



**POLICY
ANSWERS**

NORTH MACEDONIA'S ERA INTEGRATION

An update by POLICY ANSWERS

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Executive summary

Progress related to European Research Area (ERA) integration was achieved since the establishment of the new ERA along the following aspects:

- After the European Council approved the Negotiating Framework, in accordance with the revised enlargement methodology, the EU started the opening phase of the accession negotiations with North Macedonia on 19 July 2022, in addition to the screening process.¹
- The Fund for Innovation and Technological Development (FITD) as a leading government institution for supporting start-ups and innovative companies in the Republic of North Macedonia, adopted the medium-term work programme for the period 2021-2023. In order to strengthen the cooperation between academia and industry, several measures are envisioned in the programme.² As of December 2022, the Fund has co-financed 839 projects with a joint investment of 101 million euros through its financial instruments.
- The Entrepreneurial Discovery Process (EDP) in North Macedonia was successfully finalised in 2022 within the Smart Specialisation process. It involved more than 200 stakeholders from the quadruple helix, which have discussed and defined the SWOT analysis, as well as the vision and the transformation roadmap for the identified vertical and horizontal domains.
- In March 2022 the Regional Cooperation Council (RCC) published the policy document Research Infrastructure Roadmap of the Republic of North Macedonia, which presents the existing research potential of North Macedonia. The aim of the document is to set principles for the future development of research infrastructures and to propose recommendations aimed at strengthening the research sector and societal development as a whole.
- After the European Commission (EC) and North Macedonia concluded negotiations for association to the Horizon Europe programme on 28 September 2021³, they signed an agreement for closer cooperation in research and innovation (R&I) on 6 December 2021.⁴
- According to the European Innovation Scoreboard (EIS) 2022, the Republic of North Macedonia is an Emerging Innovator with its performance being at 45.6% of the EU average, which enables it to take part in the Regional Innovative Scheme (RIS) of the European Institute of Innovation and Technology (EIT) for the period 2021-2024. At the end of 2022, the procedure for the establishment of the first EIT Community RIS Hub in North Macedonia was initiated.⁵
- The Economic Reform Programme (ERP) 2022-2024 was officially submitted to the European Union on 31 January 2022, after it had been adopted by the Government of the Republic of North Macedonia on 28 January 2022.⁶

¹ https://www.eeas.europa.eu/delegations/north-macedonia_en?s=229

² Source: Medium-term Work Programme of the FITD for 2021-2023, link https://fitr.mk/wp-content/uploads/2021/09/Srednorocna-programa-na-FITR-za-2021-2023-godina-finalna_eng.pdf

³ https://ec.europa.eu/info/news/negotiations-association-horizon-europe-concluded-2021-sep-28_en

⁴ https://www.eeas.europa.eu/delegations/north-macedonia/north-macedonia-becomes-associate-member-horizon-europe-new_en

⁵ <https://eit.europa.eu/news-events/news/eit-launch-eit-community-ris-hubs-covering-all-ris-eligible-countries-and>

⁶ <https://finance.gov.mk/economic-reform-program/?lang=en>

- The budget for the Annual Programme for Research and Development Activities in North Macedonia for 2022⁷ has almost tripled compared to 2021.⁸ The increased budget is mainly for financial support of laboratory resources for higher education and research institutions.
- In the framework of the Bilateral Cooperation Programme with Austria, 14 projects out of 16 applications for financing joint scientific research projects for the period 2022-2023 were approved.
- According to the Programme Framework for Technical Cooperation between North Macedonia and the International Atomic Energy Agency (IAEA), within the framework of the project cycle 2022-2023, the implementation of three new joint projects with a total budget of 0.63 million euros allocated by the IAEA is underway.
- In 2022, the National Strategy on Equality and non-Discrimination 2022-2026 was adopted. The strategy envisions measures and actions for gender equality in all private and public sectors and decision-making bodies.
- The Acceleration Programme Autumn 2022 was launched by the Business Accelerator of the University Ss. Cyril and Methodius in Skopje (BAU) tailored to the needs of today's start-ups. In 2022, ten start-ups were financed with a total of 0.6 million euros. The Centre for Technology Transfer and Innovation at the Faculty of Engineering and Information Technology (INNOFEIT), as an important cornerstone in the Macedonian innovation ecosystem, was selected by the European Investment Bank (EIB) to become a Centre-of-Excellence in its fields of interest.

Challenges for further ERA integration:

- Since the validity period of the Innovation Strategy has ended in 2020 North Macedonia is expected to adopt its Smart Specialisation Strategy (S3) in 2023. This should help to use the national innovation and R&D funds more efficiently towards selected vertical sectors and horizontal domains, through the modification of existing measures and instruments and introduction of new ones, which will be one of the main challenges for North Macedonia.
- The adoption of a strategy with specific measures for the improvement of the quality of human resources for R&D in North Macedonia is another big challenge for national policy makers. Highly trained and qualified people are emigrating to more developed countries, which makes the brain drain one of the biggest problems. There are some isolated measures for improving the quality of human resources for R&D in North Macedonia, however, an integral strategy with more effective measures is still missing. The strategy should also envision measures and instruments in terms of how to significantly increase the attractiveness of the national R&D and innovation system and how to attract international talents in the national R&D system.
- Under-funding of R&D and innovation by both public and private sectors (GERD was 0.37% of GDP in 2020), along with the other weaknesses is a serious threat for the leading role of R&D and innovation in the creation of a knowledge-based society. Therefore, in order

⁷ <https://finance.gov.mk/wp-content/uploads/2022/07/%D0%A0%D0%B5%D0%B1%D0%B0%D0%BB%D0%B0%D0%BD%D1%81-2022-%D0%A1%D0%BB%D1%83%D0%B6%D0%B1%D0%B5%D0%BD-%D0%92%D0%B5%D1%81%D0%BD%D0%B8%D0%BA.pdf>

⁸ <https://finance.gov.mk/wp-content/uploads/2021/07/%D0%98%D0%B7%D0%BC%D0%B5%D0%BD%D0%B0-%D0%B8-%D0%B4%D0%BE%D0%BF%D0%BE%D0%BB%D0%BD%D1%83%D0%B2%D0%B0%D1%9A%D0%B5-%D0%BD%D0%B0-%D0%91%D1%83%D1%9F%D0%B5%D1%82%D0%BE%D1%82-%D0%BD%D0%B0-%D0%A0%D0%B5%D0%BF%D1%83%D0%B1%D0%BB%D0%B8%D0%BA%D0%B0-%D0%A1%D0%B5%D0%B2%D0%B5%D1%80%D0%BD%D0%B0-%D0%9C%D0%B0%D0%BA%D0%B5%D0%B4%D0%BE%D0%BD%D0%B8%D1%98%D0%B0-%D0%B7%D0%B0-2021-%D0%B3%D0%BE%D0%B4%D0%B8%D0%BD%D0%B0.pdf>



to accelerate the approach towards the European Research Area (ERA), North Macedonia should significantly increase the R&D and innovation funds, along with the adoption of an appropriate internationalisation strategy and a roadmap.

- The structures of North Macedonia's GERD by its sector of performance and funding sources are unfavourable. The main weaknesses are the relatively small shares of business expenditures on R&D (25.68% of GERD in 2020), and of private R&D funding (22.00% of GERD in 2020). Therefore, the economy should encourage the private sector to increase its R&D and innovative activities.
- Poor cooperation between the academic community and the industry, as well as the lack of measures to support knowledge transfer, are regarded as weaknesses of the national R&D and innovation system. The success of the already initiated measures is hampered by the fact that the private sector has a low capacity for R&I. Namely, the business sector comprises only 8% of the total number of researchers in paid employment in research and development, and according to SciVal the share of Academia-Business Collaboration papers versus the total number of papers was only 2.4% for the period 2017-2021. To overcome these shortcomings, the FITD plans to significantly increase the support for the cooperation between academia and industry through specific measures as part of the Medium-Term Work Programme for the period 2021-2023. However, a more integrated approach with greater financial resources is recommended to mitigate these weaknesses.
- Besides the fact that the Republic of North Macedonia has 24 bilateral agreements with EU and non-EU countries, only one call for projects under the bilateral agreement between North Macedonia and Austria was launched in the period 2021-2022. The bilateral cooperation programme should intensify its activities with appropriately greater financing.
- Gender equality is key in all areas and sectors of the society. However significant gender inequalities in specific domains still remain, such as income and earnings, and the ratio of women to men for inventorships⁹, which is only 0.01 for the period 2015-2018.¹⁰

⁹ Inventorship focuses on the invention that is claimed, not on all subject matter described in the patent application

¹⁰ Source: EU publication She Figures 2021, link: <https://op.europa.eu/en/publication-detail/-/publication/67d5a207-4da1-11ec-91ac-01aa75ed71a1>

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List of abbreviations used in this document

ABW	Association of Business Women
APRDA	Annual Programmes for Research and Development Activities
BAU	Business Accelerator of the University Ss. Cyril and Methodius
BAU APA2022	BAU Acceleration Programme Autumn 2022
BCP	Bilateral Cooperation Programme
BERD	Business Expenditure on Research and Development
BSC	Business Start-up Centre
CEEPUS	Central European Exchange Program for University Studies
CEESDA	Consortium of European Social Science Data Archives
CERN	European Organisation for Nuclear Research
COST	Cooperation in Science and Technology
DOAJ	Directory of Open Access Journals
EBAN	European Business Angel Network
EC	European Commission
EDP	Entrepreneurial Discovery Process
EIB	European Investment Bank
EIS	European Innovation Scoreboard
EIT	European Institute of Innovation and Technology
EOSC	European Open Science Cloud
ERA	European Research Area
ERAC	European Research Area Committee
ERC	European Research Council
ERP	Economic Reform Programme
ESS	European Social Survey
EU	European Union
EuroHPC JU	European High Performance Computing Joint Undertaking
EUSAIR	EU Strategy for the Adriatic-Ionian Region
FEEIT	Faculty of Electrical Engineering and Information Technologies
FITD	Fund for Innovation and Technological Development
FTE	Full-Time Equivalent
GBOARD	Government Budget Appropriations or Outlays on Research Development

