202] The relationship between public and private R&D funding (2020). Oxford Economics. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/897470/relationship-between-public-private-r-and-d-funding.pdf

[203] The Impact of Public R&D Expenditure on Business R&D (2000). OECD, https://www.oecd-ilibrary.org/docserver/670385851815.pdf?expires=1689154509&id=id&accname=guest&checksum=1F31CC98E0A9DA8A0ABF5829D3758B74

[204] Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. (2021). Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

[205] The 2022 EU Industrial R&D Investment Scoreboard (2022). European Commission. https://iri.jrc.ec.europa.eu/scoreboard/2022-eu-industrial-rd-investment-scoreboard

midterm and a final evaluation[206]. In addition, the country has developed an indicator platform called FECYT[207] reuniting Spanish scientific data both in production and cultural aspects.

Belgium has in place a country-level database that compiles figures and statistics on a variety of areas, policies and programmes. This source, STATBEL[208], is an official platform of the government using information obtained from surveys and partners at an international level.

6.1.2. Notable trends

Key findings on Coordination of research and innovation investments

Generally, the **share of public R&D expenditures financed by the private sector** in the EU remained quite stable between 2010 and 2020. Initially, Romania, Lithuania and Germany presented the highest values, however, their performance has changed over time. Romania and Lithuania exhibit variability over the period, while Germany remained stable over the last decade.

In the case of the Associated Countries, Türkiye is the only country that has witnessed an increase in the private sector financing of public R&D expenditures. Serbia and Norway, on the other hand, have shown a negative trend.

The private sector plays an important role in the advancement of R&D priorities across the EU, therefore measuring public-private cooperation in research is of high importance. Businesses' willingness to co-fund governmental R&D initiatives could be a proxy for companies' collaboration with high education public institutions. Accordingly, the private sector contributes to public spending on R&D thus not only providing its expertise but also financial resources. To assess the extent of these private contributions, an indicator on this topic is analysed:

Table 16. Overview of the indicators related to support to prioritise and secure long-term research and innovation investments

Note: Annex A2.5 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
55. Share of public R&D expenditures financed by the private sector

R&D investment by the private sector

The indicator **share of public R&D expenditures financed by the private sector** shows a constant trend for the period 2012-2020 with minimal variations in the EU average values for this indicator, which decrease slightly from 8% to 7% across this period (Figure 37 in Annex 2). The highest average expenditure of EU Member States was reached in 2010, with 8.54%. Since then, there have been small changes, registering the lowest values in 2013, and in the period from 2018 to 2020, when the share of public R&D expenditures financed by the private

[206] Monitoring and evaluation of the EECTI 2021-2027 (n.d.). Ministerio de Ciencie e Innovacion. https://www.ciencia.gob.es/en/Estrategias-y-Planes/Estrategias/Seguimiento-y-evaluacion-de-la-EECTI-2021-2027.html
[207] Plataforma de indicadores (n.d.). FECYT. https://indicadores.fecyt.es/#/
[208] National Statistical Institutes (n.d.) StatBel. https://statbel.fgov.be/en/about-statbel/our-partners/statistics-portal/national-statistical-institutes

sector did not surpass the 8% threshold. The average share for Associated Countries is caused by big differences between the countries, showing a relatively low value in 2020.

Among EU Member States, Romania, Germany, Latvia, Lithuania, and, sporadically, Malta, are the countries with the highest share of public R&D expenditures financed by the private sector across the EU. Among them, Romania presents the highest average for the period 2012-2020 with an average share of R&D expenditures financed by the private sector of 12.71%, a value that is more than one percentage point apart from the second country that exceeds the EU average, Germany. The performance of Romania might be enhanced by the implementation of a Consultative Board for Research, Development and Innovation (CCCDI)[209] that, as indicated in the OECD STIP Survey, aims to coordinate the establishment and development of national initiatives related to these areas. As a general overview, the difference for this indicator between the average value of the best performing countries and the EU average is around four percentage points over the entire time series.

Considering Associated Countries, Israel illustrates the highest share in terms of public R&D expenditures financed by the private sector for the analysed period. Despite no big changes from 2010 to 2013, the country overall registered high results for the whole period, reaching a peak in 2016 which was followed by a negative trend until 2020.The Israeli figure of 7.6% in 2020 remains noticeably higher than the average for Associated Countries. Türkiye is the only country that experiences a positive trend; however, the value remains close to 2%.

6.2. Sub-priority 4.2: Support to prioritise and secure long-term research and innovation investments and policy reforms

6.2.1. Overview

The EU's objectives for investment in research, development and innovation seek to have a long-term impact that allows for innovation efficiency and feedback over the years. As defined in the Council Recommendation on a Pact for Research and Innovation in Europe[210] this sub-priority should focus on:

- Maximising synergies and impacts of R&D initiatives at all governance levels (EU, national and regional) by promoting cross-sectoral collaboration, coordination and engagement with regulatory sandboxes and experimentation provisions.

At the European level InvestEU[211]is a key initiative as it is a “programme to encourage investment”. At the national level, there are specific initiatives to secure R&D investments and analyse its performance. The Irish Research and Innovation Strategy, known as *Impact 2023*, is related to programmes such as Horizon Europe, ERA, the Creating Our Future campaign, and the Smart Specialisation Strategy. Through its involvement in the mentioned policies, it maximises the impact and development of research and innovation activities[212].

[209] Government of Romania (2021) Consultative Board for Research, Development and Innovation https://www.old.research.gov.ro/ro/articol/4600/sistemul-de-cercetare-colegiul-consultativ-pentru-cercetare-dezvoltare-si-inovare-cccdi#

[210] Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. (2021). Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

[211] InvestEU: EU programme to encourage investment (2021). European Parliament. https://www.europarl.europa.eu/news/en/headlines/eu-affairs/20210225STO98708/investeu-eu-programme-to-encourage-investment

[212] Impact 2030: Ireland´s Research and Innovation Strategy (2020). Government of Ireland. https://www.gov.ie/ga/foilsiuchan/27c78-impact-2030-irelands-new-research-and-innovation-strategy/

Poland presents the Implementation of National Foresight Programme Results and the final outcomes related to the identification of the main technological scope for future investment and the digital systems to monitor future projects[213]. Both programmes defend the importance of the current actions to settle effective future initiatives that make them attractive for investors.

6.2.2. Notable trends

Key findings on Support to prioritise and secure long-term research and innovation investments and policy reforms

Securing long-term research and innovation investment is measured through the **Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher**. The period analysed is from 2010 to 2020, which shows a general decline in the EU-27 trend. The highest values among the Member States are presented by Belgium and Italy, while Bulgaria and Hungary presented the lowest values in 2020.

Both Italy and Belgium have developed key initiatives at the national level. In the case of Belgium, the Four-year Strategic Work Plan for National Recovery and Investment plays a key role in protecting the R&I environment, while in Italy one of the main plans in this area is Funding for Private R&D on clean energy to promote innovation towards the green transition.

Associated Countries generally exhibit a modest upward trend over the analysed years. Notably, Norway remains above the EU-27 average, despite presenting a slight decrease during the period. Similarly, Serbia has shown a consistent upward trajectory, albeit maintaining a position below EU values.

National governments and other sources of public investment are considered some of the main players in the development of research and innovation programs, directly attached to the ERA priorities. Projects at the European level and in other global spheres in the long-term, are therefore dependent on public resources that guarantee the finalisation of these initiatives. Hence, the share of government budget allocated for R&D is an important factor on the production of those public programmes at an international level. For this reason, the following indicator has been considered for analysing this priority:

Table 17. Overview of the indicators related to coordination of research and innovation investments

Note: Annex A2.5 includes graphs illustrating the trends for all Member States and Associated Countries

Indicator
56. Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher

[213] Implementation of National Foresight Programme Results (2015). STIP OECD. https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F5376

R&I Investments (transnational cooperation)

The data for government budget allocations for R&D (GBARD) allocated to European transnational, bilateral or multilateral, public R&D programmes per FTE researcher is available between 2010 and 2020, represented in Figure 38: Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher in Annex 2. The EU has experienced an overall negative trend with a decline of EUR 147.7 million.

At the national level, countries have experienced considerable fluctuations, with many countries above the EU average, with Italy and Belgium displaying a larger budget allocated per FTE researcher. However, while Italy has experienced an increase over the 2010-2020 period, Belgium has decreased its budget allocations. In Belgium, the four-year Strategic Work Plan for National Recovery and Investment plays a key role on protecting the R&I environment. For the case of Italy, *Funding for Private R&D on clean energy* becomes an important element towards the promotion of R&I investments and reforms. Luxembourg follows Italy (EUR 3,567.69 million), in 2020, with a significant increase since 2010 (EUR 2902.20 million). Other countries which are consistently above the EU average include Sweden, Cyprus and Austria.

Bulgaria (EUR 139.43 million), Hungary (EUR 153.00 million) and Portugal (EUR 283.23 million) can still be considered lower performing Member States, although Bulgaria and Hungary show a positive evolution since 2010 of EUR +82.55 million and EUR +104.48 million, respectively. Still, according to the OECD STIP Survey, these countries have already established initiatives to work towards this sub-priority as the Council for Smart Growth[214] in Bulgaria or the National Open Science Advisory Board[215] in Hungary. Similarly, the monitoring mechanisms of the Portuguese National Innovation Agency (ANI)[216] encourage the country's commitment in this regard.

When considering the Associated Countries, information is only available for Norway and Serbia. Norway performed above the EU-27 average in 2020, with a government allocation of EUR 2075.13 million for R&D. Still, the country presents a slightly negative trend during the broader period. Serbia, despite the positive trend over the period 2010-2020, is consistently performing below the EU average.

[214] World Bank (2013). Input for Bulgaria's Research and Innovation Strategies for Smart Specialization https://www.mi.government.bg/files/useruploads/files/innovations/input3s.pdf
[215] EOSC (2023). Perspective from Hungary Science Policy and Funding. https://eosc.eu/wp-content/uploads/2023/01/NTE-Hungary-Istvan-Szabo_.pdf
[216] ANI (n.d.) Monitoring and evaluation. https://www.ani.pt/en/monitoring-and-evaluation/

CONCLUSIONS

The ERA Dashboard comprises a set of indicators and qualitative information used for monitoring progress of the EU Member States and eight Associated Countries (Armenia, Georgia, Iceland, Israel, Montenegro, Norway, Serbia, and Türkiye) towards the ERA objectives. This monitoring focuses on four ERA priority areas: (1) deepening a truly functional internal market for knowledge, (2) taking up together the green transition and digital transformation, (3) enhancing access to research and innovation excellence, and (4) advancing concerted research and innovation investment and reforms.

In terms of the **first ERA priority** of deepening a truly functional internal market for knowledge, several countries excel in their overall performance. Sweden, Finland, Denmark, Belgium, Germany, and Luxembourg consistently demonstrate strong achievements across various aspects of this priority. Similarly, Norway and Iceland among the Associated Countries exhibit commendable performance. In addition, there are countries that fare especially well on some sub-priorities such as 'gender equality, equal opportunities for all and inclusiveness'. Nevertheless, equality and inclusion need to be further improved.

Under **ERA priority 2**, Germany, France and Belgium are performing particularly well among EU Member States, while Norway and Türkiye stand out among Associated Countries. However, there are variations in performance among both country groups. For instance, when considering national public and private investments. Further, there is a stagnation at the EU level regarding patents on environment technologies, indicating a big room for improvement there.

For the **ERA priority 3**, most of widening countries experience stagnation or even a slight decrease in total R&D expenditure in the period 2011 to 2021, with the exception of Portugal and Cyprus, for which the value increased. Both the Member States and the Associated Countries have initiatives supporting synergies between Union, national and regional funding programmes, as well as collaborative links between R&I systems.

Regarding **ERA priority 4**, when we look at the proportion of public R&D expenditures funded by the private sector, most countries have shown minimal change over the past decade. Among the Associated Countries, only Türkiye has witnessed an increase in this regard. Concerning GBARD allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher, the highest values among the Member States are reported by Belgium and Italy, with the Associated Countries demonstrating a slight increase in the analysed period of 2010 to 2020. Mixed results indicate a potential for progress in this priority.

In general, there is a varying performance across objectives, and specific examples indicated in the report highlight how countries can make advancements in areas that need improvement. As we navigate this path, it becomes evident that joint efforts at the European and national levels are necessary to address disparities and ensure continuous progress throughout the ERA.

BIBLIOGRAPHY

Academia Europaea Tbilisi Knowledge Hub. (n.d.). Available at: *https://www.aetbilisihub.org/*.

Agency for Science, Innovation and Technology. (2019). Protection of industrial property rights (InnoPatent). Available at: *https://mita.lrv.lt/en/national-r-d-programmes/innopatent*.

Athens Science Festival. (n.d.). Available at: *https://www.athens-science-festival.gr/*.

Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, available at: https://www.bmk.gv.at/themen/innovation/schwerpunkte.html

Austrian Federal Promotion Bank. AplusB Scale-up, available at: https://www.aws.at/aws-aplusb-scale-up/

Austrian Research Promotion Agency (FFG). (n.d.). COMET – Competence Centers for Excellent Technologies. Available at: *https://www.ffg.at/en/comet/programme*.

Austrian Research Promotion Agency (FFG). (n.d.). Available at: https://www.ffg.at/#term-2

Austrian Research Promotion Agency (FFG). (n.d.). Available at: https://www.ffg.at/#term-4

Bürger schaffen Wissen. (2023). Bürger schaffen Wissen. Available at: *https://www.buergerschaffenwissen.de/en*.

Business Finland. (2018). Co-Innovation. Available at: *https://www.businessfinland.fi/en/for-finnish-customers/services/funding/cooperation-between-companies-and-research-organizations/co-innovation*.

Centro Ciência LP. (n.d). Available at: https://www.ciencialp.pt/en/centro-ciencia-lp-english/#background

Charles University. (2021). *Message from the Heart of Europe (Prague Declaration II).* Available at: https://www.coimbra-group.eu/wp-content/uploads/Prague-Declaration_2021_final_for-printing-.pdf

Civic Innovation Platform. (2023). Civic Innovation Platform. Available at: *https://www.civic-innovation.de/en/home*.

Computer Centre of the University of Belgrade. (n.d.). Policy for Transparent Access to Research Infrastructures at the Computer Centre of the University of Belgrade: TRAP-RCUB IT solution and organisational model for the implementation of institutional or thematic repositories. Available at: *https://repowiki.rcub.bg.ac.rs/index.php/Policy_for_Transparent_Access_to_Research_Infrastructures_at_the_Computer_Centre_of_the_University_of_Belgrade:_TRAP-RCUB_IT_solution_and_organizational_model_for_the_implementation_of_institutional_or_thematic_repositories.*

Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe. (2021). Official Journal of the European Union. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

Council Recommendation (EU) 2021/2122 of 26 November 2021 on a Pact for Research and Innovation in Europe (OJ L 431 02.12.2021, p. 1, ELI: *http://data.europa.eu/eli/reco/2021/2122/oj*).

Czech Ministry of Education, Youth and Spors. (2017). The Higher Education Act (Act No. 111/1998 Coll). https://www.msmt.cz/areas-of-work/tertiary-education/the-higher-education-act

Danish Agency for Science and Higher Education. (2018). *Denmark's National Strategy for Open Access*. Denmark. https://ufm.dk/en/

DataverseNO. (n.d.). Available at: https://dataverse.no/.

Department of Enterprise, Trade and Employment (2015). Innovation 2020. Available at: https://www.djei.ie/en/Publications/Innovation-2020.html

Department of Further and Higher Education, Research, Innovation and Science. (2021). National Research And Innovation Strategy 2021 to 2027: Consultation Paper. Available at: *https://www.gov.ie/en/publication/a526a-national-research-and-innovation-strategy-2021-to-2027-consultation-paper/*.

Department of Further and Higher Education, Research, Innovation and Science. (2022). National Challenge Fund. Available at: *https://www.gov.ie/en/press-release/c41f6-65-million-fund-for-green-transition-and-digital-transformation-announced-by-minister-harris/*.

Digital Transformation Office of the Presidency of Türkiye. (2022). Türkiye Digital Innovation and Collaboration Platform. Available at: *https://cbddo.gov.tr/projeler/diib/*.

Direction Générale des Entreprises. (2023). Stratégie nationale pour le développement de l'hydrogène décarboné en France. Available at: https://www.entreprises.gouv.fr/

Eco Fund. (2023). *Slovenian Environmental Public Fund (Eco Fund).* Available at: https://www.ekosklad.si/

EC-OECD (2023), *STIP Compass: International Database on Science, Technology and Innovation Policy (STIP)*, edition November 7, 2023, https://stip.oecd.org

EC-OECD. (2023) *STIP COMPASS*: *Policy initiatives France - Investment on Clean Aircraft Technologies.* Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99994872

EIFL. (2022). The Latvian Open Science Strategy. Available at: https://www.eifl.net/news/latvian-open-science-strategy.

EIGE. Gender Equality in Academia and Research - GEAR tool, available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/italy

EIGE. Gender Equality in Academia and Research - GEAR tool, available at: https://eige.europa.eu/gender-mainstreaming/toolkits/gear/legislative-policy-backgrounds/poland?language_content_entity=en

ESFRI. (2023). *European Strategy Forum on Research Infrastructures.* Available at: https://www.esfri.eu/

Estonian Research Council. (2015). RITA – Support for sectoral R&D. Available at: *https://www.etag.ee/wp-content/uploads/2022/03/Lopparuanne_RITA-mojuanaluus-1.pdf*.

Estonian Research Infrastructure Roadmap 2019 (2019). Estonian Research Council. https://etag.ee/wp-content/uploads/2019/06/ETAg_Research_Infrastructure_Roadmap_2019.pdf

Eureka (n. d.) Eureka Network. https://www.eurekanetwork.org/why-eureka/

EU valorisation policy: making research results work for society (n. d.). European Commission. https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/eu-valorisation-policy_en

European Regions Research and Innovation Network (ERRIN). Available at: https://errin.eu/events/czech-presidency-conference-synergies-research-and-innovation-funding-europe

EU-Citizen.Science. (n.d.). EU-Citizen.Science: An online platform for sharing knowledge, tools, training and resources for citizen science. Available at: *https://eu-citizen.science/*.

Euraxess (2017), Flexibility of the Future – A pension that travels with your researchers, wherever they go… - RESAVER, Giving you the facts, p.2, available at: https://www.euraxess.lt/sites/default/files/policy_library/resaver_pension_factsheet-2017q1.pdf

EURAXESS. Researchers in motion, available at: https://euraxess.ec.europa.eu/content/home

EUREKA. (2023). *Eureka: About us.* Available at: https://www.eurekanetwork.org/

European Commission (2021), the EU Research and Innovation Programme 2021-2027, available at: https://research-and-innovation.ec.europa.eu/system/files/2022-06/ec_rtd_he-investing-to-shape-our-future_0.pdf

European Commission, Directorate-General for Research and Innovation. (2021). Proposal for a COUNCIL RECOMMENDATION on a Pact for Research and Innovation in Europe. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2021:407:FIN#:~:text=The%20Pact%20for%20Research%20and%20Innovation%20in%20Europe,the%20vision%20and%20objectives%20of%20the%20new%20ERA.

