RESEARCH, DEVELOPMENT AND INNOVATION COUNCIL

Government of the Czech Republic

Analysis of the state of research, development and innovation in the Czech Republic and their international comparison in 2021

SUMMARY

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SUMMARY

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This publication provides a current perspective on the system of research, development and innovation (R&D&I). In addition to traditional statistics, it makes the maximum possible use of unique data from the R&D&I Information System, available to the Research, Development and Innovation Council (RDI Council).

The analysis of the research, development and innovation in the Czech Republic (CZ) in 2021 contains:

- Indicators illustrating the state of R&D&I in CZ and their international comparison
- Indicators set in the strategic document National Research, Development and Innovation Policy of the Czech Republic 2016–2020
- Evaluation of 9 key topics:

FINANCE:
▹ Financial flows in research and development (R&D)
▹ Research and development financing from the state budget
▹ R&D&I support in CZ from European funding

RESEARCH FACILITIES AND INFRASTRUCTURE:
▹ Research infrastructures

R&D&I PERFORMANCE AND EFFICIENCY:
▹ Research and development results
▹ Innovation performance of the Czech economy and its international comparison
▹ Implementation of RIS3 in CZ

HUMAN RESOURCES:
▹ People in research and development

INTERNATIONAL COOPERATION:
▹ International cooperation in R&D&I

The analyses indicate the strengths and weaknesses and formulate visions and opportunities of the R&D&I system.

STRENGTHS

+ Economic potential
The Czech Republic has a strong industrial and research base.

+ Growing private and public R&D expenditure
Total R&D expenditure in CZ reached a record CZK 121.9 billion, i.e. 2% of GDP in 2021.

+ Research infrastructure built
Modern research infrastructures and centres of excellence in research and development have been built in recent years.

+ Strong publication culture
In 2021, over 80% of results were published in journals indexed in the Web of Science or Scopus databases.

+ Gradually developing internationalisation
It leads to excellence in some fields of science.

+ Qualified people and traditionally strong academia
The number of researches has been growing in CZ in the long term.

WEAKNESSES

- Low level of cooperation between the private and public sector in the R&D&I system
The needs of the business and the research sphere are not always aligned

– Unsatisfactory participation of Czech research organisations and teams in framework programmes
The number of CZ applicants in the Horizon 2020 programme is notably lower compared to EU15 states with a similar population size.

– Insufficient set-up for the development of the needed professional capacities and skills of researchers
Their potential is not sufficiently utilised, e.g. the success rate in completing doctoral studies is decreasing across fields.

– Low representation of women in research
The gender imbalance among researchers persists in all sectors. The share of women in CZ researchers ranged only around 24%.

– Inadequate conditions for effective functioning and development of innovation activities
The limiting factors from the point of view of businesses are: lack of own funding, of qualified staff and financial sources outside the enterprise, the administrative burden and time required by the public procurement process and low flexibility in project implementation.

– Insufficient use of the possibilities of intellectual property protection
The patent activity in CZ is low compared to EU states and the growing expenditure of the business sector is not reflecting in a higher number of patent applications.

VISIONS AND OPPORTUNITIES

Support for research, development and innovation is one of the key investments in our country's future, prosperity and competitiveness, the quality of life of all its inhabitants and a cohesive and resilient society.

Modern, coordinated and transparent management system The role of the Ministry for Science, Research and Innovation and the RDI Council	Functioning legislative environment and R&D&I evaluation	R&D&I financing Synergistic setting of tools for direct and indirect support	Support for venture capital investment and a higher use of intellectual property protection	Creating an environment for enhancing the innovation potential and establishing start-ups and spin-offs
Development of the R&D&I staff base Supporting women and young scientists in their career Supporting mobility and setting up a return-to-work policy	Effective targeting of R&D&I capacities including prioritisation of selected topics of support and fields of science	Enhancing international cooperation including a higher participation in framework programmes	Supporting excellent research centres and research teams	Improving the conditions for effective knowledge and technology transfer

An essential factor in the R&D&I system development is a **modern, coordinated and transparent management system**. To that end, the office of the Minister for Science, Research and Innovation, who also chairs the RDI Council, was established in 2021. The establishment of that office marked R&D&I as one of the priority areas for the future direction of CZ. CZ also strengthened its position in designing conceptual documents at the international level, because a more active and professional participation in the design of strategic plans such as framework programmes is key for CZ.

The Czech Republic has a **strong industrial and research base and modern research infrastructures**, but the needs of the business sector and the research sector not always match, which reflects in the still low level of cooperation between the two sectors. Therefore, it is important to set up functional and clear coordination mechanisms for efficient cooperation among the R&D&I system actors at all its levels.

§

The management system needs a **functioning legislative environment** that is likely to be enhanced by the comprehensive amendment to Act No 130/2002 Coll. on support for research, experimental development and innovation, aimed at reducing the administrative burden and fragmentation and simplifying the overall system of management and support, and further improving the evaluation of the R&D&I situation including adequate evaluation of purpose-tied aid programmes, and facilitating the knowledge and technology transfer to practice. The functioning of the legislative environment can be improved, inter alia, by more flexible and experimental approaches to regulation design (e.g. *sand box*). That activity requires cooperation with all actors in the R&D&I system and active monitoring of the developments abroad and of good practice.

It is essential not only to **set well the current tools of direct and indirect public support**, but also to **search for new forms of support and motivation**, in order to accelerate private R&D&I expenditure and increase the orientation of research and development on the application of its results. So it is important to focus on improving the conditions for effective **knowledge and technology transfer**, and on **creating stimulating conditions for the establishment of start-ups and spin-offs**. CZ must continue to create an environment for the innovation potential development. That includes **support for risk capital investments** and a **higher use of intellectual property protection** in the form of international patents. We need to pay special attention to setting the support for excellent research centres and research teams.

The effective setting of public support must go hand in hand with **developing the personnel base of the R&D&I system**. One of the persisting problems in this area is the low **representation of women**. An opportunity is to create conditions for reconciling research work and parent responsibilities and for women returning to the work after maternity and parental leave. We also need to enhance the **motivation of young scientists** to pursue a research career, create an attractive working environment for **excellent Czech and foreign researchers**, support **international and national mobility** in combination with a well set **return-to-work policy**.

It is essential to build relationships with foreign partners, create long-term links with top-level scientific centres and to **enhance international cooperation** including higher participation of Czech research organisations and teams in the framework programme Horizon Europe (mainly for ERC activities, partnerships and EIC schemes).

For the Czech Republic, it is key to **effectively target its R&D&I capacities** and to be able to respond to the dynamic developments in the society including the fast development of new technologies, but mainly to major societal challenges. CZ needs to define the priorities for increasing the resilience of the society and to motivate providers to support specifically focused research programmes relevant for the defined threats with a societal impact.

The events associated with the COVID-19 pandemic, the energy crisis and the Russian aggression in Ukraine will have a substantial impact on the direction of the R&D&I system in the next years. The **priorities of support for specific fields of research** and multidisciplinary teams will be changed so as to prevent or avert the impacts of further threats of this type. It appears essential to focus on the major political priorities of the EU that are to be implemented through disruptive innovation, digital transition and transformation of the CZ economy in response to new socio-economic needs.

FINANCIAL FLOWS IN RESEARCH AND DEVELOPMENT

Key trends

- **Gross R&D expenditure (GERD)** in CZ reached a record CZK 121.9 billion, i.e. 2% of GDP, in 2021. That expenditure consists mainly of business resources and public resources from CZ and from abroad. A negligible part of the total expenditure is formed by other sources such as income of higher education institutions or non-profit organisations, not received from the state budget.

- The long-term growth of the R&D expenditure is due to the consistent growth of expenditure from **business sources**. In 2021, that expenditure reached a record CZK 72.8 bil. (10% increase year on year), which represents 1.19 % of the GDP. A significant part of the business sector expenditure is spent by large enterprises with more than 250 employees. The largest share of the R&D funding has been invested in the long term in CZ in the automotive industry and in the information and communications technologies (ICT) sector. The research expenditure in the ICT sector has been growing dynamically in recent years and in 2021 it exceeded CZK 19 billion.

- The R&D expenditure from **public sources** totalled CZK 47.8 bil. The CZ state budget resources contributed CZK 39.4 bil. Foreign public sources that include EU funds reached CZK 8.4 billion in 2021[1].

- In terms of total R&D expenditure as a share of GDP, CZ is still slightly behind the European average in an international comparison. Between 2011 and 2020, the R&D intensity had a growing trend in CZ, whereby CZ is approximating the optimal quadrant.

- **The major part of total R&D expenditure consisted of current expenditure:** salaries (63%) and other current expenditure (37%). The share of **investment expenditure** between 2016 and 2021 was 10% annually on average. The expenditure on salaries grew the most in the business sector, in 2021 it went up by 74% against 2016, which correlates, of course, with the growing R&D expenditure from business sources and the increasing number of R&D staff in the sector. In the government sector, the number of FTE employees[2] increased by 10%, hand in hand with 53% growth in the volume of expenditure on salaries. In the higher education sector, the number of FTE employees increased by 38%, while the expenditure on salaries went up by 57%.

- **In CZ, expenditure on applied research and experimental development has prevailed in the long term**, and that expenditure clearly predominates in the business sector. In contrast, the R&D expenditure of the government and higher education sector is mostly focused on basic research. This focus on basic research may be the cause of the relatively low level of cooperation between academia and the private sector, reflecting in the not very extensive volume of funding flowing between the two sectors.

Financial flows between sectors

- Business sources are used nearly exclusively to finance R&D in the business sector. The amount of funding from domestic business sources used to finance R&D activities of the higher education and government sector is still relatively low, even decreasing year on year by CZK 0.3 bil., reaching nearly CZK 3.3 bil. in 2021.

- The volume of contract research carried out by research organisations from the government and higher education sector (i.e. mainly institutes of the Czech Academy of Sciences (CAS)) for enterprises made up around 6% of the public sector expenditure

1) Note: The difference between data in the Integrated Information System of the Treasury and the Czech Statistical Office (CZSO) is due to the different methods of data collection (survey VTR 5-01 Annual R&D Statement). See e.g.: Research and development indicators – 2021. Research and development indicators – 2021 | CZSO. (n.d.). [cit. 2022-10-15]. Available from: https://www.czso.cz/csu/czso/ukazatele-vyzkumu-a-vyvoje-2021

2) FTE (Full-time equivalent) represents a unit expressing the rate of involvement or a worker capacity load converted to 100% capacity.

in 2021. In the reporting period 2015-2021, the volume of contract research in the government sector was almost constant, ranging around CZK 0.4 bil. a year. In the higher education sector, the volume of contract research grew slightly since 2018, ranging around CZK 1 billion in the last three years.

- **Public financial resources** were directed mainly to R&D implemented in the government and higher education sector, in total the sector spent CZK 40.5 bil. from public sources (of that CZK 34.7 bil. domestic and CZK 5.8 bil. foreign). Business entities obtained direct public support at CZK 7.0 bil., which is historically the highest amount over the last 5 years.

- In terms of the volume of finance, there are 4 strong groups of research organisations in the Czech R&D system – private foreign-controlled companies, higher education institutions, followed by private domestic companies, and, with a relatively large gap, the CAS institutes.

- In the business sector, the majority (63%) of R&D funding was spent in 2021 by private foreign-controlled enterprises, in the government sector it was the CAS institutes (74%) and in the higher education sector it was higher education institutions (95%).

Direct and indirect R&D support provided to private enterprises[3]

- Private companies in CZ are supported from the state budget directly (in 2021, the state budget support amounted to around CZK 3.6 bil.) as well as indirectly through items deductible from the corporate tax base (CZK 2.1 bil. in 2020). A higher volume of indirect support has been used in the long term by large enterprises, mainly those under foreign control.

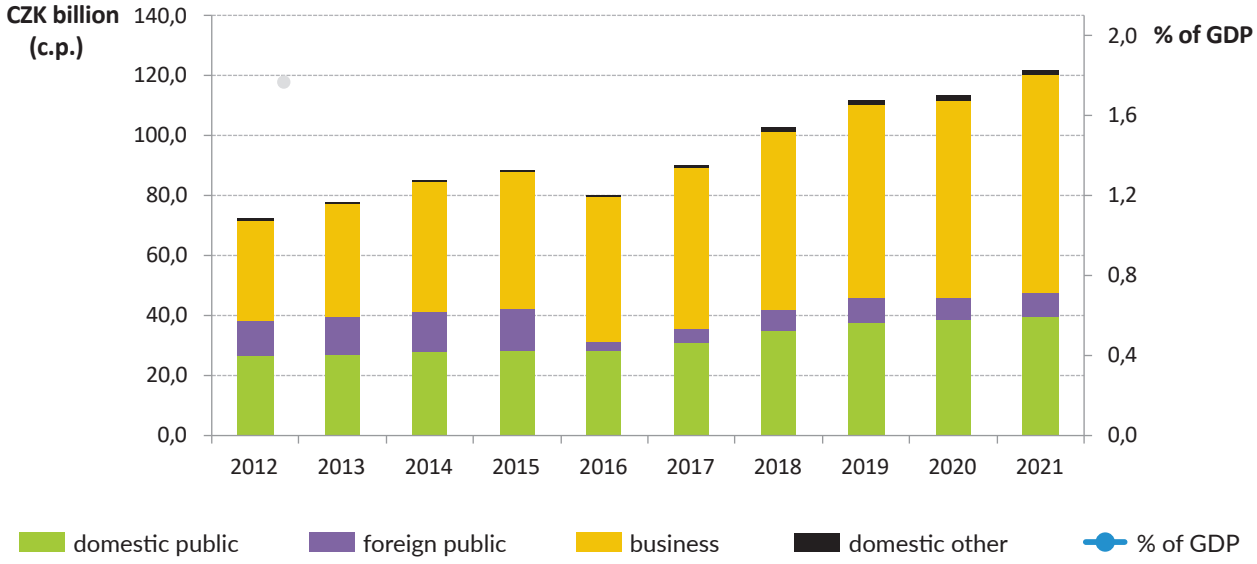
- CZ uses in particular one type of indirect support tool (tax deduction) while abroad the indirect public support of R&D activity carried out in the business sector is provided through a combination of multiple instruments.

- The decreasing number of enterprises using indirect support, in combination with a relatively sharp decrease in the amount of indirect support, indicates that the current setting of the financial instrument in CZ may not meet the needs of enterprises and that there are factors that may discourage them from making use of that instrument.

- For CZ, one of the possible ways to increase its innovation performance may be the search for new financial instruments for R&D support and a higher motivation of business entities to conduct R&D&I through a suitable mix of direct and indirect support tools.