GERD	Gross Expenditure on Research and Development
GII	Gender Inequality Index
GTF-ISG	GTF - Initiative for Sustainable Growth
GUF	General University Funds
HES	Higher Education Sector
IAEA	International Atomic Energy Agency
ICT	Information and Communication Technologies
INNOFEIT	Centre for Technology Transfer and Innovation at the Faculty of Engineering and Information Technology
IPR	Intellectual Property Rights
IT	Information Technology
KIC	Knowledge and Innovation Communities
LEO	Law on Equal Opportunities of Women and Men
LHE	Law on Higher Education
LIA	Law on Innovation Activity
LSRA	Law on Science and Research Activities
MARNet	Macedonian Research and Academic Network
MSCA	Marie Skłodowska-Curie Action
NCHESRA	National Council for Higher Education and Scientific and Research Activities
NOAD	National Open Access Contact Points
NOSCI	National Open Science Cloud Initiative
NREN	National Research and Education Networks
OA	Open Access
PCT	Patent Cooperation Treaty
R&I	Research and Innovation
RCC	Regional Cooperation Council
RI	Research Infrastructures
RIS	Regional Innovative Scheme
S3	Smart Specialisation Strategies
SEE	South East European
SEEIIST	Southeast Europe International Institute for Sustainable Technology
SEEU	South East European University
SFIC	Strategy Forum for International Cooperation
SGHRM	Steering Group on Human Resources and Mobility
SSOP	Start-up Support Organizations and Program

SSORNM	Statistical Office of the Republic of North Macedonia
STEM	Science and Technology, Engineering and Mathematics
WB	Western Balkans
WBEDIF	Western Balkans Enterprise Development and Innovation Facility
WE	Women Entrepreneurship
WEF	World Economic Forum
YES	Youth Entrepreneurial Service

1. National measures in support of the Horizon Europe association: achievements and challenges by ERA priority

1.1 ERA Priority 1: More effective national research systems

The research system of the Republic of North Macedonia and its governance are highly centralised at state level, with a dominance of the public sector in both R&D funding and performing structures. It is characterised by the absence of a science and research development strategy towards ERA and there is no multi-annual National Programme for Scientific and Research Activity in place. However, the main national policy documents state that a key strategic objective of the Government is to invest in education, science, innovation, and information technology, as elements for a knowledge-based society. The framework for these policy developments comprises the Law on Innovation Activity (LIA) from 2013, the Smart Specialisation Strategy, the Law on Higher Education (LHE) from 2018, the Law on Scientific and Research Activities (LSRA) from 2008 along with the changes of the law adopted as of 2021, the Annual Programmes for Research and Development Activities (APRDA), the Education Strategy 2018-2025, the National Strategy for SMEs Development 2018-2023 and the National Strategy on Intellectual Property of the Republic of North Macedonia for the period 2022-2026.

In what follows, the mentioned policies will be presented with their main features:

- In 2023 the adoption of a Smart Specialisation Strategy (S3) is expected to emphasise selected vertical and horizontal priority domains. This is a new approach for the development of the national research and innovation system, since the outdated Innovation Strategy of North Macedonia 2012-2020 primarily fostered the innovation capabilities of businesses horizontally, taking a neutral stance regarding sectors without imposing sector specialisation.
- The LHE adopted in 2018 is more inclusive towards the teaching staff and students, with the main goal of improving the autonomy and quality of higher education in general. The Agency for the Quality of Higher Education and the NCHEsRA are the new institutions that ensure, evaluate, develop and improve the quality of higher education.
- The LSRA regulates the principles, goals, public interest, the realisation of scientific research activity, the subjects of scientific research activity and the method of funding of scientific research activity.
- The APRDA finance scientific research activities, which include sub-programmes such as research of public scientific institutes, national and bilateral projects, publication of scientific papers and scholarships for young researchers.
- The Education Strategy 2018-2025 comprises measures, activities and indicators for the higher education, research and innovation sectors.¹¹
- The National Strategy for SMEs Development 2018-2023¹² defines a framework for cooperation between stakeholders from the public and private sectors and civil society in order to support the development of SMEs and innovation to increase their competitiveness.
- The National Strategy on Intellectual Property of the Republic of North Macedonia for the period 2022-2026 aims to address not only the acquisition of intellectual property rights

¹¹ <https://teachertaskforce.org/sites/default/files/2022-07/macedonia-education-strategy-for-2018-2025-and-action-plan-strategija-za-obrazovanie-eng-web-1.pdf>

¹² <https://economy.gov.mk/Upload/Documents/Strategija%20za%20MSP%20-%20finalna%20verzija%2003%2004%202018%20.pdf>

(IPRs) and their legal protection and enforcement, but also includes relevant aspects of the creation of IP objects and their commercialisation and business use.¹³

According to the latest available data from eCorda from November 2022, there is not a single project funded by the European Research Council (ERC) in the Republic of North Macedonia, since all three submitted applications were not retained for funding. Furthermore, North Macedonia has four proposals from four different institutions in Marie Skłodowska Curie Actions (MSCA) under Horizon Europe, out of which two are European Researchers' Night and two are Doctoral Network projects. However, none of the proposals was retained for funding. At the level of individual researchers, only one researcher from North Macedonia is involved in one MSCA Postdoctoral Fellowship proposal retained for funding.

According to the World Intellectual Property Organization, North Macedonia filed six Patent Cooperation Treaty (PCT) applications (international phase) by country of origin in 2021¹⁴. Furthermore, North Macedonia has 41 PCT national phase entries (by office and origin) in 2021, while it had 44 in 2020.¹⁵ According to the EIS 2022 the relative performance of the indicator PCT patent applications per billion GDP (in Purchasing Power Standard) was 30% of the European Union (EU) average, with a performance change of 11.3% compared to 2015. The value of the indicator was 0.6 for 2021.

The value of the indicator related to scientific publications among the top-10% most cited publications worldwide as a percentage of total scientific publications of North Macedonia was 407 in the EIS 2022, with a relative performance of 34.4% of the EU average. The performance increased by 23.4% compared to 2015.

In the period 2017-2021, based on SciVal, the total number of publications indexed in Scopus from North Macedonia was 5,434 from 4,248 authors. The share of publications in top journal percentiles (top 10% by Cite Score Percentile) was 18.3% for 2021, or 15.4% for the period 2017 - 2021. The Ss. Cyril and Methodius University in Skopje, as the largest and most important higher education institution in North Macedonia, has obtained the highest share of publications indexed in Scopus with 56% of the total number of publications.

According to the latest available data from the State Statistical Office of the Republic of North Macedonia (SSORNM), Gross Expenditure on R&D (GERD) as a percentage of GDP was 0.37% in 2020, significantly lagging behind the EU average of 2.31%. The structures of the Macedonian GERD by sector of performance and funding sources are unfavourable. The main weakness is the share of Business Expenditures on R&D (BERD), which was 25.68% of GERD in 2020, or 0.096% of GDP. The leading performing sector in the economy was the Higher Education Sector (HES) with a share of 63.58% of the GERD in 2020, while the participation of the government sector as a share of GERD was 9.62%. The structure of the GERD by funding source is also unfavourable. The government sector is the main sector for funding R&D activities in North Macedonia with 46.98% of GERD in 2020, while in terms of the HES, state universities provide 24.1% of the total R&D funds. Therefore, while the 71.06% of the R&D funding mainly comes from public sources, private R&D funding was only 22.00% of GERD in 2020. The total Government Budget Appropriations or Outlays on R&D (GBAORD) as a percentage of GDP in 2020 in the country were 0.18%.¹⁶

North Macedonia is being categorised as an Emerging Innovator with the European Innovation Scoreboard 2022 (EIS) performance index being at 45.6% of the EU average. Performance is

¹³ <http://ippo.gov.mk/docs/xFiles/xfile/1045/1aad11e0-ea8c-4d43-9f64-d3e85f96bdf7.pdf>

¹⁴ <https://www.wipo.int/edocs/pubdocs/en/wipo-pub-901-2022-en-patent-cooperation-treaty-yearly-review-2022.pdf>

¹⁵

<http://www.ippo.gov.mk/docs/xFiles/articles/izvestaj%20za%20rabota%20na%20Dzis%202021/izvestaj%20a%20rabota%20na%20Dzis%202021.pdf>

¹⁶ Own estimations based on R&D data in Statistical Yearbook 2022

below the average of the Emerging Innovators as well (50.0%). Compared to 2015, the performance of North Macedonia has increased about 12.0%, a rate which is higher than that of the EU (9.9%). Therefore, North Macedonia's performance gap to the EU is becoming smaller. Relative strengths of North Macedonia are the indicators foreign doctorate students, environment-related technologies, medium and high-tech goods exports and non-R&D innovation expenditures, which have performances higher than the EU average. The weakest innovation dimension for the Republic of North Macedonia is finance and support with the performance index being at 15.5% of the EU average, while the performances of the indicators employed ICT specialists, design applications, R&D expenditure in the business sector, government support for business R&D and lifelong learning are well below the EU average (less than 10% of EU average).¹⁷

Its low innovation performance index enables North Macedonia to take part in the Regional Innovative Scheme (RIS) for the period 2021-2024. The RIS was created by the European Institute of Innovation and Technology (EIT) to bridge the existing innovation gap between different European countries.¹⁸ The procurement procedures for the establishment of the first EIT Community RIS Hub were launched in North Macedonia at the end of 2022.¹⁹

A closer approximation of the budget outlays for R&D in North Macedonia is the science budget line, the budget line for the Academy of Sciences and Arts of North Macedonia and the budget line for FITD. Additional budget is envisioned for financing participation in EU programmes, such as Horizon Europe. In 2020, the science budget line comprised the following components: (1) an outlay for direct transfers, i.e. institutional non-competitive funding support for horizontal research, performed by public institutes (3.29 million euros); (2) funds, mainly competitive-based, for the main R&D funding instruments through APRDA (1.05 million euros); and (3) financial support for the measure Translation of 1,000 Vocational and Scientific Books, and Textbooks Taught at the most Renowned Universities in the World, which could be regarded as non-institutional competitive-based funds (0.65 million euros). The total budget line for the Academy of Sciences and Arts of North Macedonia is based on institutional non-competitive funding, amounting to 1.73 million euros. The budget line for FITD, which is mainly spent through competitive calls for innovative projects and activities amounts to 12.28 million euros. The approximate estimation shows that the competitive-based share of the state budget for R&D and innovation for 2020 was around 65%. There are separate block budget lines directed towards state universities which mainly consist of non-direct R&D expenditures for General University Funds (GUF), however, here the R&D portion is neglected.

