ERA LEARN

COUNTRY REPORT

Germany

ERA-LEARN:
enabling systematic interaction with the P2P community

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Introduction

ERA-LEARN Country Reports

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

The ERA-LEARN data used in this report mainly refer to partnerships that were launched and supported under Horizon 2020. The analyses are based on the data available in the ERA-LEARN database by a cut-off date of June 2021. A number of provisos need to be made when interpreting these analyses. In the first instance, it should be noted that the ERA-LEARN database on Partnerships at the cut-off point was around 75% complete, as not all required information (especially project-related and financial data) had been fully updated by the partnerships. It is also important to emphasise that the data collected in terms of pre-call budget committed or actual investments in selected projects do not take into account differences across countries in the eligibility of certain expenses. In some countries, for example, only additional costs of a research project are eligible, while personnel costs are not. Furthermore, in-kind contributions made by funding organisations when participating in public R&I partnerships – which differ from country to country - are not usually considered as national investments in partnerships, although this will possibly change under Horizon Europe.

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

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

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

The Structure of This Report

The report commences with an overview of the German research and innovation system in an international context, as an aid to understanding the environment in which partnership participation takes place. The key R&I funders and performers in Germany are then identified and areas of R&I strength described prior to an analysis of Germany's research and innovation partnership participation patterns. An assessment of the strengths and weaknesses of Germany's involvement in partnerships is then presented and the report concludes with a review of topics of interest for Germany, specifically, on cancer research and green hydrogen.

Acknowledgements

We owe special thanks to officials from DLR as well as to individual researchers that shared with us valuable insights, data and information about their experience of participating in public R&I Partnerships under H2020. Overall, 31 people[3] from the following organisations were interviewed:

- Federal Ministry of Education and Research - BMBF
- Federal Ministry of Food and Agricutlure - BMEL
- Federal Ministry for Economic Affairs and Energy - BMWi
- Project Management Agency in the German Aerospace Centre – DLR-PT
- German Research Foundation – DFG
- Federal Agency for Agriculture and Food – BLE
- Project Management Juelich – PTJ
- Project Managing Agency Karlsruhe – PTKA
- Agency for Renewable Resources – FNR
- VDI Technologiezentrum GmbH – VDI-TZ

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

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

- TÜV Rheinland Consulting GmbH
- Climate Analytics
- Hochschule Für Technik Stuttgart - Institut für Angewandte Forschung
- Humboldt University Berlin
- Deutsches Zentrum für Neurodegenerative Erkrankungen e.V. (DZNE)
- GEOMAR Helmholtz Centre for Ocean Research Kiel
- Charité - Universitätsmedizin Berlin
- Central Institute of Mental Health
- Karlsruhe University of Applied Sciences
- University Medical Centre Hamburg-Eppendorf
- Universität Kassel - Institut für urbane Entwicklungen

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

Key Highlights

Within Horizon 2020 (2014-2020) Germany has taken part in 87 public partnerships. This is comparable to France and Spain with 89 and 91 partnerships respectively, and by far exceeds the EU averages. Concerning the coordination of partnerships, the country presents one of the top scores (21 coordinations), coming second only to France with 23 coordinations (Table 1, Figure 1).

German ministries and funding agencies have taken part in 215 calls for proposals, which is rather similar to the number of call participations in France and Spain. When it comes to how many proposals were selected for funding through these calls, Germany is the top scorer having supported 1616 projects - almost three times the EU14 average[4] and more than four times the EU27 average - reflecting the country's significantly larger research capacity (researchers' FTE). (Table 1).

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

	D	FR	IT	ES	SE	EU13 aver.	EU14 aver.	EU27 aver.
Number of partnerships	87	89	78	91	75	38	69	52
Partnership participations	179	145	144	170	96	40	105	71
Partnership coordinations	21	23	4	5	4	3	7	7
Number of calls	215	219	193	224	143	87	154	122
Supported projects	1616	1161	843	998	709	113	618	375
Researchers (FTEs) ('000s – 2015-19)	417.98	295.88	142.57	131.54	72.57			
R&D Intensity (% GDP-2019)	3.18	2.19	1.45	1.25	3.4			

Source: ERA-LEARN database[5] (cut-off date June 2021); Eurostat; JPI data exclude the associated Cofund data

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

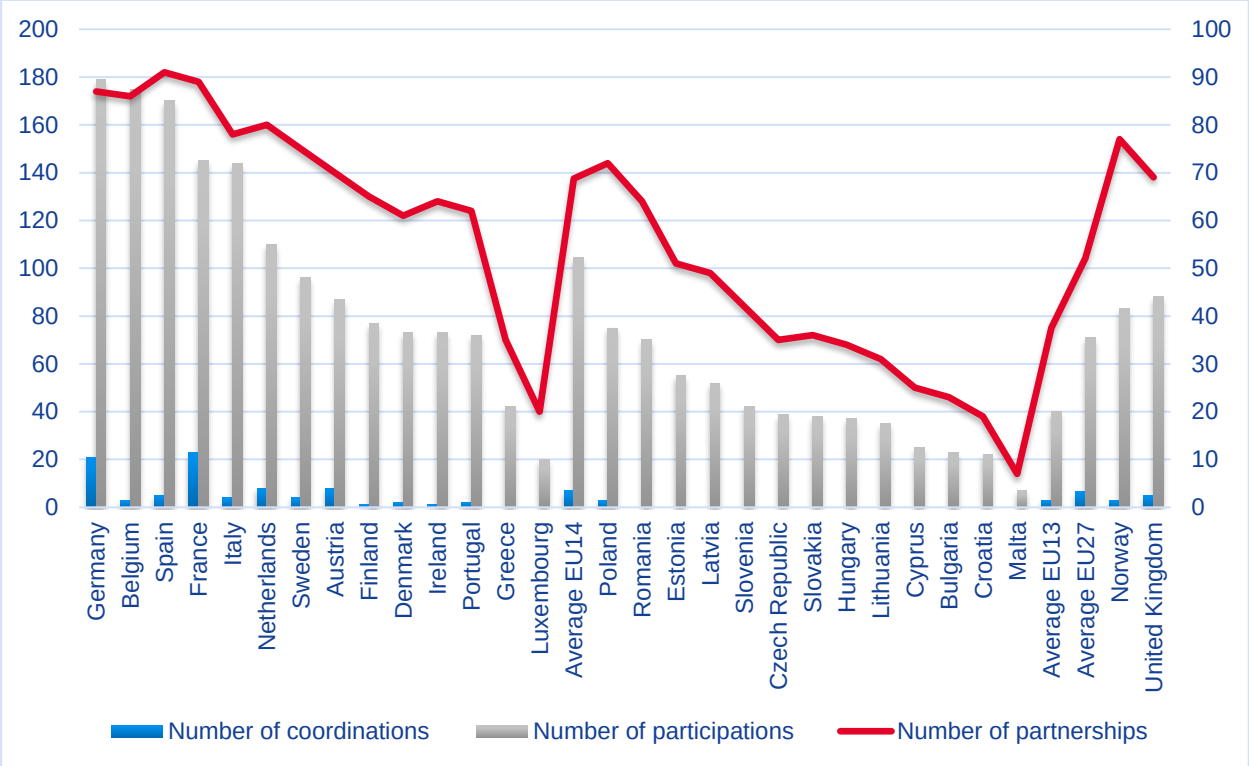
Considering the research capacity (researchers in full-time equivalents - FTE) and the R&D intensity (GERD as share of GDP), it appears that rising researcher FTE and R&D intensity levels are associated with rising numbers of supported projects in Germany, France and Italy. The outliers seem to be Spain and Sweden. Spain presents a relatively higher number of supported projects compared to Italy although the research capacity and intensity of the two countries are similar. Sweden, on the other hand, despite its top rank in terms of research intensity, presents

[4] EU15 excluding UK.

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

the smallest number of supported projects in the comparator group of countries reflecting the small size of the national research community. (Table 1)

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



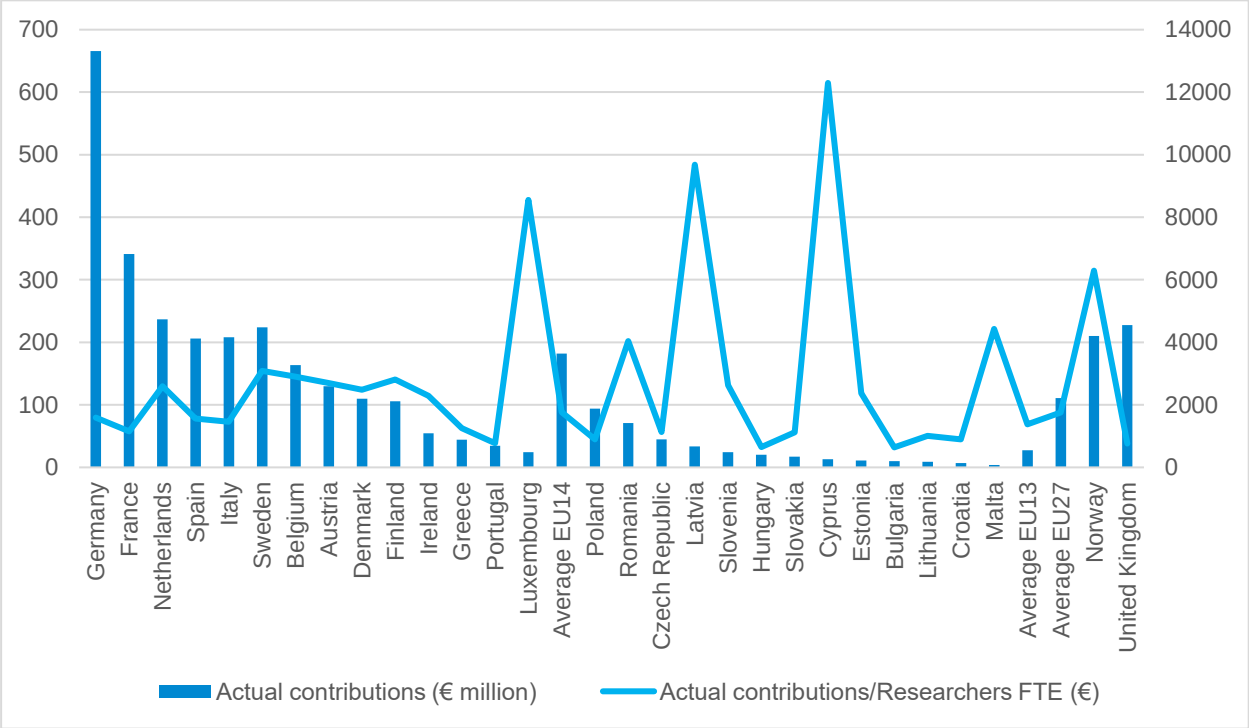
Source: ERA-LEARN database (cut-off date August 2020).
(*) Partnership coordinations: number of partnerships a specific country coordinates. Partnership participations: number of partnerships a specific country takes part as participant. Total partnership participations: number of partnerships a specific country participates in with any role (i.e. coordinator, participant, observer, other).

Germany is at the top of all participating countries in terms of the national contributions made available pre-call with € 666 million during Horizon 2020. This is almost double the amount made available by the second country in the rank, France, with € 341 million.

However, when these contributions are normalised by the number of researchers (FTE), Germany drops down to the 18th place with around € 1593 per researcher FTE. This is a bit below the EU27 or EU14 averages (around € 1760 per researcher FTE), comparable to Spain (€ 1566) and Italy (€ 1458), but above France (€ 1154) and far below Sweden (€ 3084). (Figure 2)[6].

[6] These amounts are significantly lower than those appearing in previous country reports due to the fact that the figures on researchers FTE came from the OECD Main S&T Indicators in the previous reports. The OECD figures on researchers' FTE are much lower than the respective EUROSTAT figures. As the OECD database lacks data for certain EU countries, the EUROSTAT data in researchers' FTE will be used from now on.

Figure 2: Pre-call national commitments, in total (€ million) and per researcher FTE (average 2015-2019) (in €)



Source: ERA-LEARN database (cut-off date June 2021)
(*) Pre-call budget is the money committed by each country before the launch of a joint call.
(**) Pre-call budget for each researcher is the total pre-call budget committed by a country divided by the number researchers in the country estimated in full-time equivalents (FTE). The average is for the years 2015-2019 based on EUROSTAT data.

Based on the available ERA-LEARN data, Germany presents the highest share of coordinators in partnership-supported projects. Of the total project coordinators, 15.74% are German organisations while this percentage falls below 10% for the comparator countries: Spain (9.92%), France (8.69%), Italy (7.41%) and Sweden (6.41%).

The national R&I system in Germany is among the strongest ones in the EU, backed up with high volumes of research funds, a long tradition of competitive programme-based funding for pre-commercial research, research actors of high international standing alongside industrial sectors that are pioneering in various areas of research and innovation. The areas of competence of the German researchers span a wide range of scientific and technological fields and are thus key partners in collaborative R&I activities including those of the partnerships. In addition, the national priorities in research and innovation largely reflect, similar to the EU, priorities and societal challenges. The above factors have laid favourable ground for the participation of German organisations in partnerships.

Based on the interviews held with officials from the ministries and funding agencies that are currently mostly engaged in partnerships, the opportunities offered for international collaboration are highly appreciated. Germany has always been in favour of international collaboration in research and innovation, although the research capacity and performance of the country is very strong. There are challenges that cannot be tackled by any single country alone, while international collaboration is the sine qua non of keeping abreast of developments and maintaining a leading position in key areas of strategic importance. It is also acknowledged that

partnerships provide a valuable space for mutual policy learning and for shaping and aligning policies in relation to research and innovation, and thus strengthening the ERA.

However, the funds made available for public R&I partnerships are limited in comparison, for instance, to what is available for the national programmes. On the other hand, Germany tops the other participating countries in terms of funds committed for partnerships, although it holds a rather low place in relation to the funds committed per researcher.

Based on BMBF officials, the new approach to partnerships under Horizon Europe is a clear improvement compared to the past in terms of pushing for a more strategic approach that requires long-term commitments. This has made clear that a certain level of centralisation and coordination needs to be built at the national level to support the development of a national strategy for partnerships in view of Horizon Europe. This is gradually being addressed by BMBF that is creating a coordination process that includes all relevant stakeholders from the research and business communities, as well as other relevant ministries (Economy, Environment, Health, and Agriculture). Yes, some interviewees pointed out the large size of the new partnerships may prove rather cumbersome in terms of administration, while their challenge-driven orientation might leave out certain areas such as humanities.

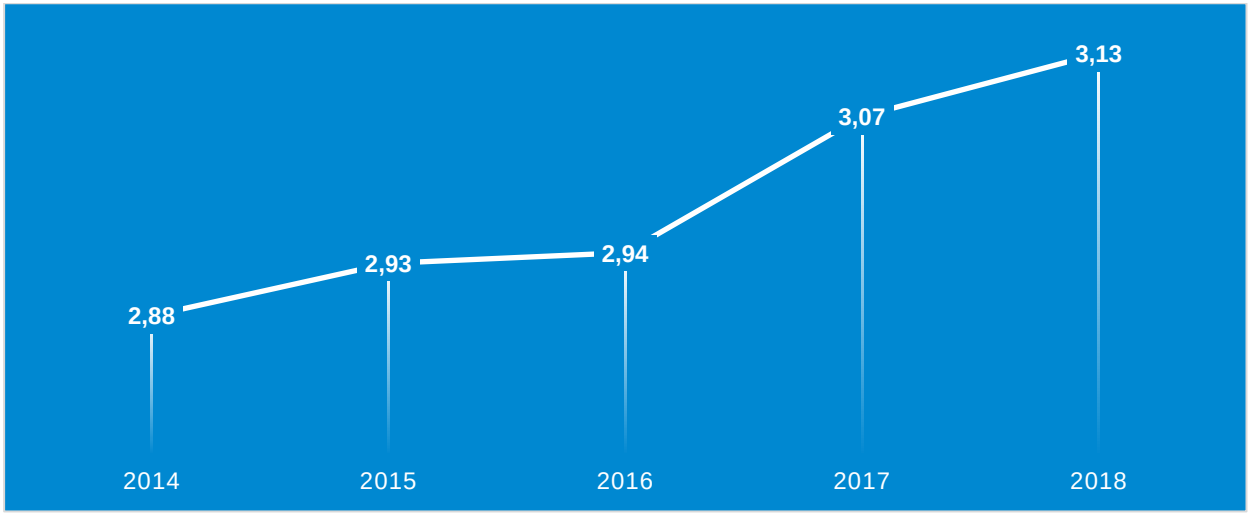
According to the interviews carried out with German researchers, partnerships offer unique opportunities for collaboration. The added value is clear in comparison with other national or transnational schemes like Horizon 2020. Partnerships enable collaboration with counterparts from other countries including non-EU countries in small-scale consortia, in projects bearing lower administrative efforts and addressing research areas that are usually not funded by the existing alternatives. There are hurdles that need to be overcome mostly in relation to the different national rules and timings of programme cycles that need to be aligned. The duration of projects as well as the funds made available per project need to be extended. Besides the drawbacks the partnerships are valued as an important instrument complementing other national and European initiatives.