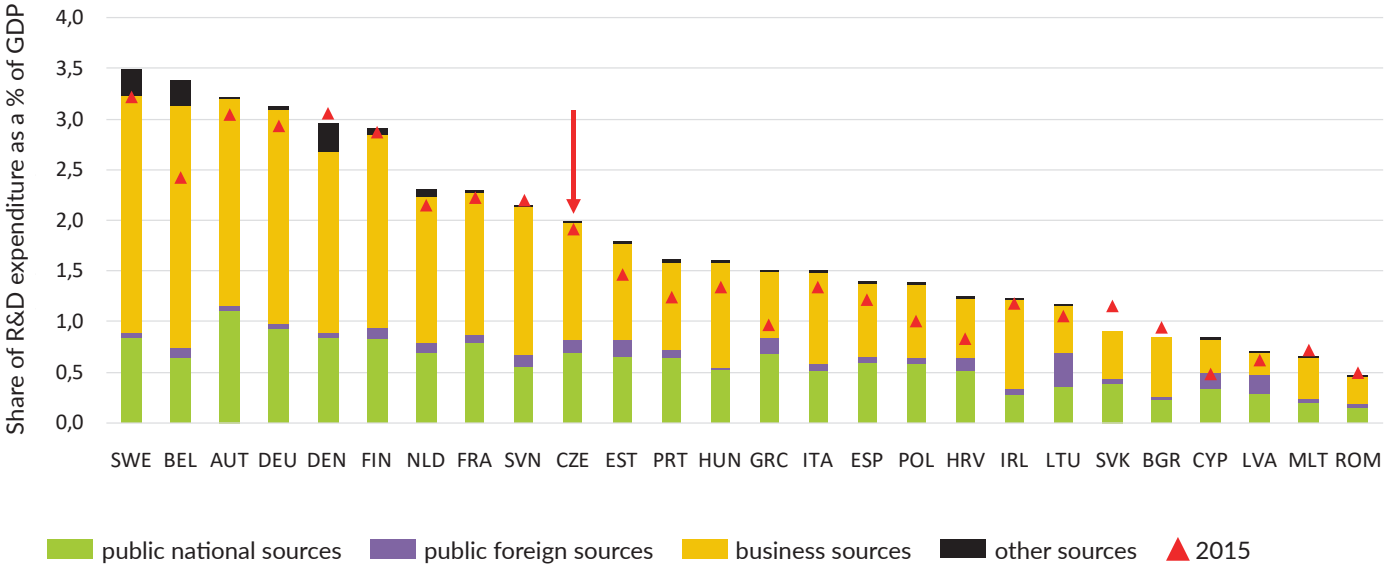
3) In CZ, indirect support can have the form of tax deductions or investment incentives. Incentives are used rather marginally and so the next chapter is dedicated to indirect support in the form of tax deductions, for which CZSO statistics are available.

Gross domestic expenditure on R&D (GERD) in CZ in the period 2012–2021 by source of financing (in current prices)



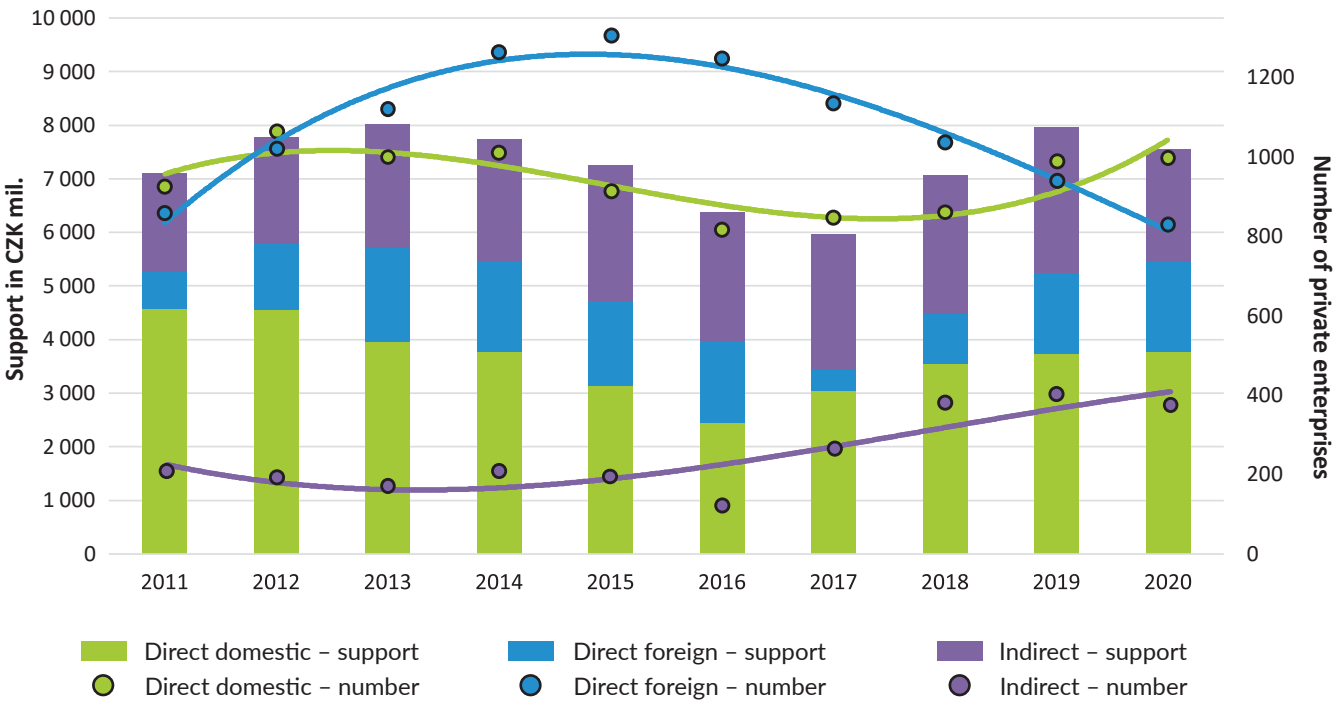
Source: CZSO, Annual Report on Research and Development | Other domestic sources are own income of higher education institutions and private non-profit institutions, not provided by the state budget, the business sector or foreign sources.

Total R&D expenditure by source of financing in EU27 countries (2015 and 2020)



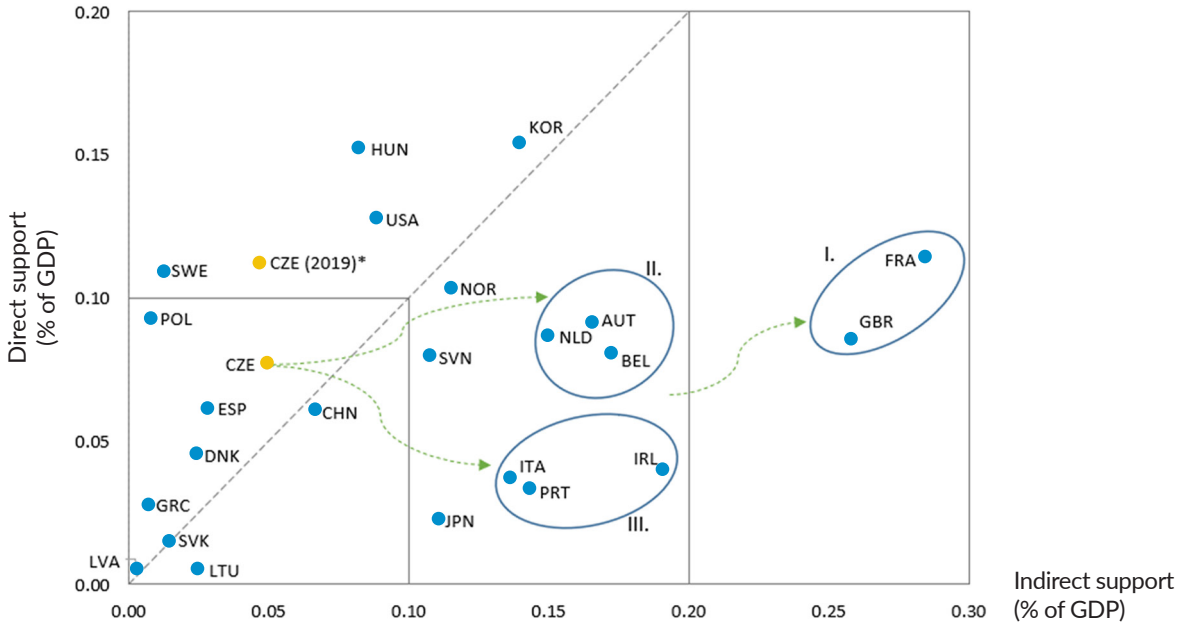
Source: Eurostat, own calculation | Foreign sources (Rest of the world – European Commission and international organisations); Other sources (Private non-profit sector and Rest of the world – other and not-classified), in SE and DK, a major part of Other sources is made up of not-classified sources).

Development of direct and indirect public support for R&D in private enterprises in CZ



Source: CZSO| Average annual indirect support for public enterprises was CZK 5 mil. in the reporting period and it was used annually by 6 enterprises on average.

Direct and indirect support for R&D&I in the business sector as a % of GDP in an international comparison (average for the 2015–2019 period)



Source: OECD – Main Science and Technology Indicators R&D Tax Incentive Indicators | CZE (2019) public support includes the public foreign sources part. In the monitored period, the following countries did not provide indirect public support of R&D through tax relief or other tax support: Bulgaria, Estonia, Finland, Cyprus, Luxembourg, Germany and Switzerland.*

RESEARCH AND DEVELOPMENT FINANCING FROM THE STATE BUDGET

- Public domestic resources intended for R&D&I in CZ are made up **primarily of the state budget funding for R&D&I which reached CZK 37.47 bil. in 2021**. The proposal has been structured in 15 budget chapters, the funding budgeted for their "operation" was CZK 2,227 mil. in 2021, (i.e. 6.0%). The state budget expenditure is further divided into institutional and purpose-tied aid.

Institutional aid

- The institutional expenditure increased by CZK 1.38 bil., while the purpose-tied expenditure declined marginally by CZK 0.16 bil. The institutional aid increase was caused mainly by the higher expenditure on long-term conceptual development of research organisations, and by the higher funding for co-financing the operational programme in the Ministry of Education, Youth and Sports (MEYS) chapter.

- According to data of the R&D&I Information System, higher education institutions (HEIs) used support from the state budget in 2021 (excluding support from operational programmes) at CZK 16.1 bil., the CAS institutes at CZK 8.6 bil., the business sector entities almost CZK 5 bil. and the other research organisations CZK 4.0 bil.

- The largest volume of institutional aid for long-term conceptual development of research organisations is provided in CZ from the budget chapters of the MEYS and CAS. In 2021, public and private HEIs drew funding for their long-term conceptual development at nearly CZK 8.0 bil. and the CAS institutes used CZK 5 bil.

Purpose-tied aid

- HEIs receive purpose-tied aid for specific higher education research (CZK 1.17 bil.) from the MEYS chapter but the aid is of an institutional nature. CAS institutes receive aid from the CAS chapter to cover "costs of activities" (CZK 1.75 bil.), and use the majority of it for R&D&I activities. That item is used, for example, to contribute CZK 210 mil. annually to the ELI Beamlines (from 2022, it will be transferred to MEYS to cover a part of the membership fee in the ELI ERIC consortium).

- Purpose-tied aid is provided mainly by the Grant Agency of the Czech Republic (GACR) - used mostly by HEIs and CAS institutes, and the Technology Agency of the Czech Republic (TACR) - supporting mostly enterprises and HEIs. The purpose-tied aid of other ministries is used by the entities funded by them, and successfully also by HEIs.

- The purpose-tied aid provided from the MEYS chapter is specific in that it covers subsidy schemes for Projects of Large R&D&I Infrastructures and for Specific Higher Education Research, but the support under those schemes is rather institutional as it is not provided based on the result of a public tender procedure. Moreover, the funding from programmes National Sustainability Plan I and II, closed in 2020, was gradually transferred to the item Support for long-term conceptual development of research organisations.

- Institutions conducting R&D are financed from multiple sources and the shares of purpose-tied and institutional aid differ both among the groups of research organisations and among the individual research organisations within a group. In 2021, the purpose-tied component of the support significantly prevailed only in enterprises while the purely institutional financing formed 41% in HEIs, 43% in research organisations of ministries, and 51% in CAS institutes.

Purpose-tied aid by field of research

- In terms of the fields of research, purpose-tied aid in CZ supports mostly natural and technical sciences, the dominance of natural science support is visible

in the public sector. At present, the institutional aid cannot be reliably broken down by field due to missing data on distribution inside the research organisations (mainly HEIs).

- Comparing the fields of purpose-tied aid for PROJECTS[1] by the provider, the aid goes, as expected, to *Engineering and Technology* mostly through TACR and Ministry of Industry and Trade (MIT) programmes. In the case of *Natural Sciences*, the largest volume of funding was distributed by the GACR. *Medical and Health Sciences* are supported the most through the Ministry of Health (MoH). The main aid provider for social sciences is TACR. The *Agricultural and Veterinary Sciences* receive the most support from the Ministry of Agriculture (MoA). The Ministry of Culture (MoC) as a ministerial provider grants the most support towards *Humanities and the Arts*.

- The international comparison of direct public support from national sources shows that in CZ, unlike in other countries, the support of natural sciences dominates, which may lead to insufficient direct support being granted to some fields in CZ. For example, the share of support for fields from the group *Medical and Health Sciences*, but also for *Humanities and the Arts*, is twice as low as that in other states.

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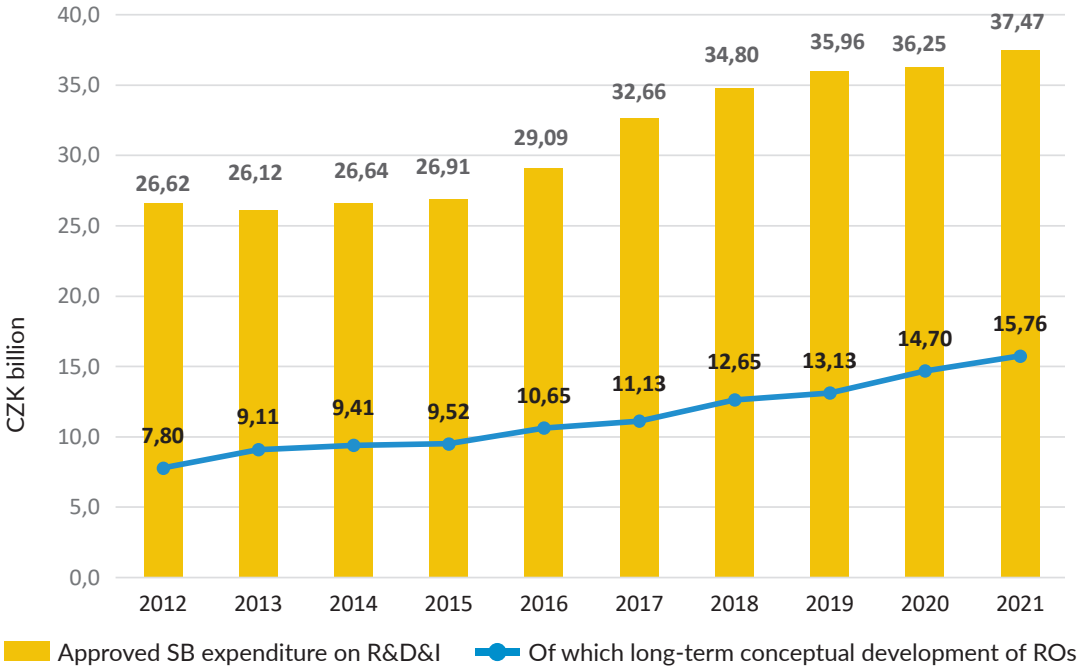
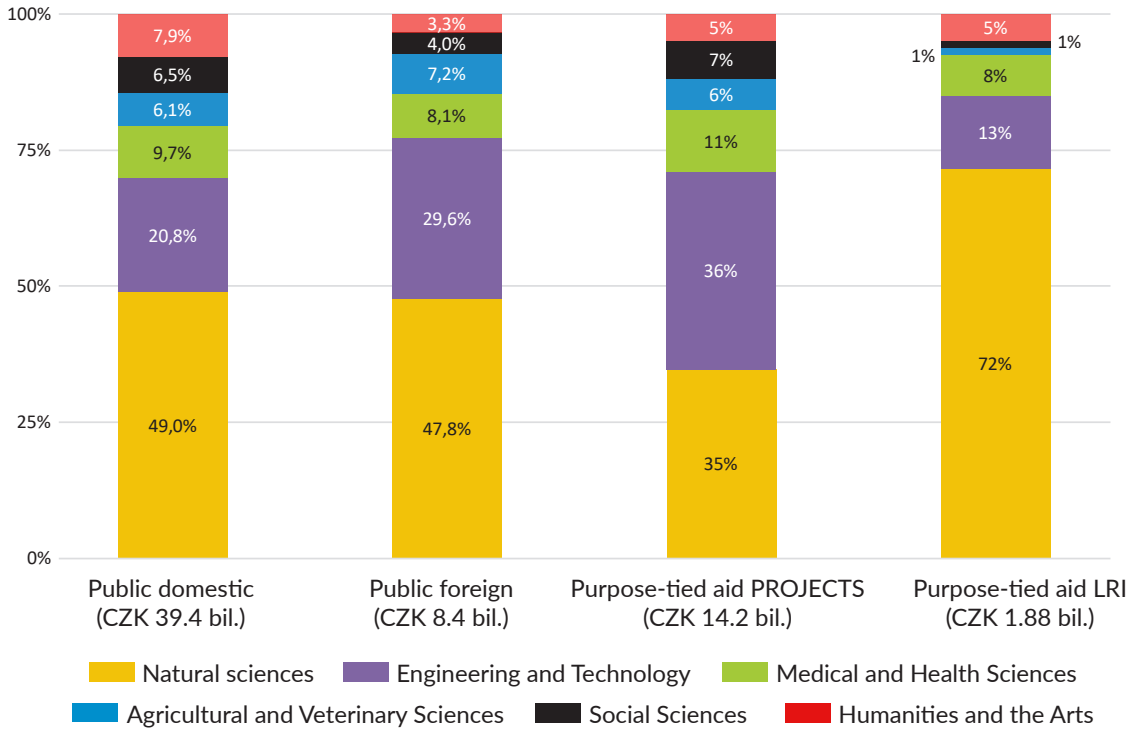
1) I.e. grant and programme projects.