The competitive-based share of the science budget is mainly realised through competitive calls launched by the FITD and by the MES according to the APRDA. According to the APRDA, the MES in 2022 has opened the competitive calls for financing national scientific research projects (2.3 million euros), programmes of the public institutes (141,463 euros), publishing scientific papers in journals with an impact factor (105,700 euros), scholarships for young researchers (696,000 euros), organisation of scientific conferences in North Macedonia (32,500 euros) and participations in international scientific conferences (1,950 euros).

The selection of public-funded projects is carried out at the institutional level, with a public competition that is succeeded by an anonymous review. After completion, the project findings are presented to the relevant scientific public, thus there is a certain level of peer review. The evaluation system was upgraded by the reporting obligations introduced in the LSRA. This law introduces a network of national coordinators for different domains and disciplines in order to achieve objective evaluation procedures. Moreover, in projects of a broader public interest, the

¹⁷ https://ec.europa.eu/assets/rtd/eis/2022/ec_rtd_eis-country-profile-mk.pdf

¹⁸ https://ec.europa.eu/assets/rtd/eis/2022/ec_rtd_eis-country-profile-mk.pdf

¹⁹ <https://eit.europa.eu/news-events/news/eit-launch-eit-community-ris-hubs-covering-all-ris-eligible-countries-and>

use of international experts and the involvement of stakeholders from both the public and private sectors is foreseen. Individual institutions could foresee specific peer review components in their evaluation processes, such as the FITD, which applies peer review services for project audits. The external assessment of North Macedonia's science and research policies is completed through the annual progress reports for North Macedonia published by the European Commission (EC).

The FITD was founded in December 2013 for the purpose of encouraging innovations by providing additional financial sources for innovation activities in start-ups, micro, small and medium-sized enterprises in order to ensure hastened technology development based on knowledge transfer, research, development and innovations.²⁰ The FITD also comprises activities such as initiating and supporting the National Start-up Council, collaboration between the private sector and start-ups, digitalisation of agriculture and public institutions, development of a National Strategy for Artificial Intelligence and supporting talented users, pupils and students. The National Start-up Council established at the end of 2020 brings together experts from various fields of business united by their goal to establish North Macedonia as a regional start-up hub.²¹

According to the performance analysis of companies co-funded by the FITD and published in September 2021, in the time period 2016-2021 projects co-funded by the FITD contributed with a total value of 88.25 million euros with 36% to 41% in GERD in North Macedonia. As analysed by the FITD, 56% of the total projects value is co-funded by FITD, while 44% are funds allocated from companies. The share of co-funding by FITD is even higher for start-ups and spin-offs (76%). In the respective period, financial support was provided for 669 projects.

In particular, the highest percentage or 24% of the co-funded projects with a total value of the projects of 21 million euros is from the information technology (IT) area. This is an expectable value because the North Macedonian IT industry currently has the highest number of innovations which have been placed on the global market. The FITD also supports the development of three business accelerators: X Factor, Seavus Accelerator and Business-Technology Accelerator UKIM, with the highest average value of the co-funding with 0.48 million euros per project.

In 2022, the FITD launched open calls for different instruments, such as technological development and accelerated economic growth; newly established start-ups and spin-offs; and commercialisation of innovation, with a total value of co-funding of 17.5 million euros.

The FITD does not use an innovation taxonomy to distinguish between deep-tech innovations and breakthrough innovations among others, although it supports certain social challenges such as climate change and green agendas. The open call from 2022 contains a finance line for the Challenge for Tackling Climate Change in the amount of 0.12 million euros, and a finance line for the Green projects-Challenge for Young Researchers that amounts to 48,780 euros.

The Economic Reform Programme (ERP) 2022-2024 was adopted by the Government of the Republic of North Macedonia on 28 January 2022 and officially submitted to the European Union on 31 January 2022.²² The Macedonian economy is recovering after the corona pandemic following the pattern of the other European countries. In the first nine months of 2021, economic activity averaged a 4.6% increase, with the highest growth rate of 13.4% being recorded in the second quarter. The recovery has been most pronounced in the service sector, while the movements in the industrial and construction sectors are still unfavourable. In its annual assessment of the previous ERP 2021 - 2023, the EC points out that the economy still faces challenges with regard to fiscal policy's transparency and targets under increased uncertainty, quality of public finances management and low realisation of capital expenditures,

²⁰ https://fitr.mk/wp-content/uploads/2021/12/FITR_REP_V1.50-2.pdf

²¹ <https://www.trendingtopics.eu/north-macedonia-sets-up-startup-council-to-promote-country-as-regional-hub/>

²² <https://finance.gov.mk/economic-reform-program/?lang=en>

low productivity and limited competitiveness of the domestic companies to integrate with the global supply chains, as well as the size of the informal economy.²³

1.2 ERA Priority 2a: Optimal transnational cooperation and competition

North Macedonia has been engaged in an extensive international collaboration in research, development and innovation through its participation in Horizon Europe, Horizon 2020, and other EU FP Programmes, the Western Balkans Enterprise Development and Innovation Facility (WBEDIF), EUREKA, European Cooperation in Science and Technology (COST) and the International Atomic Energy Agency (IAEA) Agreement on Technical Co-operation. There is evidence of successful participation in these initiatives as well as the implementation of its associated objectives and commitments.

The main national measure that supports joint transnational, bilateral and multilateral public R&D programmes in North Macedonia is the Bilateral Cooperation Programme (BCP), which is based on the signed agreements for cooperation in the areas of education, science and technological development with 24 EU and non-EU countries. The agreements take into account research agendas of other countries and adopt specific elements of common evaluation procedures. In the course of 2021, a call for financing joint North Macedonian-Austrian scientific research projects for the period 2022-2023 was published. Out of 16 applications received, 14 projects were approved, supported by the MES. The BCP is the only measure where international peer-review is introduced in national funding decisions. It is financed through APRDA, which also includes contributions and participation fees for some of the EU research programmes such as the Central European Exchange Program for University Studies (CEEPUS) initiative. A separate budget line is dedicated to other EU programmes such as Horizon Europe, Erasmus+, Europe for Citizens and Solidarity Corps (5.03 million euros for 2022). The total number of researchers in full-time paid employment (FTE) in 2020 by sector of performance was 141.39 in governmental sector, 795.04 in the higher education sector, 153.10 in the business sector, and 7.1 in the non-profit sector, or in total 1,096.63. The estimation of GBAORD allocated to Europe-wide transnational, bilateral and multilateral public programmes, including national participation for EU programmes, per FTE researcher in the public sector is estimated at 5,500 euros.

According to the SCImago Journal & Country Rank portal, which includes the journals and country scientific indicators developed from the information contained in the Scopus database (Elsevier B.V.), North Macedonia has a total of 1,115 published documents for the year 2021, or 0.56 scientific publications per population of 1,000. Compared to 2020, the total number of scientific publications in North Macedonia has slightly increased by 1.5%. According to the EIS 2022, the value of the indicator number of scientific publications per million population with at least one co-author based abroad in 2021 was 275 with a relative performance of 19.7% of the EU average. However, this is a significant increase of 16.4% compared to the year 2015. In the period 2017-2021, according to SciVal, as an integral part of the Elsevier Research Intelligence ecosystem, researchers from North Macedonia have published 5,434 papers, out of which 58.6% were written with international partners, 9.3% were national collaborations, 23.2% were institutional collaborations and 9.0% were single authorships (no collaboration).

The public network for international cooperation in R&D EUREKA is not financially supported by the state budget of North Macedonia. Therefore, Macedonian organisations participating in international R&D projects are currently not eligible for funding through EUREKA. The MES supports North Macedonian organisations interested in international collaboration by giving them access to expertise and supporting their growth.²⁴

²³ <https://finance.gov.mk/wp-content/uploads/2022/02/Economic-Reform-Programme-2022-2024-1.pdf>

²⁴ <https://www.eurekanetwork.org/countries/north-macedonia/>

As of the end of 2022, North Macedonia participates in 236 ongoing COST actions, while in the period 2014-2020 it has participated or is still participating in 385 COST actions with 2,708 participations in networking activities²⁵ in the field of biomedicine and molecular bioscience, food and agriculture, forestry, materials and nanoscience, chemistry and molecular sciences and technologies, information and communication technologies, transport, multidisciplinary sciences, social sciences, culture and health. A total of 318 researchers was trained in COST training schools and 173 researchers took part in the short-term scientific missions. The MES has established a working group to decide on the nominations of the management committee members of the COST programme based on a list of criteria. The MES in cooperation with the Faculty of Information Science and Computer Engineering in Skopje initiated the establishment of an internet-based database for national COST participations. However, no progress has been made as of the end of 2022.

Within the BCP, North Macedonia has signed STI agreements with the following 12 EU Member States: Slovenia, Croatia, Bulgaria, Poland, the Czech Republic, Slovakia, Hungary, Romania, Italy, France, Austria and Spain.

After the EC and North Macedonia concluded the negotiations for association to Horizon Europe on 28 September 2021²⁶, they signed an agreement for closer cooperation in the fields of research and innovation on 6 December 2021. The agreement grants North Macedonia an association status which enables researchers, innovators and research entities established in North Macedonia to participate in Horizon Europe under the same conditions as entities from the EU Member States.²⁷

North Macedonia signed a Programme Framework for Technical Cooperation with the International Atomic Energy Agency (IAEA). The programme envisions cooperation with IAEA through mutual project activities in which the participating institutions receive equipment, expert services and staff training in order to strengthen the capacities for efficient radiation protection in accordance with international standards and European directives. Within the frameworks of two project cycles, 2018-2019 and 2020-2021, seven national projects were realised with a total budget of 1.18 million euros allocated by the IAEA, while within the framework of the current project cycle 2022-2023, the implementation of three new projects with a total budget of 0.63 million euros allocated by the IAEA is underway.

As an EIT RIS country, North Macedonia is eligible to participate in the activities offered by the eight EIT Knowledge and Innovation Communities (KIC) through tailor-made programmes. In 2022 North Macedonia has participated in five EIT KIC projects (two projects under the EIT Manufacturing KIC; two projects under the EIT Climate KIC; one project under the EIT Raw Materials KIC).

In 2022 the EIT Jumpstarter pre-accelerator programme as a key initiative of the EIT Cross-KIC Regional Strategy Innovations Cluster received 25 applications from North Macedonia, being the top performer among the WB.²⁸

Additionally, North Macedonia participates in the EU Strategy for the Adriatic and Ionian Region (EUSAIR). The general objective of the EUSAIR is to promote economic and social prosperity and growth in the region by improving its attractiveness, competitiveness and connectivity. The representatives from North Macedonia coordinate one of the four pillars (Connecting the region).