Germany is the leader in terms of engagement and performance in public R&I partnerships. This is due to a well-funded national R&I system with world- famous research actors whose expertise covers a wide range of research areas. Although the funds committed per researcher are not that large, Germany makes the largest investment in comparison to the other countries, even though the funds made available are considered limited in some cases. German researchers appreciate the opportunities offered by partnerships for international collaboration and clearly see the added value in relation to national programmes or Horizon 2020. The new approach to partnerships is a clear improvement in relation to the past, although certain challenges going forward are envisaged.

1. German Research and Innovation in an International Context

Germany has been experiencing uninterrupted economic growth during the last decade, although, this is not granted for the future due to the global outbreak and spread of the coronavirus that is expected to lead to a steep decline in growth in the German economy.[7] With one of the highest gross expenditure in R&D in EU27 (3.13% of GDP in 2018, Figure 1) and having achieved the target of spending at least 3% of GDP for R&D even back in 2017, Germany is among the strong innovators in Europe, supported by a rich and diversified research and innovation landscape addressing all scientific and technological fields.

Figure 3: Gross Expenditure in R&D (GERD) as share of GDP in Germany



Source: Stifterverband Wissenschaftsstatistik; Federal Statistical Office; Federal Ministry of Education and Research as cited in Education and Research in Figure 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

Based on data from 2018-2020, the Federal Government's expenditure in R&D mostly focused in the areas of Health research and health industry, followed by Aerospace, Energy research and energy technologies; Climate, environment and sustainability; ICT; Humanities and social science. Public- and private-sector spending on research and development in 2018 rose by 5.3% compared to 2017 reaching €104.8 billion in total, that is 3.1 of GDP[8] and the latest goal is to reach 3.5% by 2025.[9] The R&D intensity of Germany's Länder also increased between 2007 and

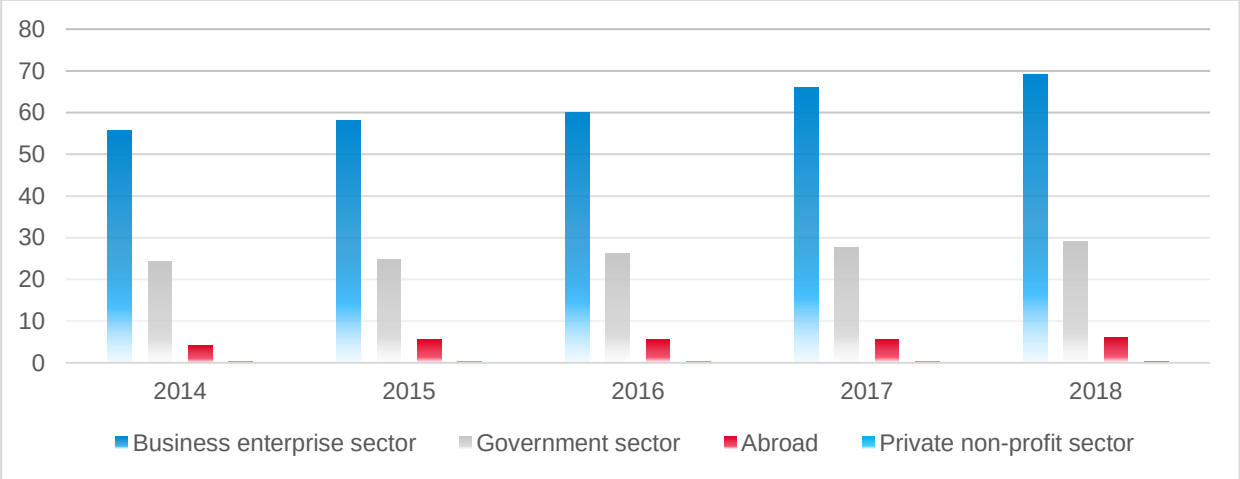
[7] National Reform Programme 2020, BMWI, https://www.bmwi.de/Redaktion/EN/Publikationen/national-reform-programme-2020.html

[8] Education and Research in figures 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

[9] National Reform Programme 2020, BMWI, https://www.bmwi.de/Redaktion/EN/Publikationen/national-reform-programme-2020.html

2017, with Baden-Württemberg topping the other Länder as it spent by far the highest percentage of its GDP on R&D, from 4.16 % in 2007 to 5.63% in 2017.[10]

Figure 4: Gross domestic expenditure on research and development, by funding sectors (implementation view) and in % of the gross domestic product (2014-2018)



Source: Stifterverband Wissenschaftsstatistik; Federal Statistical Office; Federal Ministry of Education and Research as cited in Education and Research in Figure 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

The business R&D intensity in Germany (2.2% in 2018) is the third-highest in the EU. The target that at least two thirds of the gross expenditure in R&D should come from the business sector has already been achieved in 2017 and the trend has been increasing over the years. Internal corporate expenditure on R&D reached €68.8 billion in 2017 (Figure 2). Thus, the business sector is performing the largest share of R&D in Germany, although business R&D is predominantly performed by large firms in R&D-intensive industries, whereas SMEs' R&D expenditure has stagnated over the past decade (ZEW, 2019).[11] The vehicle construction field is the one that absorbs most of the funds together with the electrical/electronic and mechanical engineering sectors, chemicals as well as pharmaceuticals.

The European Innovation Scoreboard 2021 places Germany in the group of *strong iinnovators* with the strongest innovation dimensions being *innovators*, *intellectual assets* and in particular, *pct patent applications, employment impacts* (in particular *employment in innovative enterprises*), *firm investments, and linkages* (in particular *public-private co-publications*). As noted by the latest EIS survey the most recent increase in the country's performance is due to improved levels of *innovative SMEs collaborating with others*, and *product and business process innovators*. On the other hand, the relatively weakest innovation dimensions (compared to EU) are *population with tertiary education, foreign doctorate students* – although there they increased by 38% in the last five years[12], *government support for business R&D, lifelong learning, and venture capital expenditures*.[13] Germany is also a worldwide leader in patent applications. Germany accounts for

[10] EFI Report on Research, Innovation and Technological Performance in Germany, https://www.e-fi.de/en/publications/reports

[11] European Semester Country Report Germany 2020, 2020 European Semester: Country Reports | European Commission (europa.eu)

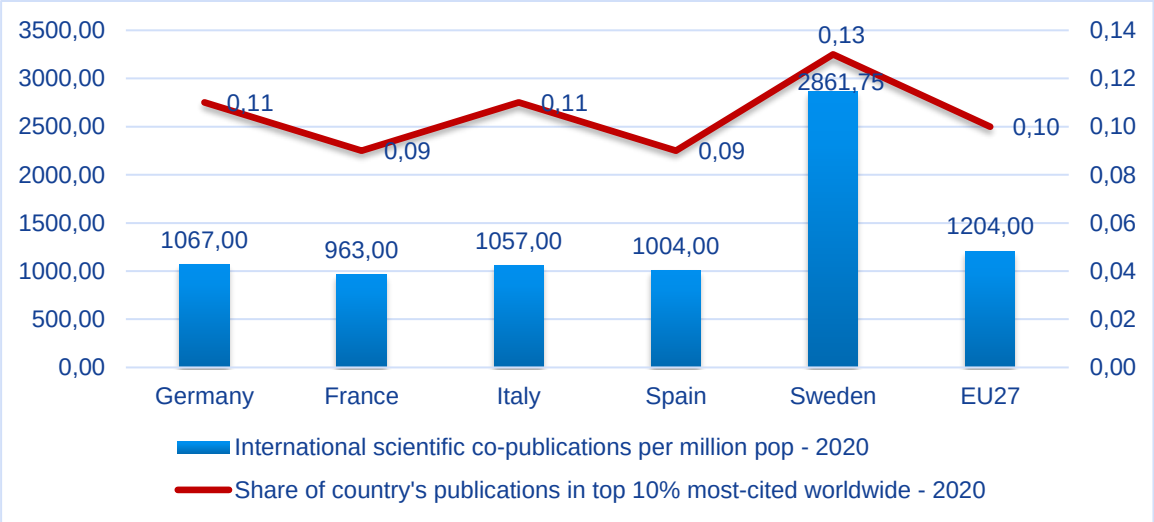
[12] Based on the Education and Research in Figures 2020

[13] European Innovation Scoreboard 2021 Country Report for Germany, https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

nearly twice as many patents with world market relevance per million citizens as the USA. International comparisons show that Germany is highly specialized in high-value technology (C 6-3) because of its traditional strengths in the automotive, mechanical engineering and chemical industries.[14]

The 'attractiveness' of the German research system[15] is relatively medium, ranking nineteenth among the countries compared in the European Innovation Scoreboard 2021. The country's performance falls to the 20th place when it comes to 'international co-publications per million population'. However, Germany is ranked 13th in terms of 'scientific publications among the top 10% most cited'. Germany compares well with all benchmark countries in terms of international co-publications and most cited publications, except Sweden where international scientific co-publications are almost three times more, although the score for Sweden for the top cited publications is not that higher than for the other countries (Figure 5).[16]

Figure 5: Selected EIS 2020 indicators for 'Attractive research systems' for Germany and the comparator countries



Source: European Innovation Scoreboard 2021

Interestingly, exploring the web of science data and studying the period 1995-2019 with citation-based indicators presented for publications until 2017[17], Stephen and Stahlschmidt, (2021)[18] conclude that Germany is among the top countries that contribute the highest shares of excellent publications[19] to the global corpus. Germany holds the 4th position in the overall share, indicating that it contributes a larger share of excellent publications than, for instance, the Netherlands

[14] Education and Research in Figures 2020

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

[16] https://interactivetool.eu/EIS/EIS_2.html

[17] whereas the European Innovation Scoreboard is based on Scopus and presents annual scores

[18] Education and Research in figures 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

[19] National shares in 10% most cited publications

(1.9%), Sweden (1.1%), Belgium (0.9%), and Denmark (0.8%).[20] In addition, as the "Education and Research in Figures 2020" show Germany's international position has been improving continuously in recent years with the relevant indicator of the quality of scientific publications from German scientists having risen from 13 to 16 between 2008 and 2016, although in 2016, articles from Germany were cited less frequently than other articles.[21]

Notwithstanding the relatively good position in terms of international research outputs, Germany falls to the 24th place in terms of 'foreign doctoral students' in the European Innovation Scoreboard 2021. The share of foreign doctorate students (in all doctorate students) in Germany is the lowest one among the comparator group and far lower than the EU27 average (11.93% for Germany vs. 18.73% for EU27).[22] Yet, based on the WIWE study 2020[23], Germany is third in rank with around 59,000 international academics and researchers at German universities after the USA (135,000) and the UK (around 65,000). The number of all international research associates at German universities has risen continuously since 2007. Italy, China, India and the two German-speaking countries, Switzerland and Austria, are the key countries of origin. German academics and researchers that live abroad are mostly employed in Switzerland (around 8,600), the United Kingdom (around 5,800) and Austria (around 5,400), while for young academics and researchers, the key host countries were the USA (13%), the UK (9%) and France (8%).

European and international collaboration have always been considered of crucial importance by the German R&I policy actors. Germany was among the first countries to prepare a national strategy and roadmap for the ERA[24]. Although the document dates around 7 years back, they are still valid and indicate the country's strategic orientation towards collaborations beyond national borders. The German ERA strategy makes specific reference to the JPIs and declares the commitment of the country to continue supporting JPIs and other instruments, initiatives and platforms of cross border cooperation such as European Innovation Partnerships (EIPs), ERA-NETs and ERA-NET Cofund Actions, EUROSTARS, COST, Art 185s, Joint Undertakings, contractual public-private partnerships, etc.

The National Reform Programme 2020 cites several important initiatives of international collaboration. In particular, Germany is providing funding of approximately €560 million up to 2023 for battery research under the overarching concept of the Battery Research Factory, and well over €1 billion for the Battery Cell Innovation IPCEI[25] including Austria, Belgium, Croatia, Finland, France, Germany, Greece, Italy, Poland, Slovakia, Spain and Sweden. Together with France, UK

[20] Stephen, Dimity; Stahlschmidt, Stephan (2021): Performance and structures of the German science system 2021, Studien zum deutschen Innovationssystem, No. 5-2021, Expertenkommission Forschung und Innovation (EFI), Berlin

[21] Education and Research in figures 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

[22] https://interactivetool.eu/EIS/EIS_2.html

[23] DAAD, DZHW. 2020. Wissenschaft weltoffen 2020. Facts and Figures on the International Nature of Studies and Research in Germany and Worldwide. wbv Media GmbH & Co. Bielefeld. ISBN: 978-3-7639-6574-8

[24]

[25] https://ec.europa.eu/commission/presscorner/detail/en/IP_21_226

and Italy, the Federation is also providing €1 billion in funding for the Microelectronics IPCEI[26] (total funding is €1.75 billion). In addition, Germany and will provide an extra €210 million for three new Quantum Technology Institutes of the German Aerospace Centre, in addition to the approximately €650 million allocated at the start to the "Quantum Technologies – from the Basics to the Market" framework programme, as well as additional funds to support quantum communication and quantum computing.[27]

Germany also plays an active role in the international landscape that is supported by the "Strategy for the Internationalisation of Education, Science and Research" [28] which the Federal Government adopted in February 2017. The country is expanding its close bilateral cooperation in science and education with industrialized nations and emerging science nations beyond the EU context. These include the Asian-Pacific area, as well as Russia, the Ukraine and states of the Eastern Partnership, Africa and Latin American countries.[29]

In summary, Germany is a strong European and international player in research and innovation with significant investments, a very rich landscape including world-renowned research actors both from academia, the public sector as well as industry. Although low in rank in terms of foreign doctoral students, Germany is one of the top destinations for foreign academics and researchers. The strong commitment of the country, backed up by the international position of German researchers, the German diaspora as well as the foreign scientists hosted by German institutions form the favourable ground where the German transnational collaborations are built upon.

[26] https://www.ipcei-me.eu/

[27] National Reform Programme 2020, BMWI, https://www.bmwi.de/Redaktion/EN/Publikationen/national-reform-programme-2020.html

[28] https://www.bmbf.de/SharedDocs/Publikationen/de/bmbf/pdf/internationalisation-of-education-science-and-research.pdf?__blob=publicationFile&amp%3Bv=2

[29] https://www.bmbf.de/bmbf/en/international-affairs/worldwide-networking/worldwide-networking_node.html

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

The Federal Ministry of Education and Research (BMBF) is the main actor holding most of the responsibilities for research and innovation policy at the federal level. The Federal Ministry of Economics and Energy (BMWi) is also involved in some areas of innovation and technology policy as well as the Federal Ministry of Defence (BMVg). The Federal Government spends 18.8 billion euros a year on R&D distributed in BMBF that spends more than half of it (58%), BMWi 23% and BMVg 7%. In addition, the Federal Ministry for Food and Agriculture (BMEL) and the Federal Ministry of Health (BMG) play an important role in supporting research in the agricultural/forestry sector and the bioeconomy as a whole and in supporting health research respectively. Beyond the federal level, the Länder also play a major role in supporting universities in their state as well as research actors. The Federal Government and the Länder cooperate in funding science, research and education.[30]

At this point certain clarifications are due with regards to the R&I funders' landscape in Germany. German Ministries allocate the role of administration of national programmes and management of national funds for supporting research and innovation to programme management agencies, that operate under the responsibility and supervision of the ministries. There is no one-to-one relationship between a ministry and a programme management agency. A programme management agency may manage national funds on behalf of several ministries and state institutions (as in the case of PTJ for instance). A Ministry may also 'utilise' several programme management agencies to manage national funds based on their areas of expertise. BMBF for instance 'uses' DLR as well as VDI-TZ.