European Commission (2022). Communication from the Commission on European Strategy for universities, available at: https://education.ec.europa.eu/sites/default/files/2022-01/communication-european-strategy-for-universities-graphic-version.pdf

European Commission (2023) Mutual Learning Exercise: Industrial decarbonisation First thematic Report, available at: https://op.europa.eu/en/publication-detail/-/publication/bb0f39f2-3b25-11ee-bd8d-01aa75ed71a1/language-en/format-PDF/source-290903511

European Commission, Directorate-General for Communication. (2021). Special Eurobarometer 516: European citizens' knowledge and attitudes towards science and technology (v1.00) [Data set]. Available at: *http://data.europa.eu/88u/dataset/S2237_95_2_516_ENG*.

European Commission, Directorate-General for Research and Innovation, (2022). *A pact for research and innovation in Europe*, Publications Office of the European Union. https://data.europa.eu/doi/10.2777/56361

European Commission, Research and Innovation. (n.d.). Repository of Best Practices. Available at: *https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository*.

European Commission. (2020). *Integrated National Energy and Climate Plan of The Republic of Slovenia.* Available at: https://energy.ec.europa.eu/system/files/2020-06/si_final_necp_main_en_0.pdf

European Commission. (2021). Commission proposes a Path to the Digital Decade to deliver the EU's digital transformation by 2030. Available at: *https://ec.europa.eu/commission/presscorner/detail/en/IP_21_4645*.

European Commission. (2021). *MORE4.* doi: 10.2777/645537. Available at: https://www.more-4.eu/

European Commission. (2023). *Pact for research & innovation in Europe.* Available at: https://ec.europa.eu/

European Commission. ERA industrial technologies roadmaps. Available at: https://research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/era-industrial-technologies-roadmaps_en

European Commission. Leveraging Deep Tech for Green Transition and Digital Solutions to Transform EU Industrial Ecosystem. Available at: https://research-and-innovation.ec.europa.eu/events/upcoming-events/leveraging-deep-tech-green-transition-and-digital-solutions-transform-eu-industrial-ecosystems-2023-03-27_en

European Commission. (n.d.). Horizon Europe. https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en

European Commission. Marie Skłodowska-Curie Actions, available at: https://marie-sklodowska-curie-actions.ec.europa.eu/

European Funds for the Modern Economy Action Feng.01.01. Smart Path (2021). STIP OECD. https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99997185

European Institute of Innovation & Technology. (2020). *Slovenia adopts EIT Climate-KIC circular economy proposal.* Available at: https://eit.europa.eu/

European Parliament. (2023). *The impact of the COVID-19 pandemic on the EU's external.* Available at: https://www.europarl.europa.eu/RegData/etudes/STUD/2023/740231/EPRS_STU(2023)740231_EN.pdf

European Research Executive Agency. ERA Chairs, available at: https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/era-chairs_en

European Research Executive Agency. ERA Fellowships, available at: https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/era-fellowships_en

European Research Executive Agency. ERA Talents, available at: https://rea.ec.europa.eu/funding-and-grants/horizon-europe-widening-participation-and-spreading-excellence/era-talents_en#:~:text=This%20action%20aims%20to%20boost,business%20collaboration%20for%20knowledge%20transfer.

European Strategy Forum on Research Infrastructures. (2016). ESFRI Roadmap 2016 - Strategy Report on Research Infrastructures. ISBN: *978-0-9574402-4-1*.

European Strategy Forum on Research Infrastructures. (2018). ESFRI Roadmap 2018 - Strategy Report on Research Infrastructures. Available at: *http://roadmap2018.esfri.eu/media/1049/roadmap18-part3.pdf*.

European Strategy Forum on Research Infrastructures. (2021). ESFRI Roadmap 2021: Projects & Landmarks. Available at: *https://roadmap2021.esfri.eu/projects-and-landmarks/browse-the-catalogue/*.

European Union. (2021). Regulation (EU) 2021/2122 of the European Parliament and of the Council of 22 November 2021, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H2122

Federal Ministry of Education and Research. (2023). *'Research for Sustainability' (FONA) Strategy.* Available at: https://www.bmbf.de/

Federal Ministry of Education and Research. (2023). *Hydrogen Flagship Projects.* Available at: https://www.wasserstoff-leitprojekte.de/home

FNR - Luxembourg National Research Fund. (2018). Industrial Fellowships (formerly AFR-PPP). Available at: *https://www.fnr.lu/funding-instruments/industrial-fellowships/*.

FNR - Luxembourg National Research Fund. (n.d.). IPBG - Industrial Partnership Block Grants. Available at: *https://www.fnr.lu/funding-instruments/ipbg/*.

Fraunhofer-Gesellschaft. (2023). *Research Fab Microelectronics Germany.* Available at: https://www.fraunhofer.de/en/

German Federal Ministry for Economic Affairs and Climate Action. (2023). *The National Hydrogen Strategy.* Available at: https://www.bmwk.de/

Government of Iceland. (n.d.). Act on Equal Status and Equal Rights Irrespective of Gender, available at: https://www.government.is/library/04-Legislation/Act%20on%20Equal%20Status%20and%20Equal%20Rights%20Irrespective%20of%20Gender.pdf

Government of the Netherlands. (2022). Available at: https://www.government.nl/latest/news/2022/04/14/government-earmarks-%E2%82%AC5-billion-for-sustainable-economic-growth-and-future-prosperity

Government of Norway. (202). Available at: https://www.regjeringen.no/en/topics/education/innsikt/internasjonalt-kunnskapssamarbeid/forskningssamarbeid/bilateralt-forskningssamarbeid/id2414374/

Government of Serbia. (2022). National Strategy for Gender Equality 2021-2030, available at: https://www.rodnaravnopravnost.gov.rs/sites/default/files/2022-03/National%20Strategy%20for%20GE%202021-2030.pdf

Government Offices of Sweden. (2016). Innovation partnership programmes–mobilising new ways to meet societal challenges. Available at: *https://www.government.se/articles/2016/07/innovation-partnership-programmes–mobilising-new-ways-to-meet-societal-challenges/*.

Higher Education Authority. (2021). Gender Equality Enhancement Fund 2023. Available at: https://hea.ie/policy/gender/gender-equality-enhancement-fund2021/

HUN-REN Hungarian Research Network - ELKH. (2023). National Position Paper on Open Science. Available at: *https://hun-ren.hu/en/research/open-science*.

Impact 2030: Ireland´s Research and Innovation Strategy (2020). Government of Ireland. https://www.gov.ie/ga/foilsiuchan/27c78-impact-2030-irelands-new-research-and-innovation-strategy/

Implementation of National Foresight Programme Results (2015). STIPC OECD. https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F5376

INES. (2023). *INES.2S - French Institute of Energy Transition.* Available at: https://www.ines-solaire.org/en/ines-2s/

Innovation - Beratung - Förderung. (2020). WIPANO-Richtlinie 2020-2023. Available: *https://www.innovation-beratung-foerderung.de/INNO/Navigation/DE/Home/home.html*.

Innovation Fund Denmark. (2014). Available at: *https://innovationsfonden.dk/en*.

Innovation Fund. (2016). Collaborative Grant Scheme Programme. Available at: *http://www.inovacionifond.rs/cms/files//psnp-dokumentacija/CGS_Program_Grant%20Manual_v1.2_%28English%29.pdf*.

InvestEU: EU programme to encourage investment (2021). European Parliament. https://www.europarl.europa.eu/news/en/headlines/eu-affairs/20210225STO98708/investeu-eu-programme-to-encourage-investment

Israel-Europe Research & Innovation Directorate. (n.d.). Available at: https://www.innovationisrael.org.il/ISERD/contentpage/about-us

Israel Innovation Authority. (2000). MAGNET Consortiums. Available at: *https://innovationisrael.org.il/en/program/magnet-consortiums*.

Israel Innovation Authority. (2001). Ideation Incentive Programme. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F5301.

Latvijas Zinātnes padome. (2018). Fundamental and Applied Research. Available at: *https://www.lzp.gov.lv/en/fundamental-and-applied-research*.

Luxembourg National Research Fund. Industrial Fellowships, available at: https://www.fnr.lu/funding-instruments/industrial-fellowships/

Luxembourg National Research Fund. PEARL Attracting Leading Researchers from abroad to Luxembourg, available at: https://www.fnr.lu/funding-instruments/pearl/

Ministère de l'Enseignement Supérieur et de la Recherche. (2018). *Luxembourg National ERA Roadmap.* Available at: https://era.gv.at/public/documents/3480/LuxNatERARoadmap2018.pdf

Ministère de L'économie des Finances et de la Souveraineté Industrielle et Numérique. (2023). *France 2030: un plan d'investissement pour la France.* Available at: https://www.economie.gouv.fr/

Ministerie van Economische Zaken en Klimaat. (2011). Bedrijvenbeleid in beeld. Available at: *https://www.bedrijvenbeleidinbeeld.nl/*.

Ministre de l'Économie, des Finances et de la Souveraineté industrielle et numérique. (2023). France 2030: un plan d'investissement pour la France, available at: https://www.economie.gouv.fr/france-2030

Ministry of Climate, Energy and Utilities. (2023). *Energy Technology Development and Demonstration Program.* Available at: https://ens.dk/en/

Ministry of Economic Affairs and Employment of Finland. (2022). The national intellectual property rights strategy of Finland. Available at: *https://ec.europa.eu/research-and-innovation/sites/default/files/kvp/files/kvp-national-ip-rights.pdf*.

Ministry of Economic Affairs and Employment. (2020). New Programme to Strengthen Finnish Ownership in Companies. Available at: https://tem.fi/en/-/new-programme-to-strengthen-finnish-ownership-in-companies

Ministry of Economics of the Republic of Latvia. (2023). *National Energy and Climate Plan for 2021-2030*. Available at: https://www.em.gov.lv/en/

Ministry of Education and Science of the Republic of Latvia. (2014). Smart Specialisation Strategy (RIS3). Available at: *https://www.izm.gov.lv/en/smart-specialisation-strategy-ris3*.

Ministry of Education and Science of the Republic of Latvia. (2016). R&D Infrastructure for Smart Specialisation. Available at: *https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F16787*.

Ministry of Food, Agriculture and Fisheries. (2023). *Green Development and Demonstration Programme.* ISBN: 978-87-7120-287-8. Available at: https://lbst.dk/

Ministry of Higher Education and Science. ESS as a Driver for Future Growth - Strategy for the Danish ESS Effort 2.0, available at: https://ufm.dk/publikationer/2020/ess-som-drivkraft-for-fremtidens-vaekst-strategi-for-den-danske-ess-indsats-2.0

Ministry of Higher Education and Science. The Danish Code of Conduct for Research Integrity, available at: https://ufm.dk/en/publications/2014/the-danish-code-of-conduct-for-research-integrity?searchterm=Research%20integrity

Ministry of Science of Montenegro. (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available at: https://s3platform.jrc.ec.europa.eu/montenegro.

Miniszterelnöki Kabinetiroda. (2022). National Digitalisation Strategy 2021-2030. Available at: *https://kormany.hu/dokumentumtar/nemzeti-digitalizacios-strategia-2022-2030*.

Monitoring and evaluation of the EECTI 2021-2027 (n.d.). Ministerio de Ciencie e Innovacion. https://www.ciencia.gob.es/en/Estrategias-y-Planes/Estrategias/Seguimiento-y-evaluacion-de-la-EECTI-2021-2027.html

Multilateral dialogue on values and principles (n.d.) European Commission. https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/europe-world/international-cooperation/multilateral-dialogue-values-and-principles_en

National Academic Infrastructure for Supercomputing in Sweden (NAISS) (n.d.) NAISS. https://www.naiss.se/#:~:text=The%20National%20Academic%20Infrastructure%20for%20Supercomputing%20in%20Sweden,acts%20independently%20with%20a%20national%20perspective%20and%20responsibility.

National Board of Research and Innovation. (n.d.). National R&I Strategy. Available at: *https://www.nbri.gov.cy/strategy-plan/national-ri-strategy/*.

National Statistical Institutes (n.d.) StatBel. https://statbel.fgov.be/en/about-statbel/our-partners/statistics-portal/national-statistical-institutes

Netherlands Enterprise Agency. (2013). SME Innovation Support Top Sectors. Rijksdienst voor Ondernemend Nederland. Available at: *https://www.rvo.nl/subsidies-financiering/mit*.

Netherlands Innovation Network. (2023). *About the innovation network.* Available at: https://netherlandsinnovation.nl/about-us/

Netherlands Organisation for Scientific Research (NWO). Aspasia, available at: https://www.nwo.nl/en/researchprogrammes/aspasia

Netherlands Organisation for Scientific Research (NWO). Athena Award, available at: http://www.nwo.nl/en/funding/our-funding-instruments/cw/athena/athena-award.html

Nordic Council of Ministers. (1946). Rules on Open Access. Available at: *https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F3511*.

NOW. (2023). *Hydrogen and fuel cell.* Available at: https://www.now-gmbh.de/en/

OECD. (2023). STIP Compass. Available at: *https://stip.oecd.org/stip/*.

OECP STIP Survey. (2023). National Guidelines for knowledge and technlogy transfer. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2023%2Fdata%2FpolicyInitiatives%2F99996926

Open Science Knowledge Hub. (2023). White Paper on the Transition to Open Science 2023-2030. Available at: *https://www.open-science.ro/cartea-alba-a-tranzitiei-catre-stiinta-deschisa-2023-2030*.

Pakt für Forschung und Innovation. (2023). Available at: https://www.bmbf.de/bmbf/de/forschung/das-wissenschaftssystem/pakt-fuer-forschung-und-innovation/pakt-fuer-forschung-und-innovation_node.html

Plataforma de indicadores (n.d.). FECYT. https://indicadores.fecyt.es/#/

Plastic Pirates – Go Europe! (n.d.). Available at: *https://www.plastic-pirates.eu/en*.

Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia. Co-financing of Research Mobility of US Citizens in Slovenia Within the Fulbright Programme, available at: https://www.srips-rs.si/en/scholarships/cofinancing-scientific-research-mobility/fulbright-scholarships

Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia. Scholarships for Doctoral Studies at the EUI, available at: https://www.srips-rs.si/en/scholarships/ad-futura-scholarships/programmes-for-promoting-mobility-abroad/scholarships-for-doctoral-studies-at-the-eui

Regieorgaan Open Science. (2023). Regieorgaan Open Science officially launched as Open Science NL. NWO. Available at: *https://www.nwo.nl/nieuws/regieorgaan-open-science-officieel-van-start-onder-de-naam-open-science-nl*.

Regjeringen.no. (2017). National goals and guidelines for open access to research articles. Available at: *https://www.regjeringen.no/en/dokumenter/national-goals-and-guidelines-for-open-access-to-research-articles/id2567591/*.

Republic of Latvia. (2021). Regarding Guidelines for Science, Technology Development, and Innovation. Available at: https://likumi.lv/ta/en/en/id/322468

Research and Innovation Repository of Best Practices. (2022). Academia Innovation Enhancer. Available at: *https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/academia-innovation-enhancer*.

Research and Innovation Repository of Best Practices. (2023). Intellectual Property Panel at University Hasselt. Available at: *https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/intellectual-property-panel-university-hasselt*.

Research and Innovation Repository of Best Practices. (2023). Master in Intellectual Property Valorisation for Knowledge Exchange & Impact. Available at: *https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/master-intellectual-property-valorisation-knowledge-exchange-impact*.

Research and Innovation, European Commission. (n.d.). Mutual Learning Exercise (MLE) on "Citizen Science initiatives – Policy and Practice. Available at: *https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-citizen-science-initiatives-policy-and-practice*.

Research Council of Finland. (n.d). Available at: https://www.aka.fi/en/research-funding/programmes-and-other-funding-schemes/academy-programmes/development-research--develop-2-20232026/

Research Council of Norway. (2008). Industrial Ph.D. scheme – Doctoral projects in industry. Available at: *https://www.forskningsradet.no/en/apply-for-funding/funding-from-the-research-council/industrial-ph.d.-scheme--doctoral-projects-in-industry/*.

Researchers' Night. (2023). Βραδιά του Ερευνητή. Available at: *https://researchersnight.gr/*.

R&D expenditure (2023). Eurostat. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_expenditure&oldid=551418

Roadmap of Large Research Infrastructures of the Czech Republic (2023). Ministry of Education, Youth and Sports of the Czech Republic. https://www.vyzkumne-infrastruktury.cz/en/roadmap-of-large-research-infrastructures-of-the-czech-republic/

Royal Netherlands Academy of Arts and Sciences (KNAW). (2011). Open Access Policy and Digital Preservation. Available at: *https://storage.knaw.nl/2023-08/open-access-and-digital-preservation-eng.pdf*.

Science Foundation Ireland. (2017). *Exploring opportunities with the National Challenge Fund*. Available at: https://www.sfi.ie/

Science Fund of the Republic of Serbia. (2019). The Serbian Science and Diaspora Collaboration Programme. Available at: *https://fondzanauku.gov.rs/the-serbian-science-and-diaspora-collaboration-program/?lang=en*.

SESAME.(2020). *What is Sesame*. Available at: https://www.sesame.org.jo/

Smart Specialisation Platform. (2020). *Strategic Research and Innovation Partnership on Circular Economy.* European Commission. Available at: https://s3platform.jrc.ec.europa.eu/en

Support to utilise international research infrastructures (2019). National Research, Development and Innovation Offce of Hungary. https://nkfih.gov.hu/english/nrdi-fund/support-to-utilise-international-research-infrastructures-2019-126-nemz-ki/call-for-project-proposals-2019-216-nemz-ki

Swedish Agency for Innovation Systems. (2013). Innovation Offices. Available at: *https://www.vinnova.se/en/*.

Swedish Agency for Innovation Systems. (2016). Model for Commercialisation of Assets in Companies. Available at: https://stip.oecd.org/stip/interactive-dashboards/policy-initiatives/2021%2Fdata%2FpolicyInitiatives%2F15842.

Swedish Agency for Innovation Systems. (2019). Environment-Driven Business Development Programme. Available at: *https://www.rvo.nl/subsidies-financiering/mit*.

The 2022 EU Industrial R&D Investment Scoreboard (2022). European Commission. https://iri.jrc.ec.europa.eu/scoreboard/2022-eu-industrial-rd-investment-scoreboard

The Impact of Public R&D Expenditure on Business R&D (2000). OECD, https://www.oecd-ilibrary.org/science-and-technology/the-impact-of-public-r-d-expenditure-on-business-r-d_670385851815

The Norwegian Language Bank. (n.d.). Resource Catalogue. Available at: *https://www.nb.no/sprakbanken/en/resource-catalogue/*.

The relationship between public and private R&D funding (2020). Oxford Economics. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/897470/relationship-between-public-private-r-and-d-funding.pdf

The Scientific and Technological Research Council of Türkiye. (2023). TÜBİTAK. Available at: *https://www.tubitak.gov.tr/en*.

The Scientific and Technological Research Council of Türkiye. (2023). 4007 – Science Festivals Support Programme. Available at: https://www.tubitak.gov.tr/en/funds/science-society/national-support-programmes/content-4007-science-festivals-support-programme

Thomas Neidenmark, Gareth O'Neill, & Istvan Karasz. (2023). EOSC Catalogue of Best Practices (Version V1). Zenodo. *https://doi.org/10.5281/zenodo.7574165*.

TÜBİTAK ULAKBİM. (n.d.). Harman. Available at: *https://harman.ulakbim.gov.tr/index*.

TÜBİTAK ULAKBİM. (n.d.). Open Science Portal. Available at: *https://portal.ulakbim.gov.tr/*.