²⁵ https://www.cost.eu/uploads/2022/08/COST_H2020_Factsheet_Rep.ofNorthMacedonia.pdf

²⁶ https://ec.europa.eu/info/news/negotiations-association-horizon-europe-concluded-2021-sep-28_en

²⁷ https://www.eeas.europa.eu/delegations/north-macedonia/north-macedonia-becomes-associate-member-horizon-europe-new_en

²⁸ EU-North Macedonia Horizon Europe Research and Innovation Committee meeting, Skopje, 17th of October 2022

In June 2022, the Digital Agenda Observatory for North Macedonia was published. This is a part of the EU Digital Agenda that covers the development of the information society in the broadest sense.²⁹

North Macedonia is a co-signatory of the Western Balkan Regional R&D Strategy for Innovation in the framework of the Central European Initiative (CEI).³⁰

North Macedonia is a non-member state with international co-operation agreements of the European Organisation for Nuclear Research (CERN). The Law on Establishing a National Agency for Nuclear Technologies in North Macedonia, adopted in 2010, creates a legal basis for the participation in CERN. The agency's funds are provided through the budget line for science. Since the funds provided in the MES budget were only partially used by the National Agency, or not used at all, the MES has not planned any funds for the National Agency since 2016.

North Macedonia is participating in most European governance bodies, such as the European Research Area Committee (ERAC), the Strategy Forum for International Cooperation (SFIC), and the ERA Steering Group on Human Resources and Mobility (SGHRM). However, due to the low administrative capacity of the North Macedonian government, the North Macedonian participation in these meetings is irregular.

North Macedonia is also aligning with the new ERA priorities and enhancing its R&I governance system.³¹ The part of the new ERA strategic objectives are incorporated in the ERP 2022-2024. National R&D policies focus on general research support and promotion. However, they take into consideration certain social challenges and grand research challenges, addressed through participation in international projects in the domain of agriculture, biotechnology, food processing, chemistry, pharmaceutical research, and environmental protection. Key research challenges are also addressed through the Smart Specialisation Strategy (S3), which proposes vertical and horizontal priority areas and subareas. Smart agriculture and food processing is selected as a vertical priority, while energy for the future is considered a horizontal priority and is subject to further elaboration within the strategy, since it has strong cross-sectoral relations with other proposed priority areas and is in line with the process of greening the industry and protection of the environment. In 2022, the FITD published a call Challenge for Tackling Climate Change, supported with 0.12 million euros.

North Macedonia is part of the Open Balkan Initiative created together with Serbia and Albania. The initiative reinforces the regional cooperation and connectivity through securing conditions for practising the four European freedoms and free movement of people, goods, capital and services.³²

1.3 ERA Priority 2b: Make optimal use of public investments in research infrastructures

In March 2022, the Regional Cooperation Council (RCC) published the policy document Research Infrastructure Roadmap of the Republic of North Macedonia, which presents the existing research potential of North Macedonia with the aim to set principles for the future development of research infrastructures (RI) and to propose recommendations aimed at strengthening the research sector and societal development as a whole. Considering the small number of internationally relevant large research infrastructures that North Macedonia is a member of, RI

²⁹ https://metamorphosis.org.mk/wp-content/uploads/2022/06/dao-cr_en.pdf

³⁰ European Commission, Directorate-General for Research and Innovation, R&I cooperation with North Macedonia, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/207774>

³¹ European Commission, Directorate-General for Research and Innovation, R&I cooperation with North Macedonia, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2777/207774>

³² <https://vlada.mk/node/30372?ln=en-gb>

in this document refer to research facilities and equipment within the scope of research institutions (universities and research institutes) whose purpose is to provide basic conditions for research activities.³³

It is important to mention the programme "Equipping laboratories for scientific research and application activity" financed and implemented by the MES since 2010 with the aim to improve the RI capacities of the public higher education institutions and research institutes. As a result of this project, a total of 80 research laboratories have been equipped with research equipment of a total value of approximately 23 million euros. Research laboratories operating within the UKIM have obtained the highest share of financial funds (77%) as it is the largest and the most important higher education institution in North Macedonia. About 11% of the funds were allocated to Goce Delchev University; other universities obtained 5% or less.³⁴ In 2021, the MES, through two public calls, allocated almost 4 million euros, of which 3.6 million euros are for supporting the laboratory resources available to higher education and scientific institutions and 0.4 million euros for the realisation of scientific projects of special public interest, which will be implemented by the seven public scientific institutes in North Macedonia.

In line with the low levels of public spending for R&D over the last decade, the research community of North Macedonia has not had a distinctive presence among the global RIs. However, it is important to emphasise that despite the unfavourable general conditions, institutions from North Macedonia are full or associated members of several large RI in Europe. North Macedonia is a member of ESFRI. Currently, North Macedonia participates in the development of one ESFRI research infrastructure project - METROFOOD-RI infrastructure for Promoting Metrology in Food and Nutrition. Furthermore, North Macedonia is a member of the ESFRI landmark CESSDA ERIC Consortium of European Social Science Data Archives (from the social & cultural innovation field)³⁵, which means that the project reached an advanced implementation stage and represents major elements of competitiveness of the ERA. North Macedonia also participates in the operations of several large European RI that are substantially important for the development of European and regional research infrastructures, such as the GEANT³⁶ Pan-European Network; the European Open Science Cloud (EOSC) Association; EGI³⁷: Advanced computing for research; OpenAIRE MAKE³⁸; the European High Performance Computing Joint Undertaking (EuroHPC JU)³⁹; European Social Survey (ESS); and the South East European International Institute for Sustainable Technologies (SEIIST). Furthermore, institutions from North Macedonia have participated in 18 international projects (11 projects within H2020 and

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<https://www.rcc.int/download/docs/RI%20Roadmap%20NMKD%20digital.pdf/ead770d94b6db137b6c2d1d7a98ea880.pdf>

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<https://www.rcc.int/download/docs/RI%20Roadmap%20NMKD%20digital.pdf/ead770d94b6db137b6c2d1d7a98ea880.pdf>

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<https://www.rcc.int/download/docs/RI%20Roadmap%20NMKD%20digital.pdf/ead770d94b6db137b6c2d1d7a98ea880.pdf>

³⁷ <https://roadmap2021.esfri.eu/projects-and-landmarks/>

³⁷ GEANT stands for Gigabit European Academic Network

³⁷ Source providers united by a mission of delivering advanced computing and data analytics services for research and innovation.

³⁸ OpenAIRE is a key EU e-Infrastructure to establish, maintain and operate an open and sustainable scholarly communication infrastructure.

³⁹ EuroHPC JU is a joint initiative between the EU, European countries and private partners to develop a World Class Supercomputing Ecosystem in Europe.

seven projects within FP7) related to the development of RI.⁴⁰ In September 2020, two projects, EuroCC⁴¹ and CASTIEL⁴² were launched with financial support from the European High Performance Computing Joint Undertaking (EuroHPC JU) as a part of Horizon 2020, with the main goal to strengthen the knowledge and opportunities for HPC in Europe⁴³. EuroCC and CASTIEL plan to build a European network of 33 national HPC competency centres. EuroHPC JU is a joint initiative between the EU, European countries and private partners to develop a World Class Supercomputing Ecosystem in Europe.⁴⁴

FNH-RI is European research infrastructure for healthy and sustainable diets, consisting of more than 150 institutes from 24 countries. North Macedonia is represented by UKIM. Its goal is to boost research on eating patterns and to foster the transition to sustainable food system and the reduction of non-communicable diseases.⁴⁵ The FNH-RI proposal for the ESFRI Roadmap (PROSPECT) has been submitted in September 2020 and is currently under review by ESFRI, awaiting the final decision whether the project shall be admitted to the Roadmap.

The Macedonian Research and Academic Network (MARNet) is a public institution established by the Law on establishing the Macedonian Academic Research Network enacted in September 2010. The MARnet provides services for national and international connectivity of the academic research network and the educational community of North Macedonia, and supports their research and educational activities. Furthermore, MARNet is engaged in promoting the use of and disseminating information and communication technologies (ICT) particularly in the academic and research sector; maintenance and management of the national domain system, international representation and membership; and development of the national academic network. The MARNet e-infrastructure includes all devices owned or leased by MARnet and all telecommunication links owned by MARNet or leased from telecommunication providers. This is very important for the information society of North Macedonia since it provides services that aim at meeting the requirements in the field of education and research. MARnet is the member of GÉANT, the high bandwidth pan-European research and education backbone that interconnects Europe's National Research and Education Networks (NRENs).⁴⁶

The RCC successfully implemented the Open Access Research Infrastructure in the Western Balkans (WB) Support Programme in 2020. The programme assisted in removing obstacles to the mobility of students, researchers and scholars. The RCC coordinated the Protocol on Open Access to Research Infrastructure in the WB negotiations. In November 2020, the WB governments endorsed the Protocol during the Berlin Process Summit in Sofia.⁴⁷

In 2021, the FITD decided to finance the innovation infrastructure through the three projects CIRCO, FEEIT and INO TEH CLUB Shtip, within the call "Challenge for establishing fabrication laboratories FAB LABS - Young people create". The projects provide access to modern technologies

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<https://www.rcc.int/download/docs/RI%20Roadmap%20NMKD%20digital.pdf/ead770d94b6db137b6c2d1d7a98ea880.pdf>

⁴¹ EuroCC aims to build a European network of 33 national HPC competence centres to bridge the existing HPC skills gaps while promoting cooperation across Europe.

⁴² CASTIEL will promote interaction and exchange of expertise across the entire EuroCC network.