In addition, there are also independent research funding organisations that primarily receive public-sector finance and thus support research projects and activities. These include the Deutsche Forschungsgemeinschaft (DFG), the German Academic Exchange Service (DAAD) or the Alexander von Humboldt Foundation. DFG offers project funding for basic research, selecting the most promising research projects by scientists and academics at universities and non-university research institutions based on a competitive basis. DAAD is the world's largest funding organisation for the international exchange of students and researchers and the Alexander von Humboldt Foundation promotes research collaboration between international and German researchers through more than 800 research fellowships and research grants every year.[31]

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

- Project Management Agency in the German Aerospace Centre – DLR-PT, managing funds of the Federal Ministry of Education and Research (BMBF);
- German Research Foundation – DFG, independent research funding organisation;

[30] https://www.research-in-germany.org/en/research-funding/funding-organisations/federal-and-state-governments.html

[31] https://www.research-in-germany.org/en/research-funding/funding-organisations.html

- Federal Agency for Agriculture and Food – BLE, a project management agency managing funds from the Federal Ministry of Food and Agriculture (BMEL);
- Project Management Juelich – PTJ, a project management agency managing funds from several Federal Ministries (Education and Research, Economic Affairs and Energy, Environment, Transport and Digital Infrastructure, Health, etc.);
- Project Managing Agency Karlsruhe (PTKA), the project managing agency in Karlsruhe Institute of Technology, managing public funding programmes on behalf of several Federal and State Ministries and regional funding institutions;
- Agency for Renewable Resources – FNR, a government agency managing several programmes for the Federal Ministry of Food and Agriculture (BMEL) but also other federal ministries;
- VDI Technologiezentrum GmbH – VDI-TZ, a project management agency, managing the German participation in trans-national partnerships on behalf of BMBF in specific sectors (quantum science and technologies, photonics, material science and security research);
- TÜV Rheinland Consulting GmbH, managing and supporting national programmes in the field of transport and mobility on behalf of the Ministries of Transport and Economic Affairs.

The role of these organisations in international collaboration and in public R&I partnerships in particular is discussed below based on the views and experiences of their officials.

2.1. Bundesministerium für Bildung und Forschung (BMBF) - Federal Ministry of Education and Research

Education and research are a Federal Government policy priority in Germany and the main policy actor is the Federal Ministry of Education and Research (BMBF), although school and university education are mainly in the remit of the Länder. Placing special emphasis in research excellence, the research and innovation policy focus is defined in the High-Tech Strategy 2025 (HTS 2025)[32] that forms the strategic framework of the Federal Government's research and innovation policy.

There is strong commitment among German policy cycles in building and strengthening the ERA through multi-lateral European collaboration but also international (beyond the EU) collaboration. The role of science diplomacy is also strong in keeping, maintaining and improving collaboration with other countries. The German national priorities are in line with the EU priorities, and this has been achieved all through the years with close interactions with the EU and other countries. In line with the EU R&I policy, Germany gives special attention in meeting certain societal challenges including 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security' and 'Economy and work 4.0'. International research partnerships and specific initiatives such as the ERA-NET ERA-MIN, or the JPI Oceans and the research partnerships in health and care are cited in the HTS 2025.

HTS 2025 has adopted a mission-oriented approach bringing together all the relevant players from the policy, science and research communities, the private sector and civil society. Twelve missions have been set addressing, health and care, decent work and living standards, mobility, AI and an open innovation culture, as well as environmental and sustainability challenges for present and future generations. These missions form a new instrument of innovation policy and are expected to strengthen inter-ministerial cooperation in research and innovation policy.

The policy framework is also complemented by the Pact for Research and Innovation[33], the Contract for the Future of Higher Education and Teaching[34], and the Excellence Initiative[35] that is now superseded by the Excellence Strategy[36] consisting of two funding lines, the Clusters of Excellence and the Universities of Excellence and aiming at strengthening the international competitiveness and visibility of German science in the long term.

Participation in public partnerships in R&I has started back in 2006 for Germany with the first ERA-NET scheme which was launched under FP6. A long-standing experience has been built

[32] https://www.bmbf.de/bmbf/en/research/hightech-and-innovation/high-tech-strategy-2025/high-tech-strategy-2025.html

[33] https://www.research-in-germany.org/en/research-landscape/r-and-d-policy-framework/pact-for-research-and-innovation.html

[34] https://www.research-in-germany.org/en/research-landscape/r-and-d-policy-framework/future-contract-for-strengthening-studying-and-teaching.html

[35] https://www.dfg.de/download/pdf/dfg_im_profil/geschaeftsstelle/publikationen/exin_broschuere_en.pdf

[36] https://www.bmbf.de/bmbf/en/academia/excellence-strategy/excellence-strategy_node.html

since then. According to BMBF officials, the primary reason for joining partnerships has been to collaborate at programme level with EU counterparts. Partnerships offer one of the rare opportunities to do so and have proven quite important over the years for German researchers. Partnerships usually have larger success rates and less administrative burden than the EU framework programmes. Coverage of certain non-EU countries is another asset for partnerships.

> *"Overall, partnerships have been a success; it has been a positive surprise that national contributions increased over the years despite the financial crisis. The fact that all the MS have now committed around € 10billion is impressive!" (BMBF official)*

Decisions on which partnerships to join are taken based on the interest of the Ministry's thematic Units and the level of interest of German researchers. Similarly, decisions on the level of national investments to be made in R&I partnerships is under the responsibility of the Ministries' thematic Units and their respective programme management organisations. The ERA Funding Unit of the Ministry has the role of overseeing the level of Germany's participation in the various partnerships managed by the Ministry's units and supports the units with resources to help with the organisation of preparatory actions to facilitate participation (i.e., activities to raise awareness, explore national interest in call topics, build administrative skills, etc.). The system currently in place is rather decentralised and bottom-up. However, it also implies certain independence of the Ministry units and ability to address relevant topics rather in short notice.

According to the interviewees, this decentralisation is now gradually replaced by centralisation and coordination in favour of building up a strategy for partnerships in view of the new wave under Horizon Europe. The ERA Unit of the Ministry is mandated to create a coordination process that will include all relevant stakeholders from the research and business communities, as well as other relevant ministries (Economy, Environment, Health, and Agriculture). This process will help identify those topics that should remain within national focus and those that need/can be strategically addressed at the trans-national or international level.

> *"Given the great complexity in the German R&I system governance, it is doubtful whether a national coordination process would have been attempted without the pressure in relation to participation in partnerships." (BMBF official)*

Views on the new approach to partnerships under Horizon Europe are quite positive. As an interviewee noted, it is a clear improvement compared to the past in terms of, for instance, allowing Member States and the European Commission to get involved in certain Co-programmed Partnerships and pushing for a more strategic approach in the Co-funded Partnerships. The new partnerships will also need to demonstrate that collaboration is possible beyond joint calls, i.e. through standardisation, sharing / creating research infrastructures, implementation of research results, etc. Although present in past work-programmes of partnerships, such activities were underdeveloped. It is also important that the preparatory work on the new partnerships is also aligned with other relevant work done for the ERA such as the ERA scoreboard, the ERA progress reports, etc. as partnerships are an important tool for developing the ERA. At the same time, the large size of the new partnerships has been criticised by some interviewees in terms of the efforts needed for administration.

2.2. Bundesministerium für Ernährung und Landwirtschaft (BMEL) – Federal Ministry of Food and Agricutlure

Following BMBF, the Federal Ministry of Food and Agriculture (BMEL) has a strong presence in the public R&I partnership landscape. Currently, the ministry takes part in 15 ERA-NET Cofunds and is also involved in 4 JPIs, 2 EJPs, 2 ESFRI projects, and the European Innovation Partnership 'Agricultural Productivity and Sustainability'. Under Horizon Europe, BMEL is interested in taking part in ten partnerships in Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment), one partnership in Cluster 2 (Culture, Creativity and Inclusive society), as well as the PPP for a Circular Biobased Europe.

> *"The main motivation driving participation in partnerships is the benefits offered by international collaboration in terms of knowledge and access to complementary expertise, creating a critical mass for good scientific work and access to infrastructures abroad. International collaboration is also beneficial for funding agencies as it allows mutual learning." (BMEL officials)*

As BMEL officials note, the main criterion for selecting which partnerships to join is the level to which the partnerships contribute to the political objectives of the Ministry and the relevant national priorities. These tend to be in line with those of the partnerships as Germany takes an active role in the preparation of the strategic research and innovation agendas of the partnerships and is also active in relevant strategic actors in the area like SCAR and FACCE JPI.

Agricultural research is by definition a research area requiring international collaboration considering biodiversity or climate change for instance. German researchers prefer to take part at EU level collaborative research activities even though there are considerable funds availably also for national calls and the administrative burden of managing a national project is lower.

BMEL has an overall budget of around 4.5 million per year for all European collaboration activities, both in dedicated R&D programmes and national R&D programmes, including some not-predetermined budget for European collaboration. Moreover, additional funds are usually made available by BMBF to cover for all German participation in the successful projects supported by partnerships. BMEL collaborates with BMBF when setting the priorities in agricultural research to ensure that adequate resources are earmarked for European/international collaboration.

Germany's performance in partnerships is facilitated by the large research landscape including numerous research organisations (research organisations, non-university research institutions, etc.). However, German researchers are reluctant to take the role of coordinator. This needs to be addressed through capacity building activities and/or related incentives. Another key area of improvement is the exploitation of the knowledge produced. Projects need to be followed up to examine and measure what sort of impact they create in society. In this regard, BMEL also supports activities examining the results or research projects and how they can be made useful.

2.3. Bundesministerium für Wirtschaft und Energie (BMWi) - Federal Ministry for Economic Affairs and Energy

The goal for the Federal Ministry for Economic Affairs and Energy is to ensure both Germany's competitiveness and a high level of employment through its legislative, administrative, and coordinating role in the fields of energy, industrial, innovation, competition, SME, and European policy. Based on the ERA-LEARN data, currently, BMWi takes part in two public partnerships (MarTERA and SAF€RA that has become self-sustained). In addition, the Ministry oversees participation of German researchers in EMPIR through its supervised institute PTB, and a number of industry-led partnerships, i.e., Joint Undertakings[37] and contractual PPPs[38], which, however, are not the main focus of this report.

In the maritime area, the primary motivation of participating in partnerships is the need to connect the German industry with researchers and other companies at European level to successfully address the issues in maritime technological research, which cross national borders, and maintain international competitiveness.

Based on BMWi officials, Germany has been part in MarTERA since the launch of the first initiative in 2016 and has invested around € 20 million per year in the last 3-4 years in MarTERA calls. The interest of German research groups has been high leading to a usual oversubscription rate of around 6. The experience of industry partners has also been positive. The small-scale projects concentrating on something very specific and allowing collaboration with a small number of European partners was highly appreciated. Germany's participation is facilitated by the existence of a strong industry in maritime technologies as well as the presence of a national programme supporting this area, which allocates around € 60m per year. There is much interest to continue to collaborate internationally and, in the absence of an ERA-NET scheme in the future, Germany is interested to prepare with other interested countries a proposal for a CSA to continue collaboration in maritime technologies.

Overall, the experience has been beneficial as well as intriguing.

> *"It is excellent that we collaborate with lots of countries that we never had in mind were active in this area of research such as Romania, Poland or Turkey. On the other hand, one would expect that other countries with strong shipping industry (like Denmark, Sweden, Finland or the Netherlands) would make high contributions to the calls but they never took part in the last 4 years, the major reason being the lack of a national programme to support participation of national researchers." (BMWi officials)*

[37] https://ec.europa.eu/programmes/horizon2020/en/partnerships-industry

[38] https://ec.europa.eu/programmes/horizon2020/en/contractual-public-private-partnerships

According to the interviewees, the experience of participating in EMPIR through PTB[39] is equally valuable. Metrology research has always been international as its mission is to develop measuring capabilities and harmonise metrology at the global level. Based on PTB officials, there is a long history in collaboration among the metrology institutes in metrology, but EMPIR has been vital in raising this collaboration to a new level.

EMPIR has enabled collaboration of larger and smaller institutes across more than 25 countries and made it possible to share with them PTB's unique infrastructure (e.g., large particle accelerators) which only few other countries in Europe also have (France and UK).

> *Due to EMPIR there has been a step change in the metrology capabilities of the participating institutes and countries. We have been able to do more and better at the European level and EMPIR brought Europe in a globally leading position." (PTB official)*

The opportunities offered to collaborate with non-EU countries such as US, South Korea, China and other Asian countries, as well as Eastern European Countries like Ukraine is also a highlight of EMPIR. This is very important for the international harmonisation in metrology. Benefits also refer to improved capabilities of German metrologists who learned a lot regarding management, strategy development and other competences from their counterparts in other countries.

As noted by PTB officials, EMPIR projects have been influential, initiating capital investments and strongly affecting the overall strategy of PTB. This has been possible due to the possibilities offered by EMPIR being implemented as an Article 185 of TFEU, with 7 years of calls that enable strategic planning for the institute.

> *"We wouldn't be able to do that if we had applied occasionally under the H2020 calls. In my view this instrument of the EU is one of the best for European collaboration and integration." (PTB officials)*

Notwithstanding, there are certain areas that still require attention. High administrative efforts are a barrier for German researchers to become project coordinators, although PTB provides additional support to researchers (under PTB's budget) when they become coordinators.

[39] Besides PTB that is a member of EMPIR, there are three other institutes participating in EMPIR as Designated Institutes https://www.euramet.org/about-euramet/members/associates-designated-institutes/ and several others that take part as external partners.

2.4. Deutsches Zentrum für Luft- und Raumfahrt (DLR) German Aerospace Center

As part of the national Aerospace Center, the DLR Projektträger (DLR-PT) is one of the major project management agencies addressing key areas of research, innovation and education under the supervision of BMBF. Germany has a good international standing and partnerships are an important opportunity for national researchers to maintain and further strengthen Germany's international position in research and innovation. Based on DLR officials, partnerships are filling in a funding gap in terms of supporting medium size projects (3-7 partners) and are a steppingstone for larger programmes like Horizon. They are valuable for building international profiles especially for young researchers, although applicants include all levels of experience. Another asset that attracts the interest of Germany in partnerships is the engagement of international actors, i.e. from countries beyond the EU.

Based on the ERA-LEARN data, DLR currently takes part in 18 partnerships, while it coordinates 5 of those (AXIS, HDHL-INTIMIC, NEURON Cofund 2, ERA-CVD, and SEA-EU-NET, which is a self-sustained partnership).

As DLR officials noted, the investments made by Germany in partnerships are considered anchor investments in the sense that they can indeed determine the realisation of partnership calls and activities. For example, Germany's contribution accounts for an average of 23.5% of the total funding made available in BiodivERsA. Germany also has long tradition in a wide range of research areas. As a result, a German participant may appear in almost all successful proposals, and this offers good arguments to national officials in supporting partnerships. At the same time, certain areas need international collaboration by default. In the health area, for instance, access to diverse profiles, patient cohorts, and joint use of complex infrastructures beyond national borders are important. Standards for data acquisition and harmonized methods help to improve the quality of (clinical) studies. Similarly, different perspectives, backgrounds, and contexts are important in the social sciences and humanities, an area not adequately covered in other transnational or international programmes like Horizon 2020/ Horizon Europe.

The national contribution ranges from one area to the other, but the overall rule is to try and cover the German participations in all successful proposals. As an indication, between 2008 and 2020 the DLR Health Department has spent € 218 million as BMBF contribution to a total of € 883 million funding to research projects through the calls launched by the health-related partnerships. The partnerships cover a broad range of research areas, such as brain health, cancer, cardiovascular disorders, infectious diseases, nutrition research, personalized medicine and rare diseases.