Urban Europe. (2023). *Introduction to JPI Urban Europe.* Available at: https://jpi-urbaneurope.eu/about/intro/

Utbildningsdepartementet. (2020). Research, freedom, future - knowledge and innovation for Sweden. Available at: *https://www.regeringen.se/rattsliga-dokument/proposition/2020/12/forskning-frihet-framtid--kunskap-och-innovation-for-sverige/*.

van Wezenbeek, W., Touwen, H., Versteeg, A., & van Wesenbeeck, A. (2017). *Nationaal plan open science*. Ministerie van Onderwijs, Cultuur en Wetenschap. *https://doi.org/10.4233/uuid:9e9fa82e-06c1-4d0d-9e20-5620259a6c65*.

Vinnova. (n.d.). Inkubationsstöd. Available at: *https://www.vinnova.se/e/inkubationsstod/*.

World Intellectual Property Organization. (1968). Israel Patents Law, 5727-1967. Available at: *https://www.wipo.int/wipolex/en/legislation/details/2364*.

Българския портал за отворена наука. (2023). National Open Science Programme. Available at: *https://bpos.bg/*.

ANNEX 1. LIST OF INDICATORS INCLUDED IN THE ERA DASHBOARD

AREA	INDICATOR	SB / DB	SUMMARY	SOURCE
R&D investment and landscape	1. Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP	ERA Scoreboard	Share of total expenditures on R&D as a percentage of GDP	Eurostat [RD_E_GERDTOT]
	2. Government Budget Allocations for R&D (GBARD) as share of GDP	ERA Dashboard	Share of Government Budget Allocations in R&D as a percentage of GDP	Eurostat [GBA_NABSFIN07_custom5043928]
	3. Researchers (in full-time equivalent) per million inhabitants	ERA Scoreboard	Share of researchers in full-time equivalents per million population.	Eurostat [RD_P_PERSOCC]
	4.Business Enterprise expenditure on R&D (BERD) as a percentage of GDP	ERA Dashboard	Share of R&D expenditures in the business sector as a percentage of GDP	Eurostat [RD_E_BERDINDR2__custom_5031360]
Deepening a truly functioning internal market for knowledge	5. Share of publications available in open access (green, gold and diamond)	ERA Scoreboard	Open access scientific publications with digital object identified (DOI) as a % of total scientific publications with DOI.	OpenAIRE DG RTD – SRIP 2022
	8. Share of national public R&D expenditure committed to European research infrastructures	ERA Dashboard	Data for this indicator has been provided by ESFRI, the indicator has slightly changed instead of the Share of national public R&D expenditure committed to joint programmes and initiatives, research infrastructures and European Partnerships the report includes the Share of national public R&D expenditure committed to European research infrastructures	ESFRI
	9. Number of European research infrastructures in which a Member State or an Associated Country participates	ERA Dashboard	Absolute number of European research infrastructures in which a Member State or an Associated Country participates (which financially contributes to operations).	ESFRI
	11. Share of women in grade A positions in HEIs	ERA Scoreboard	Share of women in the single highest grade/post at which research is normally conducted within the institutional or corporate system out of all women in HEIs.	Women in Science (WiS) database
	12. Proportion of papers with mixed gender	ERA Dashboard	Proportion of papers in the Scopus database and NamSor with co-	Science-Metrix using the Scopus database (Elsevier) and NamSor

	authorship, 2000-2020		authorship between 2000-2020 out of all available papers.	
	13. Proportion of women in authorships of the top 10% most cited publications, 2000-2018	ERA Dashboard	Proportion of women in highly cited publications (top 10% most cited publications) in the Scopus database and NamSor between 2000-2018 out of all available papers.	Science-Metrix using the Scopus database (Elsevier) and NamSor
	14. Women in Digital Index	ERA Dashboard	The Woman in Digital (WiD) index is an aggregate indicator ranging from 0 to 100 that brings together 13 subindicators that assess the performance of Member States in three main areas: (1) Internet use, (2) Internet user skills, and (3) specialist skills and employment.	Women in Digital Index (WDI)
	15. Proportion of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM)	ERA Dashboard	Graduates (people who, during the reference school or academic year, have successfully completed an education programme) and first-time graduates (people who, during the reference school or academic year, have successfully completed an education programme at the given level for the first time) holding a PhD or equivalent in one STEM field out of all doctoral graduates.	Eurostat [EDUC_UOE_GRAD02__ custom_5107514]
	16. Share of foreign doctorate students as a percentage of all doctorate students	ERA Dashboard	This indicator measures the proportion of foreign doctorate students as percentage of all doctorate students.	Eurostat [EDUC_UOE_MOBS03 $DEFAULTVIEW]
	17. New doctorate graduates per 1,000 inhabitants aged 25-34	ERA Dashboard	Graduates (people who, during the reference school or academic year, have successfully completed an education programme) and first-time graduates (people who, during the reference school or academic year, have successfully completed an education programme at the given level for the first time) holding a PhD or equivalent between 25-34 years, per 1,000 population.	Eurostat [EDUC_UOE_GRAD07]
	18. Job-to-job mobility of Human Resources in Science and Technology	ERA Scoreboard	Movement from an employee to a job from another, from one year to the next in the field of HRST.	Eurostat [HRST_FL_MOBSEX]

	19. Share of public-private co-publications per million population	ERA Dashboard	Number of public-private co-authored publications per million population. Each co-publication is counted as one publication for each country, irrespective of the number of co-authors and (parent) organizations listed in the author affiliate address(es).	Eurostat Bibliometrics
	20. Best practice examples and methodologies for knowledge valorisation	ERA Dashboard	Qualitative information on practices, 'learning from experience' examples and relevant policies regarding transformation of research results into societal and economic benefits. The information is included within the narrative of the report	OECD
	22. Number of PCT patent applications divided by GDP in million euros	ERA Dashboard	Number of patent applications requested to the PCT -the International Patent System-during every year divided by GDP in million euros.	OECD Eurostat [NAMA_10_GDP]
	23. Share of innovating firms collaborating with higher education institutions or public/private research institutions	ERA Scoreboard	Proportion of innovating firms collaborating with HEIs/PROs out of all innovating firms.	Eurostat [INN_CIS7_COOP]
	25. Business enterprise researchers as percentage of national, total	ERA Dashboard	Human resources devoted to research and experimental development (R&D) as defined in the OECD Frascati Manual, per total researchers.	OECD
	26. Business enterprise researchers in full-time equivalent per thousand employment in industry	ERA Dashboard	Research and development (R&D) personnel in the business enterprise sector. Measured in full-time equivalent are the number of total R&D personnel and researchers in the business enterprise sector by industry according to the International Standard Industrial Classification (ISIC) revision 4.	OECD
	27. Number of scientific publications among the top 10% most cited publications worldwide as a percentage of all publications	ERA Scoreboard	Proportion of highly cited publications (top 10% most cited publications) out of all publications.	DG RTD
	28. Academic Freedom Index	ERA Dashboard	The indicator assesses de facto levels of academic freedom across the world based on five	V-Dem

			indicators: freedom to research and teach, freedom of academic exchange and dissemination, institutional autonomy, campus integrity, and freedom of academic and cultural expression. The V-dem project implements and adapts this indicator by making use of 2,197 country experts worldwide, standardized questionnaire and a statistical model.	
	30. International co-publications with non-EU partners per 1,000 researchers	ERA Scoreboard	Proportion of international co-publications with non-EU partners per 1,000 researchers.	Science-metrix and Scopus
	31. European and international co-patenting in EPO applications at national and EU level	ERA Dashboard	Number of requests for patent protection of an invention filed with the European Patent Office (EPO) regardless of whether they are granted or not. The number of applications include direct European applications filed in the reference year (Direct) and international (PCT) applications for which the applicant(s) opted to protect their invention in Europe by selecting the EPO during the reporting period (PCT regional)	Eurostat [PAT_EP_IPC]
Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society's participation in the ERA	33. Government budget allocations for R&D (GBARD) by NABS	ERA Dashboard	Allocations distributed to R&D in central (federal) government, regional (state) and local (municipal) government. They refer to provisions, not to actual expenditure. Local government budget funds may not me included if their contribution is not significant or if the data could not be collected. GBARD data are covering all public budget spending related to R&D and are linked to policy issues by means of a classification by "objectives" or "goals" (NABS 2007). Only NABS related to ERA action 10 have been selected: environment, energy, and transport, teleco and other infrastructure	Eurostat [GBA_NABSFIN07]
	34. R&I investments (transnational	ERA Dashboard	GBARD allocated to Europewide transnational, bilateral	Eurostat

	cooperation): GBARD (EUR) allocated to Europewide transnational, bilateral or multilateral, public R&D programmes per FTE researcher in the public sector		or multilateral, public R&D programmes per FTE researcher in the public sector.	[GBA_TNCOOR]
	35. Environmentally related government R&D budget as percentage of total government R&D	ERA Scoreboard	Budget destined to R&D green transition, growth, and environment.	OECD
	37. National public and private investments as suggested in the SET Plan progress report 2021	ERA Dashboard	Sum of public and private investments on R&I in a country based both on financial information from publicly available company statements and patent data from PATSTAT, and IEA statistics.	SETIS research and innovation data
	38. OECD Patents on environment technologies	ERA Dashboard	Patents in environment-related technology according to OECD classification as percentage of technology patents.	OECD
	39. Share of researchers receiving transferable skills training	ERA Scoreboard	Proportion of researches trained in transferable skills, according to the MORE survey, out of all researchers in the country.	MORE survey
	40. Innovative enterprises that co-operated on R&D+I with universities and HEIs	ERA Dashboard	Absolute innovative enterprises, according to Eurostat criteria, that co-operated on R&D+I with universities and HEIs	Eurostat [INN_CIS12_COOP__ custom_5206298]
	41. Direct government support plus Indirect government support through R&D tax incentives as a percentage of GDP	ERA Scoreboard	Public financing of R&D can take two forms: Direct funding for R&D through instruments such as grants and public procurement, and Indirect support through the tax system. This indicator measures the sum of both as a percentage share of GDP	OECD Eurostat [RD_E_GERDFUND]
	48. Trust in Science	ERA Dashboard	Indicator based on several questions of the Eurobarometer 516 that measure the trust in science of Europeans. Numerator: all individuals that replied very positive to QA6 and/or strongly agree to QA9 or strongly agree to QA10.3 or strongly agree to QA10.5. Denominator: all individuals.	Eurobarometer 516 on “European citizens’ knowledge and attitudes towards science and technology”

Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union	49. Increase in total R&D expenditure in widening countries expressed as a percentage of GDP	ERA Scoreboard	The increase in total R&D expenditure for widening countries as a percentage of GDP	Eurostat [RD_E_GERDTOT]
	55. Share of public R&D expenditures financed by the private sector	ERA Scoreboard	Share of R&D expenditures by the higher education and government sector that are financed by the business sector	Eurostat [RD_E_GERDFUND]
Advancing concerted research and innovation investments and reforms	56. Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher	ERA Scoreboard	The indicator measures the share of government budget allocations for R&D allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per million researchers.	Eurostat [GBA_TNCOOR]