Development of total budgeted expenditure of the state budget (SB) on R&D&I (in CZK bil.)



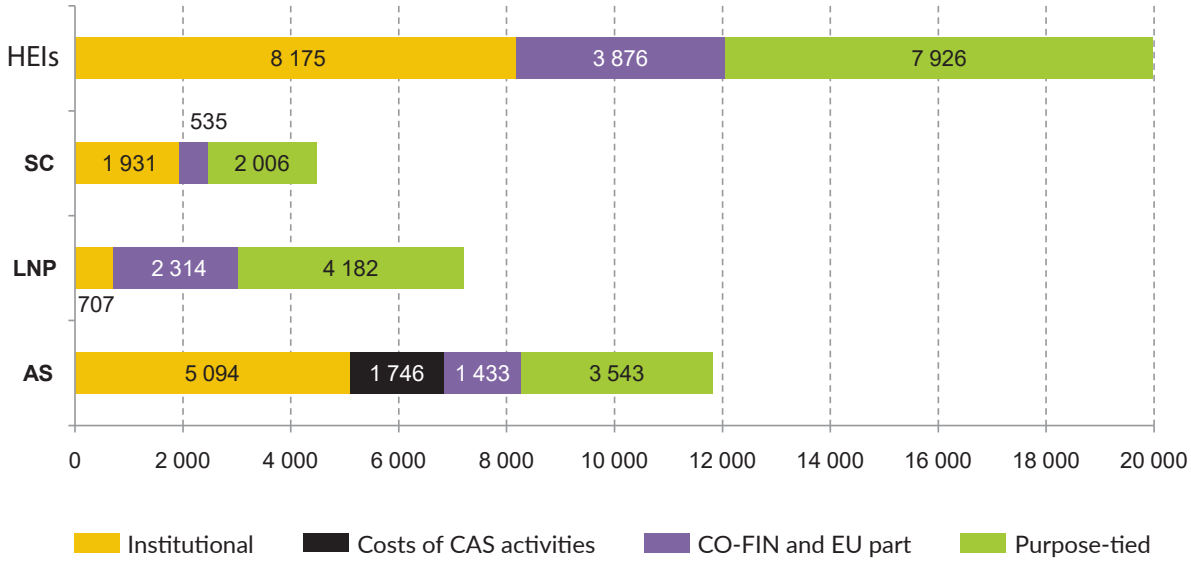
Source: State Budget Acts in the relevant years

Breakdown of direct support by field group and by source of financing (year 2021)



Source: CZSO and R&D&I Information System | Note: The Recovery and Resilience Facility (through the National Recovery and Resilience Plan - NRRP) finances the "Programme supporting excellent research in priority areas of public interest in healthcare - EXCELES" (implementation instrument of component 5.1 of NRRP). It is expected that 90% of the support will be granted to medical sciences and 10% to social sciences.

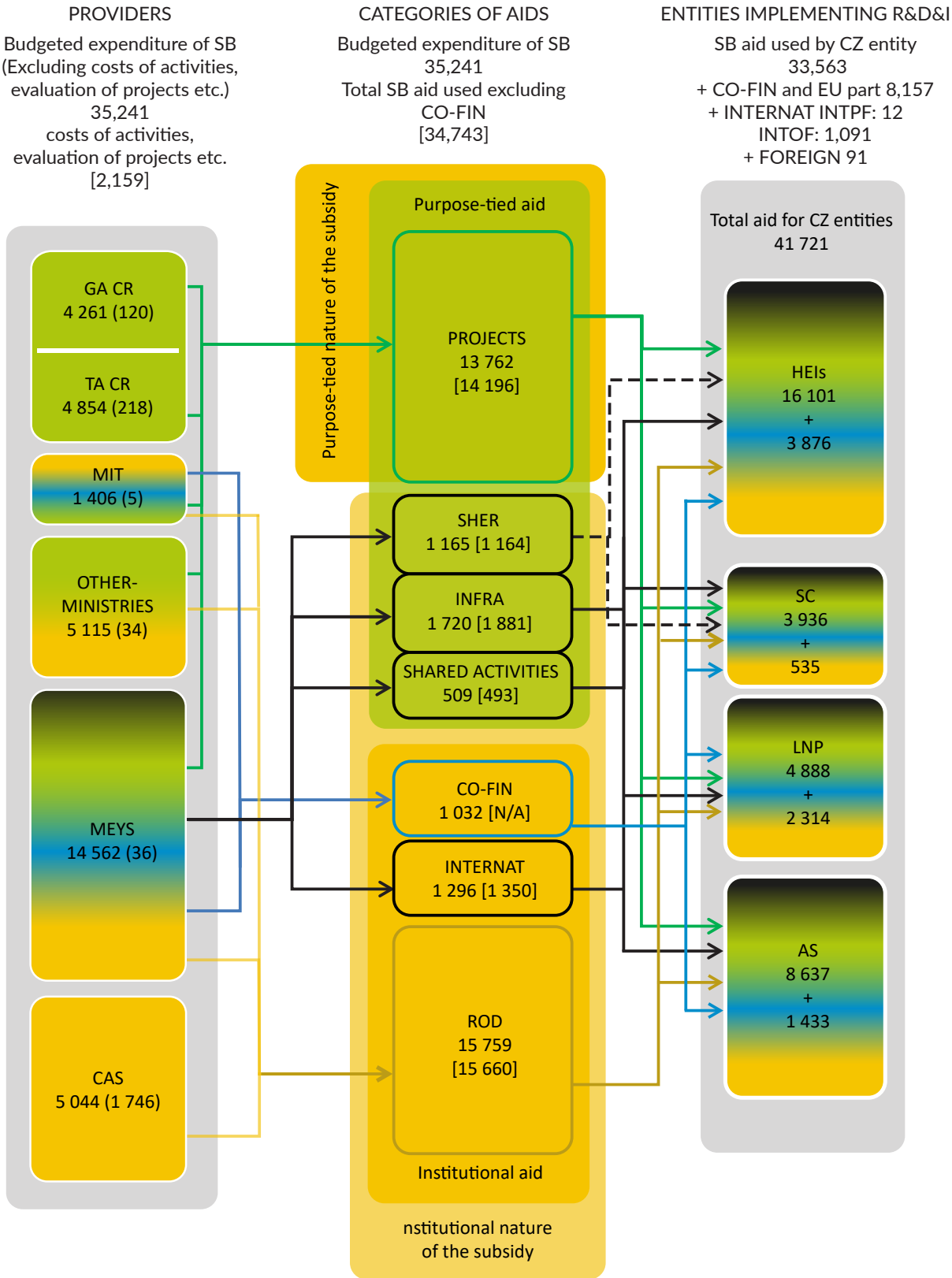
Volume of state budget funds and a part of OP funds, used by groups of beneficiaries in 2021 (in CZK mil.)



Source: R&D&I Information System [cit. 2022-07-22] | Does not include funding to cover fees for CZ participation in international R&D programmes and for membership in international R&D organisations. | CO-FIN – co-financing from operational programmes (OPs), EU part – support from OPs paid by the EU.

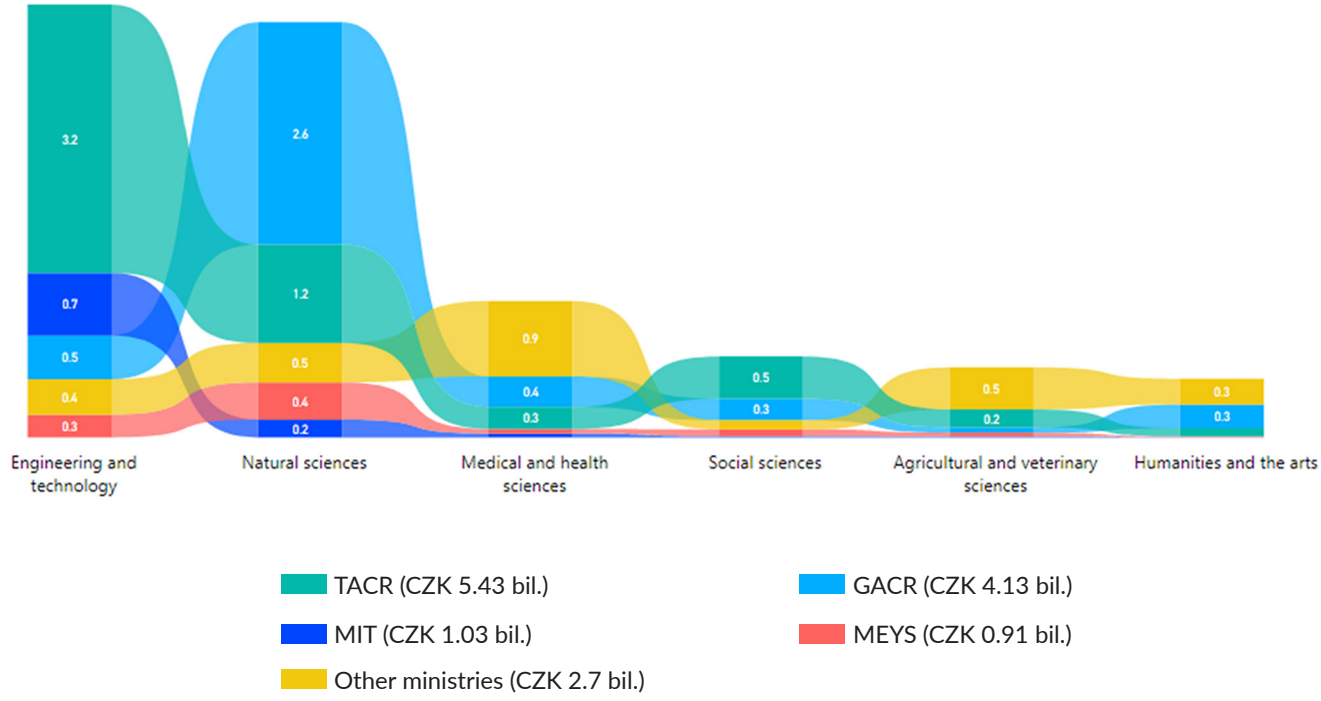
AS – public research institutions established by CAS pursuant to Act No 341/2005 Coll.; HEIs – higher education institutions (public, state and private); SC – state contributory organisations, organisational units of the state and public research organisations excluding CAS institutes and state HEIs; LNP – legal and natural persons, individuals and institutions not falling under any of the above groups, e.g. public and private limited liability companies, public benefit societies, foundations, civic associations,

How R&D is financed from the state budget, with volumes of funding spent in 2021 (in CZK mil.)



AS – public research institutions established by CAS pursuant to Act No 341/2005 Coll.; HEIs – higher education institutions (public, state and private); SC – state contributory organisations, organisational units of the state and public research organisations excluding CAS institutes and state HEIs; LNP – legal and natural persons, individuals and institutions not falling under any of the above groups, e.g. public and private limited liability companies, public benefit societies, foundations, civic associations, FOREIGN – foreign entities | PROJECTS – grant or programme projects; SHER – specific higher education research; INFRA – projects of large research infrastructures; SHARED ACTIVITIES - shared activity projects; CO-FIN – co-financing of OPs; INTERNAT – international cooperation; INTPF– feesfor CZ participation in international R&D&I programmes; INTOF– feesfor CZ participation in international R&D&I organisations; ROD – long-term conceptual development of ROs

Purpose-tied aid for PROJECTS from the state budget to field groups in 2021 by provider (in CZK bil.)



Source: R&D&I Information System [cit. 2022-07-22]

R&D&I SUPPORT IN CZ FROM EUROPEAN FUNDING

Research and development financing from public foreign sources

- CZ ranks among EU states with a relatively significant share of public foreign support for R&D&I in the total public support. For CZ, the key sources are EU funds (formerly called European structural funds, ESIF) and EU framework programmes. Other public foreign sources include international, governmental or public organisations outside the EU (e.g. CERN, Institut Laue-Langevin (ILL), ESA, NATO, OECD, UN, WHO, Norway Grants / EEA etc.).

  The highest volume of public foreign sources for R&D&I activities was spent in the higher education sector, specifically by higher education institutions. Other significant beneficiaries in terms of the volume of aid are the CAS centres and private domestic enterprises.

R&D&I support in CZ from European funds

- The European funds are used through operational programmes managed at the national level.

R&D&I support from operational programmes: 2014-2020 programming period

- In the 2014–2020 programming period, research capacities were strengthened mainly through the Operational Programme Research, Development and Education (OP RDE) and the Operational Programme Enterprise and Innovation for Competitiveness (OP EIC).

- The aid spent on R&D&I projects under OP RDE reached almost CZK 37 bil. by 2021. The highest share of the support was granted to HEIs (56%) and CAS institutes (32%). A significant part of the support (46.8%) was directed to research infrastructures, and, for example, mobility projects received CZK 2.11 bil. Support exceeding CZK 1 billion was granted to entities from the City of Prague and the South-Moravian Region. OP RDE registered over 16.5 thousand results, of that 73% were peer-reviewed articles. The results were produced by more than 9.5 researchers, of which 16% were foreign researchers. Men represented 66% of the participating scientists. The majority part of public support (over 75%) was spent on projects in natural and technical sciences.

- OP EIC supported R&D&I projects with CZK 7.2 bil. The highest share of the aid was received by enterprises (92%), as expected. Over 1.7 thousand results were produced, mostly applied ones. The results were produced by more than 2.9 thousand researchers, of which 4% were foreign researchers. Men represented 87% of the participating scientists. The majority part of public support (over 75%) was spent on projects in technical sciences.

R&D&I support from operational programmes: 2021–2027 programming period

- The follow-up operational programmes in the 2021–2027 period are the Operational Programme Johannes Amos Comenius (OP JAC) and Operational Programme Technologies and Applications for Competitiveness (OP TAC). The envisaged allocation for R&D&I support under OP JAC is CZK 43 bil., and under OP TAC it is CZK 31.1 bil.