In other cases, e.g., social sciences and humanities, BMBF commits around € 3 to 5 million per call for the HERA partnership, but there are always excellent projects on the ranking list which cannot be funded because the EU top-up funding or the different national budgets run out.

According to the interviewees, the demand for collaborative, international funding is very high in humanities and social sciences. In fact, the German research community is very much attracted to ERA-NET 2 HERA and ERA-NET 3 CHANSE, the two partnerships in social sciences and humanities. Based on DLR data, CHANSE had 366 proposals submitted in the present call for € 30 million, while one of the earlier HERA calls had over 600 proposals for less than € 20 million. German organisations are included in around 1 out 2 pre-proposals. In terms of funds, the actual agency budget that was spent after the selection of proposals reached € 3.1 million in HERA although the initial earmarked budget was € 2,3 million.

In the DLR Environment and Sustainability Unit, €105 million per year is spent on global climate change research, around 5% of which is invested in partnerships. In the case of BiodivERsA, Germany usually invests from €1m to 4.5 million per call, and DFG committed/envisaged €1.5 million for each of the first two calls of the BiodivERsA+ Partnership.[40] Admittedly this is not much for Germany, but there is also a need for a balance across the different national contributions in partnerships and Germany invests the highest contributions overall (see Figure 2). Based on the interviewees, the question of which areas to invest nationally and which at the European or international level is always open and, in some cases, as in ERA4CS, the decision was made not to invest any more at the national level. This gives a more important role to partnerships in the national landscape.

As DLR officials noted, partnerships help raise awareness in a particular issue that needs policy attention and bring the research and policy communities closer together while also aligning policies across the EU:

> *"When discussions started in Germany on what can climate research do for policy 15 years ago, bringing these two worlds together was not self-evident. Now we can bring the research and policy communities together not only in Germany but also across many countries and the EU through the partnerships. This is of great value and the results of these interactions certainly influenced how the EU is supporting climate change and how they perceived important structures such as the Green Deal. The reverse is also true in the sense that the joint discussions and seeing what other countries are doing and how have influenced national programming in Germany too."* (DLR official)

Participating in partnerships is also beneficial for programme managers.

> *"Although we consider ourselves advanced as programme managers, we have learnt a lot in relation to management of participation through the learning that is enabled and the identification of good practices." (DLR official)*

> *"The opportunities that partnerships offer to discuss common challenges together and how these should be addressed and the calibration enabled among funding agencies on the way to go and how, are the real value of the partnerships. This value certainly goes beyond*

[40] VDI replaced DLR in managing the BMBF participation in BiodivERsA 2020 onwards.

the launch of joint calls and how much money is invested by the participating countries." (DLR official)

DLR officials also highlighted the strategic importance of the partnerships. For example, the AXIS ERA-NET was the result of close interaction of some countries in JPI Climate that saw the importance of creating a network to support the assessment of cross - sectoral climate impacts and pathways. This was a gap in research support that was bridged by individual countries collaborating under JPI Climate, that eventually created an ERA-NET[41].

Interviewees also noted that German researchers are attracted to partnerships for a number or reasons: the benefits of collaboration and networking at European / international level with the best researchers in the field and the already known national procedures that need to be followed at the end of day. The National Contact Point network is also very active in raising awareness about all the funding possibilities including those of the partnerships, and in helping researchers to submitting proposals, but also in bringing ideas to the Programme Committees.

> *"The interest of German researchers has been quite high. The calls are usually oversubscribed by 7. We also hear that German beneficiaries are more interested in partnerships like BiodivERsA than H2020 calls as they take less efforts and BiodivERsA funds smaller projects (3-4 partners) which are more appealing than H2020 larger consortia."* (DLR official)

Yet, they also marked several areas of improvement. More clarity is needed in the operationalisation of the different funding regulations across the different partnership types. In addition, there needs to be more coherence between the themes addressed by the partnerships and those covered by the framework programme. It is encouraging that people from various thematic units of the EC are now joining the relevant discussions. At the same time, outsourcing the management of the partnerships on the EC side to external agencies might bring new difficulties. The lack of a monitoring system and indicators of success for partnerships at a central level is also crucial. Thus, the new coordinating function that the EC is developing for the new partnerships under Horizon Europe is very important.

It has also been challenging to reconcile the different timing of the national programmes across the countries and this might continue to be so in the future. In addition, the high administrative costs that are connected to the additional activities of the partnerships and which cannot be fully covered by the EC contribution have been a concern for the partners.

[41] http://www.jpi-climate.eu/AXIS

2.5. Deutsche Forschuungsgemeinschaft (DFG) – German Research Foundation

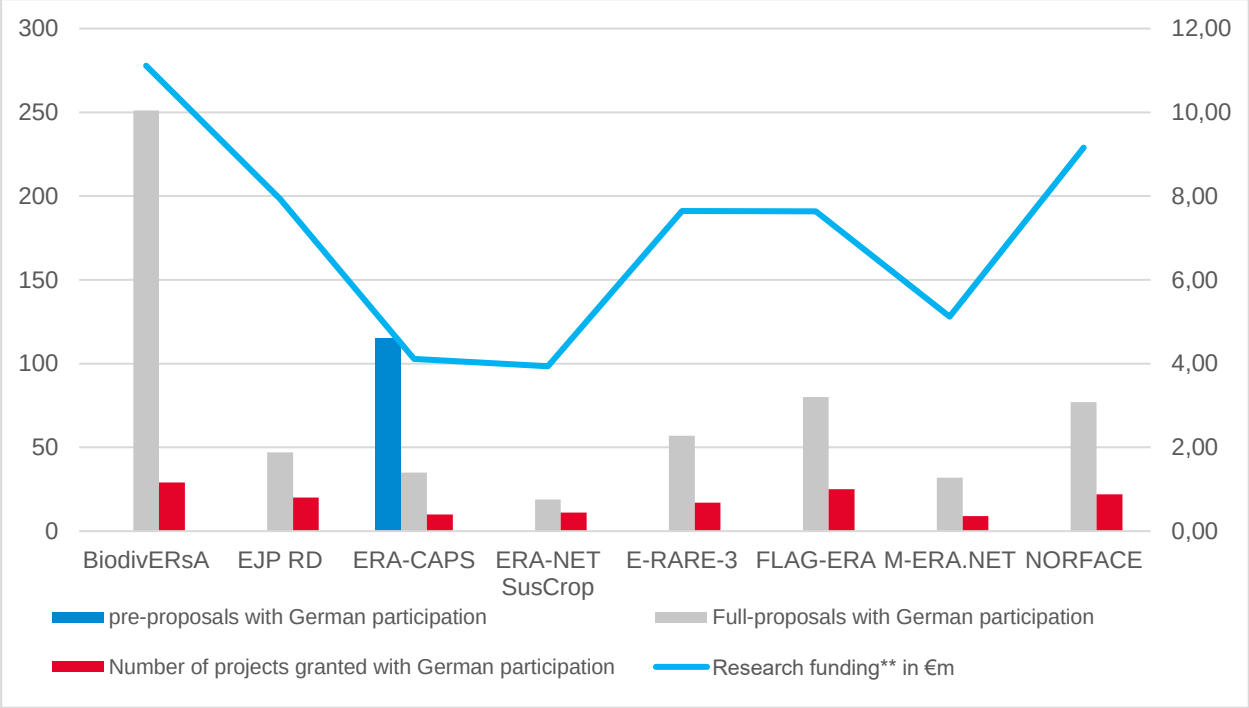
DFG is the central, independent research funding organisation in Germany addressing all areas of science and the humanities by funding research projects at universities and other research institutions on a competitive basis. Applying a bottom-up approach in identifying the research areas to support, as well as which partnerships to join, through the Review Boards that consist of elected scientists, DFG offers multiple possibilities both for national and international collaboration.

> *"The main motivation has been to enable international collaboration for German researchers. They are strongly involved in international networks, thus an additional source funding is important. Certain areas of basic research require international efforts by default, and this is another reason for participating in partnerships." (DFG official)*

DFG has significant experience in participating in international partnerships either, bilateral through bilateral agreements, or multi-lateral through partnerships like ERA-NETs and JPIs. DFG has an annual budget of € 3.3 billion, provided primarily by the German federal government (69%) and the states (30%), also including EU funds and private donations. Around 25% of DFG budget goes to international initiatives overall that include national programmes with international guests/collaboration partners, bi-lateral agreement, international and European partnerships, and other trans-national initiatives. Partnerships account for around 5% of this amount.

Based on DFG data, during H2020 (2014-2020) the total DFG budget that was spent on partnership-supported projects with German participation amounted to € 56.65 million. The largest part of these funds was spent on projects funded under BiodivERsA calls (€ 11.11 million) and NORFACE calls (€ 9.16 million) followed by around € 7.5-8 million spent on FLAG-ERA, EJP RD and E-RARE 3 calls. Albeit the lack of information on the number of pre-proposals, the most successful calls in terms of success rates of the German applications (number of granted projects divided by the number of full-proposals) have been those of ERA-NET SusCrop and EJP RD, followed by those of FLAG-ERA and E-RARE-3, that achieved a success rate of around 1 out of 3.5 proposals. (Figure 6)

Figure 6: Proposals and granted projects with German participation under partnership calls during H2020 (2014-2020)



Source: DFG
(*) The DFG database is lacking reliable information on pre-proposals. Most BiodivERsA Calls did not have a pre-proposal stage (just a formal check of eligibility as a first stage). Also, when both DFG and BMBF (via DLR, PTJ, VDI) participate in calls, pre-proposals are often not yet assigned to one or the other funding agency making it difficult to provide the data per agency.
(**) The funding level may slightly vary from the actual budget spent in case the beneficiaries have not yet claimed part of, or all, the funds that have been awarded to them.

DFG officials note that the interest from the German scientists in partnerships is significant. ERA-NETs help fill in gaps in the support of basic research.

> *"For instance, we have the Graphene flagship and Quantum Technologies flagship, and the respective ERA-NETs cover the areas that are not supported by these flagship initiatives. In addition, ERA-NETs are funded and managed by national agencies. Although they are harder to manage than bi, tri-lateral cooperation programmes, they are still easier than EU programmes, and this is appreciated by scientists." (DFG official)*

> *"In terms of negative impacts there are not many, besides the fact that managing participation in international partnerships require some more work / resources at the head office. This includes talking to partners to harmonise processes, and the more partners there are, the more difficult / time-consuming it may get. On the other hand, you earn a lot so, overall, it is well-invested time and effort despite the additional efforts needed." (DFG official)*

At the same time, the specific focus of the partnerships does not enable the bottom-up approach that is essential in basic research that allows researchers to address any topic they consider important. This can be counterbalanced by call topics that are collectively broad enough as in the case of BiodivERsA. The views of DFG officials about the new types of partnerships under Horizon Europe, is that they are significantly larger than the existing types. As a result, there may be less possibility for certain areas of basic research to be supported. On the other hand, they enable long-term research support, which may counteract the administrative burden required.

2.6. Bundesanstalt für Landwirtschaft und Ernährung (BLE) - Federal Agency for Agriculture and Food

The Federal Office for Agriculture and Food (BLE) manages participation of German stakeholders in public partnerships in research and innovation on behalf of the BMEL. The responsible department of European Research Affairs was founded in 2011 and CORE Organic was the first ERA-NET that BLE and BMEL joined and promoted agricultural research at European level. Currently, BLE takes part in several ERA-NETs and two JPIs. Albeit the lack of data in Table 2, it is interesting to note that the number of granted projects with German participations is more than half of the total granted projects in the cases of Core Organic, SUSFOOD 2, Sumforest, INTIMIC, FOSC and JPI HDHL. The highest success rates are noted in WaterWorkds2015 (87.5%), SusAn (71.43%) and ICRAD (64.29%).

Table 2: German participation in partnerships under H2020 (2014-2020) managed by BLE

	pre-proposals with German participation	**Share of total pre-proposals** (where possible)	**Full-proposals with German participation**	**Share of total full-proposals** (where possible)	**Projects granted with German org**	**Share of total projects granted** (where possible)	**National budget committed by** BLE **(€ million)**	**Actual** BLE **budget spent (after selection of proposals) (€ million)**
ICT-Agri					13	21,67%	1.00	1.17
ICT-Agri II					9		1.10	1.06
ICT-AgriFood Cofund					18	94,74%	1.00	3.02
Core Organic	28	56,00%	16	48,48%	7	58,33%	1.20	2.01
Core Organic+					7	63,64%	1.00	
Susfood	68	47,55%	18	42,86%	4	26,67%	1.00	0.79
SUSFOOD 2	97	62,58%	33	36,67%	16	55,17%	2.40	2.70
Euphresco II					3			0.28
ANIHWA					6	18,75%	2.00	1.16
Cofasp	8	10,13%			5	31,25%	1.00	0.93
C-IPM	6	12,50%	2	8,00%	4	28,57%	1.40	0.54
Sumforest			17	62,96%	5	71,43%	0.80	0.76
FACCE ERA-NET+	74	61,16%	26	66,67%	2	18,18%	0.50	0.48
FACCE SURPLUS					2	14,29%	0.50	0.62
ERA-HDHL	35	48,61%	21	52,50%	9	47,37%	1.00	0.92
WaterWorks2015	66	39,52%	8	38,10%	7	33,33%	0.50	0.57
FACCE ERA-GAS	13	54,17%			4		0.50	1.03
SusAn	32	59,26%	14	48,28%	10		2.00	2.83
INTIMIC	65	70,65%	34	75,56%	7	58,33%	0.80	0.56
BlueBio	10	12,05%			3	15,79%	1.00	1.05
ICRAD	38	35,51%	14	41,18%	9	47,37%	2.00	2.54
FOSC	37	52,11%	26	60,47%	10	58,82%	1.30	1.90
JPI FACCE					8			0.65
JPI HDHL			10	23,81%	3	50,00%	1.60	1.53

Source: BLE

BLE officials stress that, overall, transnational collaboration is deemed very important for the BLE as certain challenges cannot be dealt with by individual countries alone. Resources need to be pooled together and ERA-NETs are very important instruments in this regard. ERA-NETs are very successful in establishing close collaborations and fostering transnational research activities. This is beneficial not only for research organisations but also for the involved funding agencies.

> *"It is very useful to know what the priorities are among different countries and build a trusting collaboration and learn from one another. This is very valuable." (BLE official)*

The view of BLE officials is that German researchers primarily want to work collaboratively at the trans/international level rather than the national and are quite attracted to the ERA-NET calls. Germany is one of the bigger players with several successful projects. Around €500,000 to 1 million per call is usually offered to fund successful German project teams.

> *"Considering the limited budget (€ 3million) that needs to be spread across around 15 ERA-NETs annually, it is not unusual to skip a call, although for the calls in the food area there is complementary budget coming from BMBF…The specific funds are very limited also compared to those made available for the relevant national programmes." (BLE official)*

Regarding the submission processes, where BLE is responsible for the Call Office, this is often facilitated by the DLR submission tool, which runs quite smoothly. Only after the call procedure is concluded at the European level, and projects are selected, the German participants are required to submit a proposal in German, which will be part of the grant agreement to be signed.

BLE undertakes the review of the partnership landscape and makes suggestions to the BMEL on which partnerships to join. The decision then is approved by BMEL. The basic criterion for this decision is the added value of participating in the partnership for the German researchers and adherence of the priorities addressed with the Ministry's national priorities in the whole value chain, i.e., not only agriculture but also food and nutrition.

Based on the interviewees, certain projects have been quite successful in impacting policy and society. As an example, a specific project contributed to applying nutri-scores[42] on all food products. Partnerships are complemented by national initiatives in certain cases. CORE Organic, for instance, that is still running, is complemented by a large national scheme supporting organic farming.

At the same time, however, more efforts need to focus in disseminating the projects and their results at national level to support the implementation into practice. Additionally, the efforts that are needed to administer participation in partnerships, are not adequately covered by the EC as was the case in the FP7 ERA-NETs, and the large size of the new partnerships and the governance systems, including both funding agencies and research actors, might prove complex.