ANNEX 2. GRAPHS FOR THE DASHBOARD INDICATORS

A2.1 Indicators for R&D investments and landscape

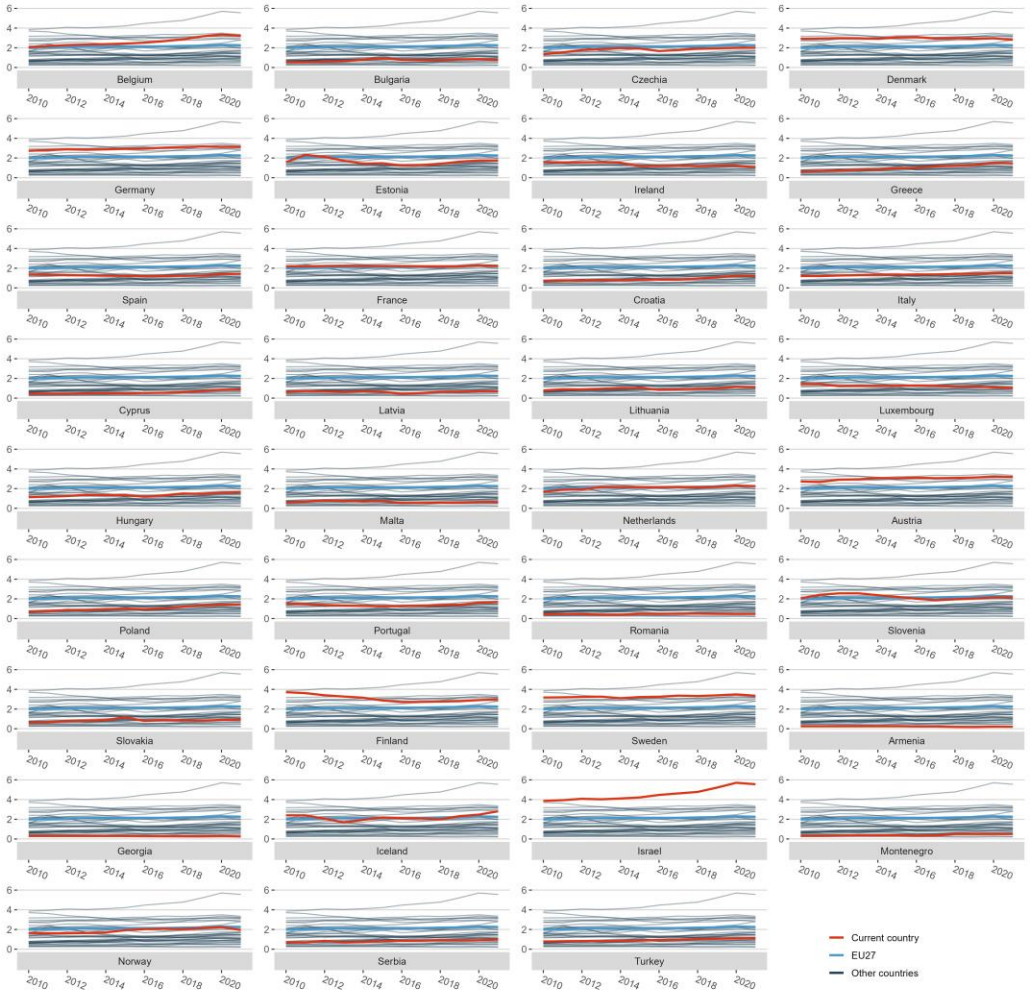


Figure 1. Gross Domestic Expenditures on R&D as a % of GDP

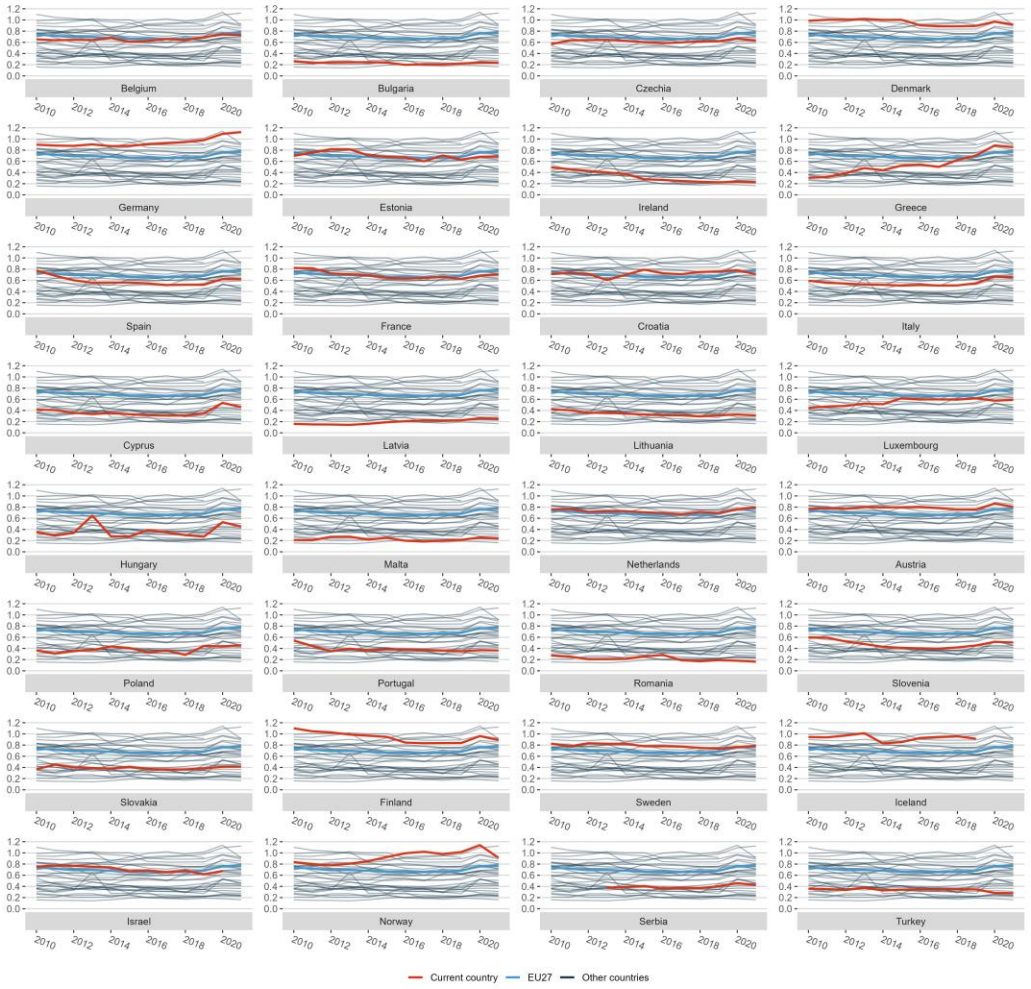


Figure 2. GBARD as percentage of GDP

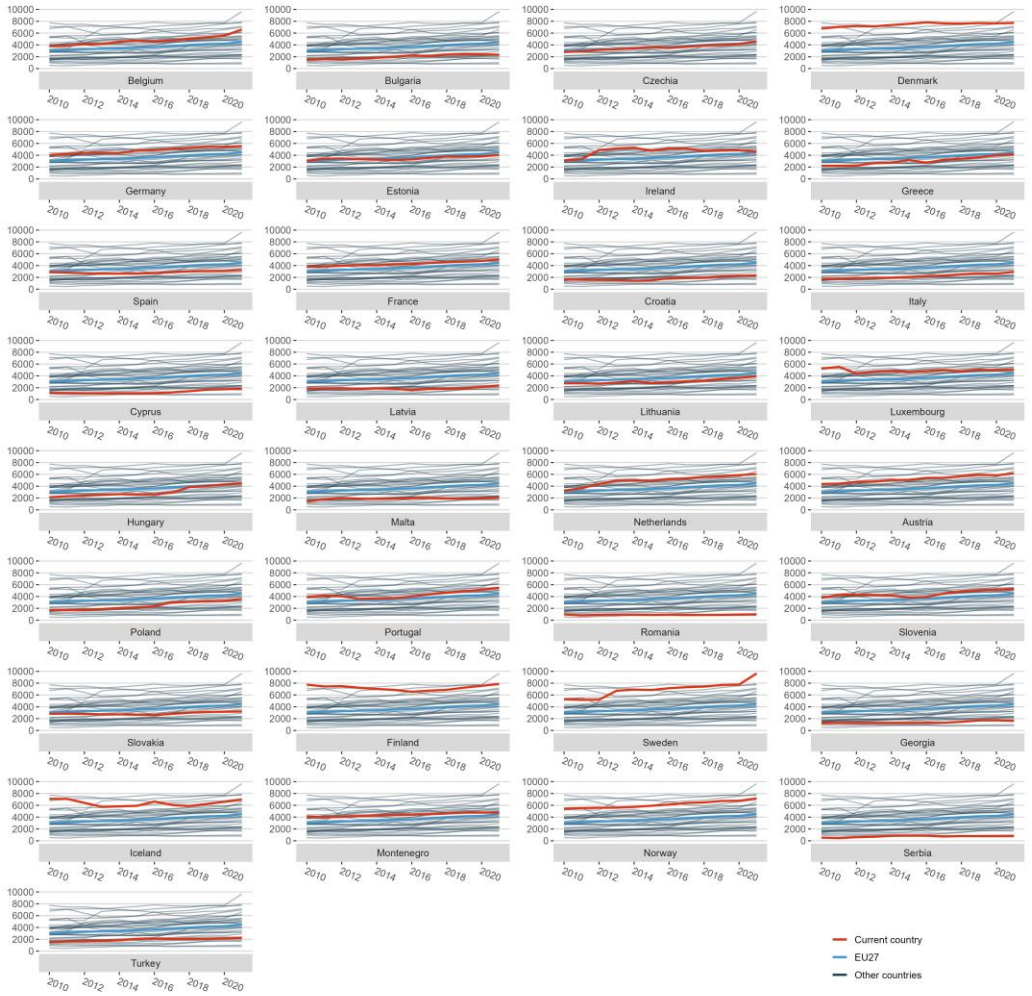


Figure 3. Researchers (in full time equivalent) per million inhabitants

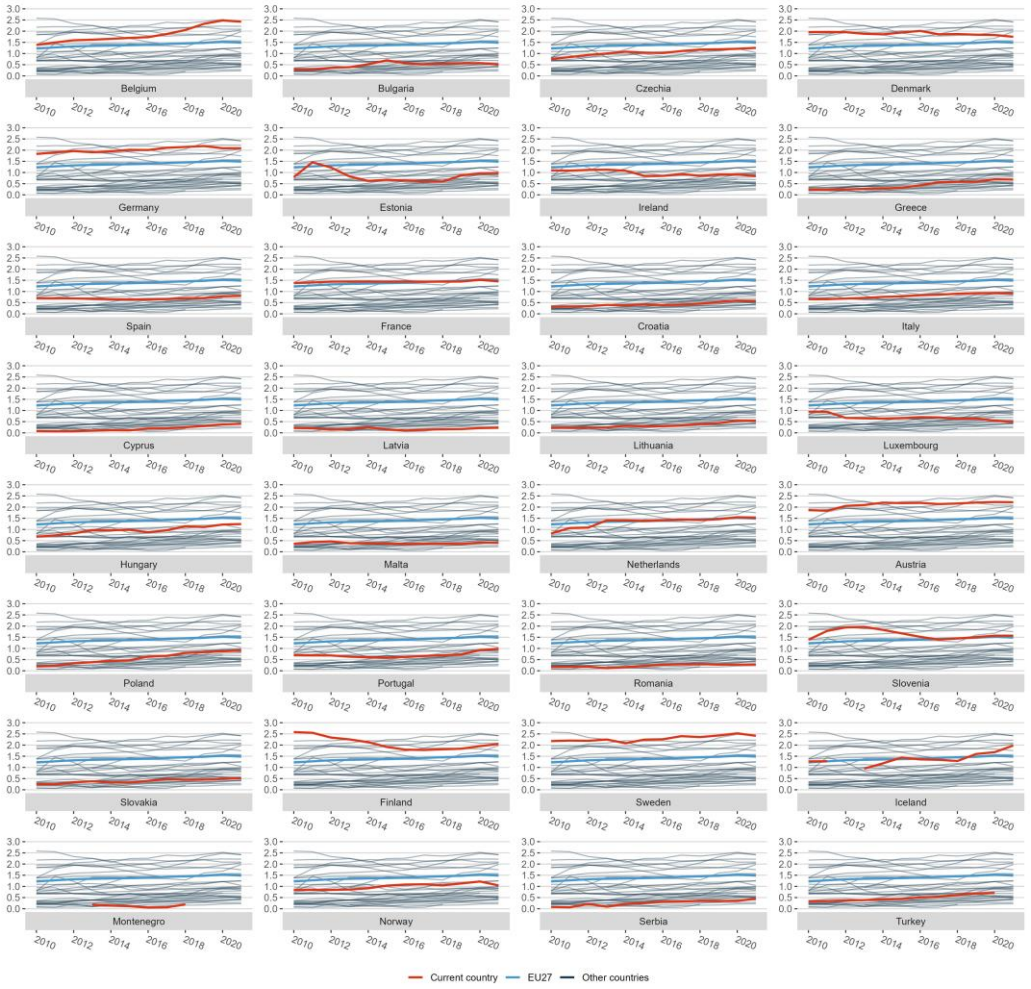
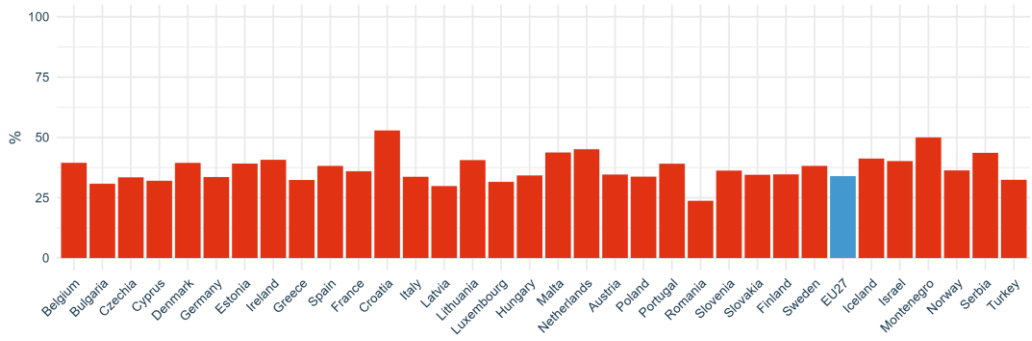


Figure 4. BERD as percentage of GDP

A2.2 Indicators for ERA priority 1: Deepening a truly functional internal market for knowledge

Indicators for Open Science

2010



2019

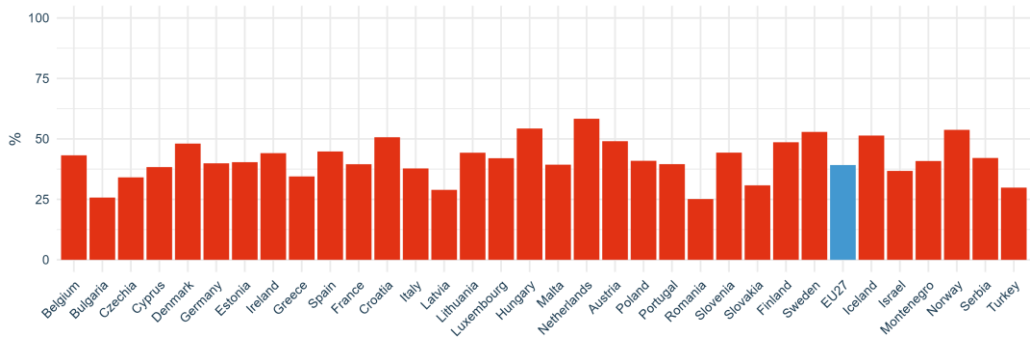


Figure 5. Open access scientific publications with digital object identifier (DOI) as % of total scientific publications with (DOI), data for 2010 and 2019

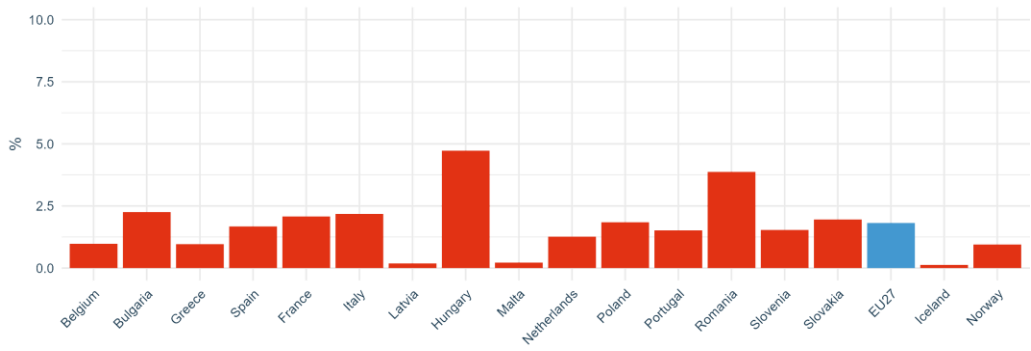


Figure 6. Share of national public R&D expenditure committed to European research infrastructures, Data for 2022. [217],[218]

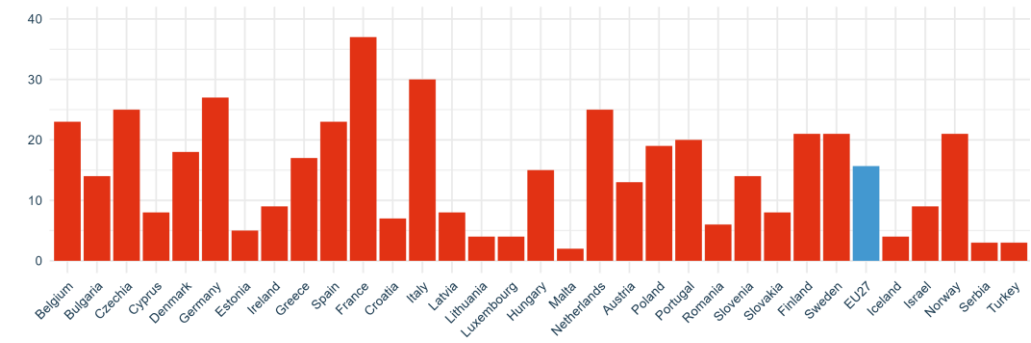


Figure 7. Number of European research infrastructures in which a Member State or an Associated Country participates (financially contributes to operations), Data for 2021

[217] Data is available for 17 countries; the EU average is calculated as an average of the shares of the 15 MS.
[218] The fees and host contributions in absolute numbers:

MS	Fees and host contributions	MS	Fees and host contributions	MS	Fees and host contributions	MS	Fees and host contributions	MS	Fees and host contributions
BE	47.857.458,00 €	FR	383.592.177,00 €	IS	247.023,00 €	MT	86.731,00 €	PL	59.700.209,00 €
BG	4.624.718,00 €	GR	14.934.021,00 €	IT	222.662.704,32 €	NL	88.943.286,00 €	PT	22.199.501,00 €
ES	140.068.820,00 €	HU	30.579.414,00 €	LV	350.836,00 €	NO	37.327.096,00 €	RO	18.945.014,00 €
SK	8.988.013,00 €	SI	5.268.030,77 €						

Indicators for Gender equality, equal opportunities for all and inclusiveness

Figure 8. Share of women in grade A positions in Higher education institutes (%)

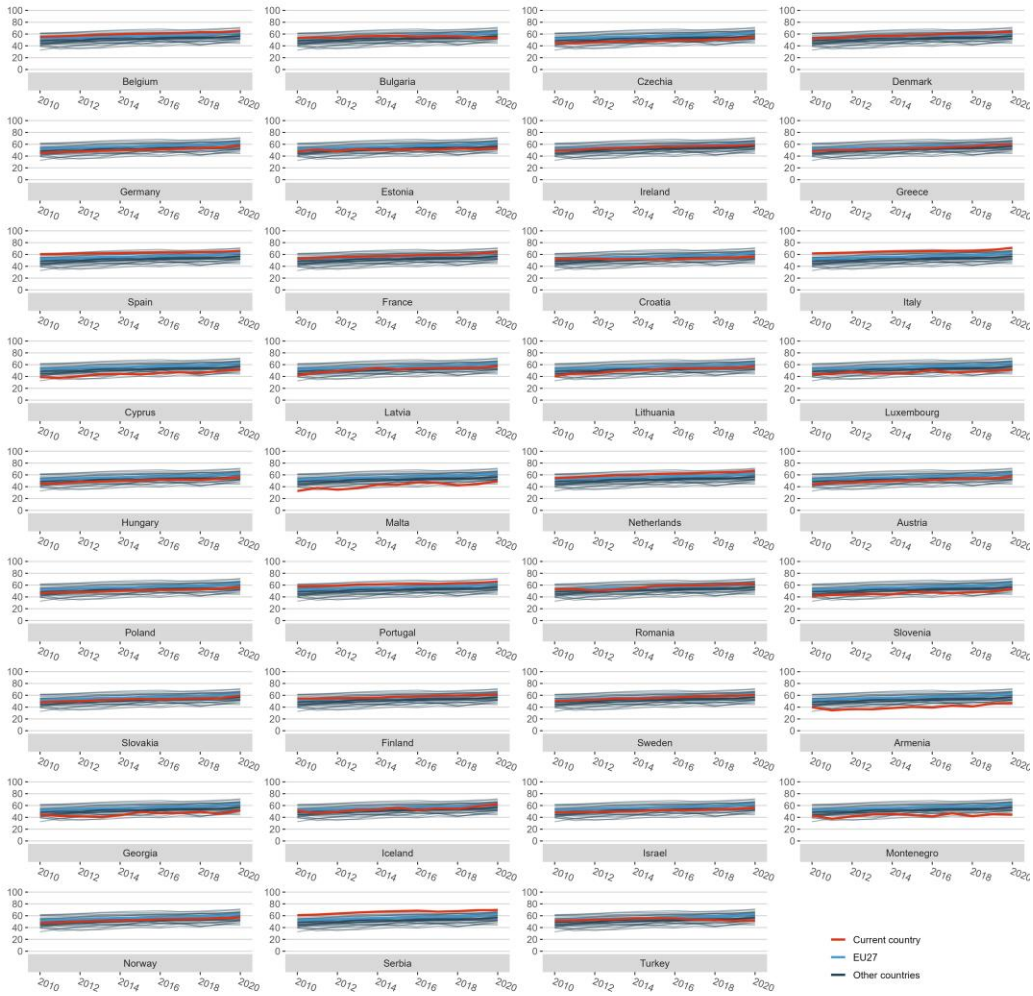


Figure 9. Proportion of papers with mixed gender authorship (%)

Figure 10. Proportion of women in authorship of the 10% most cited publications (%)

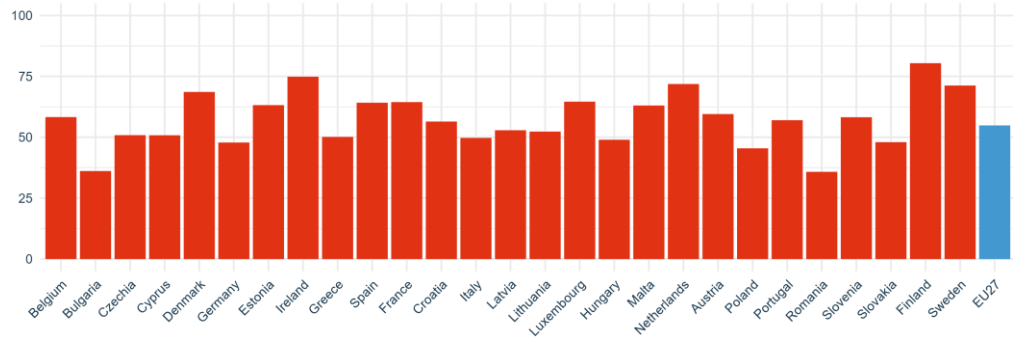


Figure 11. Women in Digital Index, data for 2022

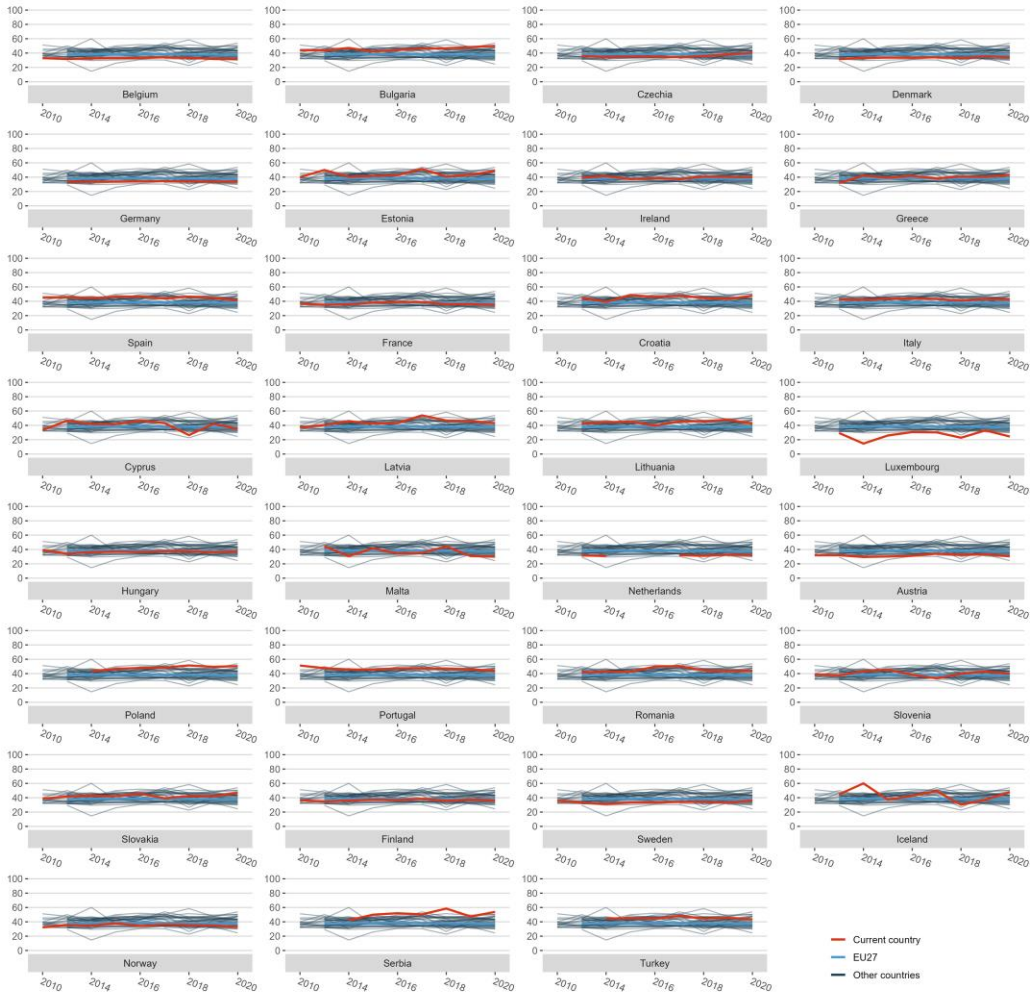


Figure 12. Proportion of women among doctoral graduates by narrow fields of Science, Technology, Engineering and Mathematics (STEM) (%)