⁴³ <https://digital-strategy.ec.europa.eu/en/news/eurocc-and-castiel-two-new-projects-boost-european-hpc-knowledge-and-opportunities>

⁴⁴ https://eurohpc-ju.europa.eu/index_en

⁴⁵ <https://fnhri.eu/>

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<https://www.rcc.int/download/docs/RI%20Roadmap%20NMKD%20digital.pdf/ead770d94b6db137b6c2d1d7a98ea880.pdf>

⁴⁷ <https://balkaninnovation.com/open-access-research-infrastructure-in-the-western-balkans-support-programme/>

for high school students and young people, as well as training and mentoring for innovative solutions, from idea to prototype and testing, with the possibility of a small serial production.⁴⁸

In 2021, the project Startup Genome was commissioned by the GIZ⁴⁹ to conduct an ecosystem mapping of the WB in order to contribute to the professionalisation of Start-up Support Organizations and Programs (SSOPs). The findings are presented in the report The Western Balkan Start-up Ecosystem Report Assessment and Development Roadmap.⁵⁰ According to this report, North Macedonia along with Serbia is the most advanced in creating local connectedness, however, North Macedonia has low global connectedness. Furthermore, the majority of SSOPs in North Macedonia cover the stages ideation and incubation, offer technical and entrepreneurial skills and provide early-stage funding. Most SSOPs currently depend on external funding to operate.

The FITD and Start-up Macedonia prepared the report Connecting Macedonian Start-up Ecosystem 2021⁵¹. It stresses out that the share of the total number of start-ups that generate revenue has increased from 55.4% in 2018 to 72.0% in 2021, while the FITD was a driving force behind seed and early-stage funding. The majority of start-ups (62.7%) have applied to its funding calls, and the majority of those have received some funding (59.4%).

In North Macedonia there are no initiatives for development of deep tech infrastructures, and deep-tech start-ups are not in the main focus of SSOPs.

The National Initiatives for Open Science in Europe - NI4OS Europe, aims at being a core contributor to the European Open Science Cloud (EOSC) service portfolio, commit to the EOSC governance and ensure inclusiveness at the European level for enabling global Open Science.⁵²

1.4 ERA Priority 3: An open labour market for researchers

North Macedonia is characterised by a well-regulated labour market for researchers, with certain institutional autonomy in the recruitment processes for researchers. The general conclusion is that the Law on Higher Education (LHE) and the rulebooks provide an open, transparent and merit-based recruitment of researchers. However, international researchers without North Macedonian citizenship are allowed to compete for the internationally announced vacancies only if they possess a work permit issued by the Employment Agency of North Macedonia. The BCP is the only measure that allows a researcher affiliated with a foreign institution to apply for grants offered by national institutions, provided that this option is envisioned in the signed agreements. Since a low level of migration of researchers between institutions has been recorded in North Macedonia, there is no framework that enables the portability of researchers' funding.

Due to the unattractive domestic research market, there is almost no interest of foreign researchers for employment in North Macedonia. Therefore, despite the presence of open and transparent recruitment procedures, mainly domestic researchers are interested in filling the vacancies in universities and research organisations. Another obstacle for the employment of non-nationals at most of the universities is the required knowledge of either North Macedonian or Albanian language. The issue is partially transcended with the LHE from 2018, which obligates the universities to have at least two study programmes in the first cycle of studies and two study programmes in the second cycle of studies in English language.

⁴⁸ <https://fitr.mk/en/the-establishment-of-fab-labs-fabrication-laboratories-young-people-create-begins/>

⁴⁹ GIZ stands for Deutsche Gesellschaft für Internationale Zusammenarbeit

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https://www.wbstartupalliance.org/uploads/documents/GIZWesternBalkansEcosystemAssessmentReport_compressed.pdf

⁵¹ <https://fitr.mk/wp-content/uploads/2021/11/ECOSYSTEM-REPORT-2021-PDF-Web.pdf>

⁵² <https://ni4os.eu/overview/>

North Macedonia has lost 10% of its citizens due to massive emigration in the last three decades.⁵³⁵⁴ Conservative estimations show that at the beginning of the 21st century, approximately 20% of North Macedonian citizens with a university degree resided abroad.⁵⁵ According to the 2019 Global Competitiveness Report of the World Economic Forum (WEF), brain drain is among the highest in the world. Highly trained and qualified people are leaving North Macedonia. Human flight and brain drain index⁵⁶, which is in the range 0 (lowest) to 10 (highest), is 6.3 for North Macedonia for 2022.⁵⁷ Youth brain drain is one of the most worrisome problems for the WB, including North Macedonia.

The only national document that directly addresses the issue of brain drain is the National Strategy for Networking and Cooperation with Highly Educated and Professional Personnel 2013-2020. Unfortunately, only one action plan for 2013 and 2014 has been prepared, without any notification about the progress and its realisation. In order to mitigate the brain drain, through the programme APRDA, the government launched a specific measure called Scholarships for Young Scientific and Research Personnel in the second and third cycles in North Macedonia and abroad in 2021.

In 2021, the National Start-up Council proposed the measure for North Macedonia to become one of the countries that in the Law for Foreigners envisages digital nomad visa. This type of visa allows non-EU citizens to work remotely.

On the recommendation of the MES, the Academy of Sciences and Arts of North Macedonia has become a bridgehead organisation for the EURAXESS network and has launched the national EURAXESS portal in 2011. The portal enables easier integration of North Macedonian researchers in Europe by supporting the mobility of researchers in both directions, to and from North Macedonia. Three EURAXESS centres are established in different cities (Bitola, Ohrid and Shtip), which provide free of charge practical and useful information on life and work in North Macedonia for researchers. As of November 2022, only one scientific job posting was published on the EURAXESS job portal of North Macedonia, which shows that the national EURAXESS network is still far from reaching its full potential.

Two organisations from North Macedonia have endorsed the Charter & Code principles: Finance Think and the South East European University (SEEU). These two organisations have also received the HR Excellence in Research award.⁵⁸

According to the EIS 2022, the value for the indicator foreign doctorate students as a percentage of all doctorate students for North Macedonia was 39.1% in 2020, with a relative performance of 228.7% compared to the EU average. The performance change compared to 2015 was 234.8%. However, doctorate students are mainly coming from neighbouring non-EU countries.

1.5 ERA Priority 4: Gender equality and gender mainstreaming in research

Gender equality as a principle in all areas and sectors of the society has been enshrined in the Constitution, the Law on Equal Opportunities of Women and Men (LEO) with its changes adopted

⁵³ <https://www.gmfus.org/sites/default/files/2022-08/A%20New%20Youth%20Brain-drain%20Paradigm%20in%20the%20Western%20Balkans.pdf>

⁵⁴ <https://library.fes.de/pdf-files/id-moe/15274-20190408.pdf>

⁵⁵ <https://www.obserwatorfinansowy.pl/in-english/macro-economics/macedonia-is-losing-people-due-to-brain-drain/>

⁵⁶ Considers the economic impact of human displacement (for economic or political reasons) and the consequences this may have on a country's development.

⁵⁷ https://www.theglobaleconomy.com/Macedonia/human_flight_brain_drain_index/

⁵⁸ <https://www.euraxess.mk/>

in 2014 and the National Strategy on Equality and non-Discrimination 2022-2026. The law and the strategy envision measures and actions for gender equality in all private and public sectors and decision-making bodies. The actions and measures should increase the participation of the less represented gender until an equal participation of genders is achieved. However, no R&D-specific action or measure is proposed by the national authorities regarding gender equality and gender dimension in the field of research. Additionally, no study is available that thoroughly analyses the situation of women and men in the scientific and research communities.

In 2019, the Republic of North Macedonia has published its own Gender Equality Index scoring 62 points, which is lower than the EU average which was 67.4 points. This ranks North Macedonia on the 16th place in comparison with the EU countries. In the domain of power, North Macedonia scores better than the EU, while significant gender inequalities remain, especially when it comes to income and earnings, and the sharing of household responsibilities.⁵⁹ Furthermore, the gender analysis of the 2020 EC Country Reports for the WB indicates that procedures for a legal gender recognition in line with the ECHR ruling from January 2019 are still to be established in North Macedonia.⁶⁰

The Global Gender Gap report of the WEF for 2022 indicates that gender equality in North Macedonia has improved to a score of 0.716 (comparing to 0.635 in 2020). North Macedonia was ranked on the 27th place out of 35 European countries⁶¹. In the EU North Macedonia 2021 report, the section on equality between women and men in employment and social policy suggests that the gender employment gap and salary gap stand at 19.9% and 12% respectively.⁶²

In 2018, the Strategy for Women Entrepreneurship Development in the Republic of North Macedonia 2019-2023 was adopted, which aims at economic empowerment of women by creating a supportive business climate and providing support for the development of their entrepreneurial potential.

In May 2021, the project National Platform for Women Entrepreneurship (WE) was launched, co-financed by the EU. The main focus of the project is on increasing equality and promoting inclusive and sustainable economic growth through the creation of such a platform. The platform provides structural support and strengthens women entrepreneurship, with the aim of empowering women from urban and rural areas economically.⁶³

Recognising the linkages between women economic empowerment and sustainable growth as well as the importance of joint collaboration, in 2022 the initiative WE has agreed to launch the Regional Network of Women in Entrepreneurship to further support the advancement of women entrepreneurs from diverse backgrounds in the WB.⁶⁴

In December 2017, the WE MAKE Project was launched, led by GTF - Initiative for Sustainable Growth (GTF-ISG) from Croatia in partnership with the Association of Business Women (ABW) from North Macedonia. The project activities are diverse and geared to improving competitiveness of the North Macedonian economy by encouraging women entrepreneurship, export and innovation, including ICT/STEM/GREEN and SOCIAL entrepreneurship. The project targets young girls and women, potential and existing entrepreneurs, and government and civil society stakeholders in the selected municipalities.

⁵⁹ <https://eige.europa.eu/news/north-macedonia-publishes-its-own-gender-equality-index>

⁶⁰ Pasquinella, G. (2021). Gender Analysis 2020 EC Country reports for the Western Balkans. THE KVINNA TILL KVINNA FOUNDATION, Brussels.

⁶¹ https://www3.weforum.org/docs/WEF_GGGR_2022.pdf

⁶² EU North Macedonia 2021 Report, page 83

⁶³ <https://en.weplatform.mk/za-proektot/>

⁶⁴ <https://www.rcc.int/docs/613/declaration-on-the-launch-of-the-regional-network-of-women-in-entrepreneurship>

In 2020, the Ministry of Economy of North Macedonia announced a measure to support women entrepreneurship, targeting women-owned and women-managed enterprises.⁶⁵

According to the SSORN, out of the total number of students enrolled in higher education institutions in North Macedonia in the academic year 2021/2022, 58% are women, while the share of women in the total number of graduated students is 59%. The share of women is also higher when it comes to the binding degree of Doctor of Science and Master of Science, amounting to 57% and 60% respectively. In terms of the share of total number of researchers, women account for 53%, while the share of the total number of women researchers with a Doctor of Science degree is 52%. In the Higher Education Sector (HES), the share of women in the total number of researchers is the same as the share of women in the total number of researchers with a Doctor of Science degree and they both amount to 51%.