[42] A nutri-score is a nutrition label that converts the nutritional value of products into a simple code consisting of 5 letters, each with its own colour. Each product is awarded a score based on a scientific algorithm.

BLE officials also note that the key priority areas addressed through partnerships include, digitisation and ICT, sustainable animal production as well as soil, health and food. There are also areas that are not addressed by the current partnership landscape, including shifting diets, or animal productions system connected to sustainability issues e.g., climate change, greenhouse gas emissions, etc. Regarding the new partnerships, BMEL intends to take part in the European Partnership Agriculture of Data.

2.7. Projektträger Jülich (PtJ) - Project Management Jülich

PtJ is one of the leading project management agencies in Germany, working on behalf of public authorities i.e., Federal Ministries (Education and Research, Economic Affairs and Energy, Environment, Transport and Digital Infrastructure, Health, etc.) to implement research and innovation funding programmes. As a largely independent organization, PtJ is affiliated with Forschungszentrum Jülich GmbH. The activities and services of PtJ cover the entire chain of innovation – from basic research right up to market entry.

PtJ started participating in ERA-NETs since the early days in FP6. Based on PTJ officials, the PtJ's staff involved in ERA-NETs and other public partnerships (JPIs, Art 185s, etc.) has grown to around 15 people. PtJ manages the German participation on behalf of Federal Ministries in partnerships in the areas of agriculture, bioeconomy and biotechnology, energy, marine technology, materials and circular economy. This involves having an overview of the European scenery in terms of upcoming initiatives and making suggestions to the Federal Ministries on which partnerships to join.

The initial motivation to participate in such partnerships reflected the wish of the involved Ministries to establish contacts with other national programmes in other countries, to share ideas and best practices, and do this complementary to the Framework Programme. It was attractive to have a structure similar to the framework programme but supporting smaller and leaner projects to address more precisely defined technological innovation issues.

> *"In a coordination action like the ERA-NET, PtJ has the opportunity to work with other research funding agencies and offer researchers transnational collaboration benefits on the base of national administrational procedures, which researchers are familiar with. This is often easier in terms of administration for both academia as well as companies…." (PtJ official)*

The European dimension is a priority for Germany. The ERA-NET scheme has played an important role in facilitating such collaboration and from the very beginning this type of cooperation, with smaller project sizes, has been attractive to German researchers and funding agencies alike.

"The thematically focused nature of ERA-NETs really help having the right people around the table to identify and implement joint measures which are most suitable for the research communities in the thematic remit of the individual ERA-NET" (PtJ official)

Although there is a double proposal submission system, this is not too heavy a burden to the researchers. Once proposals are positively evaluated, the contract negotiations start but the English version of the proposals is accepted. Usually, only certain information needs to be submitted anew in German.

As the interviewees noted, there are several benefits from participating in ERA-NETs both on the researchers' and the funders' side. The funders are used to working with peers in other countries on day-to-day basis and have improved their managerial and administrative competences as the ERA-NET scheme requires to orchestrate effectively 10-15 different national regulations routinely. At the same time, the collaboration among researchers has increased tremendously in the last 17 years.

Regarding the future, the new type of partnerships under Horizon Europe present very different features from the past. They require many more partners, and bring together different types of partners, i.e., both funders and researchers, which may create conflicts of interest. With that entirely new geometry of the consortia the agencies will phase entirely new challenges with regard to legal and managerial aspects.

Karlsruher Institut für Technologie

2.8. Project Managing Agency Karlsruhe (PTKA)

The Project Managing Agency in Karlsruhe Institute of Technology manages public funding programs on behalf of federal and state ministries and regional funding institutions. PTKA is an independent partner in the co-design of programs that fund scientific research, development, innovation, and investments. PTKA supports parties interested in funding as well as applicants and beneficiaries in program-based project funding and the dissemination of research results. One main area of focus is the future in value creation based on the current national funding programme[43], encompassing technologies and services in manufacturing, new forms of work. Other focus areas include water technology, waste disposal research, and environmental and energy research. Currently, PTKA is involved in ERA-NET MANUNET III and M-ERA.NET 2.

PTKA officials stated that the main motivation of participation is to facilitate trans-national collaboration of German entities. Small companies are able to enter into collaboration with others

[43] https://www.zukunft-der-wertschoepfung.de/de/forschungsprogramm-1750.html

from other countries but also within Germany. The easily manageable size and scope of the ERA-NET projects - usually of 2-year duration with 3-5 partners - is also an asset.

> *"It is very often the case that the leader in projects are large research institutes and SMEs are partners or technology providers. Yet, we also see companies coming up as coordinators. ERA-NETs are a important piece in the puzzle to support SMEs. Although there are resources and a variety of funding programmes in Germany, ERA-NETs are still an important instrument for SMEs to go international." (PTKA official)*

As an indication for the financial contributions, PTKA usually dedicates €2-2.5 million for each MANUNET call covering all excellent proposals with German participations. In the four calls launched so far, the success rate – number of granted projects with German participations divided by the number of pre-proposals with German participations - ranged from 8% in the 2017 call to 30% in the 2020 call, thus marking a total average of 12%. In addition, while the number of pre-proposals including German organisations account for 17% of the total pre-proposals, this falls to 7% in the case of granted projects. (Table 3)

Based on PTKA officials, there is need for raising awareness about the various existing funding programmes (ERA-NETs, EUREKA, Horizon 2020) and building competences and capacities to try and apply for funding. Efforts should be put in reaching out to SMEs and in networking them with more experienced actors also including research institutes or universities. Activities are also needed that bridge the newcomers with experienced applicants. Funding agencies can support such efforts at the national level, but it is important that partnerships also create connections with other funding schemes/instruments. In relation to administering the partnerships it is always a challenge to try to align the different timing in funding, national rules and procedures, etc, across the countries.

Table 3: German participation in MANUNET III calls under H2020 (2014-2020)

	Total number of pre-proposals	pre-proposals with German participation	%	Total number of full proposals	Full-proposals with German participation	%	Total number of projects granted	Number of projects granted with German particip.	%
MANUNET III									
Call 2017	125	26	21%	62	2	3%	40	2	5%
Call 2018	66	0	0%	31	0	0%	19	0	0%
Call 2019	65	16	25%	34	2	6%	16	1	6%
Call 2020	58	10	17%	27	4	15%	16	3	19%
TOTALS	**314**	**52**	**17%**	**154**	**8**	**5%**	**91**	**6**	**7%**

Source: MANUNET III secretariat

2.9. Fachagentur Nachwachsende Rohstoffe e.V. (FNR) – Agency for Renewable Resources

FNR is a government agency under the Federal Ministry of Agriculture (BMEL), managing several programmes for BMEL and other federal ministries, mainly focusing on R&D. FNR has been a partner in various partnerships since 2004 including for instance the ERA-NETs CoBioTech, ForestValue, ERA-GAS, WaterWorks, and the ERA-NET Bioenergy which is now a self-sustained network. To date around 7 million € BMEL funding were provided to Germany participants in the frame of ERA-NETs via FNR.

FNR officials value transnational collaboration in research and innovation. As stated,

> *"International collaboration is important even for large and well-advanced countries in research and innovation, with well-developed own capacities in several areas throughout the chain or research and innovation. There is value in collaborating with excellent partners in other countries especially in areas that require collaboration to be on the top, such as biotechnology for instance." (FNR official)*

Based on the interviewees, success varies from one partnership to another. From the FNR perspective ForestValue (formerly WoodWisdom-Net) is the most successful partnership in terms of number of projects and provided funding. Based on FNR data (Table 4), in the Joint call 2017 the share of pre-proposals and full-proposals with German participation reached 63% and 52% of total proposals, while the granted projects including German research groups accounted for 70% of total projects granted. According to the participation in joint calls in both networks in 2016, ERA-Gas as well as WaterWorks also were attractive to German researchers especially in the pre-proposal phase, although the number of successful proposals with German groups was limited. In the area of bioenergy, where biomass is the focus area of FNR, performance was slowing down over the years mainly due to the controversial issues governing the political discourse on this topic recently.

FNR has a certain degree of freedom in making decisions on which partnerships to join, although decisions need then to be validated by BMEL. In terms of funds made available, it is not more than 5% of FNR's annual budget that is spent on international collaboration activities overall. This percentage is not predetermined. Attention is paid to cover the cost of German participation in all approved applications. As the data show (Table 4), FNR earmarked more funds than what was actually needed to support the successful projects including German research groups. Yet, FNR officials believe that a higher national budget would make it possible to support even more projects.

Call topics are, as usual, jointly shaped by all partners including FNR and are, thus, usually in line with the German priorities. However, there are cases where the FNR specific priorities are hard to identify especially in call topics that are too broadly defined (as in WaterWorks or ERA-GAS). Managing participation in partnerships became more challenging according to the views of FNR officials. In the early ERA-NET days, the resources (managerial, administrative) needed for

agencies to be part of partnerships were financially covered by the EC. The non-research related funds provided now (unit costs or black box) are limited, which requires more negotiations within the consortium and makes it necessary to also devote own funds.

Attention is paid so that any extra burden for the researchers is kept to the minimum. Proposals go to a single-entry point (at the secretariat of the partnerships) and sometimes FNR requests the German participants to also fill in some specific national forms at the first stage of the evaluation, where two – stage evaluation is applied.

> *"For the researchers that see the value of international collaboration, this burden is manageable." (FNR official)*

Table 4: German participation in partnerships under H2020 (2014-2020) managed by FNR

	pre-proposals with German participation	Share of total pre-proposals	Full-proposals with German participation	Share of total full-proposals	Projects granted with German org	Share of total projects granted	National budget committed by FNR (€)	Actual FNR budget spent (after selection of proposals)
ERA-NET Cofunds								
ForestValue								
Joint Call 2017 (cofunded)	65	63% of 102	25	52% of 48	12	70% of 17	4.000.000	4.000.000
Joint Call 2021	n.a.		26	55% of 47	4	50% of 8	4.000.000	1.878.925
WaterWorks 2015								
Joint Call 2016 (cofunded)	11	17% of 62	1	2% of 42	1	4% of 21	500.000	340.958
ERA-Gas								
Joint Call 2016 (cofunded)	10	41% of 24	1	5% of 20	1	10% of 10	500.000	300.000
ERA CoBioTech								
Joint Call 2016 (cofunded)	6	5% of 119	4	9% of 41	2	9% of 22	2.000.000	609.336
TOTAL	**92**	**30% of 307**	**57**	**28% of 198**	**20**	**25% of 78**	11.000.000	**7.129.219**

Source: FNR

FNR officials also noted that proposals are typically evaluated as they are submitted, whereas the national submission system applied by FNR is more interactive. Support is given to applicants to improve their proposals from the one stage to the other. Thus, it is a challenge sometimes to ensure that the ERA-NET application process is compatible with the national administrative requirements. Yet, researchers see great value in getting more in-depth knowledge of what researchers are doing in other countries and learning about new approaches or about different/better equipment and infrastructure, and where they stand with their own research internationally. In addition, they value the team spirit and trust that is built in collaborative projects which may lead to long-term relationships. It is this value that is created in the smaller projects supported by partnerships, instead of larger programmes like H2020, that is highly appreciated by researchers.

2.10. VDI Technologiezentrum GmbH (VDI-TZ)

VDI-TZ is part of the VDI Group, i.e. the Association of German Engineers. As a leading project management agency in German, VDI-TZ manages the German participation in research and innovation trans-national partnerships on behalf of BMBF focusing in the areas of quantum science and technologies, photonics, material science and security research.

Due to the long history in photonics research in Germany, the country took a leading role together with the European Commission in developing the European Technology Platform, Photonics21, which was inspired by relevant initiatives in the USA. Photonics21 then transformed to a contractual public-private partnership (cPPP) in 2013 and in 2021 it became a Co-programmed partnership under Horizon Europe.[44]

Based on VDI-TZ officials, in photonics as well as in quantum research, there are areas for which international collaboration is particularly relevant, such as photonic integrated circuits and quantum computing, or biophotonics and photonic sensing. In these cases, the transnational projects combining EC funds and national funds and providing an intermediate stage between national and European programmes like the Horizon, proved to be very useful. At the same time, international collaboration is very much needed in quantum research when it comes to translating quantum science into technologies and applications. Overall, German funders in the areas covered by VDI-TZ keep participating in these partnerships to keep up the leading role and drive developments in these areas, as well as to create the necessary critical mass, share knowledge and maintain a strong position in the competition with other regions such as China or the USA. Germany has a large and top-quality research landscape consisting of all forms of universities and laboratories dealing with basic research, more application-oriented research institutes and industries of global standing, including a lot of innovative SMEs. Yet, certain topics cannot be addressed without collaboration, such as standardisation for instance, or the development of large-scale projects/infrastructures.

Based on the ERA-LEARN data, currently VDI-TZ participates in five partnerships (EuroNanoMed III, PhotonicSensing, QuantERA and QuantERA II) and is an observer in M-ERA.NET 2. Yet, the share of the funds invested by VDI-TZ in transnational activities is relatively small compared to the funds available for national programs. Based on the data provided by VDI-TZ, the actual budget spent by the agency under H2020 to support successful proposals with German participation in the areas of photonics and quantum technologies amounted to € 9.2 million. However, the German presence at the pre-proposal stage is dominant reaching 63% in total. This changes to 57% in the full proposal stage and to 60% in the final projects granted. In other words, German organisations take part in 6 out of 10 successful proposals. At the same time, the success rate of the German proposals (number of granted projects divided by the number pre-proposals)

[44] https://www.photonics21.org/about-us/photonics-ppp/

ranges from around 12% in the case of QuantERA to 28% in the case of PhotonicSensing. (Table 5)

Table 5: German participation in PhotonicSensing and QuantERA calls under H2020 (2014-2020)

	Total pre-proposals	pre-proposals with German participation	%	Total full proposals	Full-proposals with German participation	%	Total projects granted	Number of projects granted with German participation	%
ERA_NET Cofund PhotonicSensing									
Call 2016	44	25	57%	32	10	31%	12	7	58%
ERA-NET Cofund QuantERA									
Call 2017 (cofunded)	221	144	65%	91	61	67%	26	18	69%
Call 2019 (not cofunded)	85	52	61%	48	28	58%	12	5	41%
Total	**350**	**221**	**63%**	**171**	**99**	**57%**	**50**	**30**	**60%**

Source: VDI-TZ

Partnerships are very much valued by the research community. Among the benefits are the long-lasting relationships that are formed and lead to repeated collaborations.

> *"Sometimes, these projects may also act as a stepping-stone and help the participating organisations develop favourable attitude towards transnational/international activities in general. In these partnerships, we normally support the networking among projects – either midterm or at the end of the projects – and this is very positively assessed by researchers. In addition, some small companies have also found new markets (new sectors to address) through partners in such projects." (VDI-TZ official)*

On the negative side, the process of supporting transnational projects has not been homogeneous from one ERA-NET type to another or over the years (from ERA-NETs to ERA-NETs Plus, to Cofunds) and thus, the associated bureaucratic burden is sometimes unjustifiable.

> *"The complexity associated with the hybrid nature of the partnerships combining EU and national rules of participation and the diversity in participating rules makes it rather difficult to explain to researchers why they need to follow different procedures from the national programmes or Horizon."* (VDI-TZ official)

2.11. TÜV Rheinland Consulting (TRC)

TÜV is an independent organisation engaged in the sustainable development of safety and quality in the interaction between man, technology and the environment in nearly all aspects of daily life and the economy. As such, TÜV Rheinland tests technical systems, products and services, supports projects and tests processes for companies and organizations. At the moment, TÜV is coordinating the ERA-NET Cofund Electric Mobility Europe (EMEurope). The agency has strong experience in participating in partnerships starting with the first ERA-NET in the transport area that has evolved into the ERA-NET Plus action Electrobility Plus and the current EMEurope.

TÜV Rheinland Consulting (TRC) has been working closely with the German Ministries of Transport and Economic Affairs in the design, management and support of national programmes in the field of transport and mobility. Managing international participation of Germany in relevant partnerships on transport has been part of its activities. Depending on the topic, TRC has to coordinate and communicate with several ministries. As topics of concern are split between ministries depending on their foci, it is sometimes challenging to deliver the information to all necessary and interested parties.