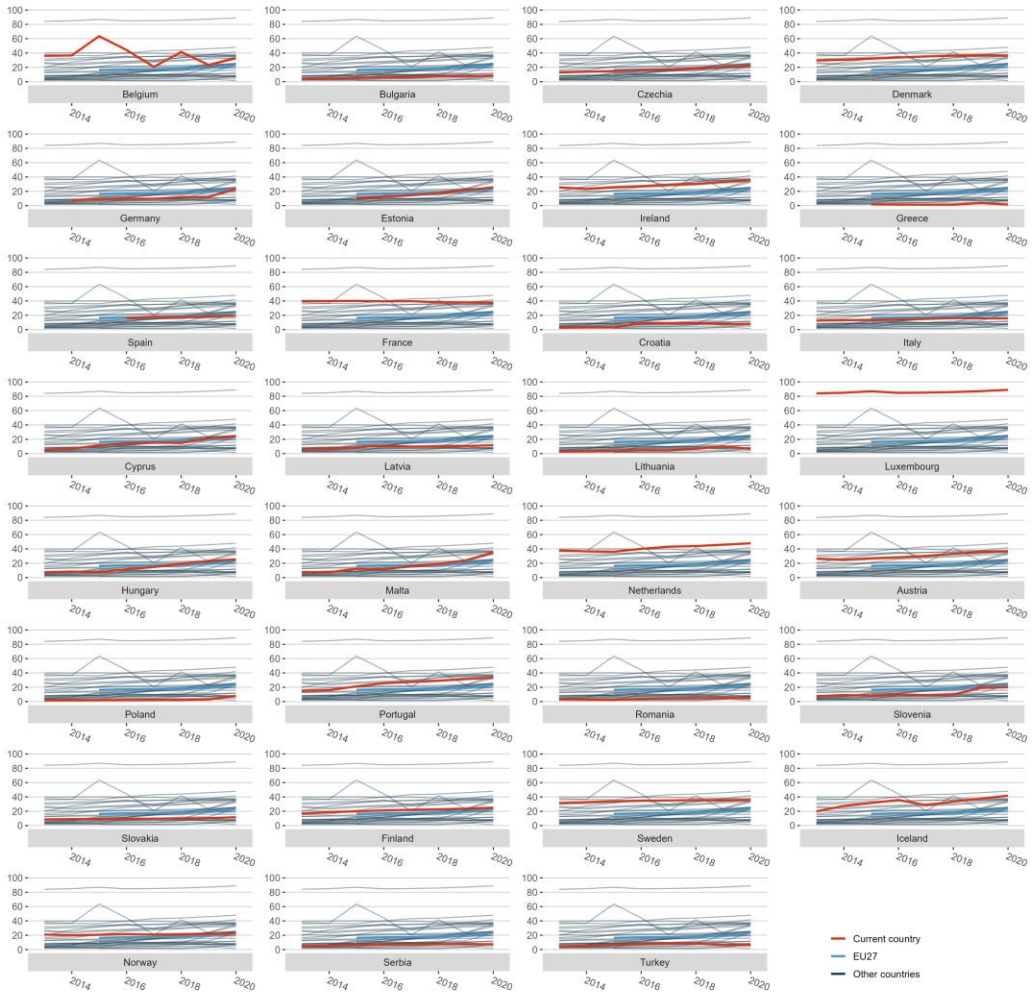


Figure 13. Share of foreign doctorate students as a percentage of all doctorate students (%)

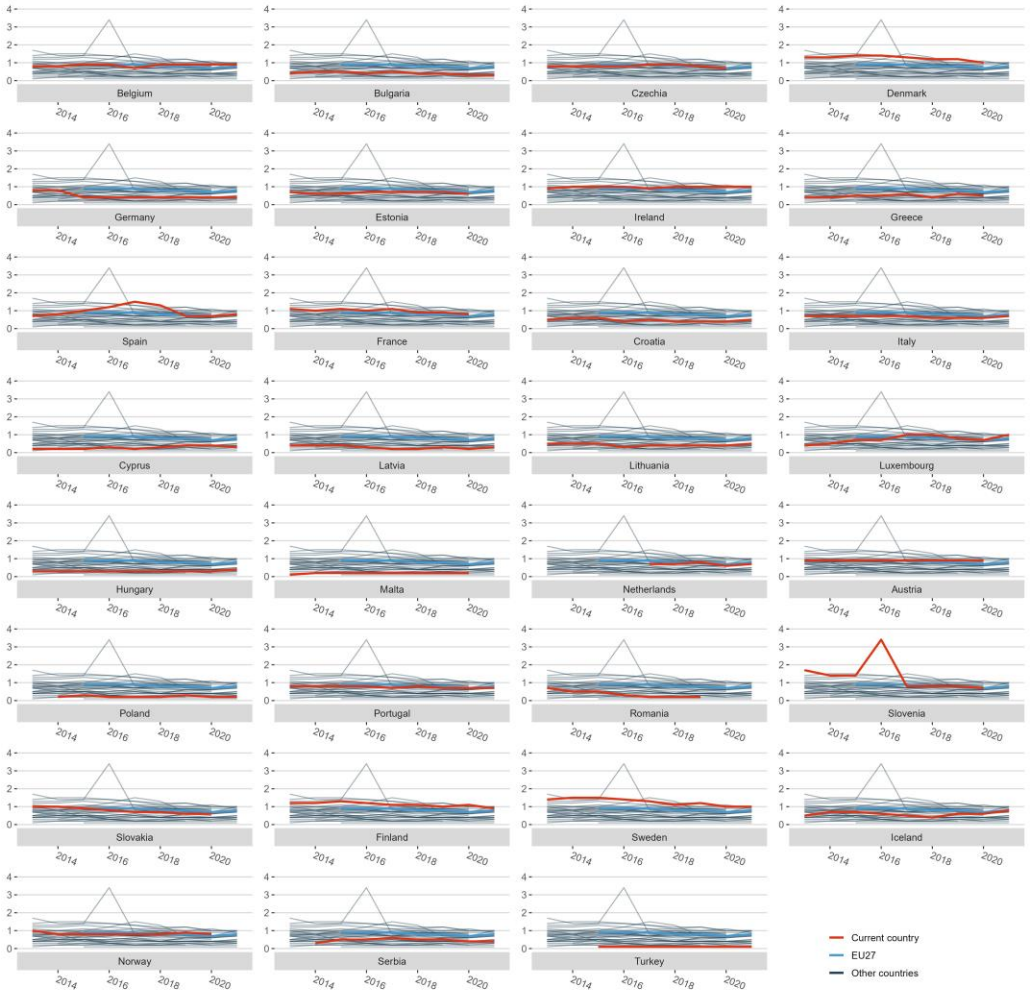


Figure 14. New doctorate graduates (25-34) per 1,000 inhabitants

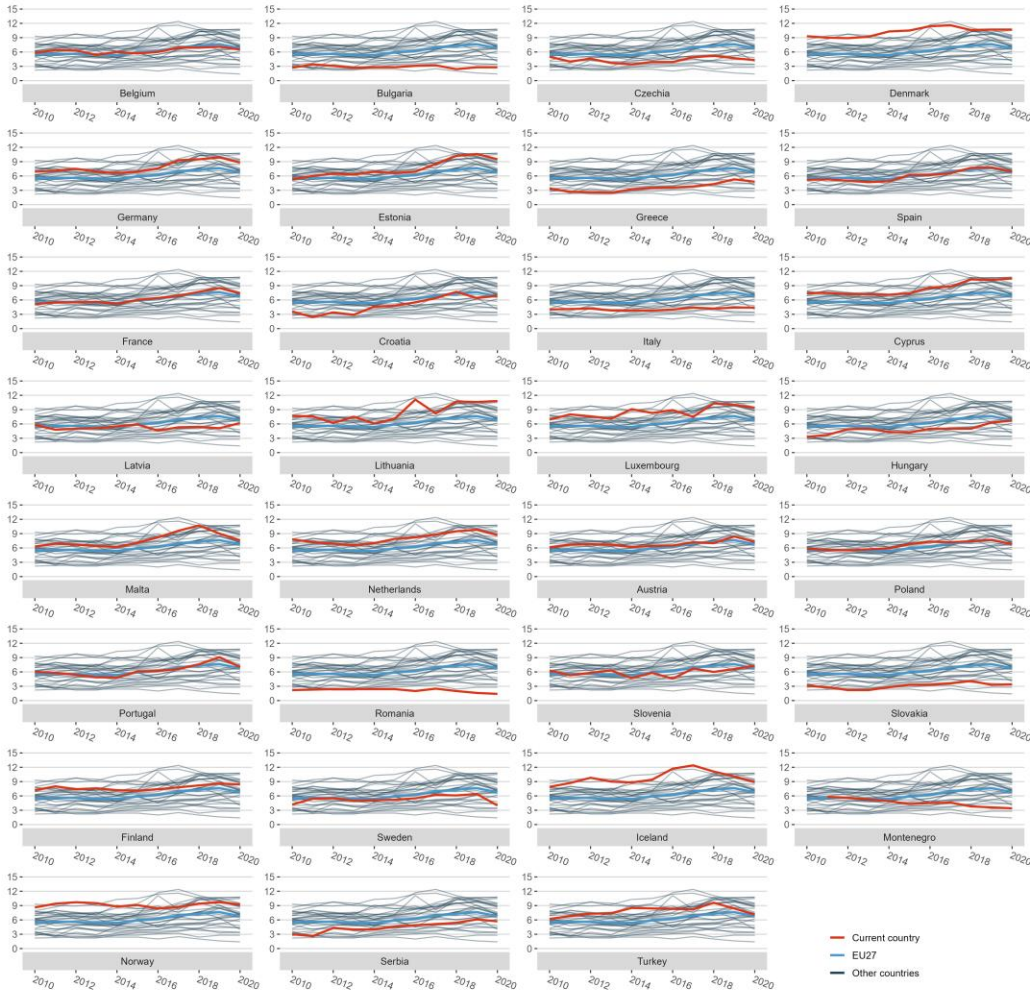


Figure 15. Job-to-job mobility of human Resources in Science & Technology

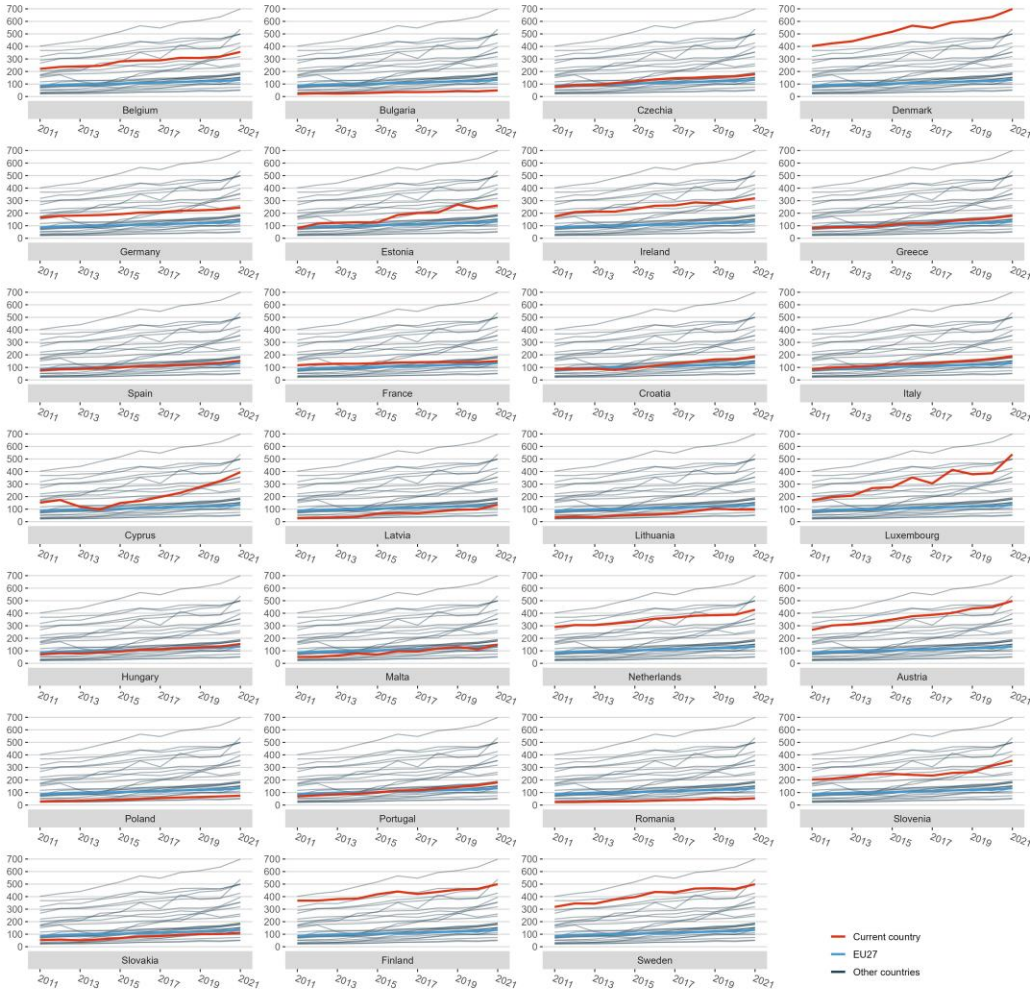


Figure 16. Share of public-private co-publications per million population

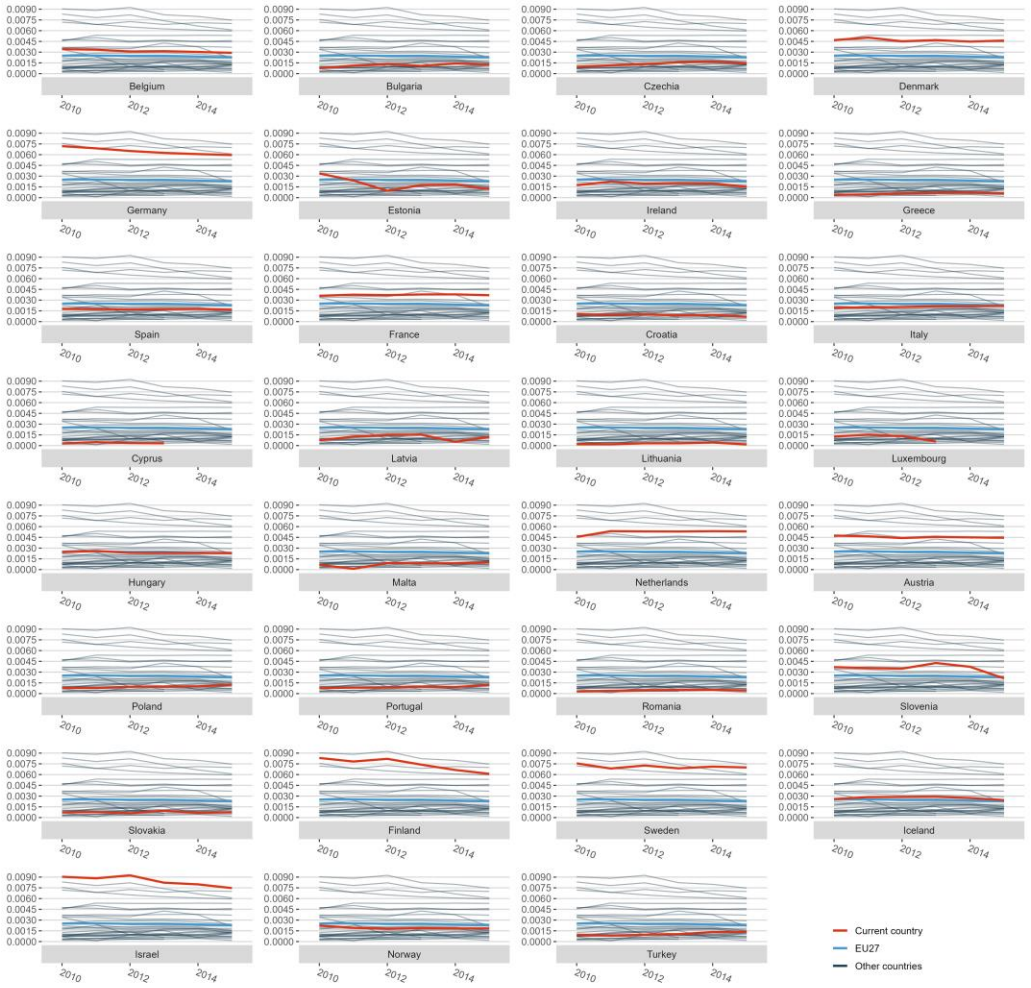


Figure 17. Number of PCT patent applications divided by GDP in million Euros

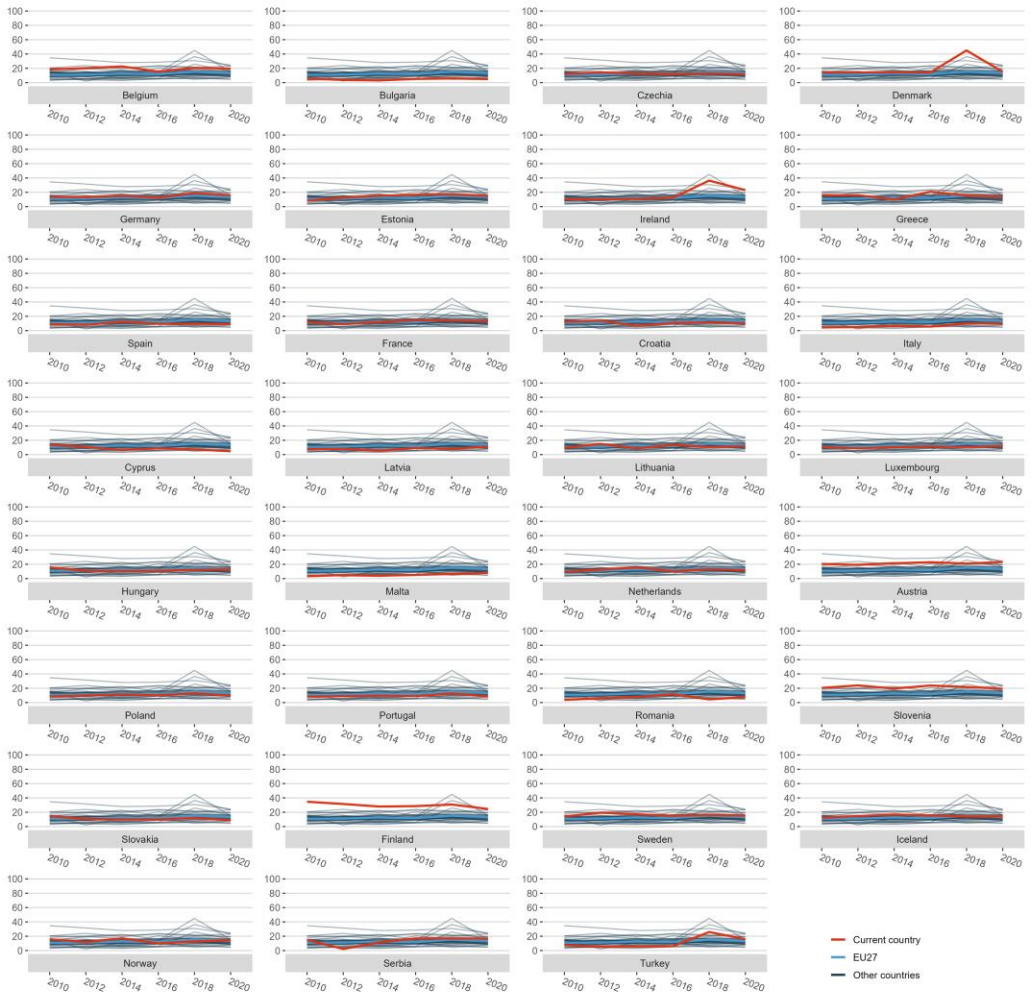


Figure 18. Share of innovating firms collaborating with higher education institutions (HEI) or public/private research institutions (PRO) out of all innovative firms (%)