The data for the HES, as well as for the R&D sector, show that the share of women relative to the share of men is slightly higher. However, the share of female graduates in science and technology, engineering and mathematics (STEM) was 47% in 2021, while the share of women with a degree of Doctor of Science in STEM was 62%. Furthermore, the share of women in Grade A and Grade C positions in the HES in North Macedonia in 2020 was 49% and 51% respectively. The share of women in Grade A positions is much higher when it comes to research institutes, amounting to 71% for 2020.

According to the She figures 2021 report, the ratio of women to men among active authors in all fields of R&D for the period 2015-2019 in the first 5 years of their careers for North Macedonia is 1.35, which is higher than the EU average of 0.74. However, the ratio decreased to 0.74 for the later stages of their careers. The ratio of women to men for inventions for the period 2015-2018 is 0.01 for North Macedonia, much lower than the EU ratio of 0.12.⁶⁶

North Macedonia has a Gender Inequality Index (GII) value of 0.149, ranking it 35th out of 160 countries in the 2017 index. Women's employment rate (34.6%) is significantly lower than men's (53.6%) and the gap between women's economic activity rate (44.3%) and men's (69.3%) is even greater. Gender bias and women's greater representation in the informal labour market tend to keep women's wages low - 39.2% of women employed in the private sector earn lower salaries than men. Only 26% of firms have a female manager and only 16% are owned by women.⁶⁷

1.6 ERA Priority 5a: Optimal circulation, access to and transfer of scientific knowledge including knowledge circulation

The legal framework for the measures that support partnerships and cooperation between research institutions and the private sector are the LHE from 2018, the LIA, the Innovation Strategy 2012-2020 and the Industrial strategy 2018-2027. The LHE envisions several mechanisms, such as the establishment of boards for cooperation and confidence, career centres and alumni associations in the university units. The LIA additionally provides a legal framework regarding the creation and commercialisation of the results of the R&D and innovation activity. The law also gives guidelines for inventions as well as for intellectual property rights resulting from state-funded research, which enables universities with appropriate legal rights to engage in

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<https://wemake.mk/notice/%d0%bc%d0%b8%d0%bd%d0%b8%d1%81%d1%82%d0%b5%d1%80%d1%81%d1%82%d0%b2%d0%be-%d0%b7%d0%b0-%d0%b5%d0%ba%d0%be%d0%bd%d0%be%d0%bc%d0%b8%d1%98%d0%b0-%d1%98%d0%b0%d0%b2%d0%b5%d0%bd-%d0%bf%d0%be%d0%b2%d0%b8/>

⁶⁶ Source: EU publication She Figures 2021, link: <https://op.europa.eu/en/publication-detail/-/publication/67d5a207-4da1-11ec-91ac-01aa75ed71a1>

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[https://www.unicef.org/northmacedonia/media/8721/file/%D0%95xecutive%20summary:%20An%20analysis%20of%20the%20situation%20of%20women%20and%20children%20\(ENG\).pdf](https://www.unicef.org/northmacedonia/media/8721/file/%D0%95xecutive%20summary:%20An%20analysis%20of%20the%20situation%20of%20women%20and%20children%20(ENG).pdf)

commercialisation activities and other forms of industry-science collaboration. The law envisions the establishment of knowledge transfer centres, establishment of university spin-off companies and stimulation of the companies to cooperate with scientific workers from HES in order to apply for projects for developing new technologies and knowledge.

Poor cooperation between the academic community and the industry, as well as the lack of measures to support knowledge transfer, are regarded as weaknesses of the national R&D and innovation systems. In order to assess the current state of the national innovation ecosystem, in 2019, three EU-funded sustainability studies were prepared under the project "A Canvas for Innovation: a way forward to strengthening the national innovation ecosystem". One of these studies, the "Sustainability Study on Innovation Policy Instrument Design and Implementation", was aimed at analysing the existing support measures and identifying overlaps and weaknesses in the national innovation ecosystem. The main shortcomings of the measures to support innovation, research and development were identified in the transfer of knowledge between the public and the private sector, as well as in the cooperation between the academic community and the industry. In order to overcome these shortcomings, the FITD plans to significantly increase the support for the cooperation between academia and industry in the medium-term work programme for the period 2021-2023.⁶⁸

With almost 1.5 million euros, the FITD also supports the development of three accelerators in North Macedonia:

- X Factor Accelerator from Veles is the first business accelerator outside of the capital of North Macedonia, Skopje, which was founded by investors with extensive practical experience in creating, managing and supporting the development of successful start-up businesses and launched in 2018. The mission of the X Factor Accelerator is to encourage regional entrepreneurship and give a strong impetus to the movement of the Macedonian start-up scene.
- Seavus Accelerator is led by the Seavus Education and Development Centre which is an active player in the international start-up community as a member of the EU-funded project My-GATEWAY and is a Start-up Europe Ambassador for North Macedonia.
- The Business Accelerator UKIM (BAU) is a business-technology accelerator, established to identify and support the growth of the most promising technology entrepreneurs, start-ups, spin-offs and scale-ups in North Macedonia. The support includes financing/investment and a custom-tailored business acceleration programme, including mentoring, access to international markets and business networks, business development, and fundraising support. BAU is considered a part of the Science and Technology Park located in the campus of the technical faculties. BAU launched the Acceleration Programme Autumn 2022 (BAU APA2022), tailored to the needs of today's start-ups. Up to six start-ups will be selected in the BAU APA2022 and they will receive 25,000 euros in cash and 10,000 euros through mentorship.

Following the adoption of the S3, the FITD should also take initiatives to adapt the support measures to the priority specialisation sectors and to identify new initiatives in accordance with the identified priority sectors. The adoption of the strategy is expected for 2023.

Different forms of science-industry cooperation like technology transfer centres, technology parks, business start-up centres and incubators, are also a significant R&D performer in North Macedonia. The initiatives with significant impact on the cooperation between academia and industry are the following ones:

- The Centre for Technology Transfer and Innovations (INNOFEIT), opened by the Faculty of Electrical Engineering and Information Technologies (FEEIT), as a part of UKIM;
- The SEEU TechPark, a technology park located at SEEU;

⁶⁸ Source: Medium-term Work Programme of the FITD for 2021-2023, link https://fitr.mk/wp-content/uploads/2021/09/Srednorocna-programa-na-FITR-za-2021-2023-godina-finalna_eng.pdf

- The Youth Entrepreneurial Service (YES) Foundation with its main component, the business incubator, whose aim is to support micro, small and medium sized enterprises in the ICT field through the process of business incubation;
- The Business Start-Up Centre of the Ss. Cyril and Methodius University of Skopje, established in 2006 as a result of a project financed by the Austrian Development Agency;
- The Foundation Business Start-up Centre (BSC) Bitola;
- Startup Macedonia;
- The CEED Hub Skopje, founded by CEED Macedonia. CEED Macedonia runs a Business Club with approximately 250 annual member-companies and a network of approximately 1,300 companies, entrepreneurs and managers, as well as a Business Angels Club. Since January 2016, the CEED Business Angels Club is officially a member of the European Business Angel Network (EBAN).

According to the SSORN, the total private R&D funding in North Macedonia was 8.9 million euros in 2020, representing 22.0% of GERD. Intramural business expenditures represented 97.2% of the total business R&D funds, while the rest is spent by the HES (2.8%). The R&D money spent by the business sector is from its own sources (83.2%), from governmental sources (12.4%), from abroad (3.1%) and from other sources (1.3%). The business sector comprises 8% of the total number of researchers in paid employment in R&D for a definite and indefinite period, and 14% of the researchers in full-time paid employment and full-time equivalent (FTE).

According to the EIS 2022, the number of public-private co-authored research publications per million population for 2021 is 37.2, with a relative performance of 25.5% of the EU average. The performance change compared to 2015 was 17.4% and 8.3% compared to 2020. In SciVal, the share of Academic-Corporate Collaboration papers in the total number of papers was 2.7% in 2021, or 2.4% in the period 2017-2021.

1.7 ERA Priority 5b: Open Access

Despite the fact that there is no legislation for Open Science in the Republic of North Macedonia, there are many initiatives at the institutional level supported by EU projects such as NI4OS, OpenAIRE and the Open Access Research Infrastructure in the Western Balkans Support Programme. The universities in North Macedonia, such as the biggest university, the Ss. Cyril and Methodius University in Skopje, support Open Access in a variety of ways. Almost all of the published journals are freely available through Open Access, and they have their own repositories according to their internal regulations.

North Macedonia is part of the National Open Science Cloud Initiative (NOSCI) which is implemented with the support by the NI4OS-Europe project. A website containing useful information on all Open Science-related principles was published and will be available for all individuals and institutions interested to support the NOSCI initiative through signing the declaration of the NOSCI. As of March 2022, 82 signatories of the declaration from North Macedonia are noted.⁶⁹

Since 2020, UKIM has been approved as a member of the OpenAIRE initiative which represents the European Research Network. The network consists of the National Open Access Contact Points (NOADs) managed by the European Support Office which supports the coordinated transition to Open Science. UKIM also signed the Berlin Declaration for Open Access.

The Open Access Research Infrastructure in the Western Balkans Support Programme, successfully implemented by the RCC in 2020, introduced the principles of Open Access to

⁶⁹ https://www.nosci.mk/?page_id=397

research infrastructures in the region and helped establish the Network of Open Access Research Infrastructures in the WB.⁷⁰

North Macedonia had 15 scientific journals listed in the Directory of Open Access Journals (DOAJ) index in 2022. In comparison to other Western Balkans economies, North Macedonia is ranked far below Serbia with 211 indexed journals, although it has a better rank than Montenegro with nine and Albania with four open accessed journals⁷¹.

In 2022, the MES decided to continue providing the public universities, the Macedonian Academy of Sciences and Arts and the National and University Library "St. Kliment Ohridski" in Skopje, free access to one of the leading scientific research bases in the world: EBSCO⁷². With the signing of the national agreement, North Macedonia provides access to 14 databases of electronic scientific journals and information with an impact factor. They, in total, include over 57,000 journals, of which over 22,000 are electronic journals in full access (full text) in PDF format, with over 5,000 highly cited scientific journals with an impact factor.

