

Innovation

arcfund.net

2021

Innovation Product

Entrepreneurship

Investment and Financing

Human Capital

Information and Communication
Technologies

Innovation.bg

Building Innovation Recovery and
Resilience in Bulgaria

EDITORS

Prof. Teodora Georgieva, Senior Expert, *Innovation.bg* Group, Applied Research and Communications Fund
Ruslan Stefanov, Coordinator, *Innovation.bg* Group, Applied Research and Communications Fund

AUTHORS

Prof. Teodora Georgieva, Senior Expert, *Innovation.bg* Group, Applied Research and Communications Fund
Assoc. Prof. Todor Yalamov, *Innovation.bg* Group, Department of Economics and Business Administration, Sofia University "St. Kliment Ohridski"

INNOVATION.BG WORKING GROUP

Georgi Apostolov, Program Manager, Safer Internet Centre, Applied Research and Communications Fund
Dr. Todor Galev, Senior Analyst, Economic Program, Center for the Study of Democracy
Assoc. Prof. Roumyana Georgieva, Technical University, Gabrovo
Dr. Fani Koleva, Senior Analyst, Applied Research and Communications Fund
Denitsa Marinova, Project Manager, Applied Research and Communications Fund
Maya Tsaneva, Expert, Applied Research and Communications Fund
Blagovesta Chonkova, Project Manager, Scientific, Innovation and Technological Policy, Applied Research and Communications Fund
Daniela Tchonkova, Programme Manager, Innovation and Business Support, Applied Research and Communications Fund
Konstantin Uzunov, Analyst, Applied Research and Communications Fund

EXPERT COUNCIL ON INNOVATION

Prof. Marin Petrov, Honorary Chairperson, Expert Council on Innovation, Applied Research and Communications Fund
Prof. Teodora Georgieva, Chairperson, Expert Council on Innovation, Applied Research and Communications Fund
Prof. Bistra Boeva, Department of International Economics and Politics, University of National and World Economy
Mara Georgieva, Journalist, *Kapital* weekly
Prof. Mitko Dimitrov, Economics Research Institute, Bulgarian Academy of Sciences
Dr. Ventsislav Slavkov, Cluster Board Chairperson, Mechatronics and Automation Cluster
Prof. Milanka Slavova, University of National and World Economy
Assoc. Prof. Olya Stoilova, Scientific Secretary of Nanosciences, New Materials and Technologies Department, Bulgarian Academy of Sciences
Assoc. Prof. Todor Yalamov, Department of Economics and Business Administration, Sofia University "St. Kliment Ohridski"



The Innovation.bg report has been published with financial support from the Konrad-Adenauer-Stiftung, www.kas.de

The Applied Research and Communications Fund is solely liable for the content of this publication and it cannot be considered to be the official position of the funding party.

ARC Consulting Ltd. (part of the Applied Research and Communications Fund Group) is the national coordinator of Enterprise Europe Network – Bulgaria, co-funded by the European Union's COSME Programme (2014 – 2020).



To be quoted as follows: *Innovation.bg* 2021: Building Innovation Recovery and Resilience in Bulgaria, Applied Research and Communications Fund, 2021

ISSN: 2815-2603

ISBN: 978-954-9456-32-5

© Applied Research and Communications Fund 2021

Licensed under CC-BY-NC-SA.

Some rights reserved.

CONTENTS

Executive summary	7
Introduction	13
Foreign investment, research and innovation	15
Innovation policy of Bulgaria – new players and new rules of the game	35
Innovation potential of the Bulgarian economy	41
Gross innovation product	43
Innovation product	43
Technological product	50
Research product	56
Entrepreneurship and innovation networks	61
Investment and financing of innovation	67
Human capital for innovation	73
Information and communication technologies	77

LIST OF ABBREVIATIONS

BAS	Bulgarian Academy of Sciences
BNB	Bulgarian National Bank
BSMEPA	Bulgarian SME Promotion Agency
CCU	Central Cooperative Union
CRM	customer relationship management
EC	European Commission
EDIH	European Digital Innovation Hubs
EEN	Enterprise Europe Network
EIS	European Innovation Scoreboard
EPO	European Patent Office
ERP	enterprise resource planning
EU	European Union
FDI	foreign direct investment
GDP	gross domestic product
IBA	InvestBulgaria Agency
ICT	information and communications technologies
IP	intellectual property
MES	Ministry of Education and Science
MFF	Multiannual Financial Framework
NCPR	North Central Planning Region
NEPR	North East Planning Region
NGEU	NextGenerationEU
NIF	National Innovation Fund
NSI	National Statistics Institute
NUTS	Nomenclature of territorial units for statistics
NWPR	North West Planning Region
OECD	Organisation for Economic Cooperation and Development
OP	operational programme
PORB	Patent Office of Republic of Bulgaria
R&D	research and development
R&D&I	research, development and innovation
RFID	radio-frequency identification
RII	Regional Innovation Index
SARI	State Agency for Research and Innovation
SCPR	South Central Planning Region
SEPR	South East Planning Region
SME	small and medium-sized enterprise
STEM	science, technology, engineering and mathematics
STP	Sofia Tech Park
SWPR	South West Planning Region
TPP	thermal power plant
TTOs	technology transfer offices
UAE	United Arab Emirates
USA	United States of America
WIPO	World Intellectual Property Organization

INDEX OF TABLES

Table 1. Economic sectors with higher than the national average decline in the number of FDI companies for the period 2014-2019, %	20
Table 2. Economic sectors with higher than the national average growth of FDI for the period 2014-2019, %	22
Table 3. Top 10 IT companies by employment at the end of 2019 with certified investment projects (2014-2019).	24
Table 4. Shares of attracted FDI by sectors, %	25
Table 5. Countries with the most FDI in Bulgaria and their relative share.	28
Table 6. Countries with the largest investment shares by sectors (2019).	29
Table 7. Dynamics of the average expenditure of an average foreign R&D company (EUR thousand)	32
Table 8. Dynamics of the number of foreign companies reporting R&D expenditures.	33
Table 9. Main financial instruments and initiatives for recovery and smart transformation of the Bulgarian economy	36
Table 10. Positioning of the planning regions of Bulgaria within the Regional Innovation Scoreboard	49
Table 11. Top-10 technological areas (IPC classification) of patent activity of Bulgarian holders, 2001-2020, (number of patents, %)	53

INDEX OF FIGURES

Figure 1. Number and volume of FDI at the end of the year.	18
Figure 2. Dynamics of FDI at planning region level, EUR thousand	26
Figure 3. Regional differences at planning region level (max/min)	27
Figure 4. Bulgaria's FDI in the world (EUR million)	30
Figure 5. Share of FDI companies performing R&D (2014-2019)	31
Figure 6. Dynamics of the number of foreign companies reporting R&D spending, by planning region.	32
Figure 7. Sources of foreign investment in companies performing R&D	33
Figure 8. European Innovation Scoreboard	43
Figure 9. Innovation potential of Bulgaria, share of EU-27 averages, %, 2021	45
Figure 10. Global Innovation Index, 2021	47
Figure 11. Patent and innovation activity of SMEs, 2013-2020.	51
Figure 12. Patent activity on the territory of Bulgaria, 2001-2020, number of patents	51
Figure 13. Institutional affiliation of the patents issued to Bulgarian holders in Bulgaria, number of patents	53
Figure 14. Patent activity of Bulgarian patent holders in foreign patent offices, main technological areas, 2000-2019, number.	54
Figure 15. Objects of industrial property with effect on the territory of Bulgaria, 2020	55
Figure 16. Publication activity in the Scopus database, 1996-2020	56
Figure 17. Publication activity in the Scopus database, EU-28, 2020	56
Figure 18. Publication activity in the Scopus database, Eastern Europe, 2020	57
Figure 19. Top-10 of the Bulgarian organisations included in Scopus database, 2009-2021	58
Figure 20. Level of the factors for scientific excellence of research organisations in Bulgaria, 2021	59
Figure 21. R&D spending in Bulgaria, 2000-2020	67
Figure 22. R&D spending by the enterprises and the public sector, 2000-2020	68
Figure 23. Annual growth of R&D spending in the enterprises sector by economic activities (CEA 2008), 2020, %	68
Figure 24. R&D spending by scientific fields, 2000-2020, BGN mln	69
Figure 25. Spending on R&D by socio-economic objectives, BGN thousand	69
Figure 26. EU's Digital Economy and Society Index, human capital, 2021	73

Figure 27. R&D staff, by institutional sectors, 2000-2020, %	76
Figure 28. Growth in exports of telecommunications, computer and information services 2010-2021, EUR million	78
Figure 29. Share of enterprises which use at least two artificial intelligence technologies.	79
Figure 30. Share of enterprises using specific artificial intelligence technologies	79
Figure 31. E-commerce profile of Bulgaria	80

INDEX OF BOXES

Box 1. List of some of the certified investments in the period 2014-2019	23
Box 2. Entrepreneurial practices in Bulgaria based on foreign investment	30
Box 3. Workplace innovation in response to today’s challenges.	46
Box 4. Innovation profiles of the planning regions in Bulgaria.	49
Box 5. Ondo Smart Farming Solutions – the Bulgarian start up with solutions for the digitalisation in agriculture	61
Box 6. COOP mobile stores serve hard-to-reach places in Bulgaria.	64
Box 7. The National Innovation Fund – small but successful player on the national innovation scene.	71
Box 8. First online MBA program for CEE countries with Bulgarian participation	74
Box 9. (Un)preparedness of human capital in Bulgaria for a digital transition	75



EXECUTIVE SUMMARY

A **unique set of opportunities** emerged in 2021, including the new European Union (EU) priorities, the recovery from the Covid crisis and public attitudes favouring an overhaul of the political status quo, which Bulgaria can use to overcome its innovation gap based on smart digital and green transformation. The country had similar expectations and opportunities in 2007, but failed to materialise them for the first two programming periods of EU membership. Therefore, it now needs a qualitatively different approach and breakthroughs to ensure the attraction of high value-added investment from the US and EU private sectors and the birth of the first unicorn.

- There is a need for a **consensual political vision** with clear priorities and national funding for the development of innovation, technology and talent by 2050. The target levels of such funding, given the experience of the Central and East European countries, should be around EUR 250-500 million per year.
- A complete **reform of the public institutional infrastructure** for science, technology, innovation and economic support is needed, based on an integrated solution similar to the model of Innovation Norway and introducing competitive appointments for all positions.
- An **annual political cycle of budgetary evaluation** should be introduced for the entirety of the innovation investment opportunities and services that the public administration provides (taxes, regulations, legislation, etc.). The experience of the Organization for Economic Co-operation and Development and the Joint Research Centre of the European Commission can be applied. Currently, the country attracts a negligible share of international innovation investments because it relies mainly on grant incentives through EU funds.

The report *Innovation.bg* presents a detailed picture of the opportunities for improving the innovation environment in Bulgaria on the basis of the most modern world research trends.

Foreign direct investment (FDI) in non-financial corporations in Bulgaria is subject to dynamic changes related to economic factors (crises in the source countries of investment), and transformations (value chains, digitalisation, labour migration), administrative changes, etc. The number of companies with direct foreign investment has been significantly reduced by about 4,300, or more than 23% in five years. On the other hand, there has been an increase of 17.4% of the total volume of investments for the same period, which reached EUR 25 billion in 2019.