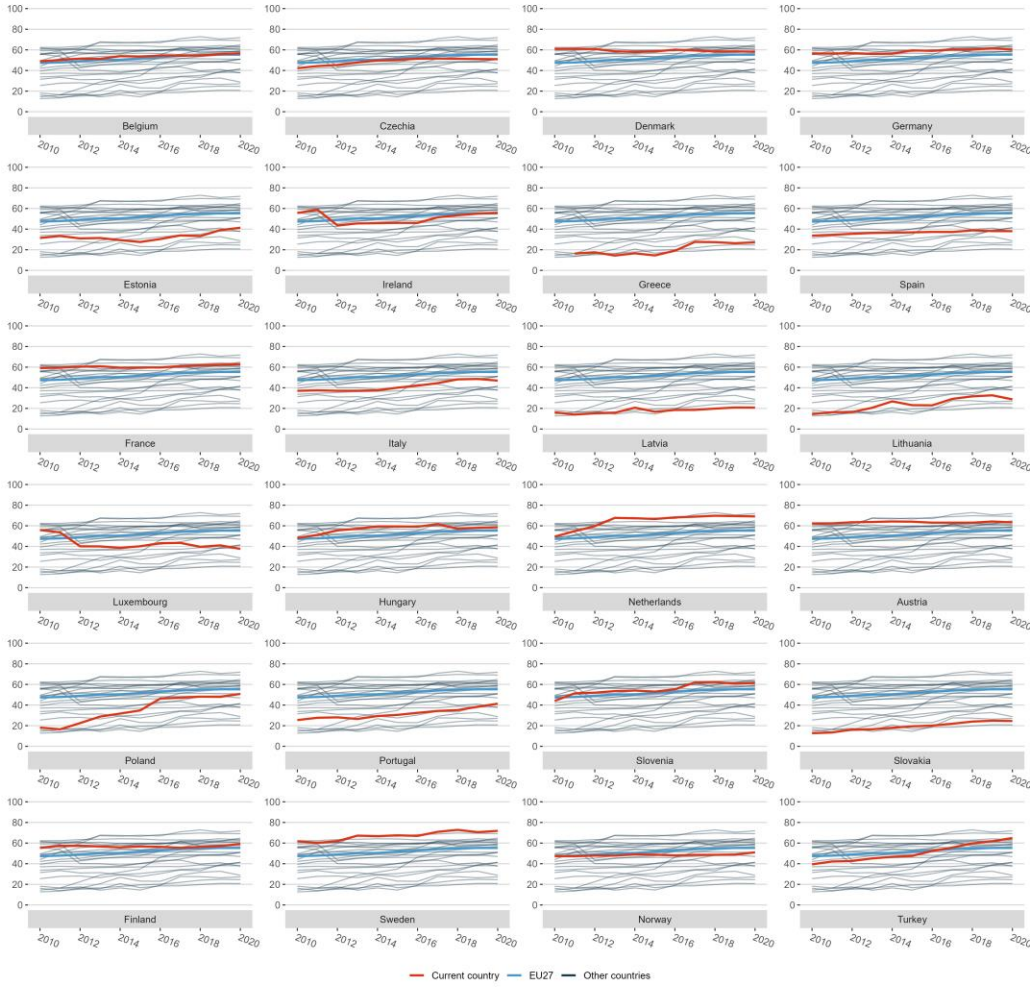


Figure 19. Business enterprise researchers as % of national total (%)

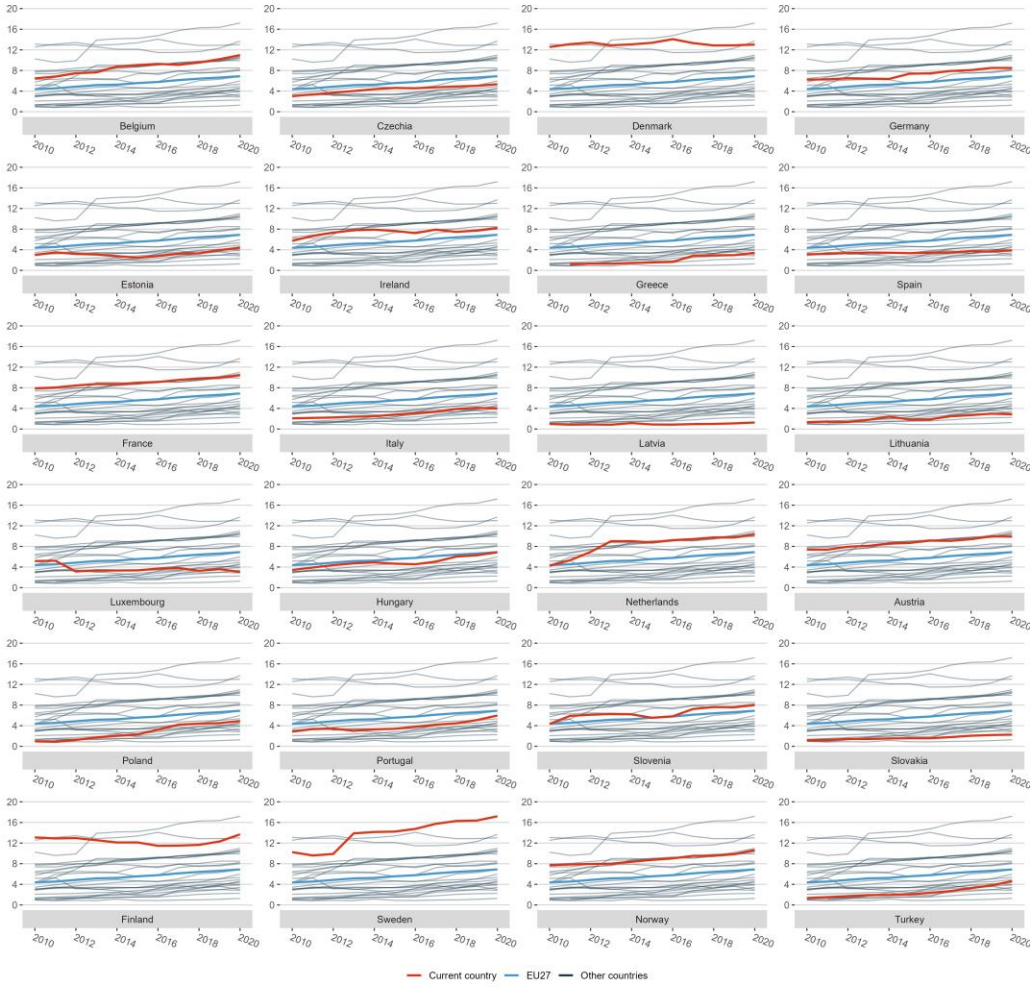


Figure 20. Business enterprise researchers in FTE per thousand employment in industry

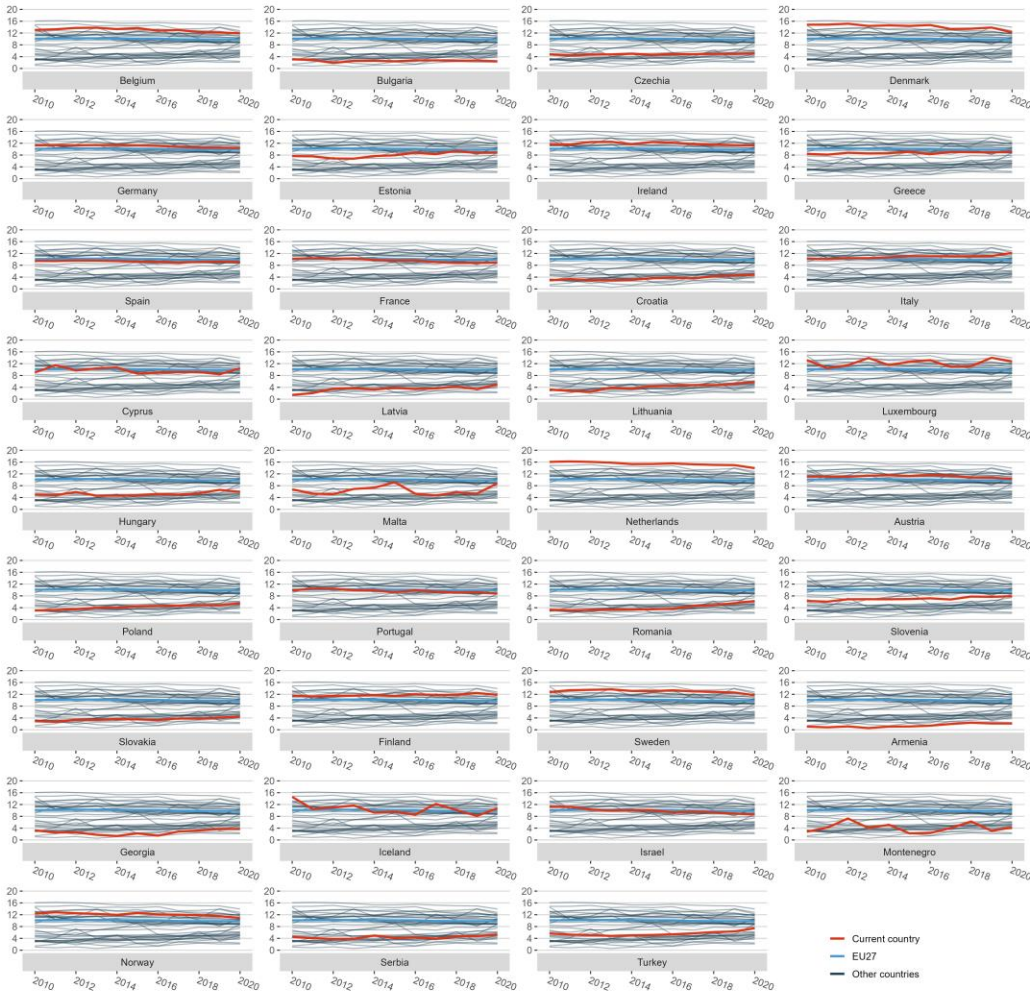


Figure 21. Number of scientific publications among the top-10% most cited publications worldwide as a percentage of all publications

Figure 22. Academic Freedom Index

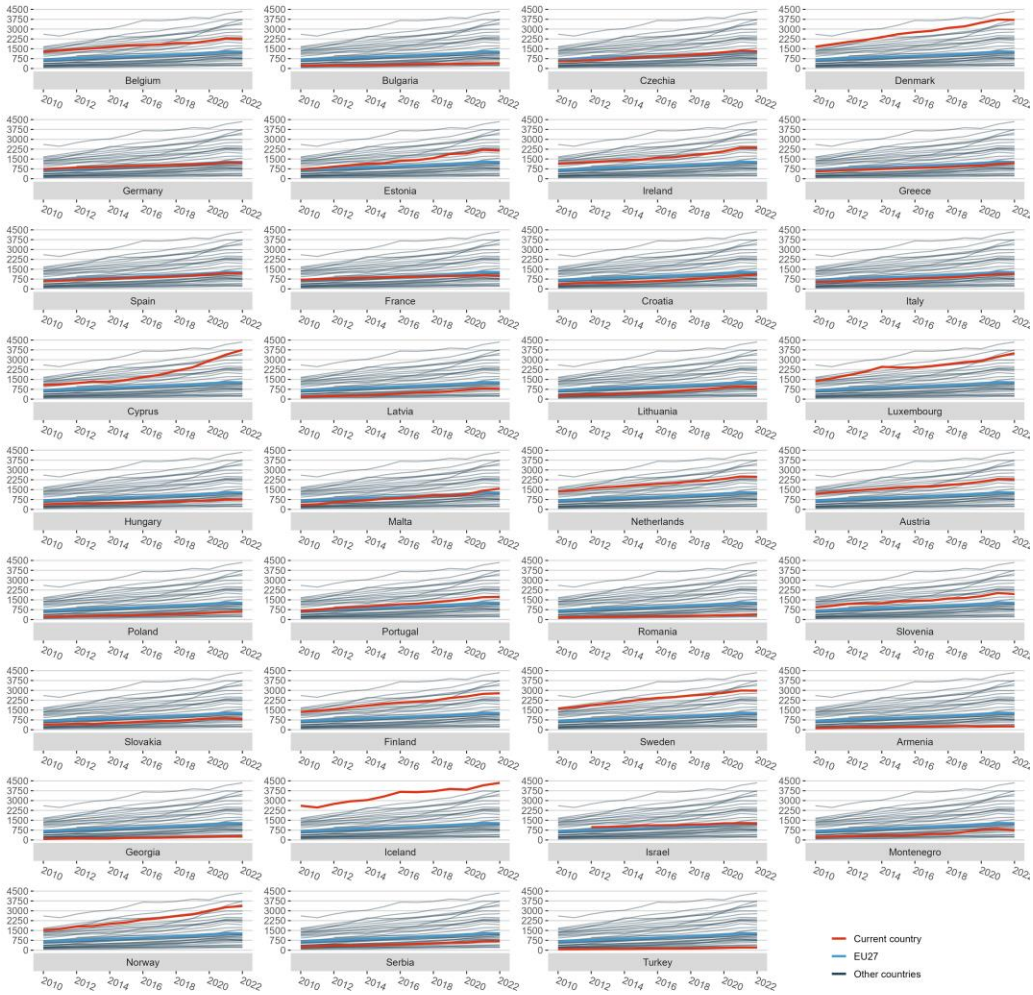


Figure 23. International co-publications with non-EU partners per 1,000 researchers in the public sector

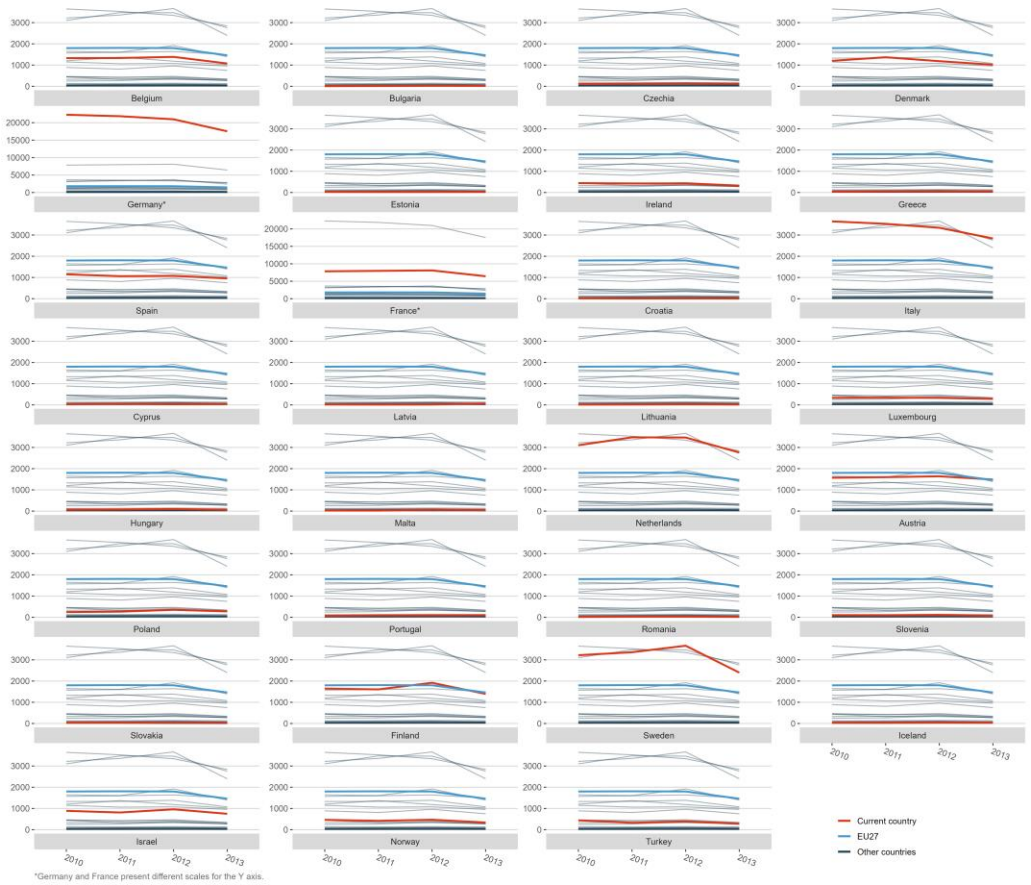


Figure 24. European and International co-patenting in EPO applications at national and EU level (n)

A2.3 Indicators for ERA Priority 2: Taking up together the green transition and digital transformation and other challenges with impact on society, and increasing society's participation in the ERA

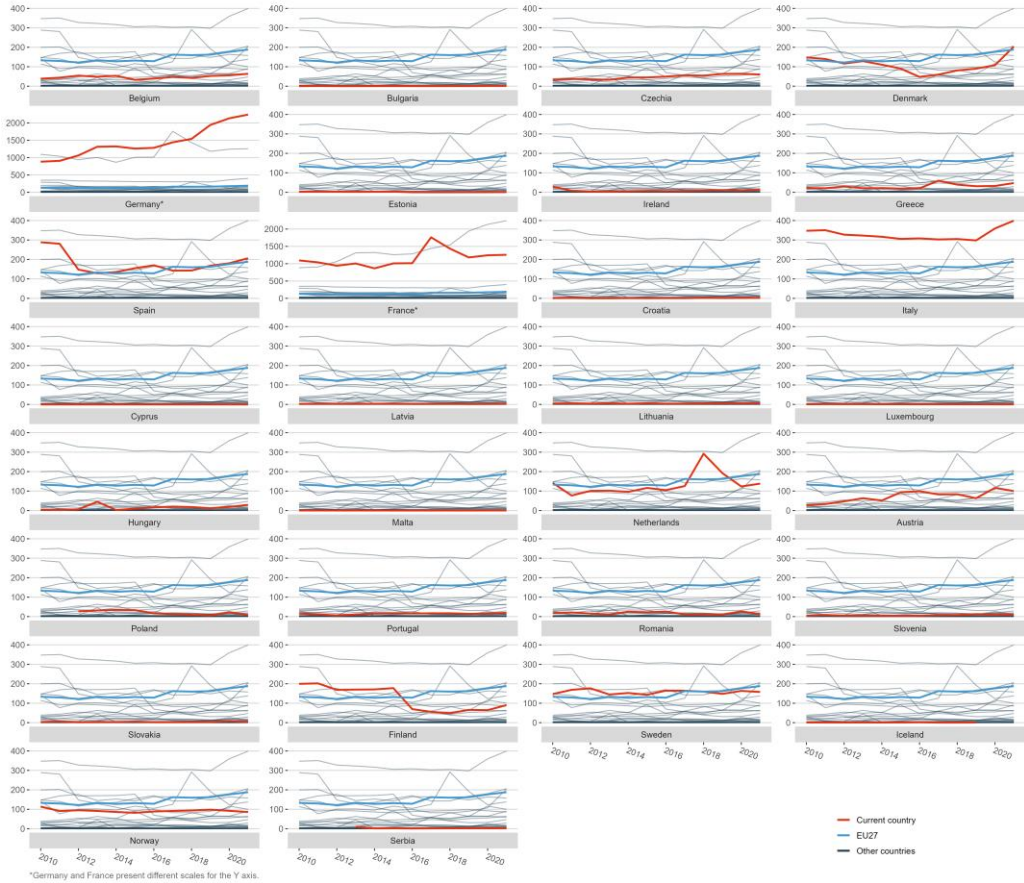


Figure 25. Government budget allocation for R&D (GBARD) by NABS (Energy)