Open Access to data on research organisations, researchers and research projects are also available through the E-CRIS repository systems, initiated and managed by the "St. Kliment Ohridski" National Library. The systems are linked to the national COBISS library information systems and its COBIB.MK bibliographic database. The mutual electronic catalogue COBIB.MK is a joint catalogue of records from the local e-catalogues of 40 libraries that are full members of the library-information system COBISS.MK. Using the COBISS/OPAC web application, users can search the databases of all libraries that are included in the COBISS.MK system.

The E-CRIS web application, which the Institute for Information Sciences in Maribor (Slovenia) offered free of charge to COBISS users, aims at establishing a record of researchers and institutions in North Macedonia. The national E-CRIS system is connected to the national library-information system COBISS, and allows immediate insight into the biographical and bibliographic data of researchers and research organisations. The national E-CRIS system includes a database of researchers, research organisations and departments, and research projects.

The APRDA envisions a measure which provides subsidies for scientific works published in a journal with an impact factor. In 2022, a total of 334 researchers were accepted for funding.

According to SciVal, in the period 2017-2021, the share of publications with Open Access of the total number of publications indexed in Scopus was 50.64% for North Macedonia, while according to the SCImago Journal & Country Rank portal, the share of publications with Open Access of the total number of publications indexed in Scopus was 60.45% for 2021.⁷³

1.8 ERA Priority 6: International cooperation

North Macedonia has no national specific and integral strategy for ERA integration. The main national programme that supports international cooperation is APRDA, while North Macedonia is also very active in EU programmes and other international programmes. APRDA financially supports international research activities mainly through the BCP (84,550 euros in 2022). A special budget line is envisioned for contributions and membership fees for international

⁷⁰ <https://balkaninnovation.com/open-access-research-infrastructure-in-the-western-balkans-support-programme/>

⁷¹

https://doaj.org/search/journals?source=%7B%22query%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22terms%22%3A%7B%22index.country.exact%22%3A%5B%22North%20Macedonia%22%5D%7D%7D%5D%7D%7D%2C%22size%22%3A50%2C%22sort%22%3A%5B%7B%22created_date%22%3A%7B%22order%22%3A%22desc%22%7D%7D%5D%2C%22track_total_hits%22%3Atrue%7D

⁷² "EBSCO" is an acronym for Elton B. Stephens Company

⁷³ <https://www.scimagojr.com/countrysearch.php?country=MK>

programmes. The biggest share of this budget line is a contribution for the EU programme Horizon Europe.

Bilateral activities are carried out on the basis of signed agreements on cooperation in the field of education, science and technology between North Macedonia and the Governments of the following 24 EU and non-EU partners: the Republic of Slovenia, Croatia, the Republic of Serbia, Montenegro, the Republic of Kosovo⁷⁴, the Republic of Albania, the Republic of Bulgaria, the Russian Federation, the Republic of Turkey, the Republic of Belarus, Poland, the Czech Republic, Slovakia, Hungary, Romania, Italy, France, Austria, Spain, USA, P.R. of China, Egypt, Japan and Israel. In the course of 2021, a call for financing joint North Macedonian-Austrian scientific research projects for the period 2022-2023 was published, within which, out of 16 applications received, 14 projects were approved and supported by the MES with 6,500 euros per project (see chapter 1.2).

According to the EIS 2022, the number of scientific publications with at least one co-author based abroad per million population for North Macedonia was 275 in absolute value, or 19.7% of the EU average. Regarding the structure and main features of the R&D activities, it is expected that the partners in the publications mainly belong to ERA countries. The value of the indicator foreign doctorate students as a percentage of all doctorate students for North Macedonia was 39.1% in 2020, with a relative performance of 228.7% compared to the EU average.

The indicator exports of medium and high technology products as a share of total product exports is a relative strength for North Macedonia according to the EIS 2022, since it has a value of 64.9, with a relative performance of 122.2% compared to the EU average. The indicator knowledge intensive services exports as a percentage of total services exports scored at 38.9, with a relative performance to the EU average of 40.6%.

Of the total number of national patent applications in 2021 (41), 39 were submitted by domestic applicants, and only 2 applications were submitted by foreign applicants.⁷⁵

2. Horizon Europe participation and financial contribution

The Republic of North Macedonia became a fully associated member to Horizon Europe in January 2021. On 6 December 2021 the country signed an association agreement with the EC, which further strengthens the cooperation in R&I.

North Macedonia has participated in EU Research and Innovation programmes since 2007. As of 28 November 2022, the total number of participations was 330, with the following structure of participations in projects according to the research programmes: two participations in FP4, 14 participations in FP5, 66 participations in FP6, 106 participations in FP7, 122 participations in Horizon 2020 and 20 participations in the Horizon Europe programme so far (see Figure 1). The total financial contribution of the EU for all participations was 35.79 million euros, while the distribution of total funds per separate programme was 0.05 million euros (0.14%), for FP4, 0.61 million euros (1.70%) for FP5, 4.87 million euros (13.60%) for FP6, 11.93 million euros (33.32%)

⁷⁴ *This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

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<http://www.ippo.gov.mk/docs/xFiles/articles/izvestaj%20za%20rabota%20na%20Dzis%202021/izvestaj%20za%20rabota%20na%20Dzis%202021.pdf>

for FP7, 14.80 million euros (41.34%) for Horizon 2020 and 3.53 million euros (9.86%) for Horizon Europe (see Figure 2).

Figure 1: Participation across European Framework Programmes

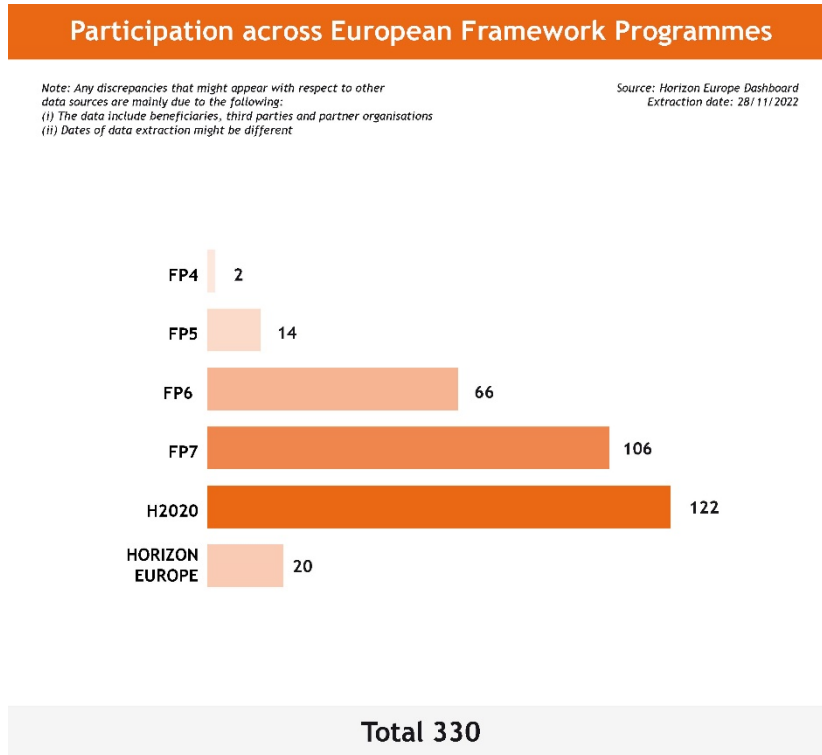
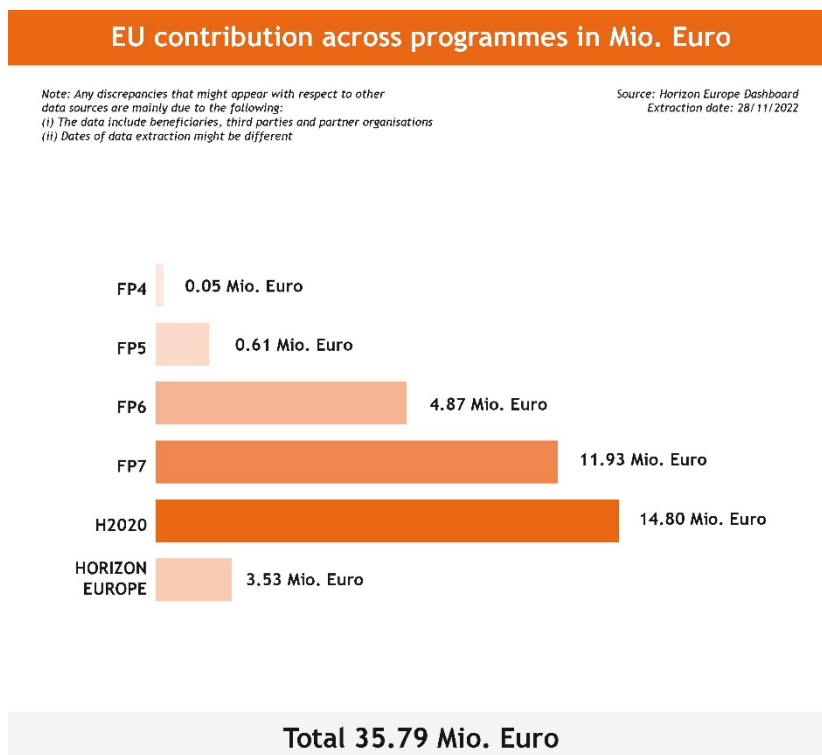


Figure 2: EU contribution across programmes in Mio. Euro



Horizon Europe includes three key pillars and a part called "Widening participation and strengthening the European Research Area". Out of the total number of 20 participations in this programme, North Macedonia has 12 participations in the pillar Global Challenges and European Industrial Competitiveness, three participations in the pillar Excellent Science, and five participations in the part Widening Participation and Strengthening the European Research Area (see Figure 3). Research organisations and institutions from North Macedonia have no participation in the pillar Innovative Europe. The total net EU contribution for all retained projects for financing is 3.53 million euros, with the following distribution per thematic priority: Excellent Science with 1.41 million euros (40%), Global Challenges and European Industrial Competitiveness with 1.32 million euros (37%) and Widening Participation and Strengthening the European Research Area with 0.80 million euros (23%) of the total funding (see Figure 4).

In the Horizon Europe programme, North Macedonian organisations had 161 applications in total, out of which 124 were eligible proposals. The country signed 16 grants with the EC, while SMEs have in total three participations (see Figure 5).