EU framework programmes to support research and innovation

- Framework programmes for research and development (FPs) represent the backbone of the science and technology policy of the EU. **Horizon 2020 (H2020)** was the 8th EU framework programme, implemented in the 2014–2020 period. Its budget was EUR 77 bil. (i.e. CZK 2,042 bil.). The CZ participation in H2020 is still insufficient in the international comparison but is improving, mainly in the case of ERC grants, the number of which has increased as opposed to the previous periods. Experience gained from FP participation based on international cooperation increases the quality of publication results, in some fields the participation in FP H2020 is directly conditioned by a high number of citations.

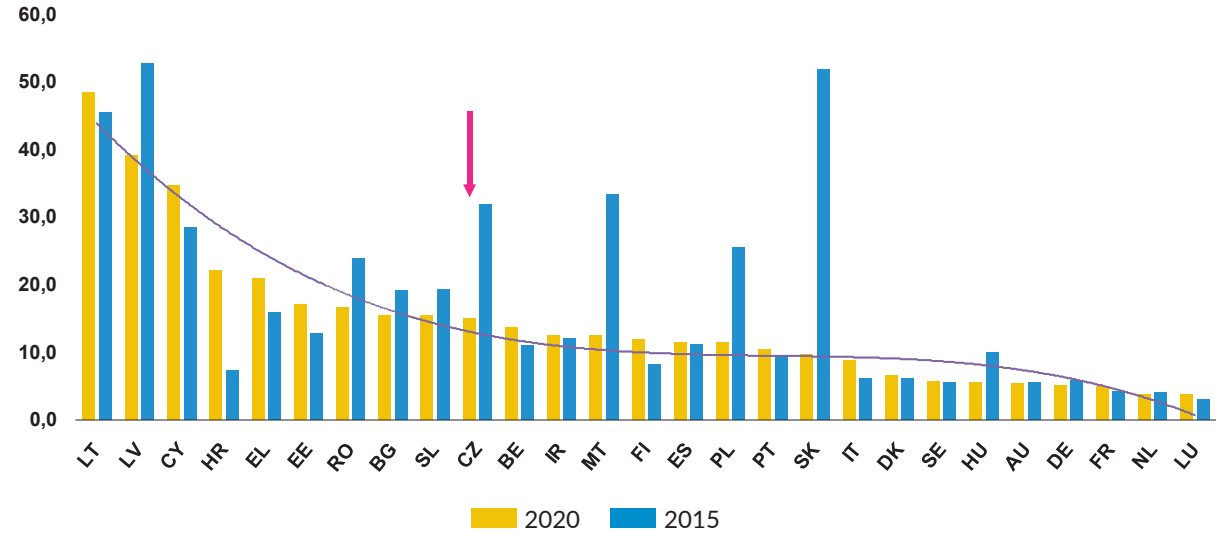
- The highest support from H2020 was won by the fol-

lowing organisations: Masaryk University, Charles University, Honeywell International s.r.o. and the Czech Technical University in Prague. An analysis has shown that the project success rate of CZ is similar to that of the other compared states. In H2020, CZ participated in almost 1.4 thousand grants.

- In terms of the highly prestigious **grants of the European Research Council (ERC)**, CZ obtained 45 grants under H2020 and its success rate is over 15%. The highest number of ERC grants was received in CZ by starting researchers (19 participations) and by applicants for consolidator grants (18 participations). The highest volume of support was directed to projects focused on natural and social sciences. CZ supports excellent research and involvement in ERC grants through instruments such as ERC. CZ (MEYS) or the grants EXPRO and Junior STAR (GACR), in 2021, support of CZK 826 mil. was disbursed to 124 projects.

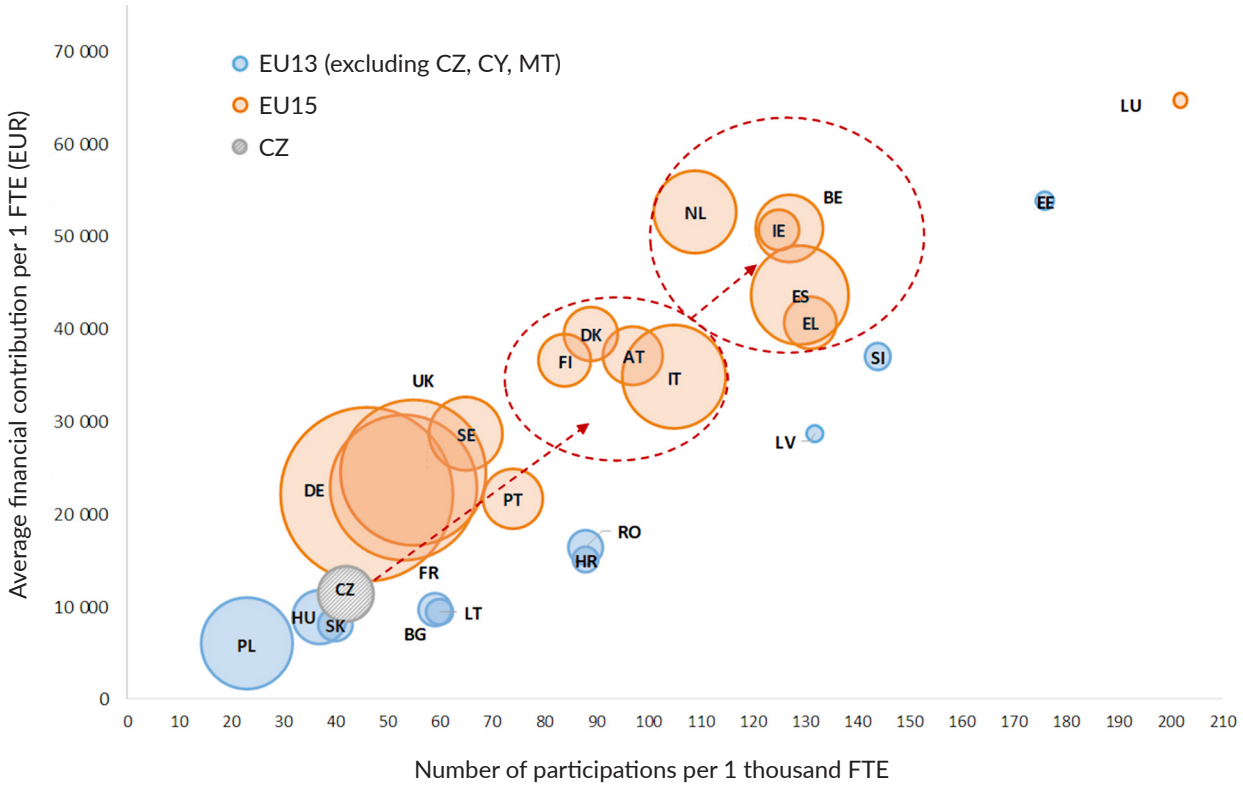
- The follow-up framework programme for research is **Horizon Europe**, implemented in the 2021–2027 period. That programme has been allocated with EUR 95.5 bil. and the budget has a structure similar to that of H2020. The most significant changes include: enshrining the European Innovation Council in the third pillar of Horizon Europe, including new activity portfolios, expanding the options of international cooperation and emphasising the open science principle.

Share of public foreign R&D support in the total public R&D support in EU27 states in 2015 and 2020



Source: Eurostat

Activity and financial contribution of EU Member States in Horizon 2020



Source: H2020 Dashboard, Eurostat [cit. 05/10/2022]

IMPLEMENTATION OF RIS3 IN CZ[1]

- The National RIS3 represents one of the implementation tools of the National R&D&I Policy of CZ in the area of oriented and applied research, and at the same time it must fulfil the enabling condition for implementing interventions of the EU regional policy in the area of R&D&I. The National RIS3 focuses on support for promising sectors and their transition towards higher added value, among other things by emphasising support for digitisation and other key technologies and knowledge.

Analytical evaluation of achievement against RIS3 objectives

- National programmes significantly complement the RIS3 support in addressing social and societal challenges: health research, security research, environmental research.

- The representation of oriented and applied research is very low in the Ústí nad Labem and Karlovy Vary Regions.

- Setting the target values of indicators for results and outputs of support for innovation in oriented and applied research is one of the most difficult activities in designing the support programmes. The indicators reflect a long time period that is affected by many external factors - in this sense it is positive that the indicators selected for monitoring the RIS3 in operational programmes report 60% and grater achievement; in national programmes, the expected results of applied research were achieved in 100% and more.

- The expectations have been met in operational programmes only partially in terms of the indicators monitoring results in the national patents granted (46%) and in the international patent applications (44%).

- Similar to operational programmes, the national programmes had a low representation of results such as patent (7%), semi-industrial operation (2%) and design (1%).

1) The chapter is drawn up by MIT – RIS3.

PEOPLE IN RESEARCH AND DEVELOPMENT

Key trends:

- In 2021, almost 85 thousand persons (FTE) worked in R&D in CZ. The highest number of R&D employees is reported by the business sector (the share of the business sector in the total R&D employment keeps growing).

- The majority of R&D employees are researchers (57%), followed by technical staff (31%) and other staff (12%). In 2021, there were 48,080 researchers (FTE) working in CZ. More than a half of the researchers work in the business sector, 30% in the higher education sector and 17% in the government sector.

- The largest proportion of researchers work in technical and natural sciences. In the business sector, the highest share of researchers work in industry and information technologies.

- In a comparison of the number of R&D employees in the EU27 countries, CZ moves around the 10th place as in the previous years. When comparing the number of researchers among the EU27 states, CZ ranks 12th.

Gender aspect

- The gender imbalance among researchers persists in all sectors. The share of women in CZ researchers ranged only around 24%. The greatest gap between male and female researchers is in the business sector (women make up only around 14%). On the contrary, the highest representation of women among researchers is in the government sector.

- From the international perspective, the highest share of women among researchers is in Latvia (49%). CZ holds the lowest ranks in EU27.

Preparation of professionals for R&D[1]

- To improve the quality and capacity of research teams, it is decisive in what extent and structure the young generation is and will be educated so that it is available for capacity expansion and generational renewal of the human potential in R&D.

- Natural sciences, mathematics and statistics clearly outride the other fields in the capacity of doctoral studies.

- 46% of first-time enrolled students in doctoral study programmes in 2021 were women (in the Education and Training field it was even 72%). 44% of doctoral graduates are women.

- The share of foreigners in the total number of first-time enrolled students in doctoral study programmes reaches up to 45% in some fields (Natural sciences, mathematics and statistics) and in 2021, it was more than double against 2010.

- The success rate in completing doctoral studies is decreasing across fields. In 2020, CZ reached 47 doctoral graduates per 1 thousand researchers.

Czech researchers abroad[2]

- In 2021, a questionnaire survey of Czech scientists living abroad was conducted, followed in 2022 by a qualitative survey in the form of a focus group with scientists living abroad. The questionnaire survey involved 198 Czech scientists living abroad and the focus group had 8 participants.

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1) Prepared by the National Education Fund. This part gives an overview of the preparation of professionals in doctoral programmes of HEIs, who represent the main source of the talent needed.

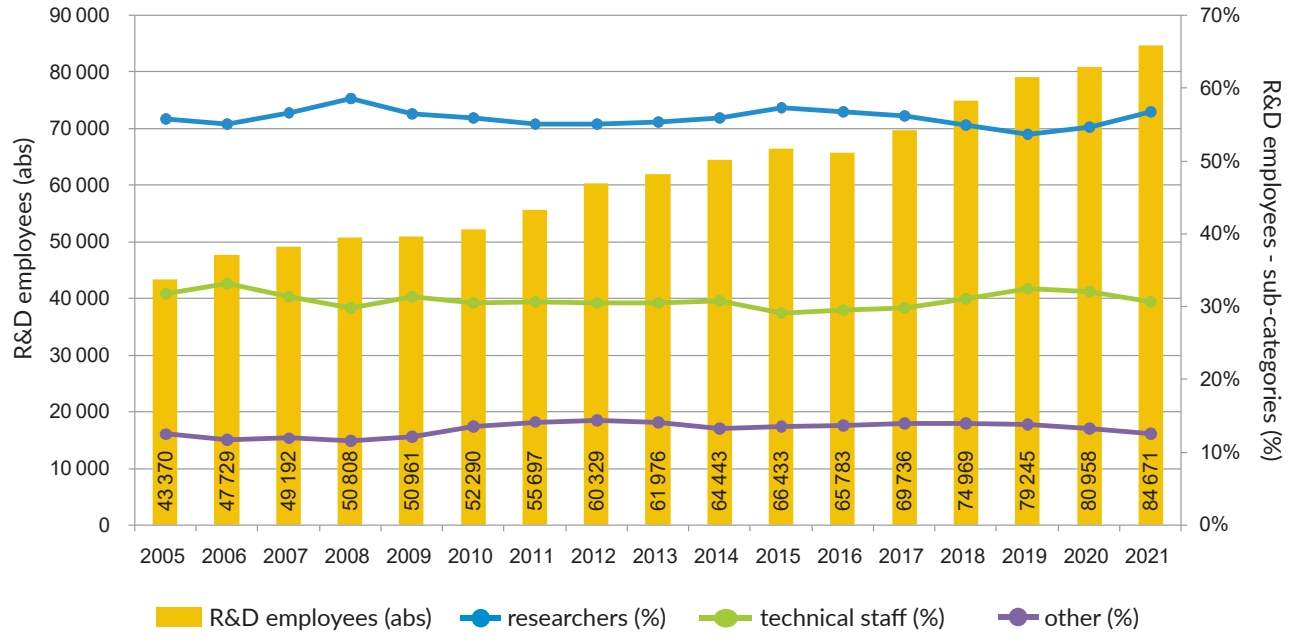
2) The research was carried out by the association Czexpats in Science, in cooperation with the Geomigration centre of the Faculty of Science, Charles University, and the Ethnological Institute of CAS. The research on Czech scientists is part of a broader project on the needs and links of Czech expats. The project was commissioned by the Ministry of Foreign Affairs and was financed by TACR. For more information see the website www.cestikrajane.cz [cit. 2022-10-15]

- The aim of the research was to find out who the Czech scientists living abroad are, where they live, in what fields they work and what links they have to CZ.