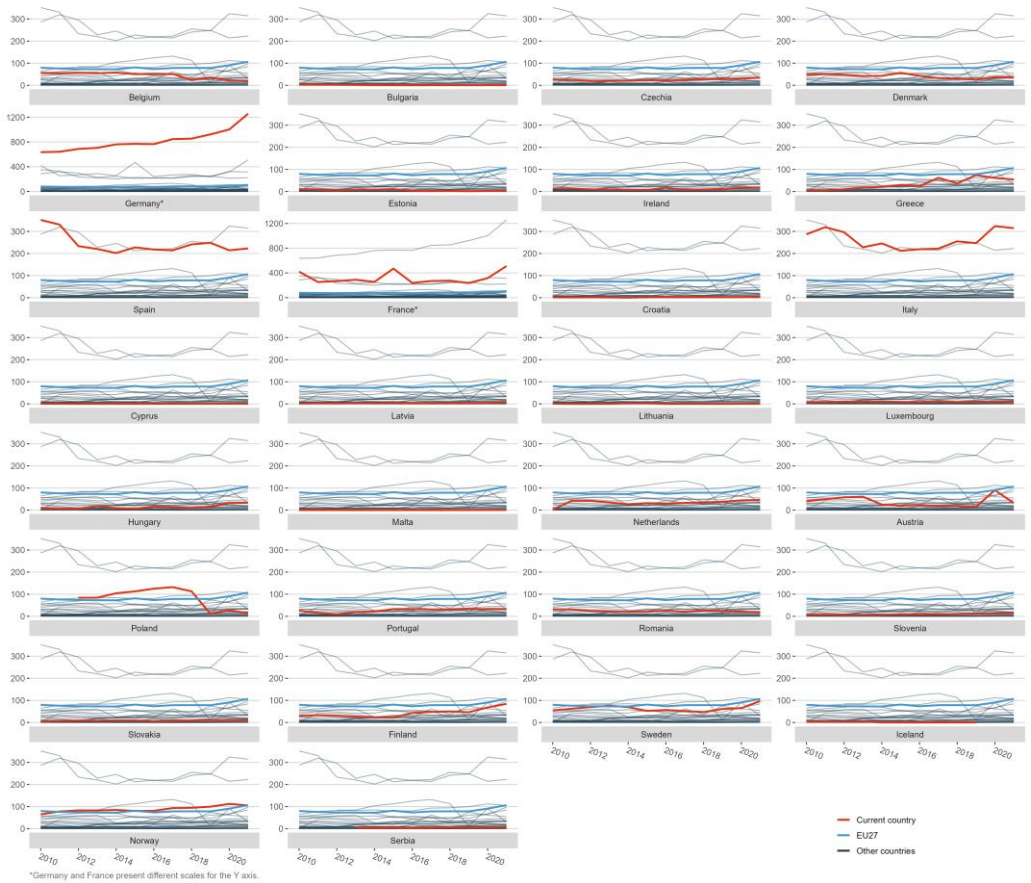


Figure 26. Government budget allocations for R&D (GBARD) by NABS (Environment)

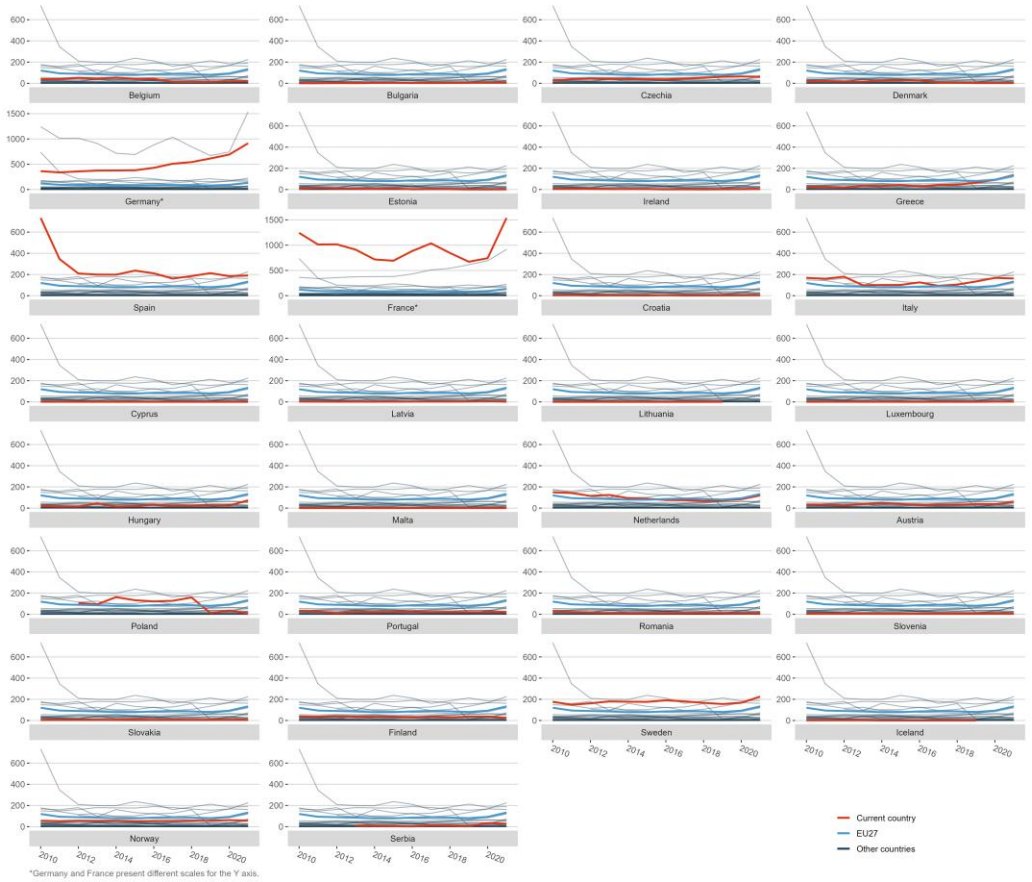


Figure 27. Government Budget Allocation for R&D (GBARD) by NABS (Transport, Telecommunications & other infrastructure)

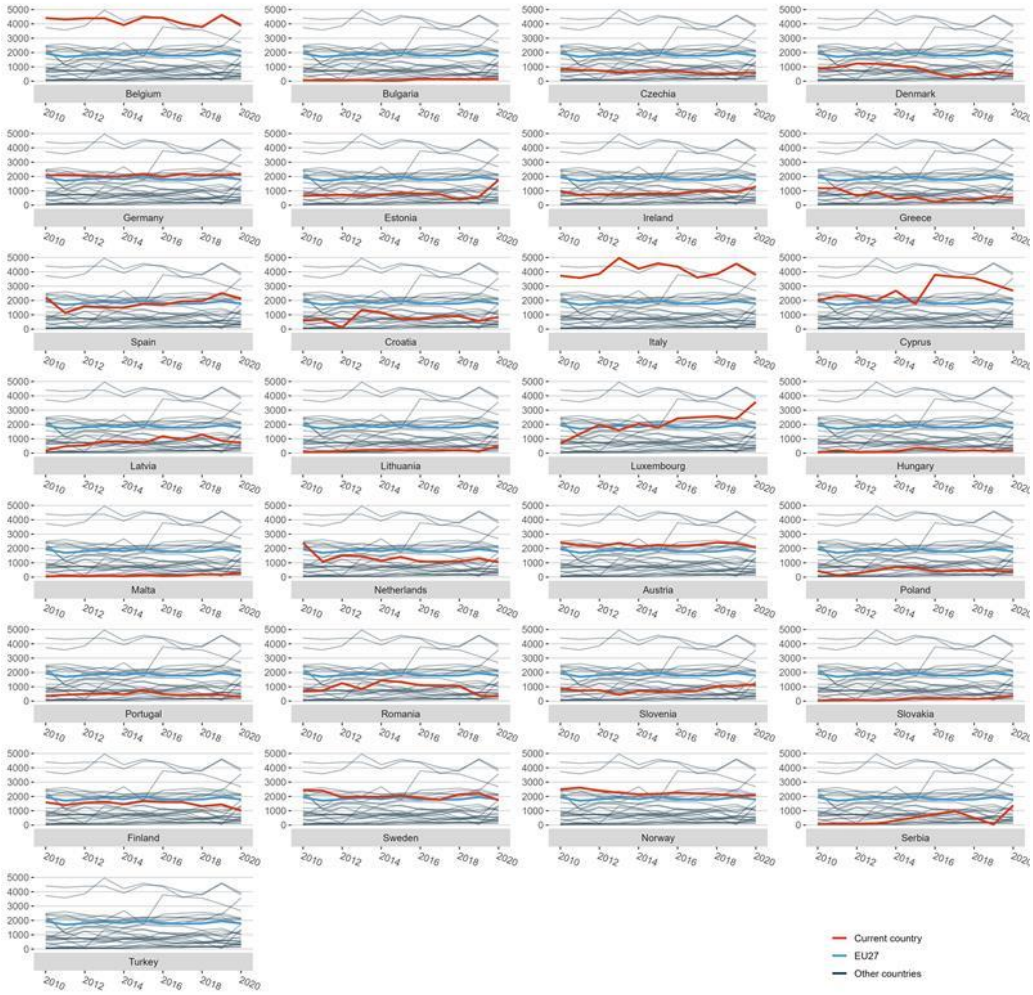


Figure 28: Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher

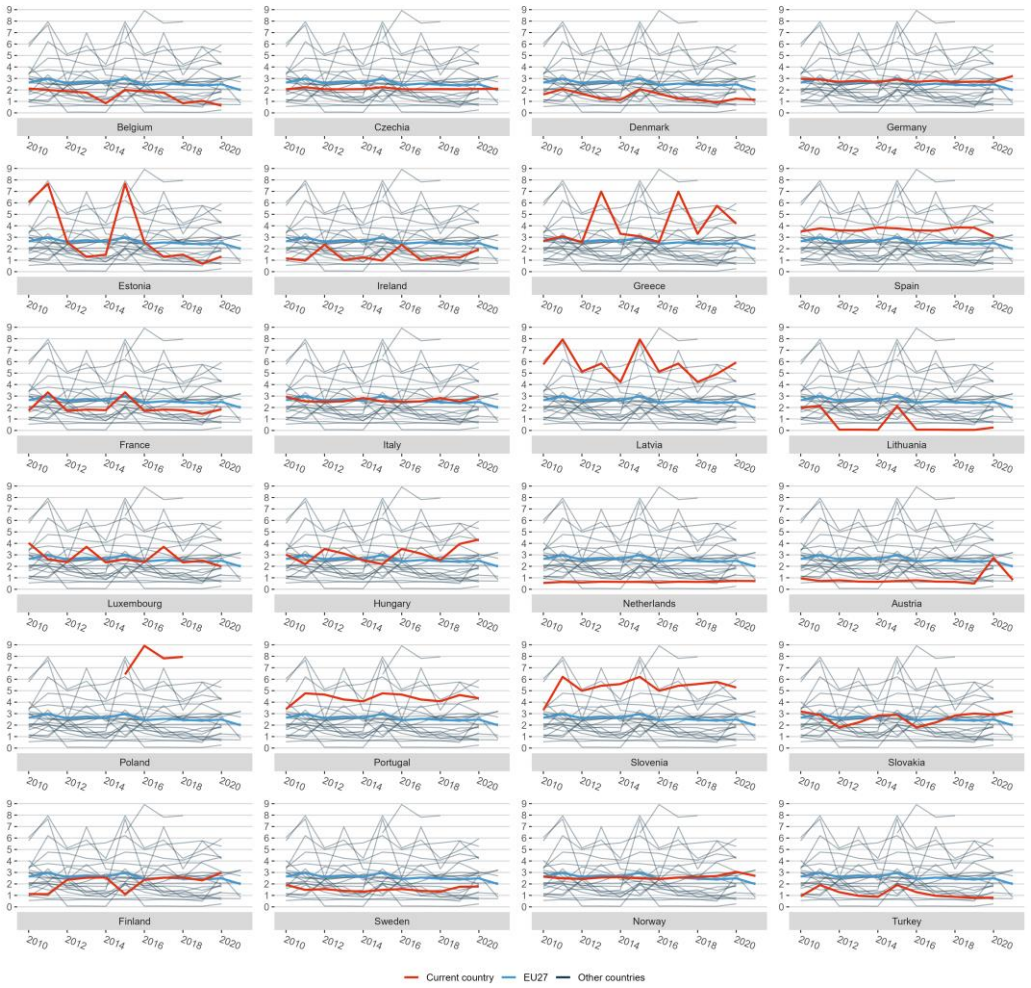


Figure 29. Environmentally related government R&D budget as percentage of total government R&D (%)

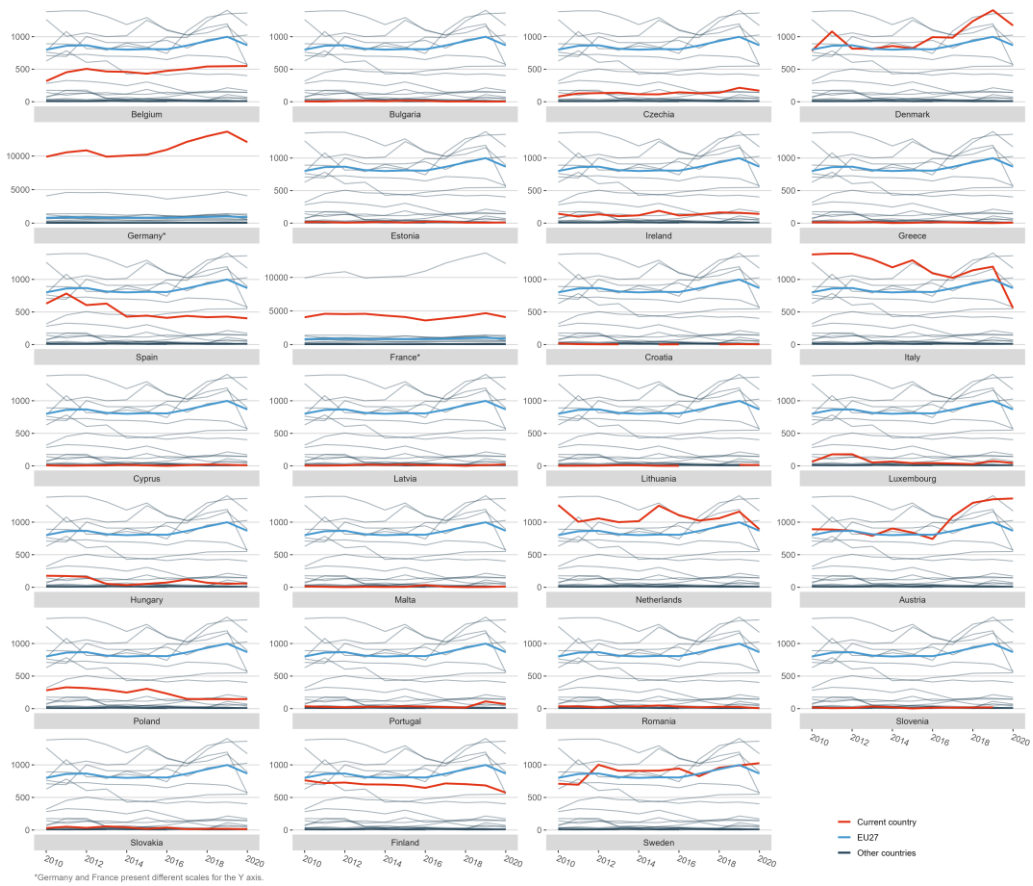


Figure 30. National Public and private investments as suggested in the SET plan progress report 2021

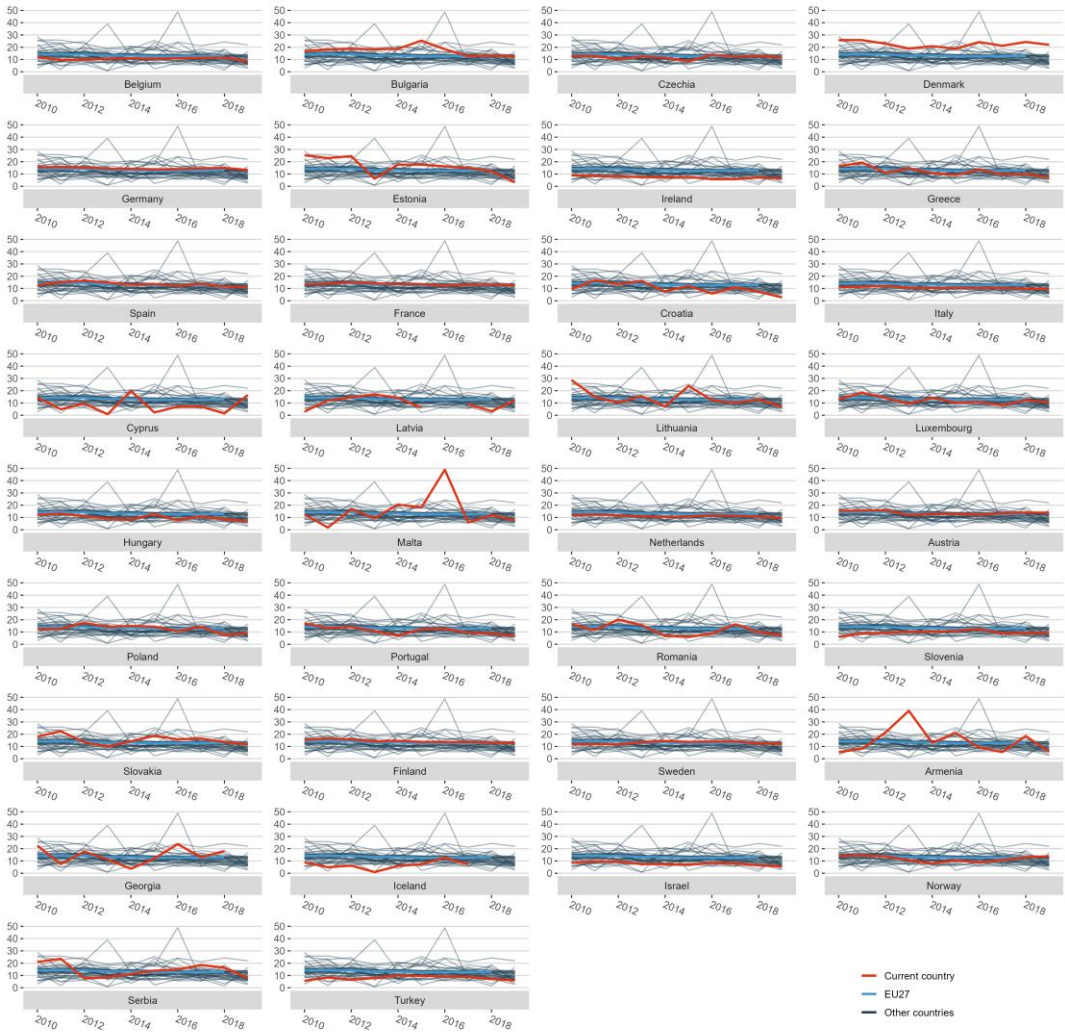
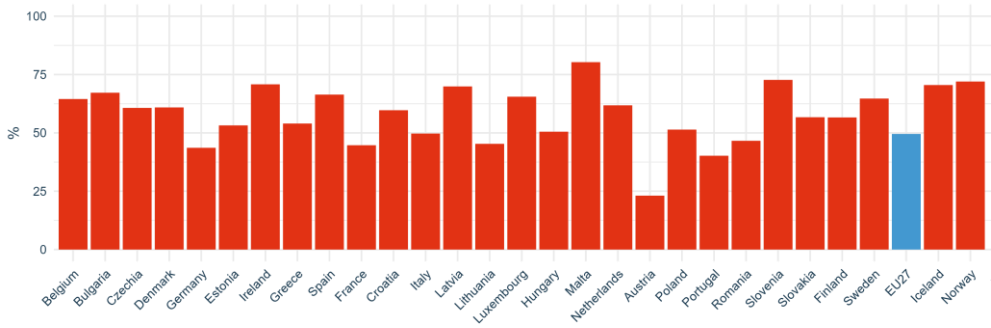


Figure 31. OECD Patents on environment technologies (n)

2016



2019

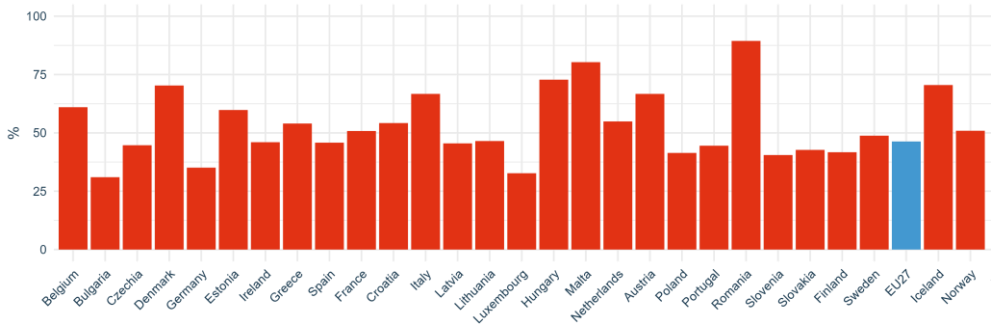


Figure 32. Share of researchers receiving transferable skills training.