Since 20 participations were retained for funding, the overall success rate in Horizon Europe in all scientific fields for North Macedonia was the same as the EU average, and compared to the other WB Economies, it is higher than the rates of Albania, Bosnia and Herzegovina and Kosovo, but behind Serbia and Montenegro.

Figure 3: Participation in Horizon Europe programmes by thematic priority

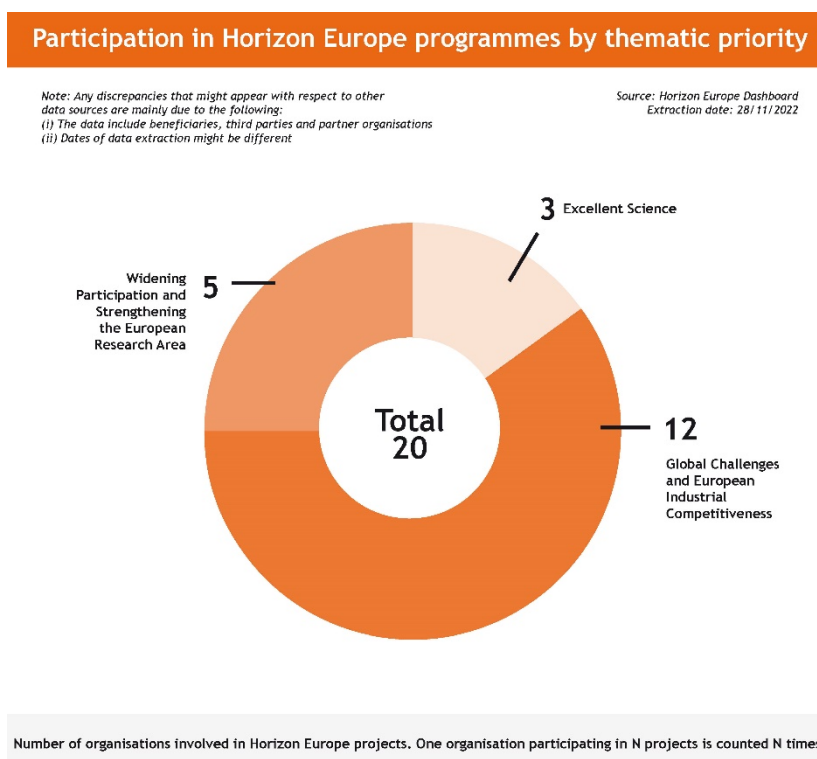


Figure 4: Net EU contribution by thematic priority in Mio. Euro

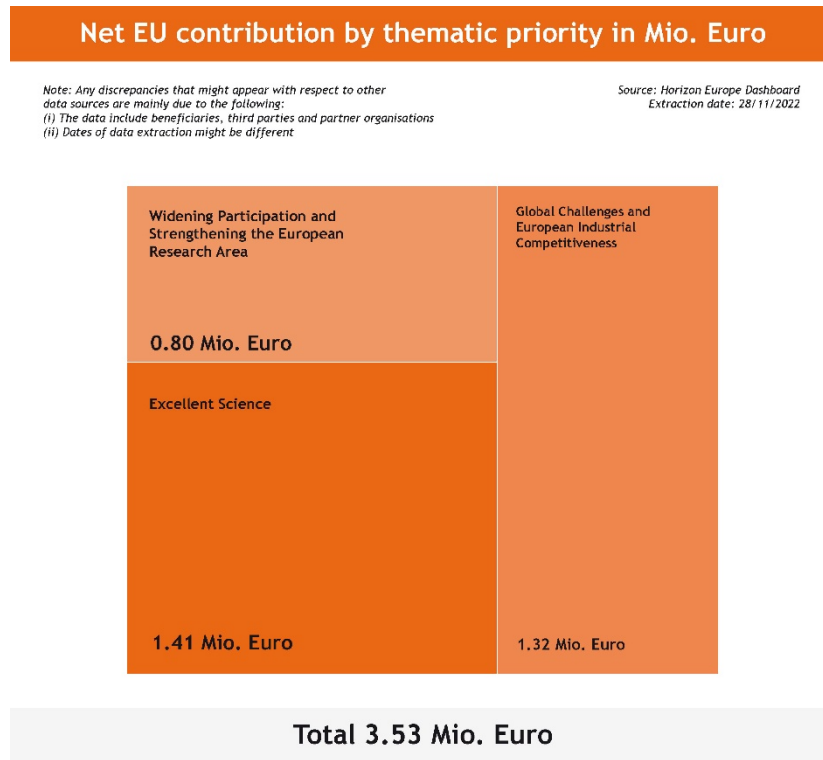


Figure 5: Data for signed grants up to 28/11/2022



3. Smart Specialisation Strategy

The development and implementation of the Smart Specialisation Strategy (S3) of the Republic of North Macedonia is a new systematic approach for introducing and supporting the development of the national innovation and research ecosystem, strengthening the institutional infrastructure and implementing concrete instruments for supporting academia-industry collaboration, new scientific research, innovation enhancement, skills development, continuous Entrepreneurial Discovery Process (EDP), strategic research and innovation partnerships. The strategy will support the innovation capacities for competitiveness promoting primarily specific instruments in identified domains for smart specialisation.

The importance of the implementation of the new strategic document for smart specialisation as a stimulus for innovation, research, growth, green and digital transition, is recognised in the Industrial strategy 2012-2020, the National Roadmap for Research Infrastructure, the EU Progress Report 2021 (Chapters 20 and 25) and the Small Business Act Policy Index. It is expected for the strategy to strengthen the national research and innovation ecosystem and to serve as a relevant framework for boosting competitiveness based on knowledge and innovation.

As of the end of 2022, the strategy is in its last phase of development, thoroughly following the Joint Research Centre (JRC) methodology and closely supervised and in collaboration with JRC experts. The process for development of the Smart Specialisation Strategy was launched in 2018. In the following years, the quantitative and qualitative mappings of economic, innovative, and research capacities based on 100 interviews with key stakeholders were completed, along with the EDP.

The EDP was successfully finalised in 2022. It involved more than 200 stakeholders from the quadruple helix, which discussed and defined the SWOT analysis, as well as the vision and the transformation roadmap for the identified domains. The identified domains for S3 are four vertical priority sectors (smart agriculture and food with higher added value; electro-mechanical industry - industry 4.0; ICT; and sustainable materials and smart buildings) and two horizontal domains (energy for future; and tourism).

In order to achieve the highest effectiveness of the S3 implementation, an action plan for the strategy is prepared by North Macedonia's S3 working group. The action plan is supposed to include various instruments and action lines for the support of targeted priority areas. Furthermore, after the finalisation of the EDP stage, the consultation of the evaluation and monitoring tools for the S3 of North Macedonia have been provided.

Green and digital transitions are also integral parts of the S3 concept, as well as other economic and social challenges that are of national interest. In the S3 development process, there were also donor projects involved that will open the floor for further collaboration in the implementation phase.

4. Conclusion

On the operational level, the main ministries and governmental institutions involved in R&D and innovation policies are the MES, the Ministry of Economy and the FITD. Based on the scope of the realised activities of the FITD in the period 2016-2022, as well as the size of the funds at its disposal, it can be concluded that the FITD is a leading government institution supporting innovative micro, small and medium-sized enterprises, with an established mechanism for developing financial instruments in order to support innovation and technological development. Therefore, it represents the main catalyst of the integration of the national research and innovation sectors towards ERA. However, under-funding of R&D and innovation in North Macedonia by both the public and private sectors, unfavourable structures of the GERD by its

sector of performance and funding sources, and the low quality of human resources for R&D are still the main weaknesses of the R&D and innovation sectors in North Macedonia.

A new impetus for the systematic development of the national innovation and research ecosystem is expected to be given by the S3 strategy, which is in the final stages of development. In 2022, the EDP stage was successfully completed within the process of developing the S3 strategy.

North Macedonia is very committed to international cooperation in R&I through participation in various European programmes and initiatives. In 2022 the opening phase of the accession negotiations started, while researchers, innovators and research entities from North Macedonia could participate in Horizon Europe under the same conditions as entities from EU Member States. Furthermore, North Macedonia as an EIT RIS country participates in EIT Knowledge and Innovation Communities, while the first EIT RIS Hub is in the process of establishment in 2023. North Macedonia also strengthens the cooperation with the IAEA through three ongoing projects from the cycle 2022-2023, and has a rich bilateral cooperation with 24 EU and non-EU countries. According to the SSORNM and She figures 2021 report, women are well represented in the HES and the research sector in North Macedonia, including Grade A and Grade C positions. However, gender employment and salary gaps still exist, as well as the gap for management positions and for the ownership of firms. Furthermore, some progress is noted in encouraging women entrepreneurship through the project National Platform for Women Entrepreneurship, which is co-financed by the EU.

Initiatives in the field of R&D and innovation with a significant focus on the cooperation between academia and industry are noted in North Macedonia through various forms of cooperation, such as business accelerators, technology transfer centres, technology parks, business start-up centres and incubators. The majority of these entities are specifically focused on start-ups and usually provide early-stage funding.

North Macedonian researchers are given free access to EBSCO by the government, while the access to other significant abstract and citation databases such as Scopus is limited. The universities from North Macedonia participate in many Open Access initiatives supported by EU projects, and support Open Access for almost all of their published journals to the general public.



ABOUT POLICY ANSWERS

POLICY ANSWERS (R&I POLICY making, implementation ANd Support in the WEsteRn BalkanS) supports policy coordination in the Western Balkans and with the EC and the EU. 14 partner organisations, representing network nodes in the region and EU expert organisations, support policy dialogue through formal meetings (such as ministerial and steering platform and ad-hoc policy meetings), monitoring and agenda setting, capacity building and implementation of the EU's Western Balkan Agenda, as well as the alignment of thematic priorities. The project implements regional pilot activities and offers an information hub based on the westernbalkans-infohub.eu online information platform. The partners provide analytical evidence via monitoring and mapping activities of the stakeholder ecosystem, of the implementation of the Western Balkans Agenda and of the Western Balkans' integration into the European Research Area as well as via strategic foresight. POLICY ANSWERS also allows for tailored and targeted capacity building activities in the Western Balkans as well as regional alignment of priorities in relation to the digital transformation, the green agenda and towards healthy societies. Pilot activities provide learning opportunities on policy and programme level and reach out to final beneficiaries related to improved academia-industry cooperation, researcher mobility, inclusion of youth in policy processes, promotion of research infrastructures and increased innovation skills in all areas.