Based on the interviewees, transnational collaboration in mobility is important in many aspects where relevant research and innovation often cannot be restricted within national borders. This becomes more relevant for Germany as it holds a central position in the transfer of goods and people being at the centre of Europe. At the same time, the opportunities to exchange views, learn from and work with different countries is valuable. In EMEurope there has been progress both in terms of technological advancements but also in the way countries collaborate with each other. Whereas, in the first collaborations the funding of joint projects was the main focus, as time passed opportunities for policy exchange were also taken up in terms of learning and understanding how and why something that is implemented in one country does, or does not, work in another. This exchange of knowledge has helped to avoid the waste of resources and to create improved framework conditions. This has been very much appreciated by the partners.

> *"Furthermore, the projects addressed research but mainly linked to implementation of developed solutions. This enabled actual collaboration with partners in different countries and an understanding of how the system works in these countries. This learning effect was very positive." (TÜV official)*

Naturally, there are challenges in combining different motivations, aims, policy measures and national contexts in the partnership, and certain procedures in the Cofund instrument are complicated. Despite that, however, it has been very constructive to bring countries with different conditions for electricfication of mobility together and to involve the policy community from the beginning.

Notwithstanding, the view of TÜV officials is that the amount of funds invested in the transnational calls are rather limited in comparison to those invested in most national programmes, although

there is no other ERA-NET or similar transnational collaboration instrument in the area of transport. As an indication, the Federal Ministry of Transport and Digital Infrastructure earmarked € 1,5 million for the 2016 call for proposals of EMEurope, while it eventually invested € 2,335 million to cover the participation of German researchers in the selected proposals. It is also important to note that the pre-proposals and the full-proposals with German participations accounted for slightly more than half of the total proposals received under the specific call (i.e. 17 pre-proposals with German participations out of 33 pre-proposals in total and 12 full-proposals with German participations out of 22 full-proposals). More importantly, the successful proposals including German researchers reached an impressive 77% (i.e. 10 out of 13 in total).

TÜV officials note that the German research community (research organisations, SMEs, industry, etc.) is attracted to EMEurope in principle, but there are also challenges to overcome. Experience has shown that it is not always easy to get funds from international programmes like H2020. The competition is very high, and the efforts needed to write an application are significant. Instead, it seems easier or realistic to get funds through a national programme. In addition, smaller companies lack the required capacity to get engaged in transnational collaborative research and the lower funding rates (under 100%) make it even more difficult for them. However,

> *"for those that do try and benefit from transnational partnerships such as the Cofund EMEurope, the efforts seem to be compensated by the results at the end." (TÜV official)*

In addition, bringing projects together from different funding sources (e.g. national programmes and H2020) is very much appreciated. To limit the administrative burden on the applicants, EMEurope applies a two-stage proposal submission with the pre-proposal being accepted in English by the participating funding agencies. Furthermore, the EMEurope consortium also takes care that applicants get the support they need throughout the entire process of applying and implementing the project if successful.

Besides the fact that certain research areas need transnational/international collaboration by default, Germany takes part in partnerships for a number of reasons, i.e. to offer the Germany researchers with benefits for transnational/international collaboration, to collaborate/align with other countries in developing policies and strategies in areas of strategic importance for the EU, to keep up the leading role and drive developments in certain areas, as well as to create the necessary critical mass, share knowledge and maintain a strong position in the competition with other world regions.

Partnerships in research and innovation are filling in a funding gap either in terms of supporting certain areas of research that are not adequately covered by national or other transnational programmes, or by supporting smaller than H2020 projects that allow, however, actual collaboration and building of long-lasting relations. German researchers appreciate the benefits of collaboration and networking at European / international level with the best researchers in the field and the already known national procedures that need to be followed. At the same time, partnerships help raise awareness in particular issues that need policy attention and bring the research and policy communities closer together while also aligning policies across the EU. The policy exchange and learning enabled is greatly appreciated.

Notwithstanding the attractiveness of the partnerships, there are several areas of improvement. More clarity is needed in the operationalisation of the different funding regulations across the different partnership types, while outsourcing the management of the partnerships on the EC side to external agencies might bring new difficulties. The high administrative burden of getting engaged with managing partnerships and participating in additional activities is another challenge, along with the fact that this cannot be fully covered by EC unit costs. Raising awareness and capacity building activities are needed to facilitate participation of certain groups (like SMEs) in projects. The sustainability issue is another serious area that needs to be addressed. The steps taken in this direction with the new partnerships under Horizon Europe might be more effective. Efforts to build synergies across the different partnerships and with other funding schemes are also important.

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

The university system, consisting of around 420 higher education institutes (120 universities, 203 universities of applied sciences, 57 film, art and music colleges, 34 colleges of administration and 6 universities of other types) carries out much of publicly funded research. They employ 738,000 staff in total, including 407,000 academic staff, and host 2.9 million students while they spend €18.4 billion euros in research (2018). [45]

The non-university research institutes, co-funded by the Federal government and the Länder, form another major research actor. These largely belong to the four major non-university research organisations: Max Planck Society (MPG), Fraunhofer Society (FhG), Helmholtz Association (HGF), and Leibniz Association (WGL). These organisations conduct interdisciplinary research with an international focus and often in collaboration with academic or private-sector partners. The non-university sector also includes the eight Academies of Sciences and Humanities that have formed a Union with more than 2,000 scientists and scholars, approximately 900 staff and an annual budget of 70.8 million euros (2021). [46]

In addition, there are 42 federal R&D institutions and 143 R&D institutions in the Länder that bring together 25,000 staff (among them 12,000 R&D personnel) and account for internal R&D expenditure € 1.5 billion euros (2019). Overall, the publicly financed non-university research organisations, together with the federal and Länder R&D institutions commit more than 14 billion euros annually to R&D.[47]

Of the comparator group of countries, Germany is only second to Sweden, and well above the EU27 average, in the three main R&D indicators (gross expenditure in R&D - GERD, business expenditure in R&D – BERD, and higher education expenditure in R&D - HERD). The country leads the group in terms of the government expenditures in R&D – GOVERD. (Figure 4)

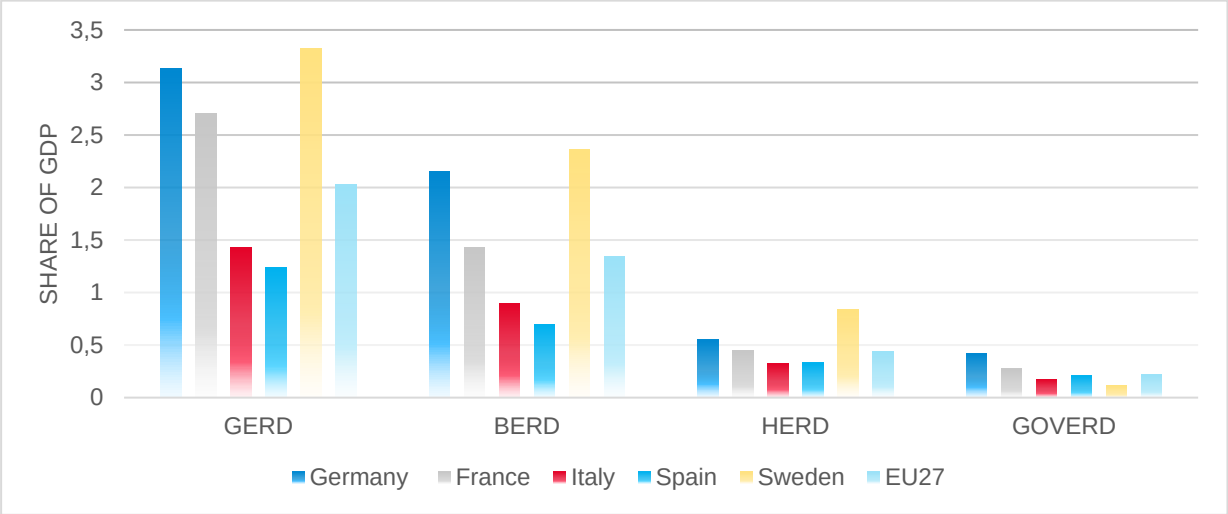
As noted above the German business sector accounts for two thirds of the gross expenditure in R&D. In fact, based on the OECD data that are annexed to this report (Annex, Main R&I indicators), the share of GERD funded by the business sector in Germany is the largest than in all the comparator countries: (66.01% for Germany, 56.08% for France, 53.68% for Italy, 49.49% for Spain and 60.76% for Sweden. The German business sector is also the one that performs the largest share of GERD (68.89%) which is comparable to that of Sweden (70.95%) that tops the comparator groups of countries. (2018 data, Annex: Main R&I indicators)

[45] https://www.research-in-germany.org/en/research-landscape/research-organisations/universities.html

[46] Research landscape - Research in Germany (research-in-germany.org)

[47] DAAD, RiG. The German Research Landscape 2021. Research performing organisations - Research in Germany (research-in-germany.org)

Figure 7: Main R&D indicators for Germany and the comparator countries and EU27 averages (2018)



Source: OECD

The higher education sector performed 17.58% of GERD in Germany in 2018, i.e. the lowest figure in the benchmark countries and below the EU27 average.[48] At the same time though, the percentage of HERD financed by the business sector is extremely high, being 13.50% for Germany, which is double the second score marked for Italy (6.02%) or the EU27 average (6.93%), possibly reflecting strong relations between businesses and academia. The performance of the government sector is rather similar in the comparator group (between 12-16%) except the case of Sweden where it accounts for a mere 3.62% of GERD. (2018 data, Annex I: Main R&I indicators)

Performance in H2020

Based on the data available in the H2020 dashboard, Germany is the strongest player overall, in terms of project participations and EU net contributions received under H2020. In terms of signed grants, the country is only surpassed by the UK (with 10,415 grants). In EU27, Germany accounts for 30.28% of total H2020 signed grants, which corresponds to 13.25% of total project participations, and receives 16.41% of net EC contributions. Germany's performance surpasses that of its benchmark countries, although closely followed by Spain, France and Italy and coming second to France in relation to the overall success rate in H2020 (Table 4).

Table 6: Key features of H2020 participation for Germany and the benchmark countries

	EU NET Contribution (€ b)	Signed grants	Project Participations	Success rate
Germany	9.91	9798	20299	14.94
France	7.30	7922	16732	15.25
Italy	5.53	7799	16741	11.75
Spain	6.24	8716	18461	12.86
Sweden	2.27	3357	5088	14.61
Total H2020	**66.9**	**35239**	**173553**	**11.95**

[48] 20.50% in France, 22.84% in Italy, 26.4% in Spain and 25.32 in Sweden; 21.94% EU27

Germany % in EU27	*16.41%*	*30.28%*	*13.25%*	
EU Member States	**60.43**	**32362**	**153266**	**11.97**

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

The top-ten German organisations receiving the largest amounts in net EC contributions (€) include:

Organisation Name	net EC contributions (€)
1. Max-Planck-Gesellschaft zur Förderung der Wissenschaften E.V.	661.314.186,04
2. Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung e.V.	659.160.225,65
3. Deutsches Zentrum für Luft - und Raumfahrt e.V.	330.745.148,01
4. Technische Universität München	253.239.372,86
5. Ludwig-Maximilians-Universität München	218.508.302,93
6. Forschungszentrum Jülich GmbH	214.388.122,54
7. Karlsruher Institut für Technologie	183.970.444,33
8. European Molecular Biology Laboratory	149.094.965,18
9. Rheinisch-Westfälische Technische Hochschule Aachen	146.404.655,06
10. Technische Universität Dresden	119.455.394,87

Source: https://ec.europa.eu/research/horizon2020/index.cfm?pg=country-profiles

How are they doing in partnerships' projects?

Based on the ERA-LEARN data, German organisations took part in 1616 projects supported by public R&I Partnerships in H2020, with a cumulative budget of approximately € 1 billion (total cost of projects). The number of projects with German participants is the highest of all the other participating countries, followed by France with 1161 projects, while being five times the EU27 average (375 projects). (cf. Table 1) German participants also present the largest share of coordinators (15.74%) in the projects supported by public partnerships, followed by the Netherlands with 11.87%.

Overall experience

Overall, the experience of the German researchers interviewed[49] were quite positive. They appreciated the opportunities offered to collaborate especially with counterparts from countries beyond the EU. Certain interviewees noted the uniqueness of the ERA-NET scheme in this regard. They also found useful to be part of rather smaller projects that could be a stepping stone to larger endeavours, although the 3-year project duration was considered a challenge.

[49] Invitations were sent to the coordinators of 35 projects that were selected randomly from the ERA-LEARN database. Interviews were conducted with 10 of those that returned a positive response.

"We accessed methods that we would have never established in our lab, it was a unique opportunity." (Project participant supported by NEURON)

"Small size cohorts are fantastic to develop new ideas. The duration should be increased, from 3 to 4-5 years, otherwise it is not possible to develop through to the translational continuum." (Project participant supported by TRANSCAN)

"It is great to work together in an international network and find people you would have never met otherwise. However, it is hard within only 3 years to be able to align university cultures and find common language." (Project participant supported by HERA)

"This is an in-between project, i.e., not as heavy as H2020 projects. We probably would have found it much more difficult to coordinate a H2020 given the limited expertise we have in managing such projects, despite our good expertise in national programmes. It is a good start for not that experienced partners. (Project participant supported by JPI Urban Europe)

The budgets made available were considered limited especially in covering the administrative efforts. This exacerbated the burden of having to report about the project progress twice, i.e., centrally to the partnership and the national funding agency, although this burden was felt differently from one partnership to another. Those of the interviewees that enjoyed extra support by their institutions (either in money or resources) to cover for the administrative efforts needed for their project were extremely grateful.

Submission of the application also needed to be done twice. Although the application process was straightforward, the need to submit a proposal to the national agency was confusing for some of the interviewees.

"Once the proposal was accepted, we had a couple of months to submit the proposal in German to the national agency. It was rather confusing not to be clear about whether the proposal needed to be re-evaluated by the national agency and could thus be rejected at the national level although approved centrally." (Project participant supported by JPI Urban Europe)

Another challenge was to align the different timings and rules of the national programmes. Although this was not the responsibility of the project coordinators, the effects on non-alignment influenced the course of projects. A project funded under NEURON, for instance, suffered from the withdraw of the Swiss partner that could not get the national funding due to a national rule allowing for only one proposal per Swiss partner to be supported and this was the second successful proposal of the specific partner. This resulted in lowering the expectations only to the pre-clinical part of the project, and the significant delays caused hindered the achievement of the project goals, although the collaboration among the partners was very good.

Another difference marked by the interviewees in relation to managing H2020 projects compared to partnership projects, was that in H2020 projects the coordinators only talk to the project officers in Brussels, whereas in partnerships they need to talk both to the partnership secretariat as well as the national funding agency. At the same time, they are the ones that are responsible for making the payments to the partners, which may lead to problems, whereas in the partnerships

this is arranged through the individual national funding agencies. Not having to talk to the several national funding agencies involved in partnership projects is as asset, although this may delay intime awareness of problems that may hinder the smooth project implementation.

Added value of partnerships

Comparing the experiences in partnerships with project experiences in national or H2020 contexts, interviewees were clear about the added value of the former. This had to do with the lower administrative efforts needed as well as the fact that such partnerships enable actual collaboration in small scale consortia with other countries including also non-EU countries and addressing actual gaps in research funding.