- The survey among Czech researchers living abroad showed the most frequent motivations to return to CZ, which are personal and family reasons and the opportunity to do science at the same level as abroad. On the contrary, Czech researchers indicate as barriers to their return mainly low salaries, lack of transparency and inbreeding[3]

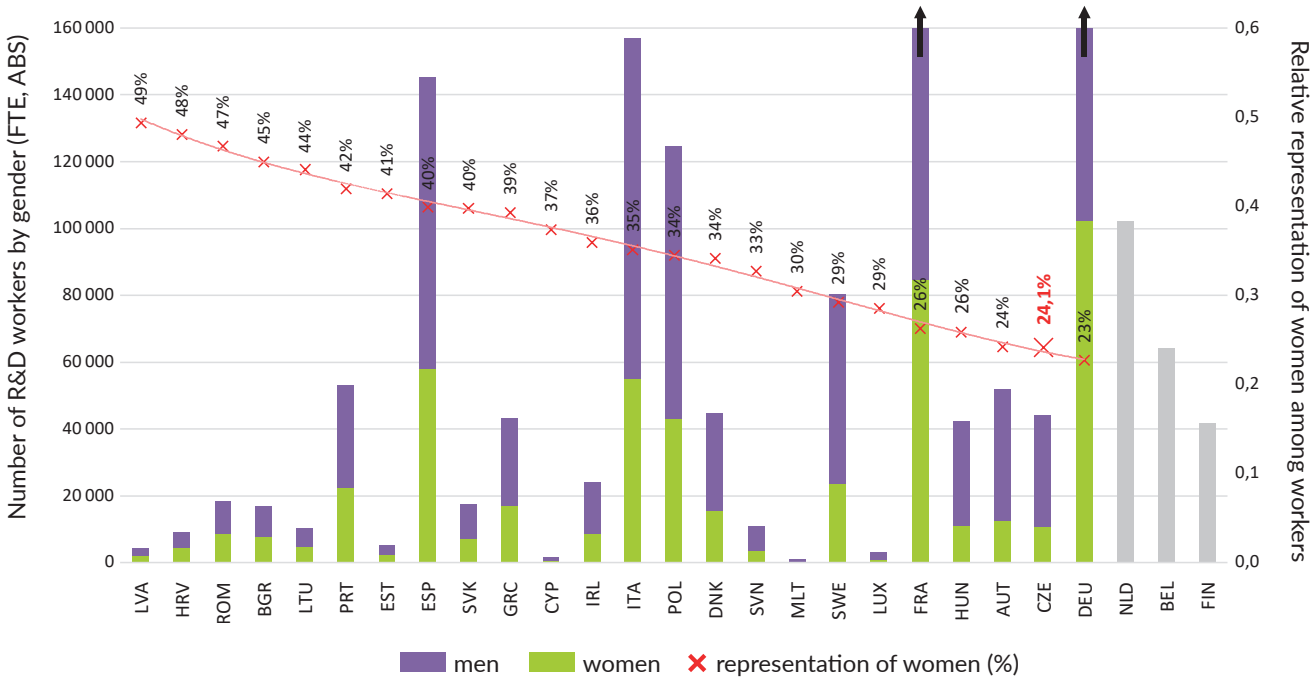
3) Academic inbreeding is a situation where research organisations employ mostly their own graduates.

The trend in the number of R&D employees and their shares by work activity (2005–2021)



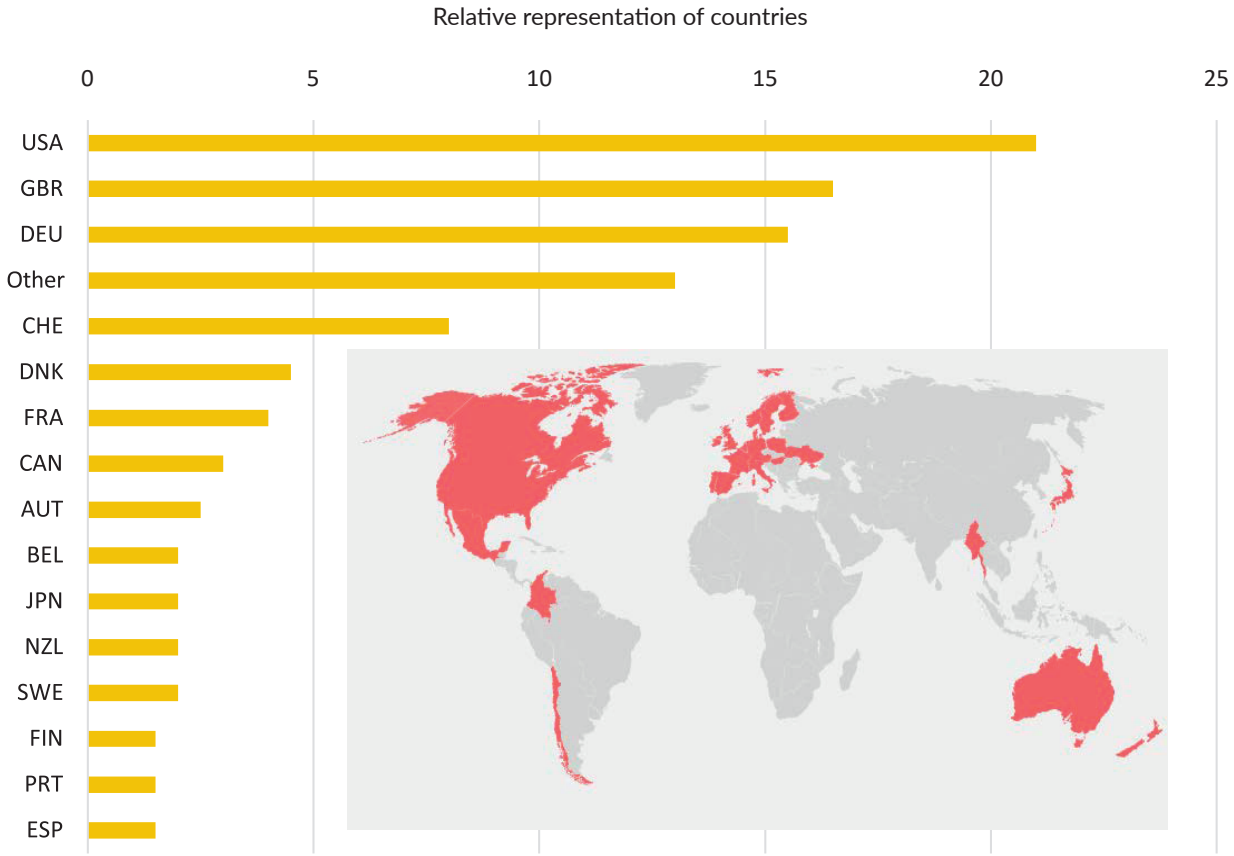
Source: own processing based on CZSO data

Representation of women among researchers in an international comparison (FTE, 2020)



Source: Eurostat | France – data for 2017; Ireland, Denmark, Sweden, Luxembourg, Austria and Germany – data for 2019; Belgium, Finland and the Netherlands – total values (women's share not indicated); ABS Germany – 450 796, ABS France – 321 550

Countries where Czech scientists live



Source: Czexpats in Science, www.czexpats.org [cit. 2022-10-15]

RESEARCH INFRASTRUCTURES

- Research infrastructures are intended to effectively interconnect all segments of the innovation chain and to enable interaction of entities involved in education, public research and the business sector, with the final effect in the form of goods and services with a high added value. They are established, developed and operated most often by research organisations and they can be considered a basic component of the R&D&I base in CZ.

- In CZ, research infrastructures are financed from multiple sources, mainly from public funding, both domestic and foreign. In 2021, research infrastructures were supported from the state budget through national programme projects of purpose-tied aid at the total of CZK 1.88 bil. and they received aid through OP RDE at CZK 2.65 bil.

- Large research infrastructure (LRI) is defined in the law as research infrastructure that is a research facility necessary for a comprehensive research and development activity with high financial and technological demands, which is approved by the government and is funded in order to be used also by other research organisations. LRI can be identified based on the life cycle phase (preparatory, operational, implementation and decommissioning phase) or based on its location (situated in one site, virtual, or a distributed LRI covering a larger number of LRIs situated at various sites). LRI is called large because it is unique and at the same time must cumulatively fulfil the criterion of open access to its capacities.

- MEYS is responsible for the design of LRI support and acts as the supervisor of international cooperation of CZ in R&D and supports also internationalisation of LRIs or international cooperation and involvement in international legal groupings, mainly legal entities of ERIC. The total amount paid for membership in ERIC consortia from the CZ state budget was nearly CZK 180 mil. in 2021.

- A specific type of research infrastructures are infrastructures operating as part of international cooperation of CZ. In 2021, the total fee paid by CZ for participating in international R&D organisations was nearly CZK 898 mil. This includes international organisations such as the European Space Agency (ESA), or the European Organization for Nuclear Research (CERN).

- MEYS issued in 2019 an update of the "Roadmap of large research infrastructures of the Czech Republic for the period 2016-2022", describing the involvement of the scientific community in various calls and opportunities in the LRI area. The Roadmap covers 48 facilities.

- In 2021, an update was presented of the ESFRI Roadmap that covers 41 European research infrastructures (ESFRI Landmarks) already implemented and 22 projects (ESFRI Projects) in the preparatory phase. The total investment in those facilities will exceed EUR 25 billion. CZ participates in 7 projects in the preparatory phase and in 26 projects already implemented.

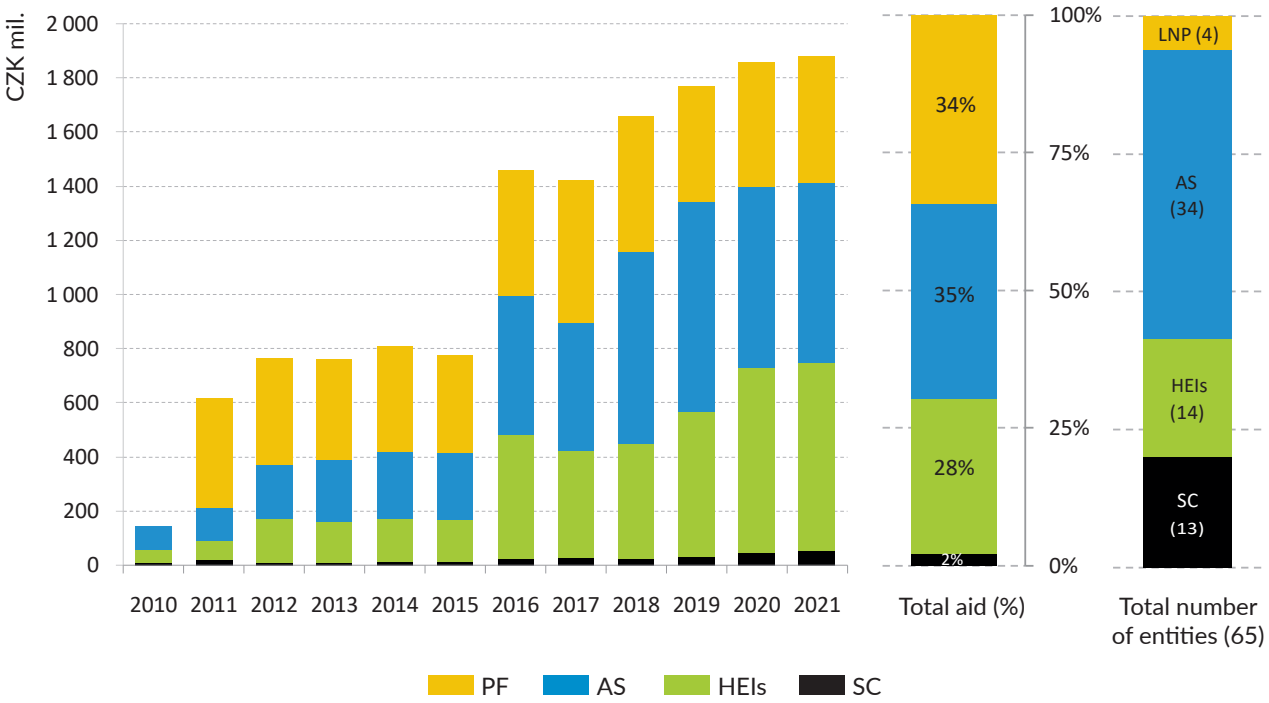
- In 2021, the R&D&I IS registered over 2 thousand results reported by principle investigators or other participants in projects financed from the LRI Projects programme (programme code: LM). The share of publication results was 82.8%, i.e. around 6 p.p. more than the CZ average. The non-publication applied results were mostly of the Software type but there were only several dozens of them.

- The R&D&I IS also makes it possible to monitor cooperation with LRIs through the reporting of results produced using a LRI capacity in the open access regime. In 2021, there were 1.8 thousand results reported, dominated again by publication results (88%). The non-publication applied results were mostly of the Software type but, again, there were only several dozens of them.

- The 2021 saw the approval of 4 projects of shared activities, intended to implement supportive activities, provide services or support the use of services at the national level, the services are to be used to organise or secure R&D&I and are accessible to public administration bodies, research organisations and other persons dealing with R&D&I. That definition implies that they are of a quasi-infrastructural nature. The total planned support approved by the government for the 2021–2027 period was nearly CZK 4 bil., the aid spent in 2021 reached almost CZK 500 mil.

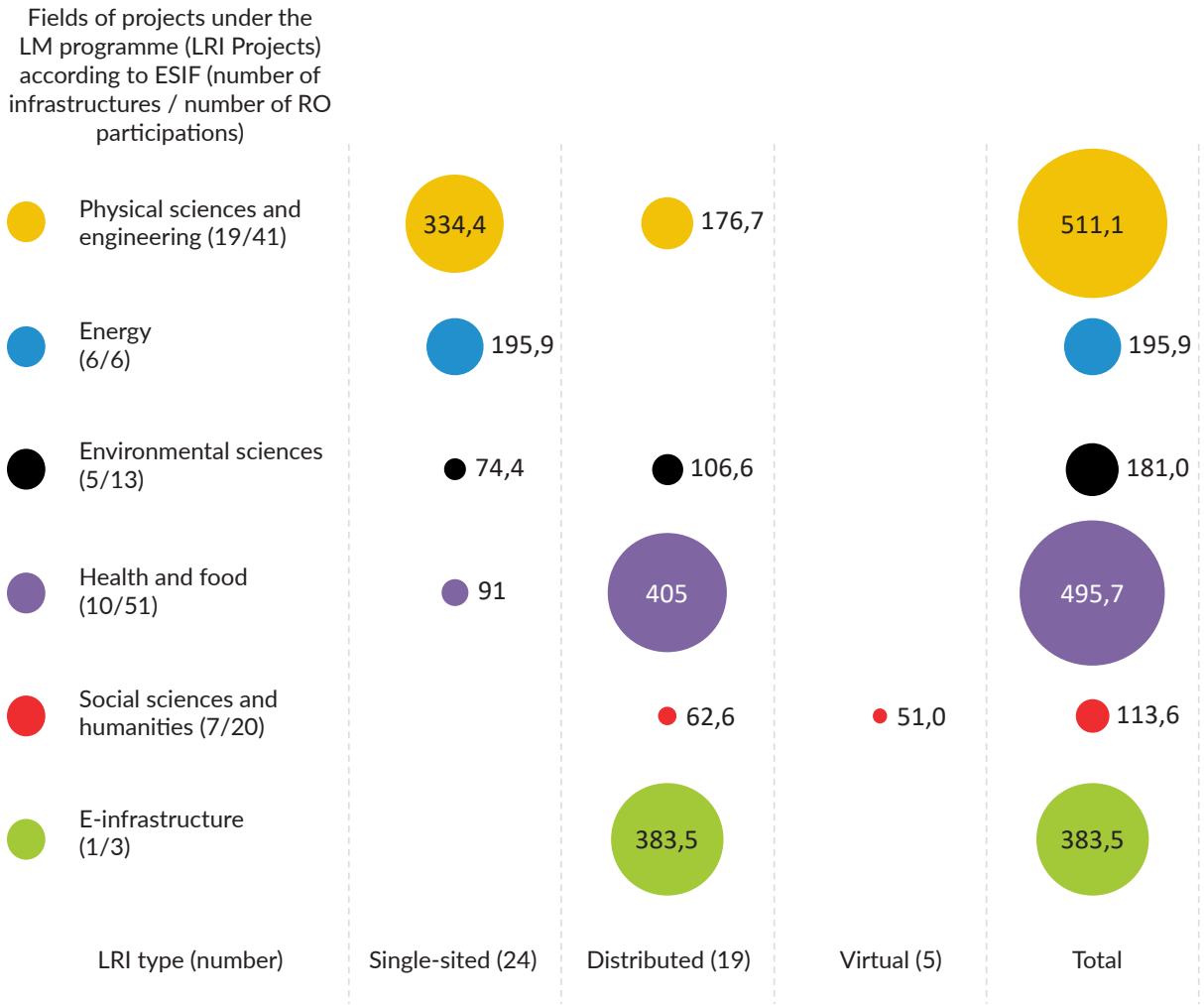
Name of the project (from–till)	Goal of the project
NCIS R&D&I National Centre for Information Support of Research, Development and Innovation **(2021–2027)**	Increasing the effectiveness of the national R&D&I through building a new comprehensive platform 'One-Stop-Shop for Researchers (OSS4R)' that will provide services in the area of information sources and other advanced assisted services and self-services of supportive nature, which will contribute to creating conditions for fulfilling the visions of the Innovation Strategy of the Czech Republic 2019-2030 and the National Research, Development and Innovation Policy of the Czech Republic 2021+.
CZELO Czech Liaison Office for Research in Brussels **(2021–2027)**	Support for intensive participation of Czech institutions in EU research and education programmes. The CZELO will provide its users with information, consultancy and advisory services and will support them in organising working meetings, workshops, seminars, conferences, congresses and other international meetings taking place in Brussels.
CZERA Deepening the integration of the CZ research and innovation ecosystem into the European Research Area, and supporting intensive international cooperation of CZ research organisations and enterprises in research, development and innovation **(2021–2027)**	To provide all CZ R&D&I stakeholders with a complete portfolio of analytical, information, advisory and consultancy services related to the requirements placed on involvement in international cooperation in R&D&I. The systematic information, consultancy, advisory and analytical activity will ensure an effective transfer of information on European R&D&I initiatives and programmes, mainly Horizon Europe, to CZ research and innovation centres that have the potential to take part in R&D&I projects supported under those instruments.
STRATIN+ Strategic Intelligence for Research and Innovation **(2021–2024)**	To provide analytical capacities and data-based strategic information (i.e. strategic intelligence services) to public administration and research organisations for implementing the R&D&I policy in the following areas: support for international cooperation in R&D&I, large research infrastructures, research and innovation specialisations, technological development, development of human capacities for research and innovation, issues of gender and conditions for engaging women in science.