However, there are **positive internal dynamics**. The sectors in which FDI is channelled are marked by low research and innovation intensity. These are real estate and construction (these two sectors account for 78% of the decline in FDI companies), hotels and restaurants, which has a 39% decline in the number of FDI companies, manufacturing and distribution of electricity, heat and gaseous fuels by 37%, agriculture and manufacture of wood, paper, and related products by 32% each. This flight is expected but it also enables local entrepreneurs to innovate through the value chain.

At the same time, there has been an **increase in FDI companies engaged in research**. And although this growth is modest (only 38), the growth in the investments in 2014-2019 is significant – over 2.5 times. Investments in FDI companies which report to the NSI that they carry out research and development increased from 5.5% in 2014 to 13.17% in 2019. Direct foreign investment of most companies engaged in R&D comes from Germany – 10%, but in terms of volume the investment is from Austria (19%). They are followed by the Netherlands, the United States, the United Kingdom and France (a total of 41% of companies). The first 10 source countries of FDI in companies engaged in R&D account for 63% of companies.

The dynamic of FDI after 2014 is associated with several key transformations not only in the economy but also in society, which have **long-term positive effects**:

- There are more jobs with higher added value and correspondingly higher incomes.
- These jobs attract not only residents of the economy, but also labour force from European Union member states (France, Italy, the Netherlands, Greece, Portugal and other countries with rarer languages).
- Other companies which see that relocating West-East is a possible and effective strategy have decided to make investments that would not otherwise have come to Bulgaria.
- The tendency for the location of these jobs to be only Sofia has been broken and there are already offers in Plovdiv, Varna and Burgas.
- Large manufacturing companies have succeeded in transforming the social environment by integrating employees from the Roma community (e.g., Yazaki and Integrated Microelectronics) and changing the behavioural patterns of entire families.

Foreign investment for the sole purpose of reducing costs is not sustainable and can easily leave the country. That is why it is necessary for the InvestBulgaria Agency (IBA), the Ministry of Economy and local authorities to negotiate and know the conditions under which already existing foreign investments can move along the value chain and engage in research.

After 14 years of full membership in the EU, **Bulgaria enters the programming period 2021-2027 with unenviable positions** in terms of innovation potential, digitalisation of business models and the spread of green technologies compared to EU averages and the achievements of the rest of the countries of Central and Eastern Europe. At the same time, a number of challenges in the business environment remain unresolved, and Bulgaria is classified as a country poor in financial and human capital.

The latest edition of the European Innovation Scoreboard (EIS) shows that Bulgaria remains in the group of **modest innovators** (now referred to as “emerging”) with an improvement of 6% compared to 2014, adopted as a baseline in EIS 2021, ranking among the ten member states with growth of the innovation index of less than 10%. In comparison, the innovation potential of European economies has improved by an average of 12.5% over the same period. Thus, **Bulgaria fails to meet its national target** of moving to the higher category of moderate innovators and achieve R&D spending level of 1.5% of GDP. Thus, the country’s lag behind the European average continues to widen.

Compared to 2014, Bulgaria has made **uneven progress**:

- Business has directed increased financial and human resources to research and development. **The growth of R&D spending by business** is nearly 4%. Employment in innovative enterprises and knowledge-intensive activities is also increasing – by 6% and 4%, respectively.
- Against this background, there has been a significant decline in innovation expenditure outside R&D (26%) and innovation costs per employee (11%). The decline in venture capital for starting a new business and expanding the activity measured as a share of GDP – 26% – was also drastic.
- **SMEs have a significantly higher innovation performance.** SME innovation has grown by almost 50%, as expressed in the launch of new and improved product offerings. The positive change in SMEs with process innovations is just under 10%. As a result, sales of new to the market and new to the company products has increased by 6%. There has been an increase of 16% in SMEs involved in the implementation of joint research and innovation projects and technology transfer with public and private research and university units, as well as with other Bulgarian and foreign companies.
- The country’s comparative advantage in trademark applications has been supported by a growth of the indicator of just over 10%. However, there has been a 13% reduction in design applications, where Bulgaria has better positions than the EU average. The increased number of patent applications of 9% failed to mitigate the significant difference from the European average in the indicator.
- **The trends in the field of human resources are extremely unfavourable,** as evidenced both by the decline of the population with a higher level of education and by the deepening processes of deskilling. Against the background of a low share of the population with digital skills, there has been no improvement compared to 2014 in the indicator for the population with above average digital skills. At the same time, the number of enterprises providing information and communication technology (ICT) training has decreased by 30% and the total number

of the population involved in lifelong learning has decreased by 20%. The number of those who acquired doctoral degrees declined also by 20%, whereas the decrease in the number of the population with higher education was 4%.

Although the summarised data on the innovation index of Bulgaria according to the EIS methodology show a slow but steady improvement, in practice the country's national innovation system does not have advantages compared to other EU member states.

The crisis year of 2020 marked a **significant increase in the patent activity of Bulgarian inventors**. The Patent Office of the Republic of Bulgaria (PORB) issued 216 Bulgarian patents, which is a new record after 2000 and a continuation of the trend of constant growth of the patent activity of Bulgarian patent holders after 2015.

While the introduction of process innovations by SMEs in Bulgaria has been almost constant over the last eight years (between 16% and 19% of the total number of SMEs), product innovations are more closely linked to patent activity. With a two-year lag between patent registration and innovation activity, the growth of patents issued in 2015 was followed by **an increase in the number of new products and services launched on the market**.

The number of scientific publications with the participation of scientists from Bulgaria continued to grow in 2020. The Bulgarian presence in the Scopus database increased with 7,021 new documents, which is a growth of 17% compared to the previous year. This ranks the country 55th in the world ranking of a total of 240 countries. Within Eastern Europe, Bulgaria ranks 11th (23 countries in total) both in terms of the number of documents referred to in the database and the H-index, which assesses both the productivity and relevance of publications.

The impact of the Covid-19 crisis on the SME sector is evidenced by a significant contraction in terms of the number of small and medium-sized enterprises and the number of persons employed in them. The decline in both indicators is -4% and -4.4%, respectively, at average European levels of -1.3% and -1.7%. An even stronger deviation of -6.2% on an annual basis was registered in terms of value added generated by SMEs (-7.6% for the EU-27).

The SME sector in Bulgaria **lags significantly behind in the field of sustainable development and digitalisation**. One of the main reasons for this is the attitude towards emerging trends as an obstacle (rather than an opportunity) to innovation, especially in terms of digitalisation and new green policies.

In 2020, **R&D spending marked a timid increase** of 2% on an annual basis (against the background of a minimal decline in GDP), which is almost entirely the result of private sector efforts. Thus, R&D spending as a share of GDP in 2020 amounted to only 0.85% – significantly below the 1.5% set in the strategic and programme framework of the country for the seven-year period. This makes the catch-up development of the country's innovation potential over the next seven years extremely difficult, all the more so against the background of the new and even more ambitious plans of the EU's innovation leaders.

Despite the good examples of SMEs with innovation activity in the pandemic and the flexible behaviour in relation to emerging market opportunities, some of which were presented in the previous edition of the report *Innovation.bg 2020*, **the SME sector as a whole is finding it more difficult to cope with the effects of the crisis**. In 2020, only large companies could afford to increase R&D spending. In all other categories – micro, small and medium-sized enterprises – there was a budget cut for research and innovation.

The analysis of the human resources in the country shows that the increasing funding envisaged in the strategic framework for the next programming period will face a **deepening shortage of human resources** and discrepancies between the available and the needed skills and competencies on the labour market. The deteriorating indicators for talent development put to the test both the practical implementation of the variety of measures and the effective use of the financial resources. Along with demographic and structural problems and the mismatch between supply and demand in the labour market, **the digital skills** of the population in Bulgaria continue **to be among the lowest in Europe**, which hinders the introduction of e-government and the introduction of Industry 4.0 technologies by enterprises.

In the last three years, **the number of R&D employees has remained almost unchanged**. In 2020, only 101 new people were added to this category of staff, despite the increased funding for research and innovation and the measures taken by the government to attract young scientists and researchers from abroad. About 1% is the positive change in the number of R&D employees in enterprises and universities, which, however, is almost entirely offset by the decline in public sector researchers.

The telecommunications, computer and information services sector is the big winner with a growth of 35% among services in the last two years of the pandemic (with a total decline in services by 27%). It increased its share in the revenues from all services from 10% in 2011 to 24% in 2021 and is estimated at **around EUR 2.2 billion in revenue per year**. Exports of telecommunications, computer and information services are growing integrally and increasing in importance, measured as a share of exports of IT services in the total exports of physical products by over 18% in the two years since the beginning of the pandemic.

Bulgaria has established itself as a **key centre of competence for customer service** in various fields such as fintech and insurtech, gaming (classic and gambling), applications of artificial intelligence, big data and semantic analysis and sentiment analysis. There has been a cluster penetration of a number of large international companies in various niches, and at the same time local companies are drastically increasing their market valuation, measured through equity investments. **Most ICT companies collaborate with universities** to attract the staff they need, including through financing capital expenditures and offering internships, and providing real-world data to develop rapid prototypes of new services. This type of collaboration between business and universities will naturally grow into joint research and publications.

One of the most interesting indicators, which gives **early signals for rapid improvement**, is the share of enterprises that use technologies with built-in artifi-

cial intelligence. Bulgaria ranks 8th in this indicator with just over 31% (compared to an average of 25% for the European Union) of non-financial companies with more than 10 employees on average per year using at least 2 technologies with artificial intelligence. Similarly, currently Bulgarian companies which are integrated into international value chains have no choice but to optimise and automate their business processes not just concurrently with their partners, but even in advance. According to these indicators, **Bulgaria exceeds the average European levels**, which is partly due to relocation of some European production to the country – automotive electronics and other related auto parts, railway carriages, lifting machines, domestic appliances. **The automation of business processes with built-in artificial intelligence** is used almost twice as much in Bulgaria (20%) as the European average (12%).

Barriers to the development of the information society and the digital economy in the country are more often associated with the need **to change the laws and their implementation** (37% for Bulgaria compared to 29% for the EU) and the lack of sufficient public trust (34% for Bulgaria and 28% for the EU). In all other external barriers, Bulgarian companies feel better prepared to cope than their European counterparts.



INTRODUCTION

The *Innovation.bg* report provides an annual assessment of the innovation potential of the Bulgarian economy in Europe and of the status and opportunities for development of the Bulgarian innovation system. It makes recommendations for improving public policy on innovation in Bulgaria and in the EU, drawing on the latest theoretical and empirical research and taking into account the specific economic, political, cultural and institutional framework within which the country's innovation system is developing.

Over the last 17 years *Innovation.bg* has made a number of concrete proposals for improving the innovation policy and practice in the country, which have been supported by the government, business, the scientific community and the European Commission. Still, there has been no breakthrough in national innovation policy so far, as it remains almost entirely dependent on EU vision, instruments and funding. The country's membership in the EU led to the development and implementation of the first comprehensive innovation strategy of the country – the Innovation Strategy for Smart Specialisation 2014-2020. Its successful continuation and achieved sustainable economic growth through innovation requires upgrading private sector efforts and overcoming the serious **institutional weaknesses in the development and implementation of public policies in this area.**

As in its previous editions, *Innovation.bg 2021* analyses the state and opportunities for development of the national innovation system on the basis of four groups of indicators:

- gross innovation product;
- entrepreneurship and innovation networks;
- investment and financing of innovation;
- human capital for innovation;
- information and communication technologies.