> *"Reporting on H2020 projects is much worse as it requires many efforts and several rounds of iteration to effectively address the finance and technical issues. The bigger the project, the more hassle it is. We could have carried out the project at the national level but you do need cross-country collaboration in the blue economy." (Project participant supported by MarTERA)*

> *"The proposal application was straightforward and simple, compared to the H2020 proposals that are more demanding – they need a significant upfront investment to prepare the proposal that is not feasible without external support" (Project participant supported by AXIS/JPI Climate)*

> *"Cross-country collaboration is important especially in relation to industries and this requires low levels of administrative burden. The annual meetings organised by MarTERA to facilitate exchange among the projects are very good to help build the community. MarTERA is a good and very important programme and it is a pity that it is not going to continue at this scale (supporting small manageable projects) in the future." (Project participant supported by MarTERA)*

> *"The experience can be compared with another project funded under IMI. The size of the project, small, manageable was much appreciated. It is in such projects where you can have nice interactions instead of big meetings where interactive discussions are not that facilitated. Smaller projects are also easier to deal with than larger H2020 projects. Smaller projects like this are really complementary to larger H2020 projects. They are also complementary to the national programmes which allow participation of foreigners but with no funding, which is not motivating. Partnership projects like these should be more. More national funds should be put in these as they really bring the European research community together." (Project participant supported by TRANSCAN)*

> *"H2020 is a bit too big for us. The efforts needed to write a H2020 application would have exceed our administrative capacity... NEURON is unique in covering the gap of smaller scale programmes addressing specific research topics …It is very helpful in establishing new collaborations and continue with other projects – we're now on route to create a follow-up project. We have many results at the end of the project but also many questions that need to be addressed to be able to proceed to the next level of translation, i.e. the clinical trials." (Project participant supported by NEURON)*

"What is good in PRIMA is the topic specificity and geographical focus which is not that much addressed in other programmes… PRIMA is a useful and important instrument. We will try for a follow-on project." (Project participant supported by PRIMA)

"The size of the project was quite manageable (6 partners). At national level they tend to be a bit smaller, whereas in H2002 the groups are usually 10-12 partners. Despite this, however, the project was powerful enough to make an impact. It allowed efficient coordination, comprehensive and inter-disciplinary work. This project filled a gap between smaller scale and bigger projects and by targeting specific question in comprehensive interdisciplinary manner. At the international stage such opportunities of collaboration rarely exist outside EU funding schemes. (Project participant supported by AXIS/JPI Climate)

Key factor for success

Interviewees also identified certain key factors for success based on their experience. First and foremost, it is the consortium and the quality of collaboration. It is advisable that at least some of the partners know each other. This helps develop the necessary level of trust early enough. If in addition, some team members have enjoyed prior collaboration, they are also more likely to be proactive in solving problems, thus contributing to a smooth project implementation. It is the achieved quality of collaboration that leads to continued collaboration in new projects.

"After the end of the project, we agreed on new collaboration with all the institutions involved. This will take place with the agreement with the pharma company that we are very close to signing and it would not have been possible if the researchers were not harmonised in their motivations and expectations. Thus, it is important to set up a sustainable consortium that can commit to continued collaboration." (Project participant supported by JPco-fuND)

"If two highlights had to be mentioned, these would be the successful collaboration and the impact-oriented research project. Several ideas and spin-offs have emerged that led to about a handful of proposals with some or all of the partners that are under review." (Project participant supported by AXIS/JPI CLIMATE)

A good communication structure is also important including the necessary infrastructure (collaboration and data storage platforms), and regular meetings within the project consortium to discuss challenges and results. A detailed as possible design of the project at the proposal stage will also ease the implementation besides increasing the chances of a positive evaluation.

"It was very helpful that PhDs and Post-docs met regularly and discussed how to bring their tasks/projects together. This allowed actual collaboration in a dense way." (Project participant supported by HERA)

"The topic addressed needs to be at the core of your interest and expertise…The better you prepare the project and more detailed the workpackages and tasks, the easier the implementation is. We prepared this project as in H2020 projects so it was easy." (Project participant supported by PRIMA)

The organisation of events bringing together the projects funded under the same call was also something that several interviewees noted as different from H2020. Such events were most appreciated as they provided new opportunities for collaboration building on the results of their projects. As an example,

> *"In such a meeting we got in touch with a pharma company with whom we started to negotiate for a collaboration. Now we are close to signing a collaboration agreement with the pharma company to further exploit our research results." (Project participant supported by JPco-fuND)*

> *"The cross-project collaboration that has been facilitated by the JPI Climate has also been useful, although if the scope of the calls is too board, there's limited room for cross-fertilisation." (Project participant supported by AXIS/JPI CLIMATE)*

Interviewees also highlighted the importance of linking research to policy.

> *"A nice feature about the JPI Climate is that it promotes a stakeholder driven process. The interface between climate science and climate policy is very important. In this regard, the new approach to partnerships in Horizon Europe that aspires to link their work with the overarching EU policies is quite positive. It is important to link the work of the partnerships to the EU decision making sphere to be more impactful. (Project participant supported by AXIS/JPI Climate)*

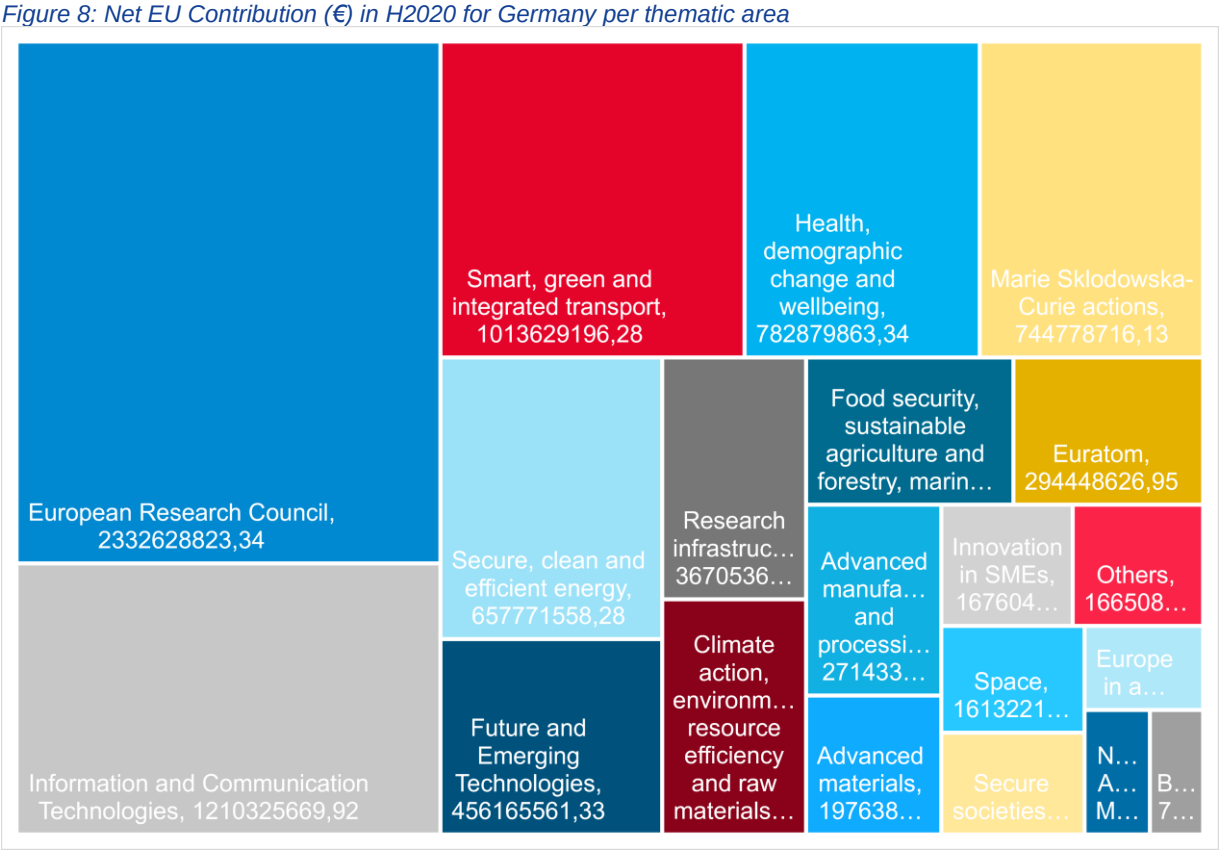
German researchers appreciate the opportunities offered by the partnerships for supporting research. There is a clear added value in comparison with other national or transnational schemes like Horizon 2020. Partnerships enable collaboration with counterparts from other countries including non-EU countries in small-scale consortia, in projects bearing lower administrative efforts and addressing research areas that are usually not funded by the existing alternatives. There are hurdles that need to be overcome mostly in relation to the different national rules and timings of programme cycles that need to be aligned. The duration of projects as well as the funds made available per project need to be extended. Besides the drawbacks the partnerships are valued as an important instrument complementing other national and European initiatives.

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

In line with the EU R&I policy, Germany gives special attention in meeting certain societal challenges including 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security' and 'Economy and work 4.0'. As discussed earlier, the HTS 2025 has also defined twelve missions addressing, health and care, decent work and living standards, mobility, AI and an open innovation culture, as well as environmental and sustainability challenges for present and future generations. Indeed, the areas of health, energy, aerospace, climate, environment and sustainability, ICT, humanities and social sciences were those that received the bulk of R&D expenditure by the Federal Government between 2018-2020.[50]

Participation in H2020 confirms the interest and strength of the Germany researchers in those areas. Besides ERC, Marie Sklodowska-Curie actions, FET and research infrastructures, the areas of ICT, transport, health, energy and climate action that received the largest shares of net EU contribution. (Figure 8)

Figure 8: Net EU Contribution (€) in H2020 for Germany per thematic area



Source: hhttps://webgate.ec.europa.eu/dashboard/sense/app/a976d168-2023-41d8-acec-e77640154726/sheet/d23bba31-e385-4cc0-975e-a67059972142/state/0

[50] Education and Research in figures 2020, https://www.datenportal.bmbf.de/portal/en/brochure.html

It is also interesting to see the distribution of the actual national contributions in the public partnerships (P2Ps) and the total project costs in the industry-driven partnerships (JUs, cPPPs). JU projects primarily focus in the areas of ICT and transport and the vast majority of the cPPP projects also fall under the ICT theme. The P2P projects, on the other hand, are distributed more widely across the areas of Health, Food and Climate action. In this regard, some degree of complementarity becomes evident.

Figure 9: Distribution of funds across partnership projects in H2020 thematic priorities (for P2Ps: actual national contributions from participating countries; for Jus and cPPPs: net EU contributions data from eCORDA)

Thematic priorities	P2Ps projects	JUs projects	cPPPs projects
Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, Biotechnology	8,91%	0,44%	3,09%
Climate action, environment, resource efficiency and raw materials	20,34%	0,48%	3,20%
Europe in a changing world - inclusive, innovative and reflective Societies (incl. secure societies - cPPPs)	2,56%		5,44%
Food security, sustainable agriculture and forestry, marine and maritime and inland water research	16,37%	6,67%	
Future and Emerging Technologies	2,08%		4,64%
Health, demographic change and wellbeing	40,73%	13,94%	
Information and Communication Technologies		26,41%	81,92%
Secure, clean and efficient energy	6,62%	7,81%	1,70%
Smart, green and integrated transport	2,38%	44,24%	
	100,00%	100,00%	100,00%

Source: ERA-LEARN database for P2Ps based on actual national contributions; eCORDA based on net EU contribution – due to different units of analysis the comparison is only possible within each instrument across the thematic areas; Values are calculated as the share of investments of the specific instrument in the specific theme in the total investments under the specific instrument

These areas reflect the national priorities as well as the large span of expertise of German researchers. Indeed, German researchers are strong in all scientific disciplines. Germany held approximately 4% of global publications in 2019 in natural, medical, and social sciences and humanities, with slightly lower shares of around 3% of global agricultural science and engineering publications. Accordingly, international collaboration of German scientists was highest in the natural sciences (68.3%), followed by engineering (56.2%), agricultural sciences (55.2%), medical sciences (54.6%), and the social sciences (49.3%), and was lowest in the humanities (19.4%) possible reflecting the more local focus and tendency toward sole authorship in the humanities. However, while all fields showed a degree of international collaboration above the OECD member countries' average over time, there was a particular large positive deviation in

collaboration in the humanities indicating a shift towards more collaboration and expansion of the focus beyond local issues.[51]

The thematic priorities addressed by the projects with German participation supported by the public R&I partnerships complement those that fall under industry-driven partnerships. Together they reflect Germany's national priorities, which are highly correlated with the strategic priorities in R&I at the EU level.

[51] Stephen, Dimity; Stahlschmidt, Stephan (2021) : Performance and structures of the German science system 2021, Studien zum deutschen Innovationssystem, No. 5-2021, Expertenkommission Forschung und Innovation (EFI), Berlin

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

Prior successful collaborations and personal networks are the main source of potential collaborators for German researchers alongside the consideration of 'where does the excellence' lie in the specific research area addressed. In addition, researchers often find new collaborators through the ERA-NET platform and partnering tools.

DFG officials noted that there are some historical patterns of collaboration with German-speaking countries (Austria, Switzerland) but also e.g. with the US and Canada as well as with France, the UK, Russia and many other European countries, In addition, in the last 20 years Germany increased collaboration with other countries / regions such as China, Japan, India, and South America and in recent years efforts have been dedicated to strengthening collaboration with partners in Africa and Southeast Asia.

Naturally there is thematic specificity in collaborations. For instance, in BiodivERsA where projects are very inter-disciplinary (combining biological, economic, and social areas of research), German beneficiaries collaborate with counterparts in Western European countries, but also the Baltic Sea, as well as non-EU like the US, Brazil and Canada. When it comes to forestry research, collaboration with Scandinavian countries stands out. In relation to transport, the collaboration patterns reflect the latest developments in how much countries invest in the transport area – many projects have partners from Germany or the Netherlands, and the EMEurope partnership promotes collaboration with as many other countries as possible to allow for a wide range of implementation of the solutions achieved in the projects. In the agricultural area, collaboration usually takes place with countries that have significant research capacities in the area such as the Netherlands, UK, France and Denmark.

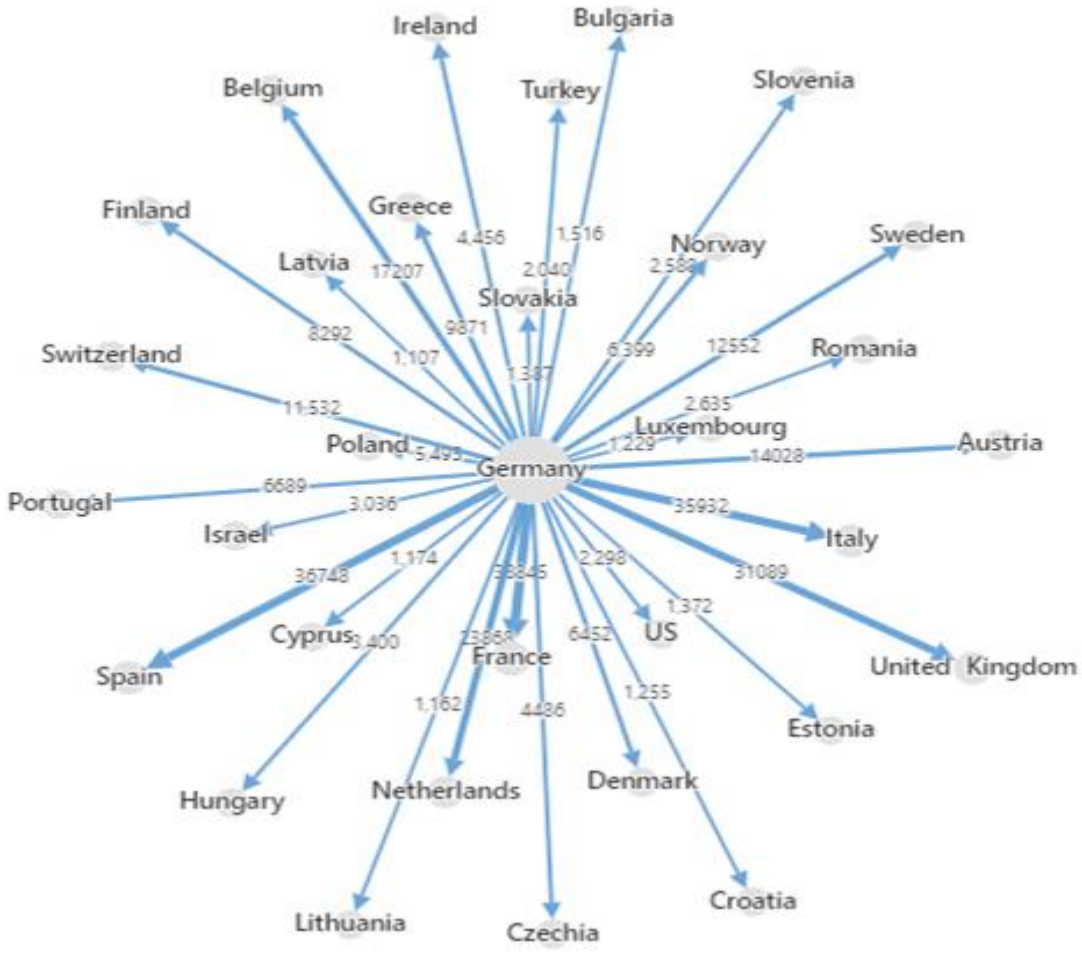
At the same time, certain partnerships, such as HERA and CHANSE, are actively promoting collaboration with all countries and pay particular attention to increasing collaboration with the widening countries. In HERA, specific matchmaking events were organised but these were not enough to help researchers from widening countries be included in successful proposals at a large scale. Further efforts are needed for improving networking and building capacity in the research communities in these countries.