The trend in the number of R&D employees and their shares by work activity (2005–2021)



Source: R&D&I Information System[cit. 2022-09-15] |AS – public research institutions established by CAS pursuant to Act No 341/2005 Coll.; HEIs – higher education institutions (public, state and private); SC – state contributory organisations, organisational units of the state and public research organisations excluding CAS institutes and state HEIs; LNP – legal and natural persons, individuals and institutions not falling under any of the above groups, e.g. public and private limited liability companies, public benefit societies, foundations, civic associations

Overview of large research infrastructure projects, their fields of research, number of research organisations involved and the aid used in 2021 (CZK mil.)



Source of data: R&D&I Information Systemand MEYS. Available from: https://www.vyzkumne-infrastruktury.cz/wp-content/uploads/2019/11/Aktualizace-Cestovní-mapy-2019_cz.pdf [cit. 2022-09-15] | Note: single-sited = research infrastructures situated in one site; distributed = research infrastructures covering a larger number of capacities situated at various sites, virtual research infrastructures.

RESEARCH AND DEVELOPMENT RESULTS

Key trends

- The total number of results has been decreasing in the last five years but still the total number of produced results is high - in the period 2017-2021, over 55 thousand results were produced annually on average.

- Over the last five years, the share of publication results was 76%, and nearly 28 thousand articles were published in specialist periodicals in 2021. More than 80% of them were published in journals indexed in the Web of Science or Scopus databases. As expected, the highest share of articles published in periodicals indexed in WoS or Scopus was produced by CAS institutes, while the lowest share by LNP (i.e. enterprises).

→ The share of non-publication results in the total number of results has been low in the long term unfortunately. Despite the growing number of patents in the past, the share of results with special legal protection, specifically patents (the P category), was very low in the monitored period 2012-2021.

- After Methodology 2017+ was introduced, the production of D-type results (articles in conference proceedings) has been decreasing. The production of results has also decreased in the category of non-publication results, mainly those marked as V - research report and N - certified methodology, medical procedure, specialised map.

Results by type of research organisation

- The largest producer of non-publication applied results are higher education institutions, mainly thanks to producing results in the category Research report. The second largest producer are the LNP entities (mostly enterprises). Those focused most on producing results of the G category - a prototype and a functional model. The CAS institutes created the fewest non-publication applied results in absolute terms. Their production focused on these types of results: Prototype, functional sample, Research report, Patent.

Results by field of research

- The highest share of results is produced in CZ in the FORD groups *Natural Sciences, Engineering and Technology*, and with a slight gap, in *Social Sciences*. In the long term, the highest share of non-publication results has been in CZ in the field groups *Agricultural Sciences* and *Engineering and Technology*, while the share has been lower in the groups *Natural Sciences* and *Medical and Health Sciences*.

Publication activity

- When evaluating the quality of publications, it is useful to monitor the structure of the publications in terms of the citation impact of the periodicals the related publication strategy that can differ from field to field. There are indications that the number of foreign journals, in which Czech authors have published, has grown in all six field groups. In all groups except for *Social Sciences*, the share of foreign journals with their article influence score (AIS) in quartile 1 (Q1) has increased. The number of Czech journals almost did not change - only small increases are recorded, moreover, most of the journals fall in the two bottom quartiles (Q3 and Q4).

- An international comparison of the developments in the normalised citation index for each field group shows that CZ ranks among states lagging behind the EU-15 average. Only in the case of the *Medical and Health Sciences* group, CZ exceeded the EU-15 average. The citation rate can be boosted also by membership of scientists in international consortia, which can be seen in the fields from the *Medical and Health Sciences* group. This typically concerns publications with 30 authors and more.

- The performance of a field can be enhanced by increasing the frequency of Czech authors working in international teams. Over the recent years, the share of quality publications created by international teams of authors has increased, compared to the average of Czech publications. The rate of publication with international participation ranged above the EU-15 average in all field groups except for *Humanities*.

- The highest rate of cooperation of Czech authors was again in the Natural Sciences field group, which corresponds to the finding that this field group has the highest number of articles with the number of authors exceeding 100. The field groups *Social Sciences* and *Humanities* still have a relatively low share of publications created in cooperation with foreign partners.

- However, more detailed analyses show that although Czech scientists cooperate with foreign partners, CZ does not always reach satisfactory quality in such publications. The collaboration of Czech authors with colleagues from Spain produces articles that have a relatively high normalised citation impact - NCI (between 3 and 4). Publications with the lowest NCI are produced in cooperation with colleagues from Slovakia.

Patent activity and licences

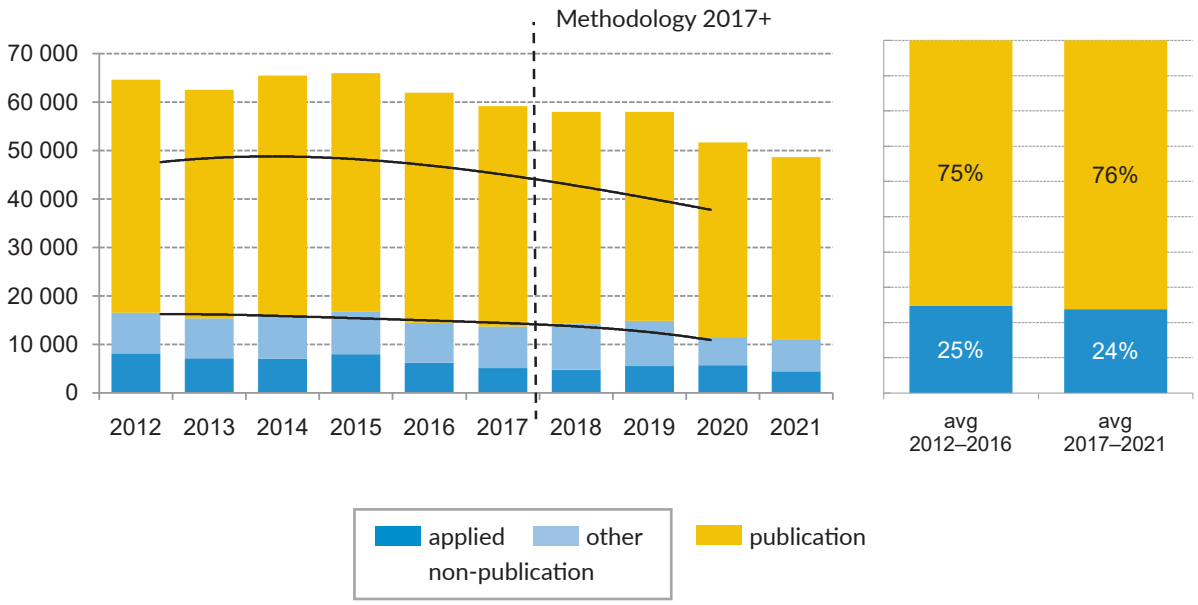
- The patent activity in CZ is low compared to EU states and the growing BERD is not reflecting in a higher number of patent applications. It must also be noted that a growing patent activity may go hand in hand with offshoring of patents achieved by Czech authors in CZ facilities.

- According to the EU, the research and innovation policies should facilitate acceleration of patent activity in clean energy technologies, mainly in sectors with high potential such as hydrogen and geothermal energy. To increase scientific productivity and knowledge transfer, it is necessary to strengthen international scientific cooperation and support further collaboration in patenting.

- In CZ, the number of patent applications is growing in cybersecurity much faster than in other EU countries, which indicates significant R&D development in this technological area.
- Between 2012 and 2021, the number of entities with a valid patent licence provided to another entity grew by almost 16%. A significant share of licence providers (51%) had zero received royalties in 2021.

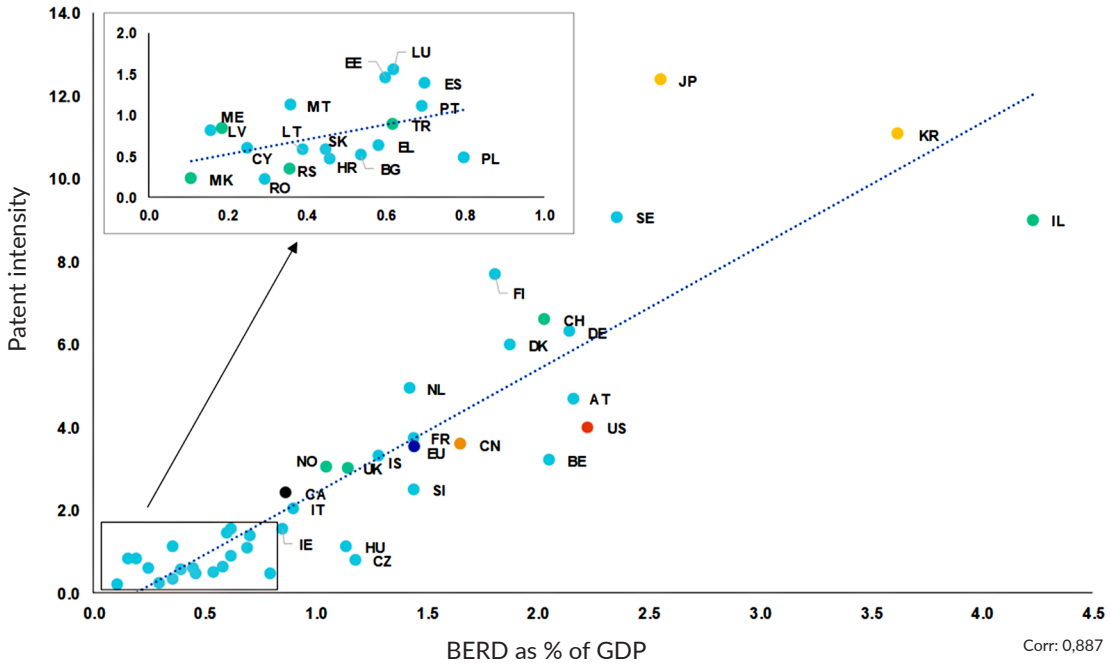
- The interest in patenting results in CZ can be seen as a positive trend, nevertheless, it has not been sufficiently accompanied so far with an increasing share of provided licences with non-zero income from royalties.

Numbers of publication and non-publication results in CZ



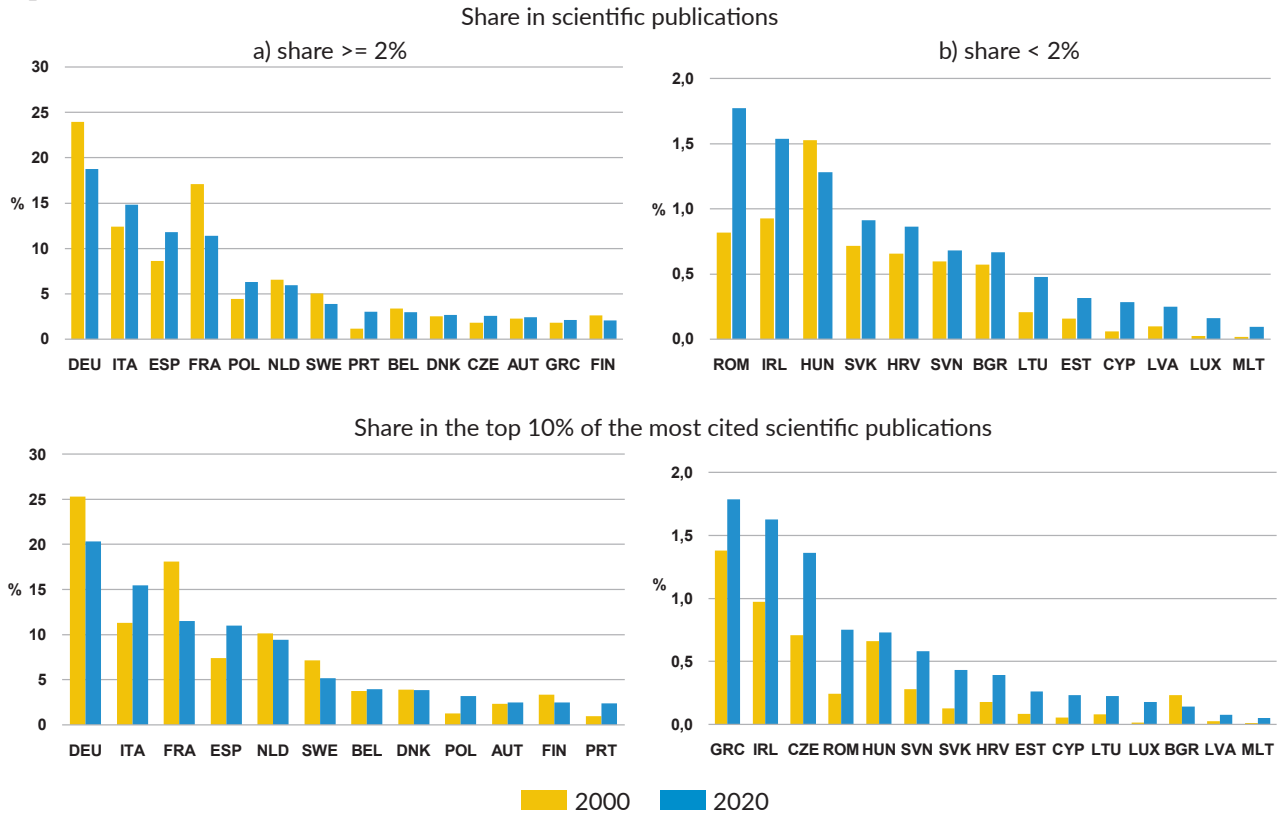
Source: R&D&I Information System [cit. 2022-08-18]

Patent intensity and BERD as a share of GDP (2018)