Foreign investment, research and innovation

Foreign investment is often viewed only through the prism of neoclassical economics and the theory of international trade. In this view, companies invest in other countries because they can produce part or all of their products cheaper there, in order to sell them at a higher profit in their own markets. This motivation is still valid now, which has led to the “export” of a large part of the production of clothing, toys, machinery, domestic appliances, electronics and all other “bodily” products from “developed” to the “developing” world. In 2019, China produced 28.7% of global manufacturing output¹, and the United States – 16.8%. Bulgaria also takes advantage of this trend to export production and especially ICT services. It ranks 17th in the world according to AT Kearney’s Global Services Location for 2021². FDI contributes to the diversification of industry, and according to this indicator the country ranks 15th in the world (GII, 2021).

Like many other countries, along with attracting foreign investment, Bulgaria also invests abroad. Exports of investments were 5-6% of the amount attracted for the last 10 years and about 2% of GDP in 2019. The motivation for these investment decisions is rather institutional-and-market (for example, rapid response to market demand – the investments of Aglika Trade in Florida, USA, or to institutional changes – the Datecs plants, and regulatory requirements – Optics and Sopharma).

“Open” economists believe that FDI “infects” local economies with technological knowledge, production processes and management practices that increase productivity and efficiency in other companies – first suppliers and customers and then others – through the normal exchange of employees who leave the FDI company and go to another or start their own. FDI leads to the import of new technologies, implementation of innovations, training of employees – own and those of suppliers and customers. Locals copy, imitate, and sometimes even develop more competitive products (this is the typical learning model of Korean

¹ [Chart: China Is the World's Manufacturing Superpower | Statista.](#)

² [The 2021 Kearney Global Services Location Index – full report – Kearney.](#)

quantitative indicators rather than qualitative ones and systemic effect. For example, fewer but sizeable and subsidiary investments were prioritised at the expense of many small entrepreneurial investments. Single investments are easier to negotiate and have a direct effect on voters (shock supply of many new jobs in a given location) than systemic changes in the functioning of the state administration and all market economy institutions (including the judiciary system) in order to make Bulgaria attractive for partial or complete relocation of foreign entrepreneurs.

Just as Bulgaria wants to attract foreign investment, in time (and this time is getting shorter) another country could attract the same investment and jobs elsewhere. Factories are becoming more mobile and can be moved easily and cheaply, especially if the labour has low added value and can be easily trained. That is why **FDI which includes R&D&I and sustainable relationships with other companies that are already in Bulgaria become increasingly valuable.** They not only provide better paid jobs, but also a kind of protection against relocation to other countries. Public policies that attract R&D&I intensive FDI are much more complex than those that attract cost-oriented FDI. They usually also include mechanisms for the return of talent from research units abroad (such as the Peter Beron programme), programmes for involving universities in international networks (such as the European Science Networks programme), and so on.

Many investors do not choose Bulgaria as a destination for relocating or expanding their business due to the lack of a large enough reserve of talent. At the same time, there are micro-trends of foreign nationals from EU countries coming to work at executive levels in foreign companies (customer service centres). **FDI which attracts foreign workers with wages well above the national average contributes further both to the economic growth and the income in the social and pension systems.**

Many Bulgarians have become entrepreneurs in other countries, while **foreigners come to Bulgaria not only to work but also to become entrepreneurs.** Among them are the children of former foreign students and diplomats in Bulgaria, refugees and top managers of foreign companies who have worked in Bulgaria and decided it was worthwhile to live here and become entrepreneurs. In some cases, they become Bulgarian citizens and so their investments lose their FDI status. This so-called immigrant entrepreneurship often has positive externalities, bringing in consumer demand from the source countries, which increases GDP.

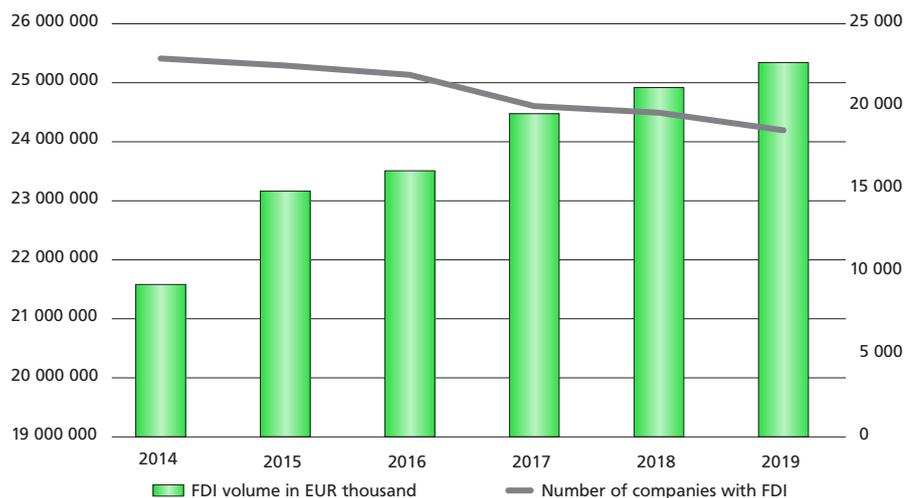
FDI comes with its socially responsible behaviour and social innovation and solves specific societal problems. For example, Yazaki Bulgaria (FDI from Japan) uses its experience in the Philippines to motivate large families of employees to work by negotiating with the head of the family. This approach solves various problems with the Roma workforce, with the additional effect of the attendance of children in kindergarten.

Dynamics of the number and volume of FDI (2014 – 2019)

FDI in non-financial corporations in Bulgaria is subject to dynamic changes related to economic factors (crises in the source countries of investment) and transformations (value chains, digitalisation, labour migration), administrative changes and others. The number of companies with foreign direct investment significantly decreased by about 4,300, which is more than 23% in five years,

while there was an increase of 17.4% of total investment over the same period, reaching a total of EUR 25 billion in 2019. However, there are interesting internal dynamics – a decrease in the number of FDI in some sectors and an increase in others, as well as significant changes in the average investment by sector.

FIGURE 1. NUMBER AND VOLUME OF FDI AT THE END OF THE YEAR



Source: National Statistical Institute (NSI).

A huge part of the overall decline in the number of FDI companies is due to the withdrawal of foreign investors from the real estate sector (decline by over 3,000 companies or 47% on a sector basis) and construction (decline by over 350 companies or 33% on a sectoral basis). These two sectors account for 78% of the decline in FDI firms. Relatively small (even micro-) investors (owning one apartment and one house) or even those who had investment plans, registered a company but gave up their intentions and withdrew from real estate operations. According to NSI data, more than half of those who withdrew were British and Russian citizens, which is confirmed by real estate agents. The average British investment in real estate in 2014 was EUR 68,000, while the Russian was almost twice as much – EUR 128,000. Five years later, the average investment from these countries is EUR 400,000 and EUR 615,000, respectively. For comparison, the average investment in 2014 in the real estate sector was EUR 470,000, and the average investment in 2019 – EUR 991,000, with a double reduction in the number of companies with foreign investment.

Some of the reasons for the exit of foreign investors are related to the failure of their plans to build luxury golf clubs and the sale of projects or properties to Bulgarian owners. One such example is the St. Sophia golf and spa complex near the town of Elin Pelin⁴, which changed its ownership from foreign to Bulgarian in 2019.

The real estate and many other sectors from which FDI is departing are characterised by low research and innovation intensity. These include hotels and restaurants, in which there is a decrease of 39% in the number of FDI companies, production and distribution of electricity and heat by 37%, agriculture and timber production, paper, and printing by 32% each. This flight is both expected and enabling local entrepreneurs to innovate through the value chain.

⁴ Deal: The golf complex near Elin Pelin has a new owner – Bloomberg (bloombergtv.bg).

TABLE 1. ECONOMIC SECTORS WITH HIGHER THAN THE NATIONAL AVERAGE DECLINE IN THE NUMBER OF FDI COMPANIES FOR THE PERIOD 2014-2019, %

Economic sectors	Change in the number of companies	Change in the volume of investment
Publishing, creation of audio-visual works, radio and television activity	-19.00	58.25
Mining industry	-20.00	-28.04
Human health	-20.00	91.24
Education	-20.48	334.38
Manufacture of textiles and clothing; leather processing; manufacture of footwear and other articles of treated leather	-23.19	7.88
Research and development	-25.64	-75.72
Manufacture of wood, paper, paperboard and articles thereof (excluding furniture); printing	-31.58	70.33
Agriculture, forestry and fisheries	-31.67	-62.08
Construction	-32.62	-39.32
Production and distribution of electricity and heat and gaseous fuels	-37.35	-9.41
Hotels and restaurants	-38.66	-7.84
Real estate operations	-46.98	11.85
Total for the country	-18.97	17.42

Source: NSI, 2021.

left due to low advertising revenues and the need to engage in unacceptable practices dictated by some intermediary companies.

A typical example of consolidation (which is reflected in the statistics as a reduction in the number of companies) after acquisitions is the restructuring of ownership following the entry of the Acibadem Group (from Turkey, but through a company in the Netherlands) by the purchase of Tokuda Hospital and City Clinic in 2016. Although the companies with FDI in the health sector had decreased by 20% for the period 2014-2019, total foreign investment almost doubled and this growth is expected to continue.

Although the **exit of foreign investors from the country** usually has a **negative media image**, in some sectors (e.g., information technology) there have been a number of exits in which Bulgarians buy shares of foreign partners and continue the successful development of companies. Such example is Interconsult-Bulgaria⁷, where the purchase of the Norwegian partner by another company led to a decision to exit and both Bulgarian co-owners bought 50% shares of the Norwegian company in 2009. The example with Bianor is similar. Managerial buyouts in other cases (such as the radio market) allow established specialists in the field to experiment beyond the limits of the standards of multinational companies and to prove themselves as entrepreneurs.

⁷ www.icb.bg

In other cases, the ownership is only ostensibly changed (in both directions – foreign to Bulgarian or Bulgarian to foreign) through companies that are controlled by the same ultimate beneficial owner. A series of such “changes” of ownership took place with newly established companies that received investments from early financing funds (Eleven and LaunchHub) or Bulgarian entrepreneurs who directly negotiate investments with foreign funds. With this restructuring of ownership, it is possible to virtually export capital (intellectual property) to a foreign country, which will serve as a more adequate guarantee for subsequent investments in the company by the same entrepreneurs abroad. These finances are transformed into operating expenses for the activity of the Bulgarian company and are no longer reported as foreign investments, but actually have the same effect that they would have if they were reported.

In addition, the transformation of the global economy from a traditional one based on resources to a modern one based on knowledge and the growth of offshoring and outsourcing (not only of individual tasks but of overall business processes) in Bulgaria leads to situations in which purely Bulgarian companies in terms of ownership and management climb the value chain without having any foreign investment (e.g., Endeavor Bulgaria, Scalefocus, Datecs, Walltopia). Decades ago, investment guaranteed significant long-term interest, knowledge transfer and stability, but today, foreign investment is not a prerequisite or condition for success.