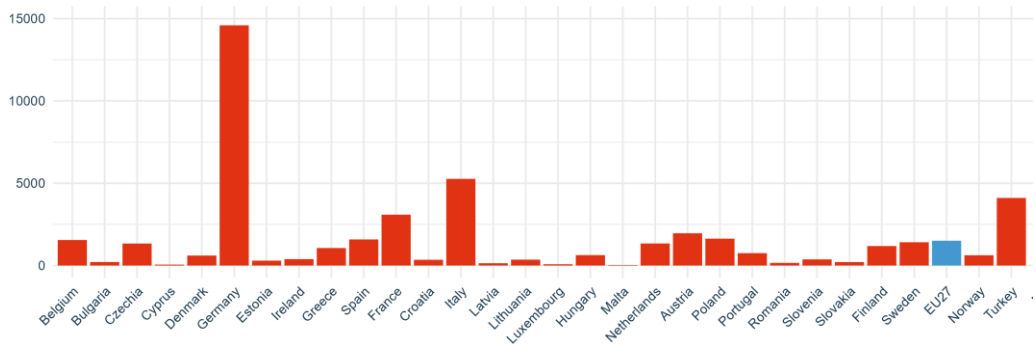


Figure 33. Innovative enterprises that co-operated on R&D+I with universities and HEIs, data for 2020 (n)

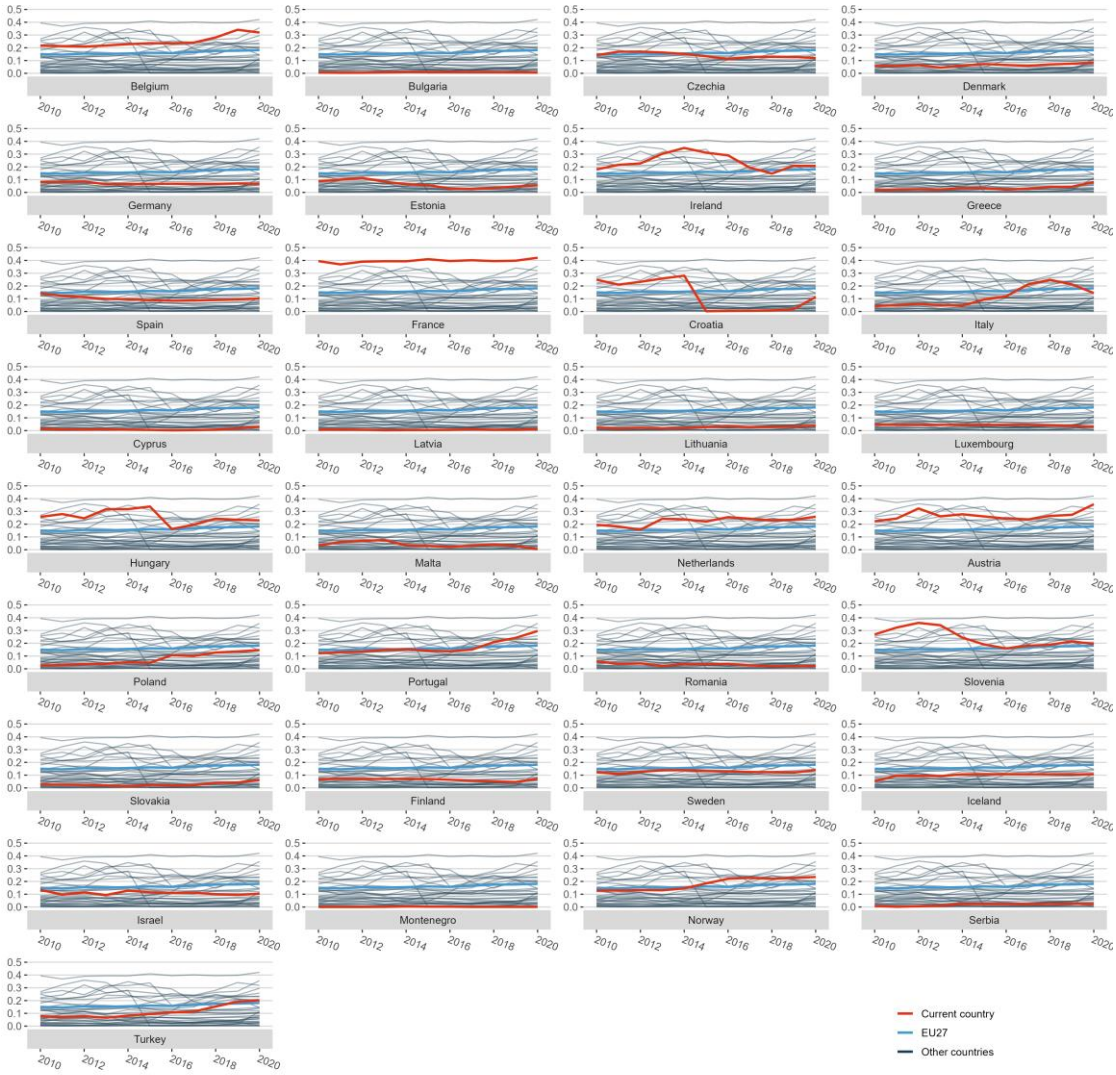


Figure 34. Direct government support and Indirect government support R&D tax incentives as a percentage of GDP

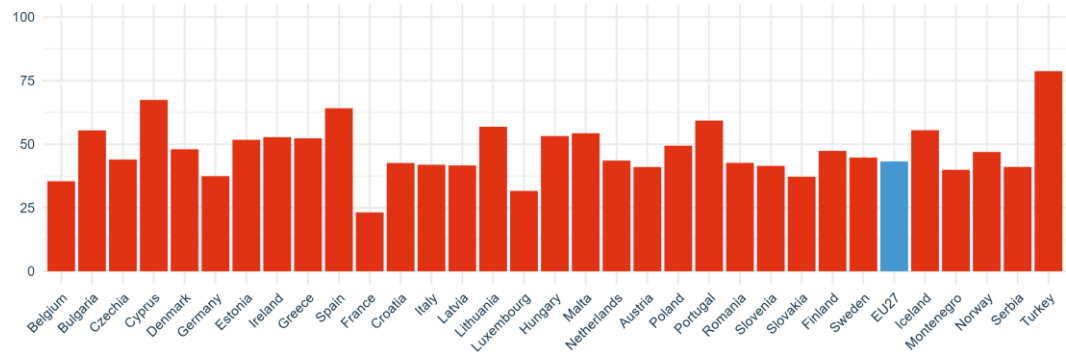


Figure 35. Trust in science

A2.4 Indicators for ERA Priority 3: Enhancing access to research and innovation excellence across the Union and enhancing interconnections between innovation ecosystems across the Union.

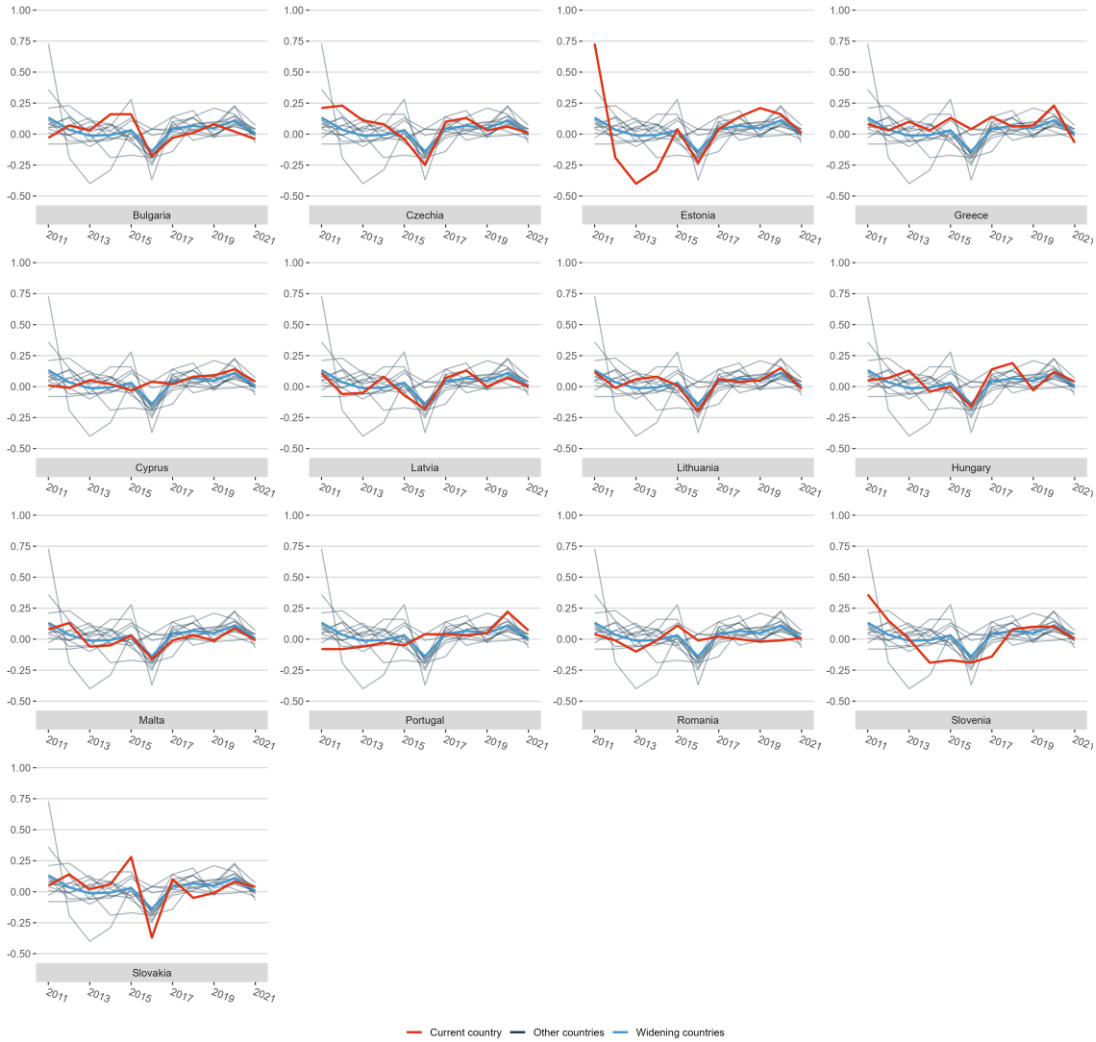


Figure 36. Increase in total R&D expenditure, expressed as a percentage of GDP (%)

A2.5 Indicators for ERA Priority 4: Advancing concerted research and innovation investments and reforms

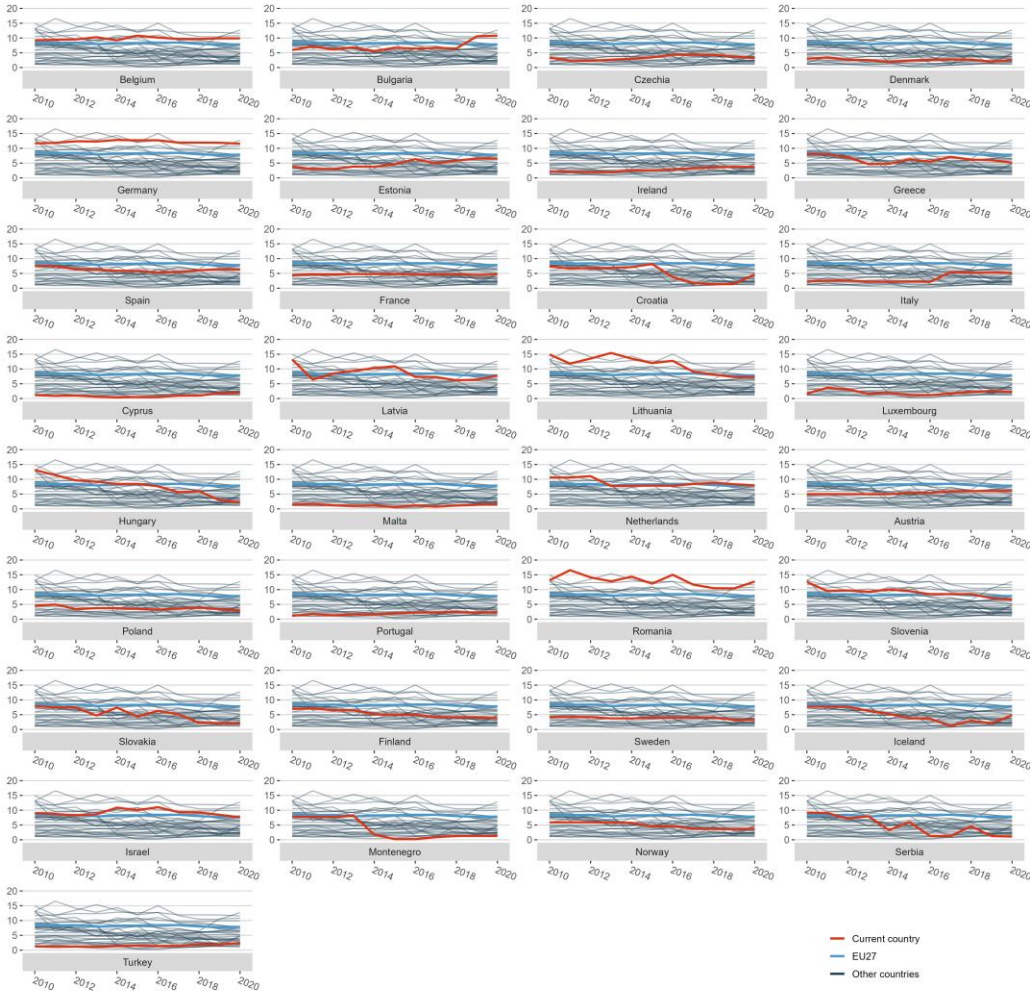


Figure 37. Share of public R&D expenditures financed by the private sector

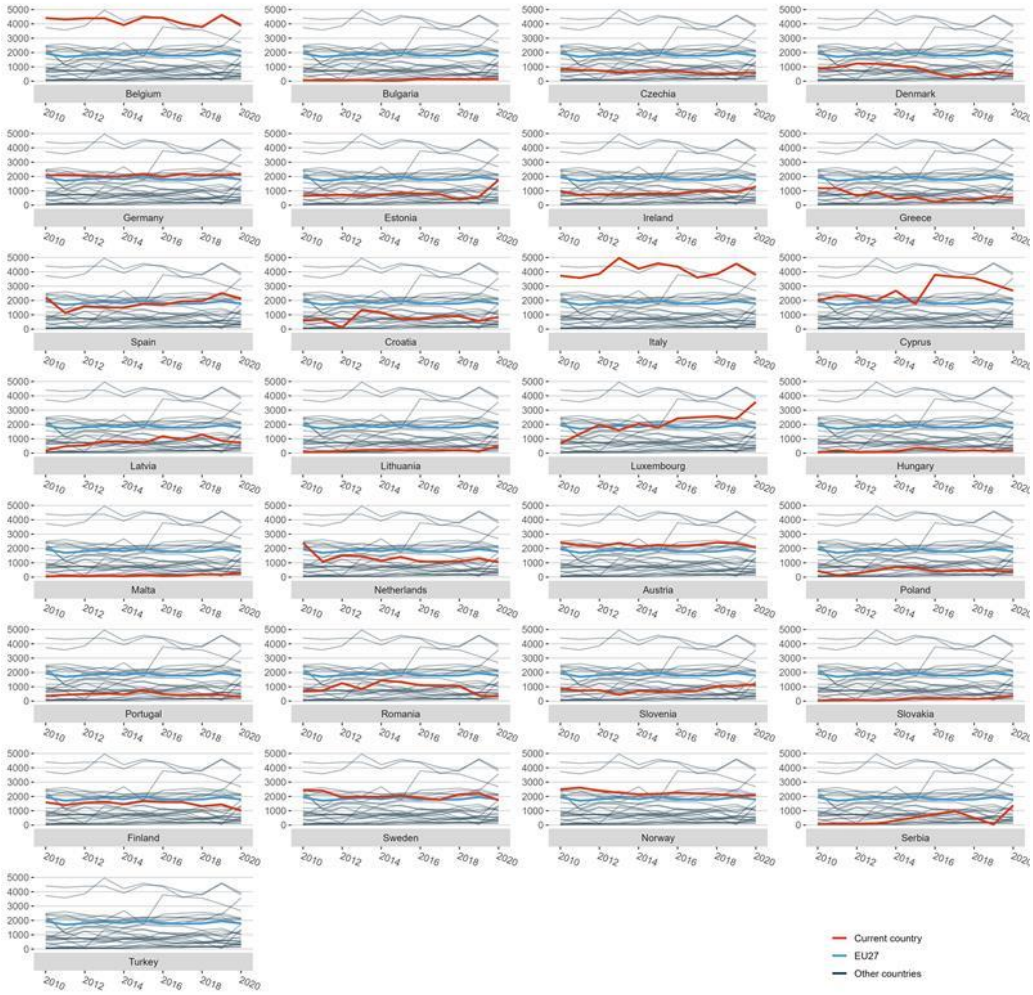


Figure 38: Government budget allocations for R&D (GBARD) allocated to Europe-wide transnational, as well as bilateral or multilateral, public R&D programmes per FTE researcher

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The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

The ERA Dashboard 2023 comprises a set of indicators and qualitative information used for monitoring progress of the EU Member States and eight Associated Countries towards the ERA objectives as define din the Pact for R&I in Europe. The quantitative information collected from different sources is complemented by qualitative information compiled by using the OECD STIP Survey and other documents. The analysis points at varying performance across objectives, and examples provided clearly show how countries can progress on identified areas for improvement.

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