Based on H2020 data[52] (including also project data from Joint Undertakings and cPPPs), German beneficiaries in H2020 projects collaborate mostly with counterparts from Spain, Italy, France, United Kingdom, Netherlands, Belgium, Austria. There is also strong collaboration with other Nordic countries (Sweden, Denmark and Finland), but also with Southern European countries

[52] https://webgate.ec.europa.eu/dashboard/sense/app/a976d168-2023-41d8-acec-e77640154726/sheet/e1b57f9a-669b-4962-bdb9-0151c523120f/state/0

such as Greece and Portugal. In terms of associated countries, the numerous links with Switzerland stand out which is nineth in rank, but also with Norway, Turkey and the US.

Figure 10: Top collaborators of German organisations in H2020 projects (links > 1000)



Based on the ERA-LEARN data[53], the picture does not change in the case of projects supported by public R&I partnerships. The top collaborators of Germany include France, United Kingdom, Netherlands, Spain, Italy, Sweden, Austria, Switzerland, Belgium, Denmark, Finland and Norway. Of the non-EU countries that Germany collaborates with through partnerships Turkey, Canada, Israel and the US stand out more than others.

Based on the researchers' testimonies, the opportunities to collaborate with non-EU partners in relatively smaller consortia allowing actual collaboration and trust building, which led to continued collaboration in some cases, was highly appreciated.

[53] https://www.era-learn.eu/network-information/countries/de/@@country-relations?type=projects

"It is great to work together in an international network and find people you would have never met otherwise." (Project participant supported by HERA)

"Although it was challenging to work with US partners, due to the different culture, it was a valuable experience…The cooperation with the partners was very good! Good working relations have been established that will continue in the future. (Project participant supported by JPI Urban Europe)

"ERA-NETs also involve non-EU countries and address lots of topics that are not covered by H2020. In this regard, alternatives to ERA-NETs are hard to find." (Project participant supported by NEURON)

In relation to publications, Germany collaborated internationally on 60% of its publications in 2019, which is similar to other large European countries such as the UK, France, and Spain. Outranked only by the USA, Germany was a common collaboration partner for many countries, particularly those regionally proximate such as Austria (10.5%), Switzerland (8.2%), the Netherlands (4.9%), Sweden (3.9%), and Belgium (3.8%). Germany itself produced most of its publications with the USA (6.2%), UK (3.1%), China (3.0%), France and Italy (each 2.0%).[54]

Driven by their prior successful collaboration experiences and their personal networks, German researchers partner with counterparts from a wide range of countries including the most active in both H2020 and European R&I Partnerships. German links also spread beyond the EU countries with Switzerland being a significant collaborator alongside Norway, but also the US, reflecting the international co-publication profiles of German researchers

[54] Stephen, Dimity; Stahlschmidt, Stephan (2021) : Performance and structures of the German science system 2021, Studien zum deutschen Innovationssystem, No. 5-2021, Expertenkommission Forschung und Innovation (EFI), Berlin

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

Strengths

- A strong national R&I system with the highest gross expenditure in R&D in EU27
- A long tradition of competitive programme-based funding for pre-commercial research
- Research actors of high international standing and industries that are pioneering in R&I
- Among the strong innovators in Europe, supported by a rich and diversified research and innovation landscape addressing all scientific and technological fields.
- A good position in terms of international research outputs (international co-publications)
- Highly attractive for international academics and researchers, although less for foreign doctoral students
- European and international collaboration always considered a strategic priority by the German R&I policy actors.
- National priorities in research and innovation aligned with the EU priorities and the societal challenges addressed by the partnerships.
- Germany plays a key role in driving the developments in relation to partnerships. The new approach in Horizon Europe is welcomed by German officials, although bearing potential challenges in terms of administration.

Weaknesses

- A highly decentralised system in relation to participation in partnerships that calls for a certain level of coordination in view of building a national strategy towards European R&I partnerships. Concerns by ministries' units and programme owners of losing certain independence and ability to address relevant topics in short notice.
- In some cases (e.g. agricultural research) the funds made available are considered limited especially compared with those made available at the national level.

7. Country-specific focus areas for Germany: Cancer Research and Green Hydrogen

Leading in terms of engagement and performance in public R&I partnerships in Europe and counting on a well-funded national R&I system with world-famous research institutions, Germany's R&I landscape has a strong presence in all research areas, also taking often a leading and coordinating role within the European R&I partnerships. Among the plethora of research areas covered by R&I partnerships, Germany has put particular emphasis on a number of research areas and has made available considerable funding sources for European cooperation in these areas. This includes, but is not limited to, the National Decade against Cancer, as part of the overall priority of health research, as well as the German National Hydrogen Strategy, as part of the overall priority of the green transition to tackle the climate crisis.

National Decade against Cancer

Cancer is a worldwide health burden and a major public health challenge. The National Decade against Cancer in Germany brings together numerous key players to strengthen cancer research, in which patients are closely involved and which offers them increasingly improved prospects for effective prevention, diagnosis, treatment and ensuring quality of life.

The Federal Ministry of Education and Research (BMBF) has joined forces with the Federal Ministry of Health (BMG) and other partners to launch the National Decade against Cancer. It started in 2019, is scheduled to run for ten years and aims to mobilize people in Germany to address the topic of cancer research. At the same time, it is also designed to reinforce support for research itself. Innovations should receive more targeted support and be made available to patients faster. By joining forces, it is hoped that cancer will be diagnosed more quickly, that better treatments will be developed, and - in a long-term perspective - there will be fewer new cases.

Joining forces in Europe

Despite significant advances in the understanding, prevention, diagnostics and treatment, cancer remains a public health problem not only in Germany but also in Europe and the world. In such a setting, translational cancer research plays a key role in successfully addressing the growing burden of cancer. The great potential of translational cancer research in Europe will only be achieved when the main barriers are systematically addressed through concerted actions between public and private organisations that provide funds for research, researchers, healthcare providers and all those engaged in the cancer research spectrum. Moreover, adequate and systematic financial support backed by a strong political commitment is absolutely essential to help reduce the burden of cancer that European citizens are currently facing. In this context, Germany strongly supports the TRANSCAN-3 network. This embodies an excellent model of transnational cooperation by bringing together 31 funding organisations from 20 countries with the common goal of supporting high-impact translational cancer research through joint calls for

proposals, and by an efficient investment of dedicated national/regional public funding, leveraged with foundation/charity-based resources and EU financial support.

Germany's National Hydrogen Strategy

The world is facing complex challenges, from the coronavirus pandemic to tackling the climate crisis and related consequences. But the year 2021 has also shown that groundbreaking research can provide effective solutions to our current challenges. Green Hydrogen holds great potential for a green recovery from the coronavirus pandemic and a green transition towards climate friendly energy systems.

Hydrogen has gained in importance on the European and international agenda. In Germany, the National Hydrogen Strategy interlinks climate, energy, industrial and innovation policies, and makes green hydrogen a key element of our decarbonisation efforts. The corresponding "package for the future" aims at speeding up the market rollout of hydrogen technology in Germany and fostering international partnerships. German research and companies are among the world leaders in hydrogen technologies. Germany wants to seize this unique opportunity to use the know-how to become a supplier of a global energy turnaround.

The Agenda process on Green Hydrogen

In order to make Green Hydrogen competitive as an energy source and facilitate the transition to a hydrogen economy, Germany relies on research and innovation, as well as on European cooperation. At Germany's initiative, a joint member-state based research and innovation initiative on Green Hydrogen was launched by the European research ministers during the German EU Council Presidency in 2020. The aim of this initiative, also called the agenda process on Green Hydrogen, is to identify the most important and urgent research needs for a competitive European hydrogen economy and bundle them in a joint strategic and innovation agenda (SRIA). Throughout a year-long participative process, experts from all over Europe and from different sectors developed such an agenda, which is expected to be published in early 2022. The SRIA is a first milestone of the European Research Area and an important contribution of the member states to the European Green Deal as well as the European Hydrogen Strategy. Subsequently, international bilateral and multilateral projects as well as initiatives and programs at the European, national and regional level can address the issues identified in the SRIA and thus contribute to the development of a functioning European Green Hydrogen economy.

As an open, transparent and inclusive bottom-up process, the agenda process involves representatives of industry, research, politics and civil society from all over Europe and beyond. Regular exchanges with the EU Commission assure that the agenda process is complementary to the Green Hydrogen activities at the EU level and that synergies are used beneficially.

The initiative is part of the EU member states' efforts to co-create and jointly implement the new ERA. By shaping the ERA from the bottom-up, including different actors and perspectives, all member states, research institutions, scientists, businesses and citizens benefit alike. Increased cooperation effectively leads to a more equal research and innovation environment across the European Union.

International research cooperation on Green Hydrogen

The Federal Ministry of Education and Research plans to advance research on green hydrogen along the entire value chain. Effective long-term links between the German research community and potential partners within and outside Europe are key to achieving this goal. Examples being:

International Future Laboratories on Green Hydrogen: The German Federal Ministry of Education and Research supports excellence-oriented international research collaboration with the "*International Future Laboratories*" funding competition. The *Future Laboratories* give renowned and talented researchers from Germany and around the world the opportunity to work together on ambitious projects. Since 2021, the establishment of future laboratories in the field of Green Hydrogen has been funded. The funding measure supports German universities and research institutions in pooling international expertise and motivating top international researchers to come to Germany for research projects.

Cooperation on Green Hydrogen with EUREKA countries: Under the umbrella of the EUREKA network, Germany and seven partner countries are jointly funding cross border cooperation projects on transport infrastructure for green hydrogen.

The new EU Clean Hydrogen Partnership

The new EU Clean Hydrogen Partnership aims to bring together the European Commission, the hydrogen industry, researchers and innovators as well as policy-makers from the Member States, building on the joint efforts of Fuel Cell and Hydrogen Joint Undertaking (FCH JU).

The new partnership is a key component of the EU's hydrogen strategy which was launched in July 2020. It will be co-funded by industry and the Horizon Europe research programme and it builds on the partnership under the previous Horizon 2020 programme. The hydrogen partnership is a part of a €22 billion package of industrial partnerships. The calls for 2022 are ready to open, with €300 million foreseen to be announced in the first quarter of next year.

To contribute to the objectives of the 2030 Climate Target Plan and the European Green Deal, the Clean Hydrogen Partnership will strengthen and integrate the EU's scientific capacity, strengthen competitiveness and stimulate research and innovation on clean hydrogen production, distribution, storage and end use applications. The research community will be included through the membership of *Hydrogen Europe Research*. Germany is represented in the State representative Group of the European Partnership Initiative.

Annex

Main indicators for P2Ps in H2020 (*)	Germany	France	Italy	Spain	Sweden	EU14 average H2020	EU13 average H2020	EU27 AVERAGE
Total pre-called budget available for P2P calls (€ m)	666	341	208	206	224	182	28	111
Number of funding organisations participating in P2Ps	53	47	38	39	18	24	9	17
Number of P2P calls with specific country participation	215	219	193	224	143	154	87	121
Number of full-proposals submitted to P2P calls (***)								
Number of eligible proposals submitted to P2P calls (***)								
Success rate (funded/full-proposals) (***)								
Number of projects funded under P2P calls	1616	1161	843	998	709	113	618	375
Number of total participations from country	1760	1110	868	975	685	629	96	372
Total costs of project participation (€)	1.002.911.215	605.096.097	268.576.089	390.918.158	386.192.670	304.893.919	26.870.115	171.030.606
Total requested EC funding (€)	573.118.185	268.547.993	167.481.848	186.253.519	197.649.518	153.755.242	16.291.570	87.569.029

Source: ERA-LEARN database (cut-off date June 2021), Estimated missing data 25-30%; (***) Data to be collected by the networks in the future.

Main R&I indicators	Germany				France	Italy	Spain	Sweden	EU 28 average
	2015	2016	2017	2018	2018	2018	2018	2018	2018
GERD (as % of GDP)	2,93	2,94	3,07	3,13	2,76	1,43	1,24	3,32	2,03
Percentage of GERD funded by the business sector	65,67	65,22	66,18	66,01	56,08 (2017)	53.68 (2017)	49,49	60,76 (2017)	57,78 (2017)
Percentage of GERD funded by government	27,90	28,52	27,72	27,85	32,41 (2017)	32,27 (2017)	38,90	25.02 (2017)	29.72 (2017)
Percentage of GERD funded by rest of the world	6,15	5,95	5,75	5,80	7,82 (2017)	10,53	7,90	10.08 (2017)	9.89 (2017)
Percentage of GERD performed by the business sector	68,65	68,16	69,10	68,89	65,41	63,26	56,50	70,95	66,28
Percentage of GERD performed by higher education	17,28	18,04	17,36	17,58	20,50	22,84	26,40	25,32	21,94
Percentage of GERD performed by government	14,06	13,80	13,54	13,54	12,50	12,43	16,83	3,62	10,90
GOVERD (% of GDP)	0,41	0,41	0,42	0,42	0,27	0,18	0,21	0,12	0,22
percentage of GOVERD financed by the business sector	11,26	11,25	10,11	9,89	7.88 (2017)	3.82	6.92	6.80 (2017)	7.76 (2017)
HERD (as % of GDP)	0,51	0,53	0,53	0,55	0,45	0,33	0,33	0,84	0,44
percentage of HERD financed by the business sector	13,87	13,83	13,35	13,50	2.71 (2017)	6.02	5.50	3.62 (2017)	6,93
BERD (% of GDP)	2,01	2,00	2,12	2,16	1,43	0,90	0,70	2,36	1,34
percentage of BERD fudned by the business sector	89,86	89,75	90,44	90,43	83.17 (2017)	83.22	82.77	83.57 (2017)	83.95 (2017)
percentage of BERD fudned by government	3,33	3,36	3,17	3,10	8 (2017)	4,92 (2017)	9.02	4.7 (2017)	5.22 (2017)
percentage of BERD funded by rest of the world	6,66	6,70	6,26	6,34	8.75 (2017)	15.95 (2017)	8.04	11.73 (2017)	10.54 (2017)
Total national public funding to transnationally coordinated R&D (€ million)	1.068,330	1.184,210	1.155,780	1274,360		707,019		173,713	
Total researchers (full-time equivalent)	387.982	399.605	419.617	433.685	306.451	152.307	140.120	75.151	2.098.323
International scientific co-publications per million pop	972.96 (2017)	999.73 (2018)	1039 (2019)	1067 (2020)	963 (2020)	1057 (2020)	1004 (2020)	2861.75 (2020)	1204 (2020)
Share of country's publications in top 10% most-cited worldwide	0.11 (2017)	0.11 (2018)	0.11 (2019)	0.11 (2020)	0.09 (2020)	0.11 (2020)	0.09 (2020)	0.13 (2020)	0.10 (2020)
PCT patent applications EIS 2020	6.36 (2017)	6.18 (2018)	6.30 (2019)	6.18 (2020)	3.54 (2020)	2.02 (2020)	1.28 (2020	8.92 (2020)	2.96 (2020)
ERC grantees by country per call year (2020)				88 (2020)	38 (2020)	20 (2020)	23 (2020)	23 (2020)	

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