What is needed is to have balanced investments that do not lead to a Dutch disease and to ensure that the withdrawal of investments is not linked to job losses or the need for additional public spending (e.g., on the environment). Therefore, the dynamics of the reduction in the number and volume of investments is not necessarily worrying if it is accompanied by positive news about the growth in the number and volume of investments in other sectors.

Only in a few sectors has there been a remarkable increase in the number of FDI companies in the five years analysed. In information technologies and information services there are 400 more companies, in advertising, veterinary and other professional services there are a little more than 100. New entries in these sectors are much more, because they are also compensated by exits. The positive news is rather related to the continuing increase in existing foreign direct investment and the expansion of production bases.

Eighteen sectors had an increase in the volume of investments above the national average – 17.42% (see Table 2). Four other sectors have lower growth and the other ten have a decline in investment.

The huge growth in the volume of investments in the residential care and education sectors is due to the extremely low levels in 2014 – respectively, four companies with a total of EUR 6,000 and 83 companies with EUR 4 million. The real champion in attracting FDI is the sector of information technologies and information services – 40% growth in the number and 173% growth in the volume of FDI, reaching EUR 635 million at the end of 2019.

Although there has been a significant increase in the number of residential care companies with FDI, with the exception of an increase of around EUR 100 million in investments in the Acibadem hospice (some of them probably as a result of accounting restructuring), most of the other new companies have a marginal activity and even some of them sent people to carry out this activity abroad

TABLE 2. ECONOMIC SECTORS WITH HIGHER THAN THE NATIONAL AVERAGE GROWTH OF FDI FOR THE PERIOD 2014-2019, %

Economic sectors	Change in the number of companies	Change in the volume of investment
Residential care activities and social work activities without accommodation	200.00	2,191.67
Education	-20.48	334.38
Activities in the field of information technologies and information services	40.10	173.01
Administrative and support service activities	-0.63	97.13
Human health	-20.00	91.24
Manufacture of computer and communication equipment, electronic and optical products	8.51	78.73
Manufacture of electrical equipment	3.85	75.59
Manufacture of machinery and equipment for general and special purpose	10.96	74.29
Manufacture of wood, paper, paperboard and articles thereof (excluding furniture); printing	-31.58	70.33
Manufacture of vehicles	26.19	65.03
Furniture manufacturing; production not elsewhere classified; repair and installation of machinery and equipment	-5.03	63.71
Advertising and veterinary activities; other professional activities	9.96	58.56
Publishing, creation of audio-visual works, radio and television activity	-19.00	58.25
Transport, warehousing and post offices	-8.66	41.16
Manufacture of basic metals and fabricated metal products, except machinery and equipment	-17.32	28.86
Manufacture of rubber, plastic and other non-metallic mineral products	-14.84	24.75
Trade; repair of motor vehicles and motorcycles	-9.95	22.57
Production of chemical products	3.08	18.08
Total for the country	-18.97	17.42

Source: NSI, 2021.

(Germany) rather than to provide services in the country. However, it is expected that there will be growth in this sector, especially from the countries of North Africa and the Middle East.

In the education sector, there was a jump in investment in 2015 of almost EUR 13 million and in the next four years these investments increased by another EUR 1 million. It is due to increases in equity (including retained earnings) and distributed profits of existing FDI companies. Many foreign education companies and institutions operate in the country, such as the private vocational college HRC Culinary Academy Bulgaria (60% from the Netherlands), Pharos schools (100% Greece), Kappa – private vocational college (100% Greece), private vocational

college Delta (100% Greece), educational platform I Learn AD (15.8% investment in the capital of LunchHub Fund Cooperative UA – Netherlands), American University, American College and Anglo-American School (100% USA), Lebanese school and many others.

During the period 2014-2019, continuing or new foreign investments were directed mostly in the sectors information technology and information services, manufacture of computer and communication equipment, manufacture of machinery and equipment for general and special purpose and manufacture of vehicles.

During the period, there were FDI that did not receive certificates from the InvestBulgaria Agency (IBA) or at least received them later (for further expansion), as was the case of the Bosch Engineering Centre in Sofia Tech Park (opened in 2019 and received a certificate for A-class investor a year later), Schwartz IT (which received a certificate in 2021, but the company has been operating since 2018 and aggressively hires people since 2020) or Corsera, which opened a development centre in Sofia in 2019.

Only ten of the largest IT companies (in terms of staff at the end of 2019) which received a certificate of investor from the IBA have hired nearly 10,000 more people than in January 2014, increasing employment more than 3 times. The increase in employment through jobs with high average wages also leads to a significant increase in the average wage in the sector.

For five years, the 10 sectors with the highest FDI had had almost no shifts except the entry of the sector “advertising and veterinary activities and other professional activities” in 9th place (from 13th in 2014) and manufacture of chemical products in 10th place (from 12th in 2014). The biggest jump was by information technologies and services, which climbed by 10 places (from 21st in 2014 to 11th place in 2019).

Box 1. LIST OF SOME OF THE CERTIFIED INVESTMENTS IN THE PERIOD 2014-2019

IBM Bulgaria

IBM Global Delivery Centre Bulgaria

VMware

PPD Bulgaria

AIG Europe (although the parent company AIG is a financial company and does not fall within the scope of analysis, their investment is not in finance but in information services)

Luxoft (part of the DXC group, but with a separate investment)

Callpoint New Europe (through which Telus International is present)

Integrated Microelectronics Bulgaria

Uber Bulgaria (IT development centre, not Uber services)

Atos IT Solutions and Services (through the Unify Service Centre, owned by Athos)

Bulpros Consulting

Coca-Cola Hellenic Business Services Organisation

Coca-Cola European Partners Services Bulgaria

Coca-Cola Hellenic IT Services

Questers Bulgaria

Cargill

Experian

ALS Bulgaria (which, as already mentioned, has left)

Sa-Ba

Melexis Bulgaria

MD Elektronik

Yazaki Bulgaria

Witte Automotive

VOSS Automotive

Palfinger Produktionstechnik (components for transport cranes)

Woodward (aircraft parts)

Source: APIS and IBA.

TABLE 3. TOP 10 IT COMPANIES BY EMPLOYMENT AT THE END OF 2019 WITH CERTIFIED INVESTMENT PROJECTS (2014-2019)

Company	2014	2019 ⁸	Growth%
Callpoint New Europe	843	3,366	299
Integrated Microelectronics	1,238	2,276	84
IBM Bulgaria	476	1,863	291
Cargill	97	1,262	1,201
PPD Bulgaria	384	1,154	201
VMware Bulgaria	423	1,090	158
Experian	301	961	219
Atos IT Solutions and Services	96	701	630
Coca-Cola Hellenic Business Services Organisation	332	665	100
Bulpros Consulting	211	506	140

Source: APIS and IBA.

Compared by the relative share of investments in sectors of the total volume for the respective year, the information technologies and services sector was in the first place with an increase of 1.43 percentage points. In second place is the trade sector (which includes repair work on cars and motorcycles) with 0.81 percentage points. This sector sustainably attracted about 19% of all FDI during the study period. The largest decline was in the construction sector, which dropped from 6th place in 2014 to 13th in 2019. However, there was a relative decline in the production and distribution of electricity and heat by 2.87 percentage points and in second place telecommunications with 2.59 percentage points, while construction was only third with -2.05 percentage points.

The dynamics of FDI between 2014 and 2019, and even later, is associated with several key transformations not only in the economy but also in society, which have long-term positive effects:

- More and more jobs with higher added value and correspondingly higher incomes are appearing.
- These jobs attract not only residents of the economy, but also labour force from EU member states (France, Italy, the Netherlands, Greece, Portugal and other countries with rarer languages).
- Companies which see that a West-East relocation is possible and effective have decided to make investments that would not otherwise come to Bulgaria.
- The tendency for Sofia to be the only location of these jobs has been reversed and there is a critical mass of offers in Plovdiv, Varna and Burgas already.
- Large manufacturing companies have succeeded in transforming the social environment by integrating employees from Roma communities (e.g., Yazaki and Integrated Microelectronics) and changing the behavioural patterns of entire families.

⁸ Number of persons paying social welfare contributions in January 2014 and December 2019.

TABLE 4. SHARES OF ATTRACTED FDI BY SECTORS, %

Sector	2014	2019
Trade; repair work on cars and motorcycles	18.56	19.37
Real estate operations	14.11	13.44
Production and distribution of electricity and heat and gaseous fuels	12.55	9.68
Manufacture of rubber, plastic and other non-metallic mineral raw materials	4.86	5.17
Manufacture of basic metals and fabricated metal products, except machinery and equipment	4.25	4.66
Telecommunications	6.72	4.13
Manufacture of food products, beverages and tobacco	4.11	3.84
Legal, accounting, architectural and engineering activities, technical testing and analysis; management consulting activities	3.89	3.46
Advertising and veterinary activities; other professional activities	2.23	3.01
Manufacture of chemical products	2.67	2.68
Activities in the field of information technologies and information services	1.08	2.51
Hotels and restaurants	2.82	2.21
Construction	4.25	2.20
Manufacture of machinery and equipment for general and special purposes	1.47	2.18
Transport, warehousing and post offices	1.73	2.07
Mining industry	3.36	2.06
Administrative and support service activities	1.17	1.97
Manufacture of electrical equipment	1.32	1.97
Manufacture of vehicles	1.18	1.66
Manufacture of wood, paper, paperboard and articles thereof (excluding furniture); printing activity	1.14	1.65
Manufacture of textiles and clothing; leather processing; manufacture of footwear and other articles of treated leather	1.18	1.08
Manufacture of computer and communication equipment, electronic and optical products	0.66	1.00
Water supply; sewerage, waste management and remediation activities	0.84	0.68
Furniture manufacturing; production not classified elsewhere; repair and installation of machinery and equipment	0.43	0.60
Publishing, creation of audio-visual works, radio and television activity	0.31	0.42
Agriculture, forestry and fisheries	0.79	0.26
Culture, sports and entertainment	0.39	0.21
Research and development	0.41	0.08
Other activities not classified elsewhere	0.10	0.08
Education	0.02	0.07
Human health	0.03	0.06
Residential care activities and social work activities without accommodation	0.00	0.00

Source: NSI, 2021.

FDI by NUTS2 planning region shows the widening differences between regions. The North West Planning Region lost more than 6% of FDI for the period 2014-2019. At the other end is the South East Planning Region, which increased FDI by more than 60%. In Bulgaria, southern regions are more developed compared to northern ones, unlike what is typical in other countries. This is due both to the fact that the two largest cities and agglomerations around them (Sofia and Plovdiv) are in the southern part of Bulgaria, and the serious infrastructure investments (the three highways) are also there. The North West Planning Region is practically detached – travelling from Sofia to Vidin takes as much time as from Sofia to Burgas, although it is half the distance.