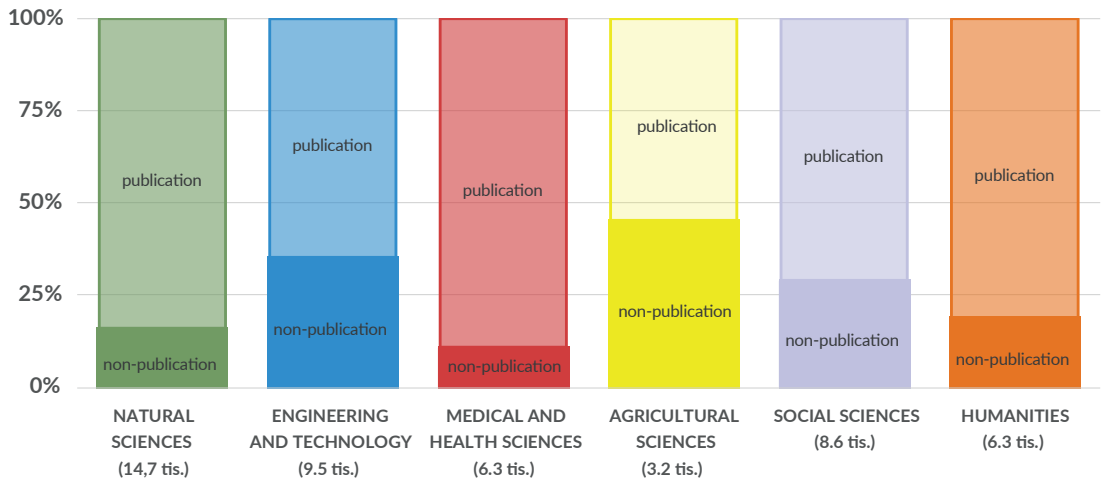
Source: SRIP (2022), own processing according to the EPO PATSTAT database, Eurostat and OECD | Patent intensity = patent applications per GDP (bil. PPS€)

Share of individual EU member states in scientific publications and in the top 10% of the most cited scientific publications within the EU



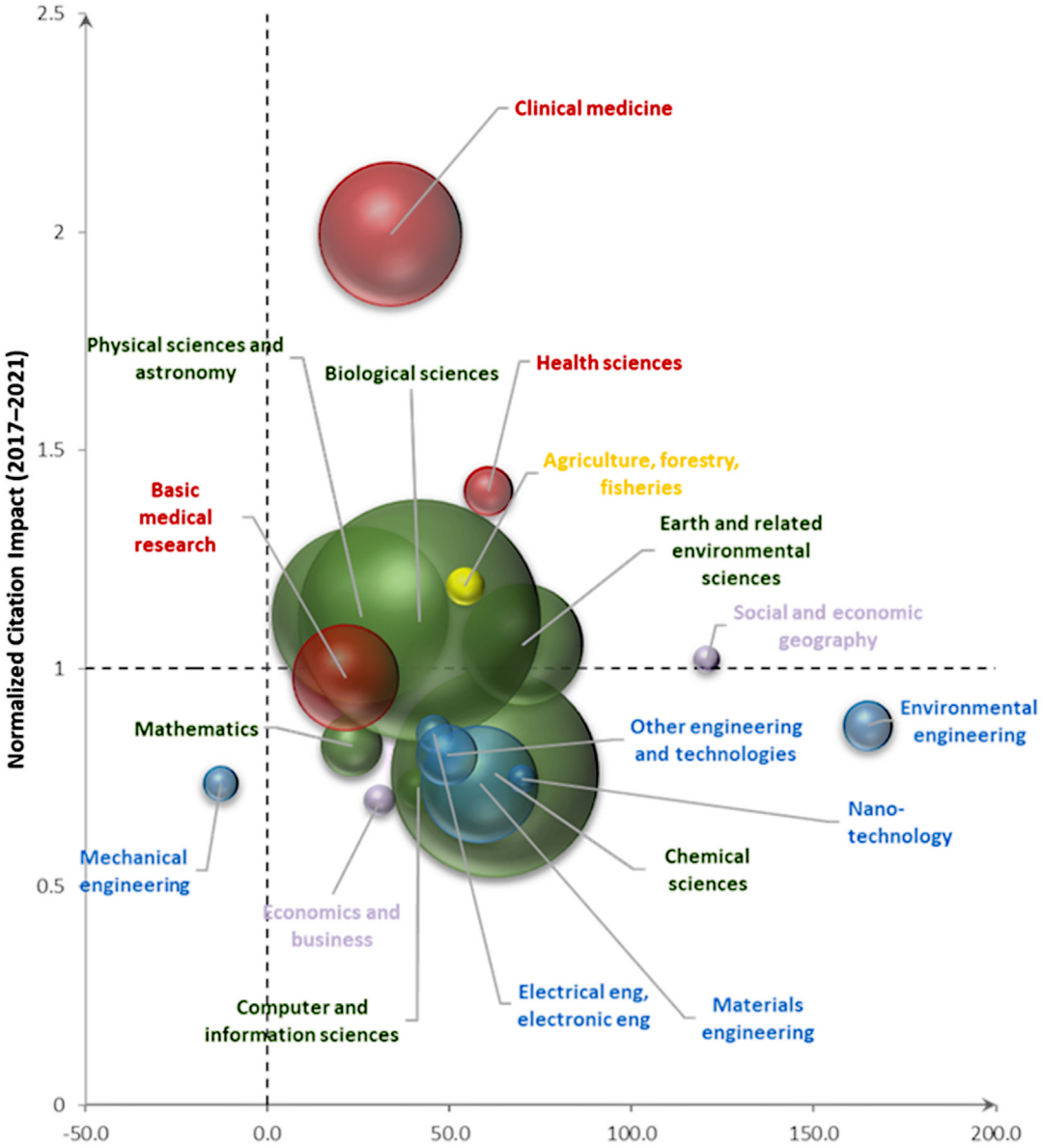
Source: Science, Research and Innovation Performance of the EU (SRIP) (2022 report), own processing

Publication and non-publication results in CZ by FORD field groups (year 2021)



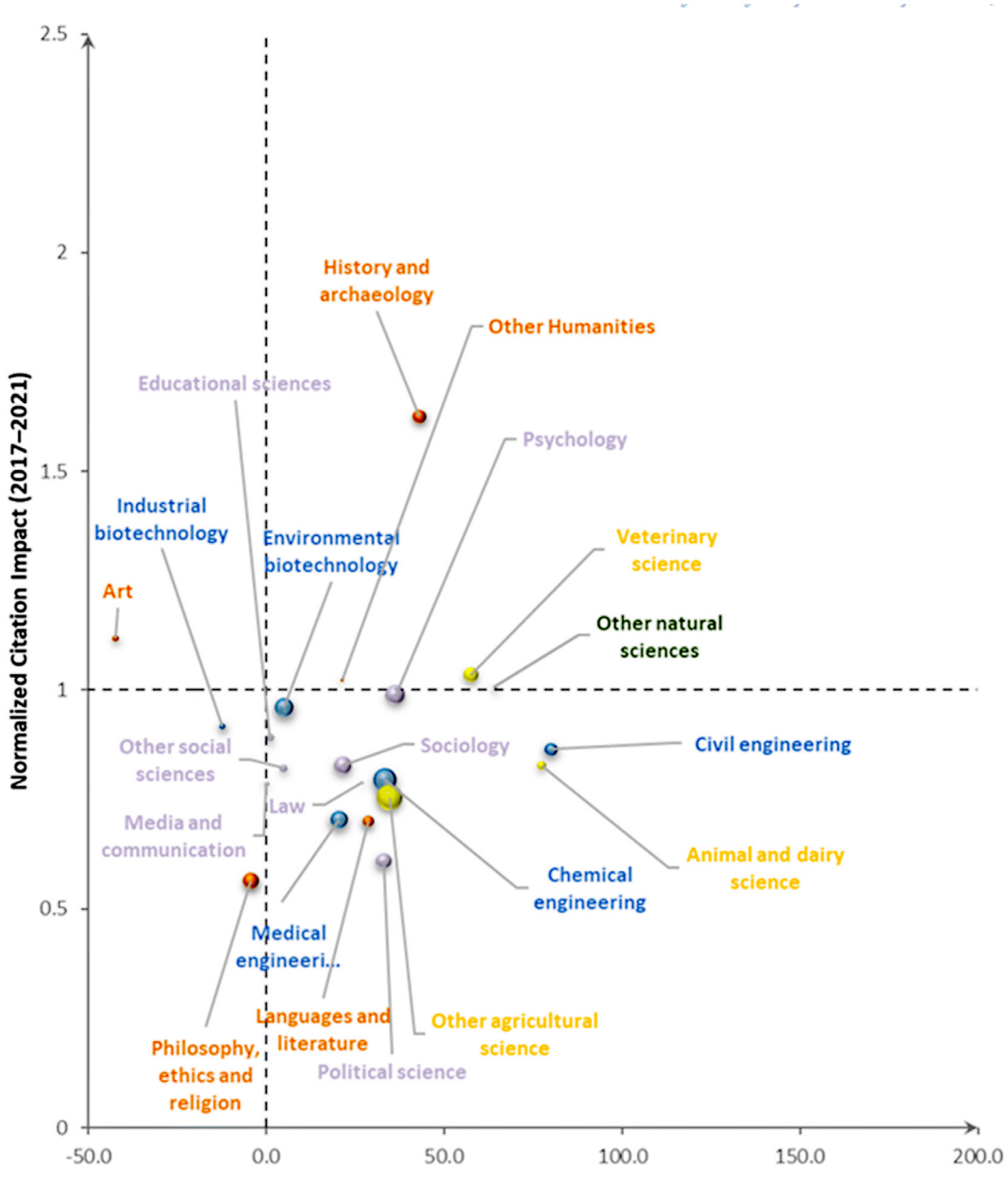
Source: R&D&I Information System [cit. 2022-08-18]

Numbers of publications by Czech authors in WoS by field and their citation rate



Change in the number of publications between 2017 and 2021 (%)

Source: WoS. | This includes publication types: article, review and letter for the 2017–2021 period in WoS Core Collection periodicals, fields according to OECD (Frascati Manual). | This includes publications where at least one of the authors has the word "Czech" in their address (co-authorship not taken into account). The left part of the figure includes field groups for which the database had at least 1,500 publications for the monitored period. | Horizontal axis:



Change in the number of publications between 2017 and 2021 (%)

Index of change in the number of publications in 2017 and 2021: (2021–2017)/2017 in %. | Vertical axis: Normalized Citation Impact as of 30.06.2022 (normalized at the field level with subsequent aggregation of the index; if the publication covers more fields, an arithmetic average is used); value y = 1 corresponds approximately to the world average. The size of the bubbles shows the number of publications in the period 2017-2021.

INNOVATION PERFORMANCE OF CZ

- Innovation activities are a key element in the long-term, sustainable economic growth and competitiveness of economies. Innovation is also often seen as a means to eliminate impacts of economic and other crises. Innovation activities have become important recently also due to the worldwide pandemic situation.

  In the international comparison of knowledge intensity for 2020, CZ ranks 10th in EU27, nevertheless, it is still behind the EU27 average.

COMPOSITE INDICATORS

Summary Innovation Index (SII):

- CZ belongs to the group of Moderate Innovators. CZ shares the group with e.g. Italy, Slovenia, Spain or Greece. CZ markedly lags behind countries such as Sweden, Finland, Denmark and Belgium.

- CZ outruns the EU average the most in indicators such as Non-R&D innovation expenditures, SMEs with business process innovations, SMEs with product innovations, Enterprises providing ICT training.

- On the contrary, values well below the EU27 average are reported by CZ in indicators such as PCT patent applications, Lifelong learning, Most cited publications, Mobility of Human resources in science and technology (HRST).

Regional Innovation Scoreboard (RIS):

- The signs of a Strong Innovator are shown only by the Prague region, the Emerging Innovator group includes the Northwest region and the remaining regions belong to the Moderate Innovator group.

Global Innovation Index (GII):

- CZ holds the 30th position out of the 132 evaluated economies (within Europe, CZ is 19th out of 39 countries). The first ranks in the GII 2022 were taken by Switzerland, the US, Sweden, and the UK.

- CZ's strengths are mostly in innovation outputs. Specific indicators with excellent levels of achievement include: GERD financed by abroad, Creative goods exports, High-tech manufacturing.

- On the contrary, CZ has weaknesses mostly in innovation inputs. The weaknesses include Global corporate R&D investors, GERD financed by business, Printing and other media, Venture capital received.

Innovation Output Indicator (IOI):

- CZ achieves excellent results in the share of medium and hi-tech products in the total export, while it strongly lags behind in patents.

Eco-Innovation Scoreboard

- According to the Eco-Innovation Scoreboard, CZ has average performance in eco-innovation. Within that assessment, CZ ranks first among EU states in the dimension of activities in eco-innovations.

Innovation in enterprises

- The share of innovating enterprises is clearly the highest in the groups of foreign-controlled enterprises and in large enterprises (the difference between enterprises operating in industry and in services is minimal).

  The proportion of innovating enterprises in CZ is slightly below the EU27 average (17th position in the EU27).

  The main limiting factors for carrying out or starting innovation activities are seen by companies in the lack of own financial resources, of qualified staff and financial sources outside the company.

  In terms of public support, enterprises would welcome a lower administrative burden, a faster public procurement process and higher flexibility in project implementation.

Business and trade dynamics[1]

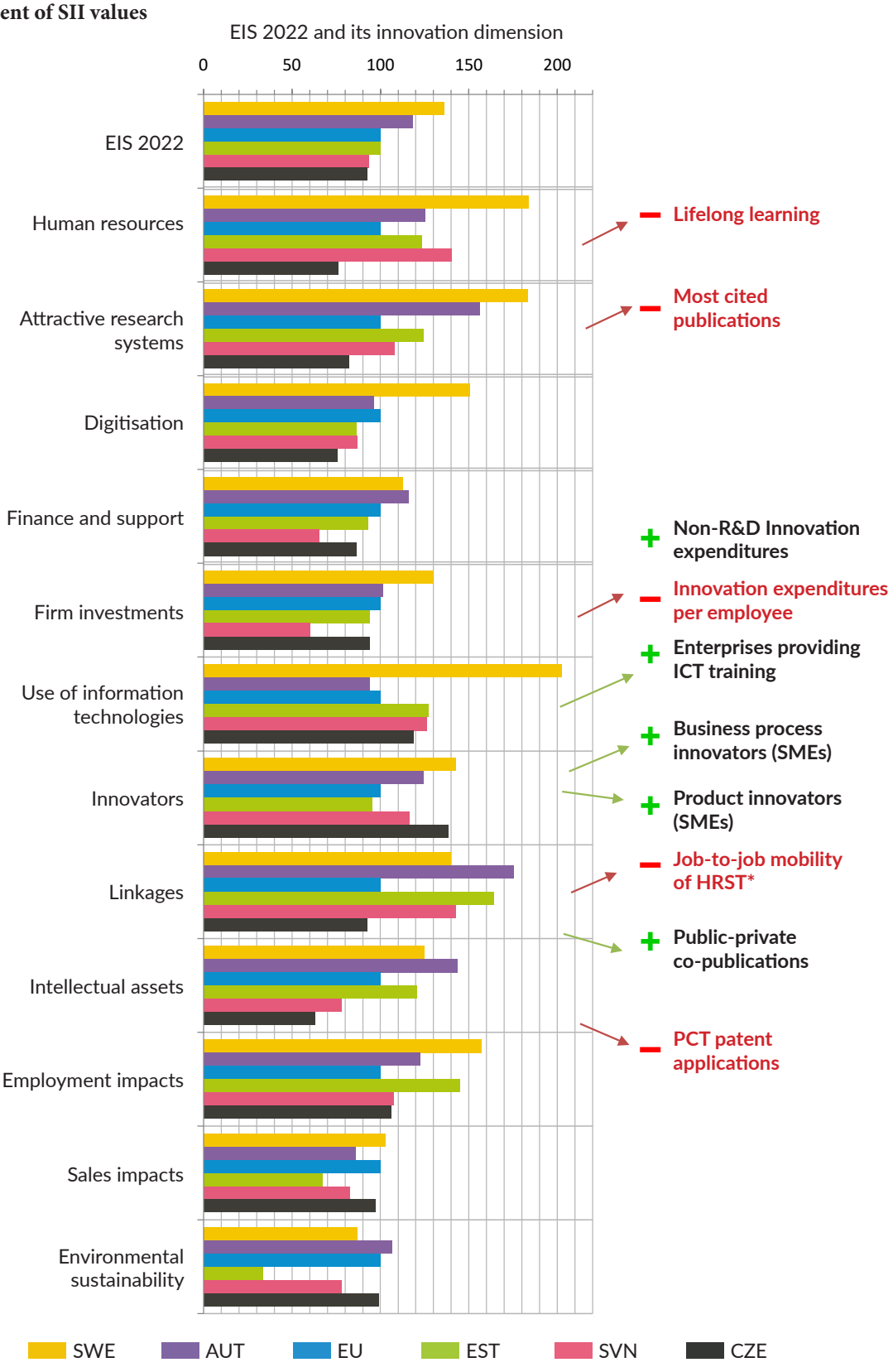
- The business dynamics in the EU is decreasing, raising concerns about the consequences it will have on innovation and economic growth. The EU still lags behind its main international competitors in terms of the number of start-ups and scale-ups. The number of so-called Unicorn start-ups is increasing in the EU but still does not reach the level of its main competitors.