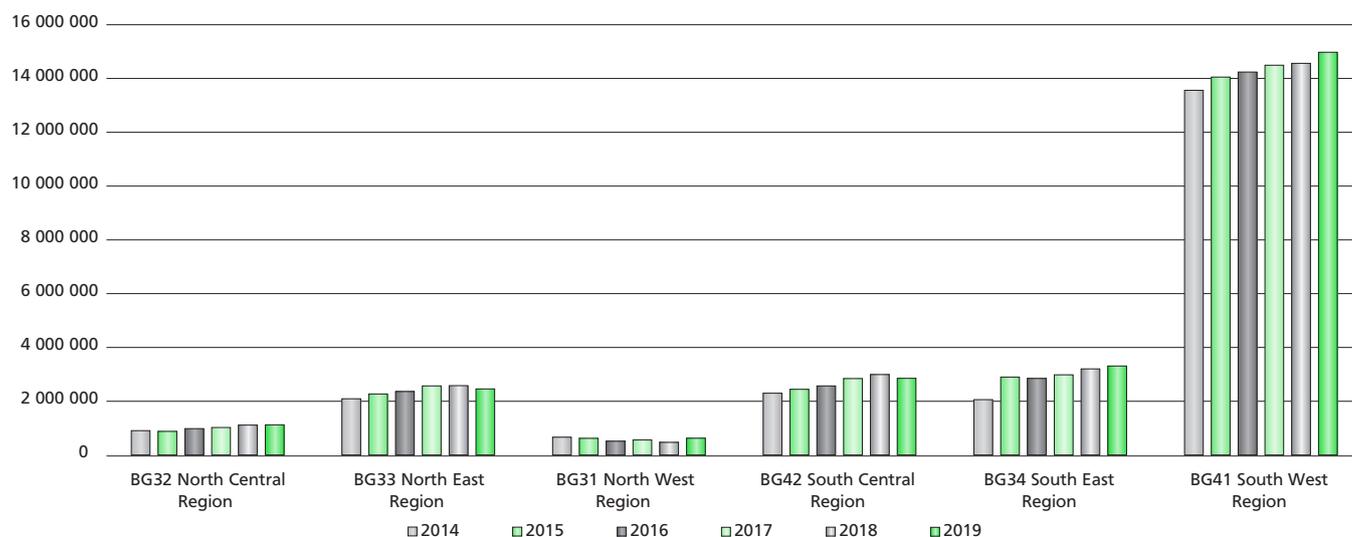
The regional differences, measured through the indicator of maximum value of FDI, divided by the minimum value of FDI at planning region level, increased gradually from 32 in 2014 to 53 in 2018, then decrease slightly to 41 in 2019. A slight reduction is observed in the difference between the regions in the number of FDI companies, which is mainly due to the closure of many companies in the real estate sector in the South West Planning Region.

Sources of direct foreign investments in Bulgaria

Foreign direct investment comes to Bulgaria from different destinations and in different ways – privatisation deals (cash or debt/equity swaps), purchase of existing private companies, greenfield investments and entrepreneurship by foreign nationals “in the field.” At the next stage, the decision to invest in the country is the result of expanding its activities with more investments or loans taken from parent companies or on the basis of profit.

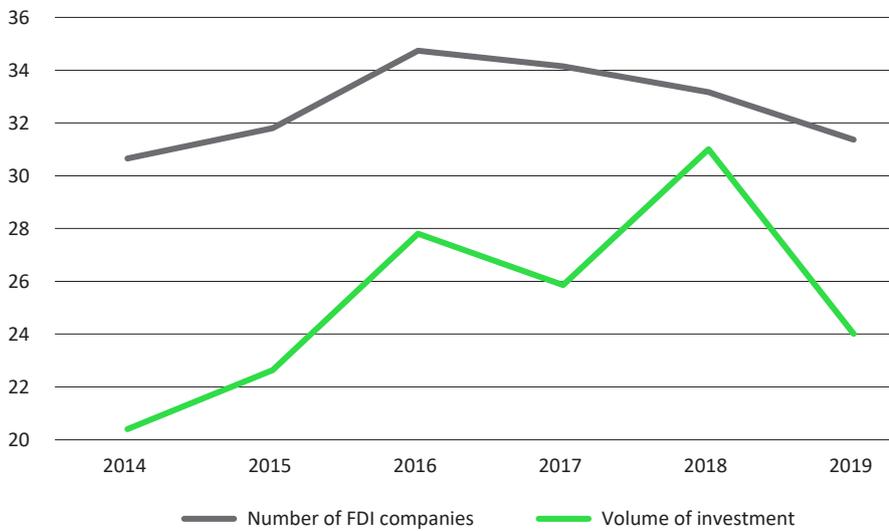
The capital source countries exert influence not only by transferring technology and management know-how, which increases productivity and competitiveness, but also by transferring negative practices, including corrupt ones. Therefore, if a country has investment from more corrupt countries, their investors also carry negative practices. This applies not just to corruption in public institutions, but also in private relations. That is why, in principle, **the government policy on attracting foreign investments should prioritise investments**

FIGURE 2. DYNAMICS OF FDI AT PLANNING REGION LEVEL, EUR THOUSAND



Source: NSI, 2021.

FIGURE 3. REGIONAL DIFFERENCES AT PLANNING REGION LEVEL (MAX/MIN)



Source: NSI, 2021.

from countries with lower levels of corruption. Of course, this applies to the ultimate beneficial owners, not the immediate direct owner. The reason is that countries such as the Netherlands (82 points and rank 8 for 2020) and Luxembourg (80 points and rank 9 for 2020), for example, have good indicators on the corruption index for Transparency International 2021, but are often a tool for other end owners (from countries with a lower rank than Bulgaria in terms of corruption) to invest in Bulgaria. In the ranking after Bulgaria are countries such as China, Turkey and Russia, as well as other smaller investors. Of course, the behaviour of investors and how much of the positive and negative practices of their national economy they transfer to Bulgaria depends on the incentives and constraints that national institutions place on them.

A more detailed analysis of investment mechanics is needed because often corporate investments come from different countries (e.g., Austria and the Netherlands for Neftochim-Lukoil) or go together with “personal” investments by people from the families of the ultimate owners or from managers of FDI companies (e.g., Italy and Luxembourg for the Miroglio family investments). However, the analysis of direct sources of FDI is also useful for policy design purposes.

There has been almost no change in the list of countries from which investments in Bulgaria come. The first five countries in 2014 remained the same and in exactly the same order as in 2019, and even slightly increased their cumulative share – from 50.47% to 53.11%. In the first 10 there was only one change – France replaced the United Kingdom (with approximately the same relative share). The remaining nine were responsible for 2/3 of the investment; in 2019 their share was by 0.78 percentage points bigger than in 2014.

The concentration of FDI sources is increasing, as measured by various indicators, such as the sum of the first largest N [N = 1 to 10] shares of investor countries or the Herfindahl-Hirschman index. This indicator shows that the growth of concentration by the volume of investments is many times higher (27%) compared to the growth by the number of companies (4.7%).

TABLE 6. COUNTRIES WITH THE LARGEST INVESTMENT SHARES BY SECTORS (2019)¹⁰

Sector	Country with the largest investment share	Share, %
Agriculture, forestry and fisheries	Italy	44
Mining industry	Netherlands	61
Manufacturing industry	Netherlands	44
Production and distribution of electricity and heat and gaseous fuels	Netherlands	28
Construction	Spain	20
Trade; repair of cars and motorcycles	Netherlands	22
Transport, warehouses and post offices	Germany	26
Hotels and restaurants	Russia	21
Creation and dissemination of information and creative products; telecommunications	Netherlands	17
Real estate operations	Netherlands	12
Professional activities and research	Luxembourg	9
Administrative and support activities	Germany	16
Education	USA	77
Culture, sports and entertainment	Germany	24

Source: NSI, 2021.

Germany ranks second after the Netherlands in the number of sectors in which it has a leading role: transport, warehouses and post, administrative and support activities and culture, sports and entertainment.

Italy is the leader in agriculture, forestry and fisheries, Spain is the leader in construction, the United States in education, Luxembourg in professional activities and research and Russia is the leader in hotels and restaurants.

An interesting type of FDI are start-ups and foreign (expat) entrepreneurship. In 2019, as many as 17% of the owners of new companies in Bulgaria (registered in 2019) were foreigners. Bulgaria is already an attractive country for people from Western Europe, not only from the Middle East, China or Russia. More than half of the new companies are owned by countries in the European Union¹¹ – in first and second place are the Greeks (15%) and the Italians (13%). They are followed by entrepreneurs from third countries – Turks (9%), Russians (8%) and Ukrainians and Macedonians with 6% each.

One of the last acts adopted by the 44th National Assembly in March 2021 regulates the issuing of the so-called start-up visa, a tool that enables enterprising young people from third countries to apply under simplified rules for obtaining a business visa for entrepreneurship. **This opportunity, however, needs to be aggressively promoted by Bulgarian trade attachés abroad.**



¹⁰ The table is based on data on investments in certain sectors by country. Where data missing because of confidentiality are too large no assumptions have been made about the share of the relevant sectors, but they have rather been left out.

¹¹ Applied Research and Communications Fund, *Innovation.bg 2020: Economic Resilience through Innovation*, Sofia, Bulgaria.

Box 2. ENTREPRENEURIAL PRACTICES IN BULGARIA BASED ON FOREIGN INVESTMENT

An interesting example of a company founded by migrants from Western Europe is Proffit Technologies (proffit.com), winner of the Innovative Enterprise of the Year Award 2017 at the National Innovation Forum organised by the Applied Research and Communications Fund and Enterprise Europe Network; the company later won a global award from Toyota. A similar example is the American national Igor Levin, who won the same award in 2016 with his company Electrosphere and product Antelope studio (antelopeaudio.com), a world leader in its niche.

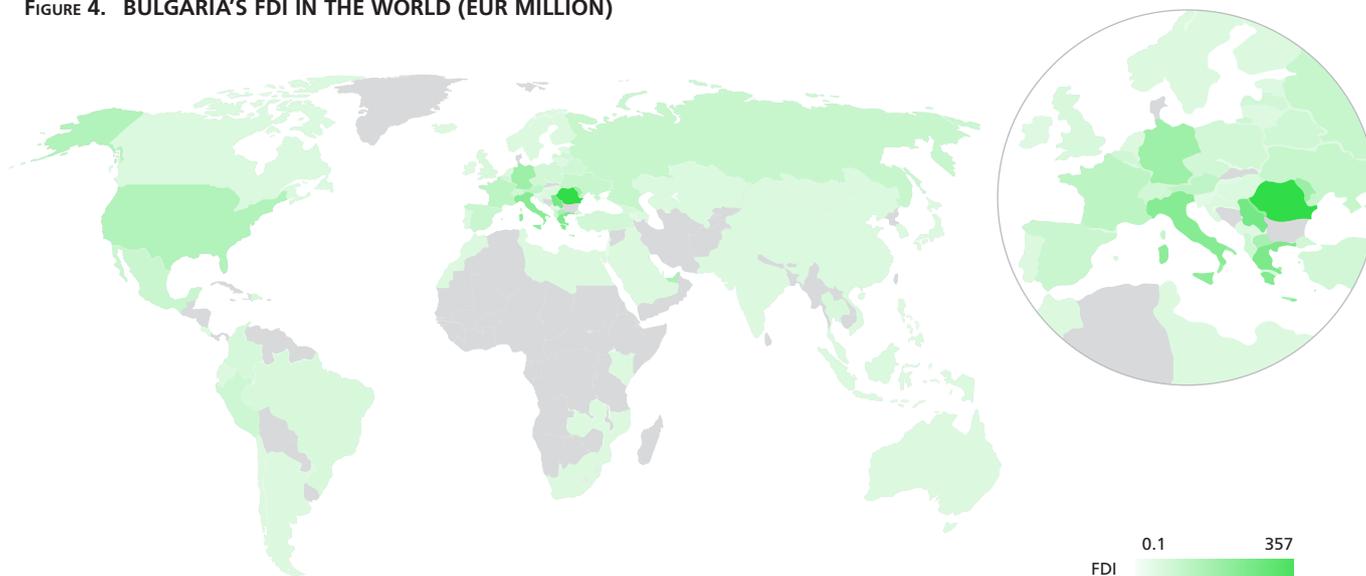
In addition to commercial entrepreneurs, Bulgaria also attracts social entrepreneurs who start their activities with the help of foundations and associations. One such example is Zoe Holiday from the UK, who founded the Humans in the Loop Foundation in Bulgaria with a mission to change the lives of people in conflict zones or refugees by providing training, career counselling and work in the field of digitalisation and data science. Humans in the Loop ranked in the top 100 entrepreneurial companies in the World Cup of Entrepreneurship of the Global Entrepreneurship Network in October 2021.