- For the EU's revival, it is essential to disseminate innovative ideas and new innovations to a greater extent. Innovative enterprises managed to adapt better to the COVID-19 shock, which confirms their crucial role of drivers of economic productivity and growth.

- The start-up statistics show that CZ has room for improvement and so it is desirable for CZ to create conditions for establishing start-ups.

1) Science, Research and Innovation Performance of the EU 2022 report. (n.d.). Research and Innovation 2022. [cit. 2022-10-15]. Available from: https://research-and-innovation.ec.europa.eu/knowledge-publications--tools-and-data/publications/all-publications/science-research-and-innovation-performance-eu-2022-report_en

European Innovation Scoreboard (EIS) 2021 and its innovation dimension, comparing CZ and selected countries, development of SII values



*Source: own processing according to EIS 2021; *Human resources in science and technology (HRST)*

INTERNATIONAL COOPERATION IN R&D&I

- International cooperation in R&D&I contributes to enhancing scientific excellence, economic competitiveness, capacity to address global challenges and development of diplomatic relations. The cooperation can be bilateral or multilateral. That cooperation can be developed through participation in the European Research Area and EU framework programmes, international research organisations and ERIC consortia or through a number of bilateral and multilateral programmes. Another important tool is science diplomacy.

- In terms of **bilateral cooperation,** there is not a fixed list of priority countries for R&D&I at present. There is no general strategic framework defining the objectives and partners for international cooperation in R&D&I. Important partners of CZ in R&D&I include, apart from the key European players, the US, Israel and Taiwan where CZ science diplomats operate. Bilateral cooperation is also supported by a network of diplomats with science diplomacy in their portfolio. The network is updated and managed by the Ministry of Foreign Affairs (covers mainly EU countries, the UK, Canada, Australia, Southeast Asia countries etc.).

- **The system of support for international R&D&I cooperation is fragmented in CZ.** The central body responsible for international R&D&I cooperation is MEYS. Moreover, there are other providers of institutional and purpose-tied support for international cooperation, mainly grant agencies (GACR and TACR) and CAS. The ministries entering this process include Ministry of Foreign Affairs, Ministry of Interior or Ministry of Defence. In that system, the RDI Council plays the role of strategic coordinator.

- International cooperation is supported with **purpose-tied aid**, the greatest part of which was spent in 2021 on LRI projects (CZK 1.9 bil.) and on the INTER-EXCELLENCE programme (MEYS, CZK 743 mil.). A significant part was directed to the Kappa programme (TACR, CZK 206 mil.) and to international bilateral projects of GACR (CZK 171 mil.).

- The core part of the expenditure on **institutional aid** for international cooperation is made up of expenditure on CZ membership in international R&D&I organisations (CZK 898 mil.) and ERIC consortia (CZK 178 bil). Significant funding from the state budget in 2021 went to the MEYS programmes such as the Joint Technology Initiative ECSEL (CZK 77 mil.), the programme Eurostars-2 (CZK 33 mil.) and the European Metrology Programme for Innovation and Research (CZK 23 mil.).

- A crucial tool for supporting **bilateral cooperation** is INTER-ACTION, where the 2021 expenditure reached CZK 289 mil. A bilateral instrument for supporting excellent research is the ERC CZ programme which received CZK 166 mil. from the state budget in 2021 (both under MEYS). This also includes programmes of TACR (Delta 2, CZK 137 mil.) and of GACR (bilateral projects CZK 171 mil. and projects of the Lead Agency type CZK 117 mil.).

- The key **multilateral tools** for supporting international cooperation include, apart from Horizon Europe, a whole range of programmes provided by MEYS. These are mainly the sub-programmes of INTER-EXCELLENCE that support cooperation in both applied and basic research. The sub-programmes are: INTER-COST (the 2021 expenditure amounted to CZK 124 mil.), INTER-EUREKA (CZK 120 mil.) and INTER-TRANSFER (CZK 103 mil.). Another important support instrument is the Eurostars-2 programme promoting research activities of SMEs (the 2021 expenditure was CZK 33 mil.).

- As the international mobility of CZ scientists and researchers is one of the lowest in the EU, it is desirable to encourage its development. In 2021, international mobility was supported from the closing OP RDE with nearly CZK 340 mil. The MEYS expenditure on the Mobility activity reached in 2021 CZK 10.6 mil., the CAS spent CZK 4.3 mil. on mobility projects in the same year.

MULTILATERAL SUPPORT INSTRUMENTS

HORIZON EUROPE

MEYS:
- INTER-EUREKA
- INTER-COST
- INTER-TRANSFER
- Eurostars
- Danube Cooperation
- EIG CONCERT Japan
- Joint Technology Initiative ECSEL
- European Metrology Programme for Innovation and Research

BILATERAL SUPPORT INSTRUMENTS

MEYS:
- INTER-ACTION
- ERC CZ

TACR:
- Delta 2

GACR:
- International bilateral projects
- Lead Agency projects
- support for ERC applicants

MIXED SUPPORT INSTRUMENTS

MEYS:
- INTER-INFORM
- INTER-VECTOR
- mobilities
- OP RDE - MSCA mobility
- CZERA
- CZELO

TACR:
- Kappa

CAS:
- mobility
- mobility plus

ANNEXES

P.1 THE MONITORING OF QUANTITATIVE INDICATORS OF MEETING THE OBJECTIVES OF THE NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION POLICY OF THE CZECH REPUBLIC 2016–2020

The National Research, Development and Innovation Policy of the Czech Republic 2016-2020 (National R&D&I Policy) as an umbrella strategic document for R&D&I includes a system of indicators. The set indicators enable an evaluation of progress in achieving the goals associated with implementation of the strategy. The National R&D&I Policy implementation should include a regular monitoring of indicators and their analysis. The **interim evaluation of the National R&D&I Policy** was made in line with the key milestones of its Specific Objective 1.3: Enhancing the strategic intelligence for the R&D&I policy in **2018 under the responsibility of OG CR - the RDI Council Department**.

As part of launching the regular monitoring, the current **values of quantitative indicators were set** (in most cases for 2016 where possible). The indicator system proposed in the National R&D&I Policy contains qualitative and quantitative indicators that were relevant at the time of its design. Table P.1 shows the values of the indicators usually for 2021 (where values for that year were not available, the value from the last year with available data is shown). The table **specifies some indicators** to improve their explanatory power. As some data used to determine the quantitative indicator values are updated continuously and modified retrospectively by their providers (e.g. numbers of publications or patent applications), the values of some indicators were determined retrospectively for previous years. Other information on determining the indicator values is provided in the notes below the table.

Table P.1: Values of quantitative indicators for evaluating the progress towards the objectives of the National Research, Development and Innovation Policy of the Czech Republic 2016–2020

	Name	Baseline value when drafting the National R&D&I Policy (year)	Baseline value for monitoring the achievement against objectives (year)	Current value of the indicator (year)
1	Number of doctoral graduates aged 25-34 years per million of inhabitants of the same age group	1,114 (2013)	1,134 (2016)	945 (2020)
2	Share of women in the total number of researchers (%)	25 % (2013)	23.1 % (2016)	24.1 % (2020)
3	Share of scientific publications in co-authorship of domestic and foreign researchers (%) [1]	35.6 % * (2012)	39.7 % * (2016)	55.3% (2020) 58.8% (2021)
4	Share of foreign researchers in the total number of researchers in the government and HEI sector (%) [2]	6 % (2011)	9.5 % (2015)	13.3 % (2020)
5	Number of participations in Horizon 2020 per thousand researchers (FTE)	–	18.4 (2016)	37.6 [3] (2021)
6	Financial contribution obtained in Horizon 2020 per € 1 bil. of GDP	–	–	1.98 [4] (2021)
7	Total number of publications registered in the WoS database per million inhabitants [1]	1,970 * (2014)	2,224 * (2016)	2,347 (2020) 2,393 (2021)
8	Number of PCT applications per million inhabitants	16.7 (2012)	18.1 * (2014)	14.0 (2018)
9	Yield from the sale of patent licences (including national) in CZK mil.	2,726 (2014)	3,356 (2016)	3,047 (2020)
10	Share of highly cited publications (share of publications included among 10 % of the most cited publications in the total number) [1]	9.2 % * (2012)	10.0 % * (2015)	9.8 % (2020) 10.0% (2021)
11	Total number of ERC grants per thousand researchers in the government and HEI sector	0.17 (2013)	0.33 (2016)	1.67 [5] (2021)
12	Share of publications produced i n public-private co-authorship in the total number of publications (%) [1]	2.1 % * (2013)	2.5 % * (2016)	3.2% (2020) 3.3% (2021)
13	Share of the business sector resources in the R&D expenditure of the government and HEI sector (%)	6.8 % (2013)	9.2 % (2016)	8.0 % (2020)
14	Share of employment in high- and medium-high-tech manufacturing industry (%)	11.2 % (2014)	11.5 % (2016)	11.3 % (2021)

	Name	Baseline value when drafting the National R&D&I Policy (year)	Baseline value for monitoring the achievement against objectives (year)	Current value of the indicator (year)
15	Share of employment in knowledge-intensive services (%)	32.6 % (2013)	32.9 % (2016)	35.9 % (2021)
16	Share of business sector resources in GERD (%)	48.6 % * (2013)	60.2 % (2016)	58.3 % (2019)
17	Early-stage investment of risk capital (% of GDP)[6]	0.002 % * (2013)	0.003 % * (2016)	0.005 % (2021)
18	Share of domestic added value in total export (%)	61.3 % (2011)	60.3 % (2014)	57.8 % ** (2018)

** Note: The baseline value of the indicator was modified using current data.*

Notes on the indicators:

1) Data taken from Web of Science InCites for publication types 'article', 'review', 'letter', 'proceedings paper'. After the database was updated, the indicator values were calculated retrospectively for the previous years using the new data. As the data from 2021 are not yet complete, the table shows data for 2020.

2) The indicator name was reformulated to match the definition in the National R&D&I Policy.

3) The value represents the number of participations in H2020 to date from the eCORDA database data of December 2021. The calculation included running and completed projects (i.e. excluding projects under preparation and suspended projects). The data do not include participants involved in the projects as third parties. The indicator value grows in time as the total number of projects implemented in H2020 increases. Therefore, the value should be compared with the sum for all EU Member States (the indicator value for EU-28 in December 2021 was 64.0).

4) The value represents the contribution from the EC obtained by CZ teams under H2020 to date, from the eCORDA database data of December 2021. The calculation included running and completed projects (i.e. excluding projects under preparation and suspended projects). The data do not include contribution obtained by participants involved in the projects as third parties. The indicator value grows in time as the total number of projects implemented in H2020 increases. Therefore, the value should be compared with the sum for all EU Member States (the indicator value for EU-28 in December 2021 was 3.74).

5) The value represents the number of ERC grants obtained under H2020 to date, taken from the eCORDA database data of December 2021. The indicator value grows in time as the total number of projects implemented in H2020 increases. Therefore, the value should be compared with the sum for all EU Member States (the indicator value for EU-28 in December 2021 was 6.60).

6) The data were taken from Invest Europe reports of June 2021. The early-stage investments are understood as "seed" and "start-up" investments.

P.2 OVERVIEW OF SELECTED STATISTICAL INDICATORS OF THE CZECH REPUBLIC 2016–2020

Expenditure on research and development and its year-on-year changes, compared with basic macroeconomic indicators

		2016	2017	2018	2019	2020	2021
gross domestic expenditure on R&D (GERD)	CZK billion	80.1	90.4	102.8	111.6	113.4	121.9
GERD share in GDP	%	1.67	1.77	1.90	1.93	1.99	2.00
R&D expenditure from domestic public sources	CZK billion	28.5	31.2	35.0	37.6	38.6	39.4
share in GDP	%	0.59	0.61	0.65	0.65	0.68	0.65
R&D expenditure from foreign public sources	CZK billion	2.7	4.3	6.6	8.1	7.2	8.4
share in GDP	%	0.06	0.08	0.12	0.14	0.13	0.14
average annual inflation rate	%	0.7	2.5	2.1	2.8	3.2	3.8
share of budgeted R&D&I expenditure from SB in total national SB expenditure pursuant to the SB Act	%	2.33	2.49	2.55	2.39	2.24	2.07
R&D expenditure from business sources	CZK billion	48.2	53.8	59.9	64.7	66.1	72.8
share in GDP	%	1.01	1.05	1.11	1.12	1.16	1.19
indirect support for private enterprises	CZK billion	2.38	2.52	2.58	2.73	2.10	–
R&D personnel	FTE	65,783	69,736	74,969	79,245	80,958	84,671
patents granted in CZ	number	4,211	5,309	5,924	7,031	7,151	6,761
to CZ applicants	number	382	397	363	437	496	448
to foreign applicants	number	3,829	4,912	5,561	6,594	6,655	6,313
revenue from provided patent licences	CZK billion	3.36	1.93	1.60	2.17	3.05	2.93
foreign trade in high-tech goods							
export of high-tech goods	CZK billion	604.8	687.1	790.2	870.9	923. 0	907. 6
share in the total CZ export of goods	%	15.22	16.19	17.94	19.02	20. 78	18.40
import of high-tech goods	CZK billion	602.8	706.7	811.9	869.7	936. 1	955. 3
share in the total CZ import of goods	%	17.25	18.59	20.18	21.12	23. 61	20. 76

year-on-year changes			17/16	18/17	19/18	20/19	21/20
gross domestic expenditure on R&D (total)	%		12.83	13.68	8.63	1.58	7.54
GDP (c.p.)	%		6.54	5. 87	7.04	-1.42	6. 99
export of goods and services	%		6.47	3.15	2.82	-6. 54	11.27

Source: CZSO – Survey on research and development, National accounts, Main economic indicators of CZ and SB Acts | The SB expenditure on R&D&I is indicated excluding expenditure to be covered from the EU budget and from financial mechanisms.

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