Some of the foreign entrepreneurs are serial entrepreneurs such as Xavier Marcenac, who co-founded Callpoint in 2004 in Bulgaria, which was later acquired by Telus International. In 2017, he founded Nasekomo AD – an innovative start-up for insect food¹². Nasekomo is holder of the Excellence in Innovation label of the Applied Research and Communications Fund awarded at the competition in 2020.

Source: Applied Research and Communications Fund, 2021.

Bulgaria is still far from the situation in Germany, where almost half of the companies are created by expats and provide over 1 million jobs¹³. **Undoubtedly, the Bulgarian health and social systems cannot sustain a worsening ratio of those working and paying social insurance to those unemployed and non-paying and hence the country needs a constant influx of talent to create and take up vacant jobs.** In order for this to happen, government policy should attract workers or students, and serious effort is needed to overcome negative stereotypes towards migrants.

FIGURE 4. BULGARIA'S FDI IN THE WORLD (EUR MILLION)

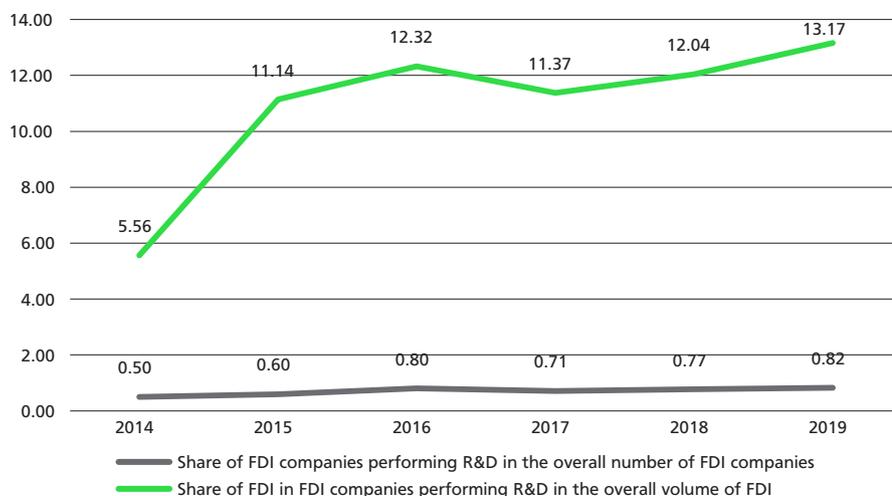


Source: Bulgarian National Bank, 2021.

¹² Insects are currently used to produce protein for animals, but already (since 2021) there is the first EC permit to use an insect (yellow mealworm) as food for humans.

¹³ "Germany: more and more migrants open private companies", *News and analyzes from Europe | DW* | 01.12.2016.

FIGURE 5. SHARE OF FDI COMPANIES PERFORMING R&D (2014-2019)



Source: NSI.

Bulgarian investments are mainly directed to neighbouring countries – Romania (13% of all outgoing FDI), Serbia (8%) and Greece (7%). The first 10 destinations have a total of 65% of all Bulgarian FDI abroad. Among them are Italy, Moldova, Germany, North Macedonia, Luxembourg and the UAE. The Marshall Islands are in second place after Romania with almost 10%.

One of the successful investments of Bulgarian companies in Romania is Remix. It is a typical representative of the circular economy with second-hand clothes and has established itself as the most successful online second-hand clothing store in Europe with a strong presence in Greece, Germany and Austria. Other investors in Romania are Monbat, Kaolin and Eurohold Bulgaria. Nedelya also entered Romania through a franchise. Serbia also attracts investors such as Sopharma, Technomarket, Kaolin, etc. Real estate (including hotels and restaurants) is a major attraction for Bulgarian investors in Greece.

Research and innovation of FDI companies

Although the growth in the number of FDI companies that carry out research is modest – only 38 – the growth of investments in 2014-2019 is significant – over 2.5 times. NSI data on R&D&I activity seem to be greatly underestimated because it is unrealistic for less than 1% of FDI companies to perform R&D. *Innovation.bg 2020* demonstrated that 2.7% of micro-firms have their own R&D units, together with 3.5% of small, 10.5% of medium and 28.4% of large companies. Earlier research by ARC Fund showed that even multinational companies which claim on their websites that their Sofia offices perform R&D&I, do not report such activity to the NSI.

There are at least 6 to 8 times more companies that perform R&D&I than reported by the national statistics. Among the factors for this discrepancy are the non-binding nature of the reports, the lack of relevant modules in the accounting software, the lack of tax relief at higher levels of reported R&D. Empirical research shows that companies with independent science and

TABLE 7. DYNAMICS OF THE AVERAGE EXPENDITURE OF AN AVERAGE FOREIGN R&D COMPANY (EUR THOUSAND)

	2014	2015	2016	2017	2018	2019
Total for the country	10,438	19,252	16,462	19,597	12,557	21,805
North Central Planning Region	3,675	10,531	–	18,716	10,140	19,616
North East Planning Region	–	–	26,249	–	20,333	–
North West Planning Region	–	15,899	–	–	5,638	2,734
South Central Planning Region	27,146	29,364	28,785	16,316	14,784	11,376
South East Planning Region	–	–	132,046	–	32,778	–
South West Planning Region	2,970	8,039	6,501	8,514	9,296	11,835

Note: – confidential.

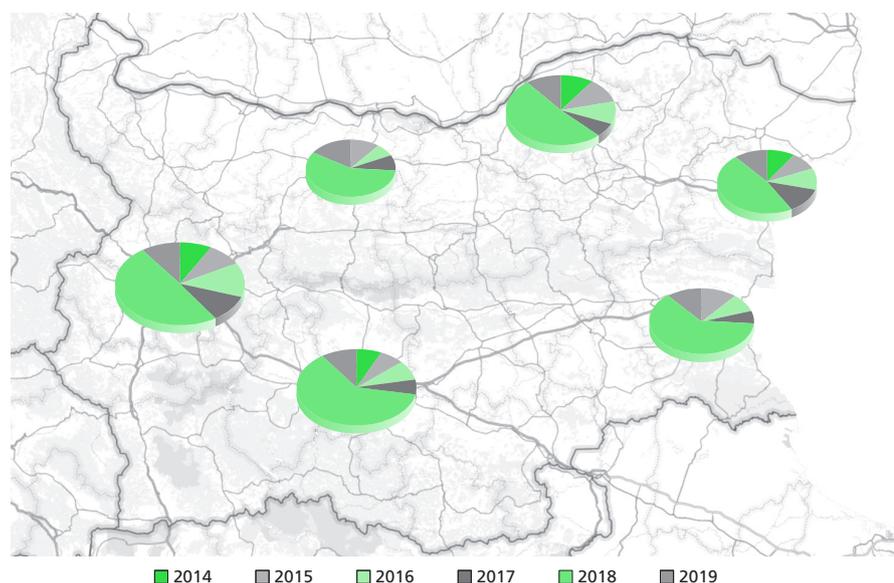
Source: NSI, 2021.

development departments have about three times higher innovation index than others¹⁴.

Investments in FDI companies that report to the NSI that they carry out research and development activities increased from 5.5% in 2014 to 13.17% in 2019. These data seem more realistic than the number of companies that report R&D, but are likely to still be underestimated.

Data on the number of companies and the average investment per company at planning region level show strong volatility in R&D expenditures, which is rather due to a reporting problem. For example, the total number of FDI

FIGURE 6. DYNAMICS OF THE NUMBER OF FOREIGN COMPANIES REPORTING R&D SPENDING, BY PLANNING REGION



Source: NSI, 2021.

¹⁴ Yalamov, T. (2021) "Innovation in companies at a time of crisis: What is the role of R&D units and employment of academic researchers in business?" *Ifac Papers Online* 54(13), pp. 402-407.

TABLE 8. DYNAMICS OF THE NUMBER OF FOREIGN COMPANIES REPORTING R&D EXPENDITURES

	2014	2015	2016	2017	2018	2019
Total for the country	115	134	176	142	783	153
North Central Planning Region	12	14	13	8	64	13
North East Planning Region	10	10	12	14	52	12
North West Planning Region	–	6	4	5	33	9
South Central Planning Region	14	14	17	13	129	20
South East Planning Region	–	10	8	6	57	10
South West Planning Region	72	80	122	96	448	89

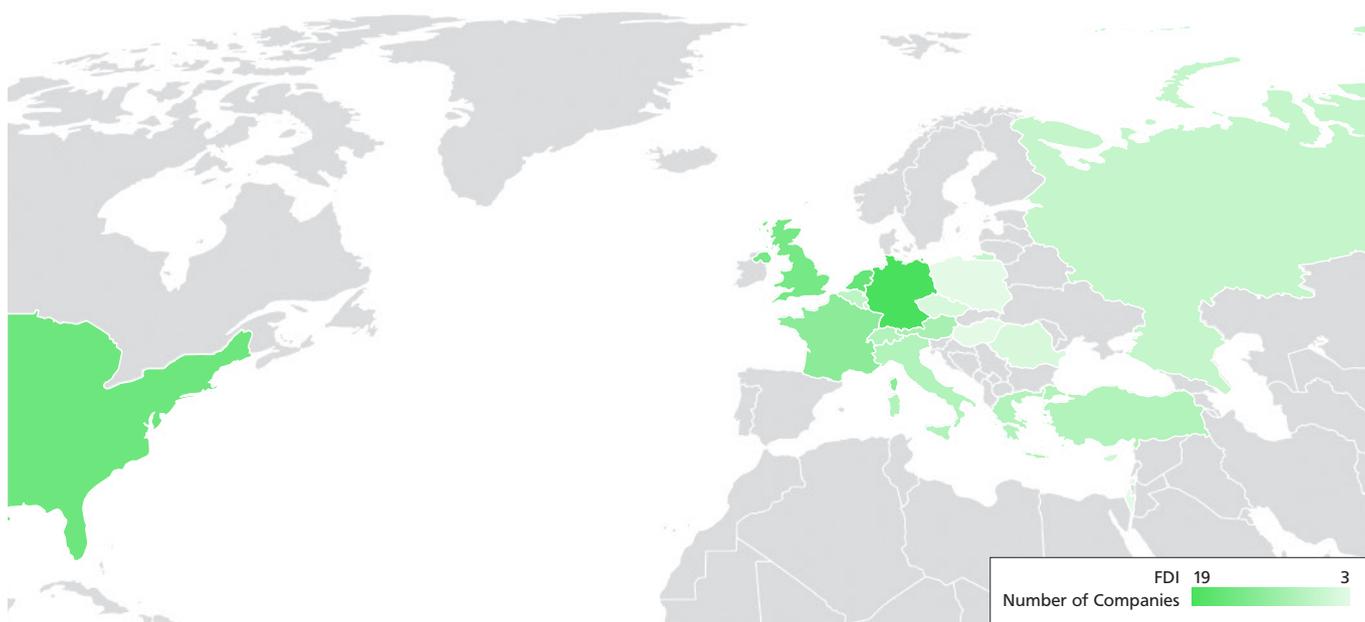
Note: – confidential.

Source: NSI, 2021.

companies reporting R&D in 2018 was 783 (Table 8). In the North Central Planning Region, the difference between 2017 and 2018 is 8 times. Most likely, this was due to some kind of administrative incentive to report more R&D than to real economic processes. In previous years, such incentives would include allowing R&D reporting to the NSI to count as evidence of innovation or the NSI being particularly active in relation to a programme with funding for innovation.

The FDI of most companies engaged in R&D come from Germany – 10%, but in terms of volume investments they are from Austria (19%). They are followed by the Netherlands, the United States, the United Kingdom and France (a total of 41% of companies). The first 10 source countries of FDI in companies engaged in R&D account for 63% of companies.

FIGURE 7. SOURCES OF FOREIGN INVESTMENT IN COMPANIES PERFORMING R&D



Source: NSI, 2021.

Large multinational companies have different strategies for their R&D&I units. For example, SAP Labs helps its Bulgarian employees co-author patents in the USA, while VMware practically does not recognise the authorship of developments leading to patents.

Foreign investment for the sole purpose of reducing costs is not sustainable and can easily leave the country. **That is why it is necessary for IBA, the Ministry of Economy and local authorities to negotiate and know the conditions under which existing foreign investments can move up the value chain and engage in research.**

TABLE 9. MAIN FINANCIAL INSTRUMENTS AND INITIATIVES FOR RECOVERY AND SMART TRANSFORMATION OF THE BULGARIAN ECONOMY

Initiatives and instruments	Budget forecast	Strategic framework	Source
Recovery and resilience facility, part of NextGenerationEU (2021-2024)	EUR 6.217 billion in grants and EUR 4.549 billion in loans	2021-2026	National Recovery and Resilience Plan
Cohesion and Common Agricultural Policy	EUR 9 billion total for all programmes	2021-2027	Programme "Research, Innovation and Digitalisation for Smart Transformation" Programme "Competitiveness and Innovation in Enterprises" Other programmes
REACT-EU	EUR 656 million (MFF 2021-2027, (NGEU 2021-2024)	2021-2022	Decision No. 573 of 2020 approving the indicative financial allocation under operational programmes 2014-2020 of the EU funds in support of overcoming the effects of the crisis caused by the Covid-19 pandemic
Just Transition Fund, first pillar of the Just Transition Mechanism	EUR 1.178 billion (MFF 2021-2027, NGEU 2021-2024)	2021-2027	Territorial just transition plans (deadline for preparation September 2021)
Three Seas Initiative	> EUR 1 billion total budget for all countries (as of July 2021)		Three Seas Initiative Investment Fund
Bulgaria's accession to the Eurozone	—	Since 2024	National plan for introduction of the euro in the Republic of Bulgaria
Membership of Bulgaria in the Organisation for Economic Cooperation and Development (OECD)¹⁹	—	2021-2023	Roadmap for deepening cooperation with OECD

Source: Center for the Study of Democracy and Applied Research and Communications Fund, *Promoting Constructive Capital in Bulgaria*, Sofia: CSD, 2021.

lack of media freedom, lack of transparency and predictability in policy development and legislative initiatives. As Bulgaria fails to deal with these problems they continue to be a discouraging factor in the eyes of investors (outflow of foreign investment, investment in low-tech activities) and for individuals when deciding on what qualifications and careers to pursue (brain drain in various forms and channels).

The start of the new EU programming period provides an opportunity to improve the management of policies and programmes in support of innovation,

¹⁹ The government has approved a new three-year roadmap (2021-2023) to deepen co-operation with the OECD. The Roadmap aims to fulfil the commitments already made related to the process of deepening the cooperation with the OECD on the basis of an amendment to Decision No. 789 of the Council of Ministers of December 2017. The Decision supports the Interdepartmental Coordination Mechanism for Bulgaria's Accession to the OECD and a proposal for financing the pre-accession period 2018-2020 is adopted.

An important step towards improving the European and international positions of Bulgaria in science and innovation is the status of “participant” which the country was assigned in the Committee on Scientific and Technological Policy of the OECD and its working bodies in July 2021. This is a stage in the implementation of the roadmap for the accession of the Republic of Bulgaria to the OECD in the period 2021-2023. However, the country still lacks a natural leader for the completion of this process and achieving OECD membership.

On the science-business relationship again

The lack of effective linkages between science and business – which include the creation of spin-off companies, mobility of scientists and researchers between scientific units and business, provision of consultations and expertise to business, cooperation in human resources development, implementation of joint national and international applications research projects, etc. – is one of the most clearly identified challenges of the national innovation system and a barrier to the development of the innovation potential of the national economy. Known examples of interaction are informal and remain hidden and not institutionalised, which hinders the use of their full capacity.

The establishment of SARI and the new Programme “Research, Innovation and Digitalisation for Smart Transformation” are seen as a response to this challenge. Through the programme, the Agency takes on European funding for science, innovation and digital governance projects amounting to nearly EUR 890 million. The establishment of SARI marks the beginning of a new policy that connects science and innovation in a common strategy, priorities and goals with a clear focus on the development of society and the economy. The transfer of functions and responsibilities from the Ministry of Economy and the Ministry of Education and Science to the new structure creates preconditions for increasing the effectiveness of policies. This will support the implementation of the priorities set out in the national and European strategic documents, as well as the management and monitoring of support measures for business and public institutions. The Agency is expected to play a key role in the interaction between research and innovation and the development of the national research and innovation ecosystem.

In addition, the promotion of technology transfer requires further integration of existing and new bodies, such as:

- The centres of competence and the centres of excellence, established with funds of the Operational Programme Science and Education for Smart Growth managed by SARI;
- industrial zones;
- the consortiums built under the national research programmes at the MES;
- European digital innovation hubs, whose launch is forthcoming;
- regional innovation centres, which are again set as a priority during the current programming period;
- the technology transfer offices at the higher schools, whose activity will also be restarted with the implementation of the Programme “Research, Innovation and Digitalisation for Smart Transformation”.

Digital and green transformation

One of the main sources of financial support for enterprises, aimed at reducing the impact on the environment, increasing energy efficiency and tackling the effects of climate change, is the Programme “Competitiveness and Innovation in Enterprises”. Its special focus is on start-ups and fast-growing enterprises, access to finance, access to markets, digitalisation and innovation, tailored to sectoral and regional specifics. The aim is to meet the challenges highlighted in the European Commission (EC) 2020 Report for Bulgaria within the European Semester. The main ones are related to insufficient investment in environmentally friendly technologies and sustainable solutions, including in the fields of transport, energy and environmental infrastructure, digitalisation and R&D. Another issue to be addressed is the lack of a comprehensive agenda for a circular economy, although the circular use of raw materials in Bulgaria is among the least developed in the EU and there are a number of challenges in the field of waste management.



Innovation potential of the Bulgarian economy



Gross innovation product

The gross innovation product, or the innovativeness of an economy, is assessed by the new products and services introduced, the new technologies created and the scientific outputs. It involves and results from the interaction of the innovation, technological and scientific products of a country. It is a major benchmark for innovation policy because it allows decision-makers to compare the outcome of the innovation system in temporal and geographical terms, as well as to estimate the need for changes in the organisation and resources of the innovation process.

Innovation product

The innovation product results from innovation activity in the form of new and significantly improved processes, products and services based on new and/or adapted existing knowledge and know-how. It is determined by the innovation activity of enterprises in the country and is the most important indicator for assessing the national innovation system. Innovation activity in business and innovation

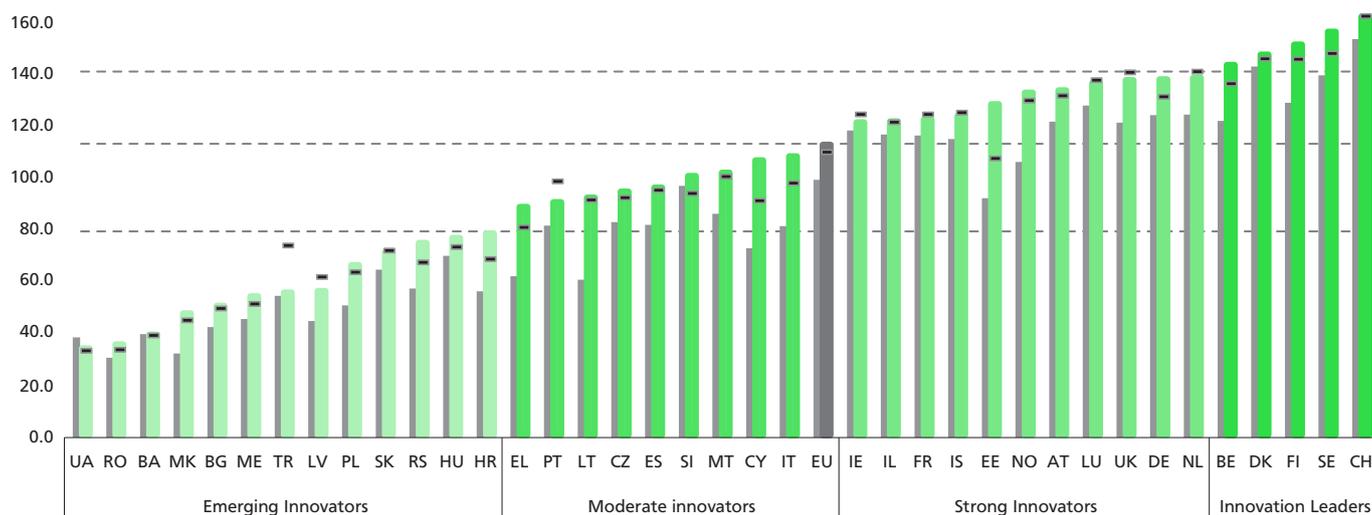
demand by the public, along with the factors which determine these, comprise the innovation potential of the economy – its capacity to develop driven by new knowledge.

Bulgaria's place on the European and international innovation map

The latest edition of the European Innovation Scoreboard (EIS) shows

that **Bulgaria remains in the group of modest innovators** (now identified as emerging) with an improvement of 6% compared to the baseline year 2014, thus ranking among the ten member states with growth of the innovation index below 10%. In comparison, for the same period, the innovation potential of European economies has improved by an average of 12.5%. Thus, **Bulgaria**

FIGURE 8. EUROPEAN INNOVATION SCOREBOARD*



* The coloured bars show the level of the member states in 2021 based on the latest data on the 27 indicators of the European Innovation Scoreboard compared to the EU average in 2014. The positions in black correspond to the same indicator, but for the previous year. The grey bars show the state of the member states in 2014 compared to the average for the EU in 2014. The dashed lines show the thresholds values of 70%, 100% and 125% between the groups of countries in 2021 and divide them into the following categories: innovation leaders – over 125% of the EU average; strong innovators – between 100% and 125% of the EU average; moderate innovators – between 75% and 100% of the EU average; emerging innovators – below 75% of the EU average.

Source: European Innovation Scoreboard, 2021.²¹

²¹ The thresholds in the EIS 2021 methodology have been adjusted upwards to reflect the increase in EU efficiency between 2014 and 2021, which explains the higher number of countries in the group of emerging innovators than in previous years.

fails to meet its national target of moving to the higher category of moderate innovators and achieving R&D expenditure level of 1.5% of GDP. In fact, the country's lag behind European average levels continues to widen.

According to the Innovation Strategy for Smart Specialisation 2014-2020, Bulgaria's progress in the field of research, technology and innovation is measured by the country's comparative positions within the European Innovation Scoreboard and the potential transition to the group of moderate innovators. **After the end of the seven-year programming period and the lack of progress compared to other EU member states, the same goal is set in the draft Innovation Strategy for Smart Specialisation for the period 2021-2027.**

Compared to 2014, adopted as a baseline in the EIS 2021, Bulgaria has made uneven progress:

- **Increased concentration of resources, including financial and human, in the implementation of research and development by business.** The growth of R&D expenditures in the business sector is almost 4%. Employment in innovative enterprises and knowledge-intensive activities is also increasing – by 6% and 4%, respectively.

Against this background, there is a significant decline in innovation spending outside R&D (26%) and innovation spending per employee (11%). The decline in venture capital for starting a new business and expanding the activity, measured as a share of GDP, is also drastic – 26%.

- **SMEs have a significantly higher innovation activity.** The innovation activity of SMEs is growing by almost 50%, expressed in the launch of new and improved product offerings. The positive change for SMEs with process innovations

is just under 10%. As a result, sales of new to the market and new to the company products increased by 6%. There is an increase of 16% in SMEs involved in the implementation of joint research and innovation projects and technology transfer, both with public and private research and university units, as well as with other Bulgarian and foreign companies.

- The country's comparative advantage in the field of trademark applications is supported by an increase in the indicator of just over 10%. However, there is a 13% reduction in design applications, where the country has better positions than the EU average. The increased number of patent applications of 9% fails to mitigate the significant difference from the European average in the indicator.
- **The trends in the field of human resources are extremely unfavourable, measured both by the decline of the population with a higher level of education and by the deepening processes of deskilling.** Against the background of the low share of the population with digital skills, the data show no improvement compared to 2014 in the indicator for the population with digital skills above the average level. At the same time, the number of enterprises providing ICT training decreased by 30% and the total number of people involved in life-long learning decreased by 20%. Also, the number of new doctorate graduates decreased by 20%, and the decrease in the number of the population with higher education was 4%.

Although the summarised data of the innovation index of Bulgaria according to the EIS methodology shows a slow but steady improvement, in practice **the national innovation system of the country does not have**



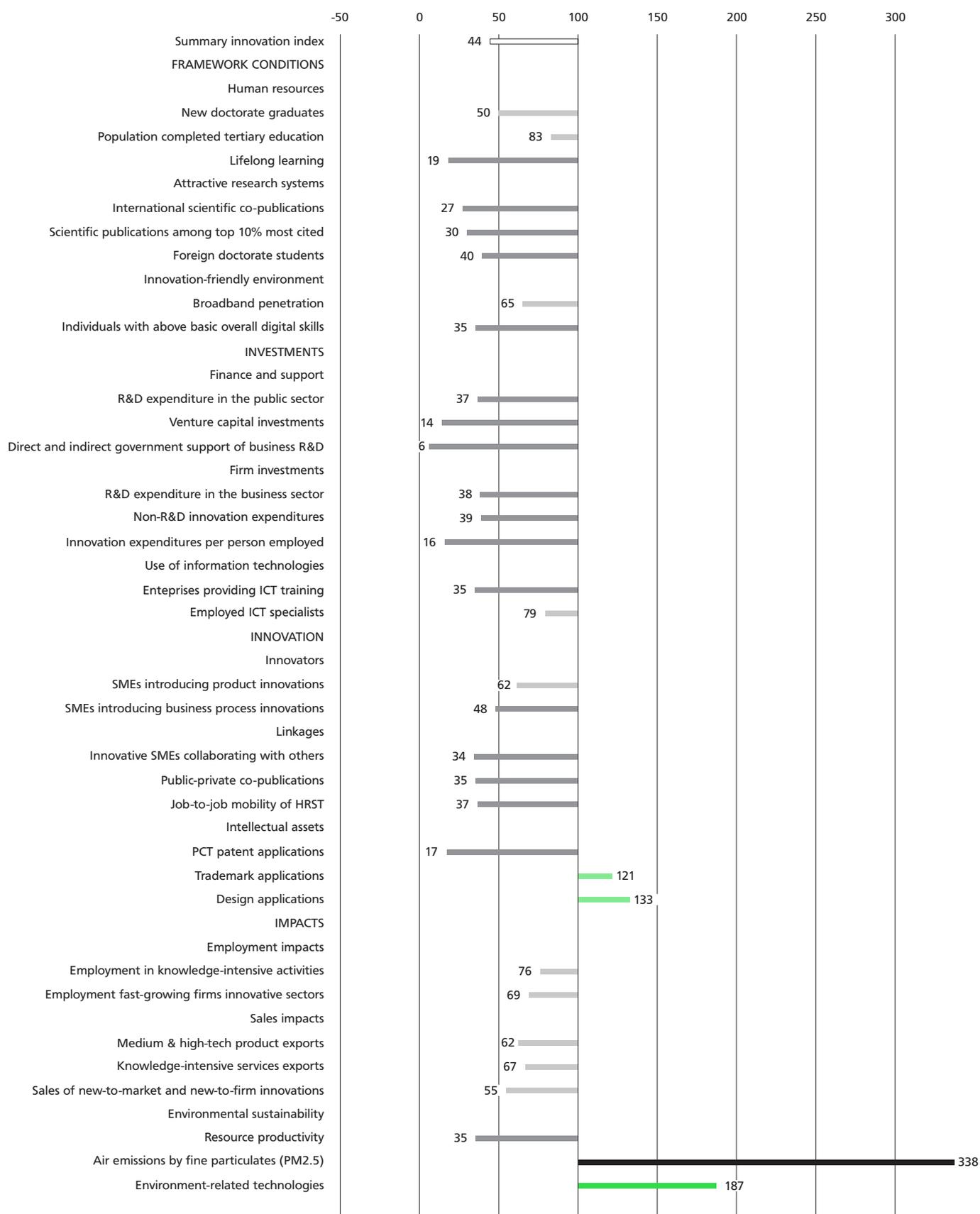
comparative advantages compared to other EU member states. Progress of almost 90% above the EU average in the development of environmental technologies, measured as a share of protected inventions in relevant areas of the total number of patents, is accompanied by a decline of the same indicator compared to 2014 levels and is one of the highest levels of air pollution in Europe. The other two areas in which the country has a leading position – trademark and design applications, are rather evidence of low-tech innovation and are accompanied by a strong lag in patent applications – an indicator that measures technological progress at world level.

In 2021, Bulgaria climbed 2 places in the ranking of the Global Innovation Index, published by the World Intellectual Property Organization (WIPO), and is 35th among 132 countries²². After 2013, this is the best performance of the country according to the WIPO methodology, which covers 81 indicators divided into seven pillars and two sub-indices – 1) innovation input, which includes data on the business environment, markets, human, financial and the intellectual resources invested in R&D and innovation, and 2) an innovation output, presented in the form of knowledge creation, intangible assets, entrepreneurial activity and market expansion, development of ICT and creative industries.

An innovation index of 42.4 points puts Bulgaria in second place after China in the group of countries with a higher average income per capita (upper middle-income group). Still, Bulgaria is the only EU member state in this category, along with the countries of the Western Balkans. Within the EU, Slovakia (40.2), Latvia (40), Lithuania (39.9), Poland (39.9), Croatia (37.3), Greece (36.3) and Romania (35.6) remain in lower positions.

²² Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis.

FIGURE 9. INNOVATION POTENTIAL OF BULGARIA, SHARE OF EU-27 AVERAGES, %, 2021



Source: European Innovation Scoreboard, 2021.

Box 3. WORKPLACE INNOVATION IN RESPONSE TO TODAY'S CHALLENGES

In the Covid-19 pandemic, SMEs have proved to be extremely vulnerable, especially in the sectors most affected by the crisis, such as transport and tourism. Due to their limited resources and more difficult access to finance, the period during which SMEs can operate with limited income is significantly shorter compared to large enterprises. SMEs often face more difficulties in the process of adapting to restrictive measures (switching to remote work, difficulties in accessing ICT, as well as difficulties in using them). In this way, the challenges of the pandemic have led to the deepening of the problems arising by the demographic crisis, migration processes and aging of the population.

In recent years, a number of studies²³ have shown that in addition to investment in research and development, an important factor in stimulating companies' innovation is their ability to encourage creative thinking and the generation of new ideas by employees, as well as the transformation of these ideas into innovations, which are also part of the main manifestations of **workplace innovation**.

Workplace innovations are new and different from traditional management practices because they lead to a change in the model of organisation of work and organisational culture in enterprises. These practices are inclusive and collaborative, i.e., they contribute to the cooperation and exchange of knowledge, experience and creative ideas among employees from different units and levels of management. Their key dimensions are the participation and commitment of employees in decision-making processes in the company (strategic and operational). Innovations in the workplace lead to the empowerment of the individual employee by providing greater independence and flexibility to employees in their job performance. They lead to increased motivation, a better working environment and the development of a company culture that unleashes the innovation potential of enterprises.

Bulgaria is among the EU countries with the lowest percentage of SMEs that have introduced remote workplace practices. Given the importance of small and medium-sized enterprises for growth and economic stability, it is crucial that they be encouraged to innovate in the workplace, as the latter increases the innovation potential as well as the resilience to crises such as the Covid-19 pandemic.

The areas in which Bulgaria lags the most in terms of workplace innovation include:

- **Motivation is lacking in 32% of the employees in Bulgaria** (for comparison, the average for the European Union is 16%).
- Bulgaria is among the countries with the highest percentage of managers who are expected to exercise control over their employees, rather than encourage their independence in dealing with challenges and decision-making (45% of the respondents, compared to the EU average of 27%).
- **the country is in one of the last places in terms of training provided to employees in SMEs**, as well as training provided during working hours²⁴. In 2019, less than half of managers and employees in SMEs (48.7%) participated in in-house training, and external specialised vocational training was provided by 38% of the enterprises.
- Most employees do not feel involved in the decision-making process, which is important and affects the future of the company.
- **Cooperation with external organisations and stakeholders is limited.**

Despite the lagging behind, a number of companies have managed to find ways to cope with the crisis precisely through workplace innovation²⁵. Moreover, **the companies that have successfully adapted to the new situation are the ones that had introduced workplace innovations before the crisis**, and the pandemic has accelerated internal changes and expanded the range of practices (increased flexibility in working hours, introduction of remote work and others). For these companies, innovation in the workplace is related to their ability to adapt quickly to changes in times of crisis.

Source: Applied Research and Communications Fund, 2021.

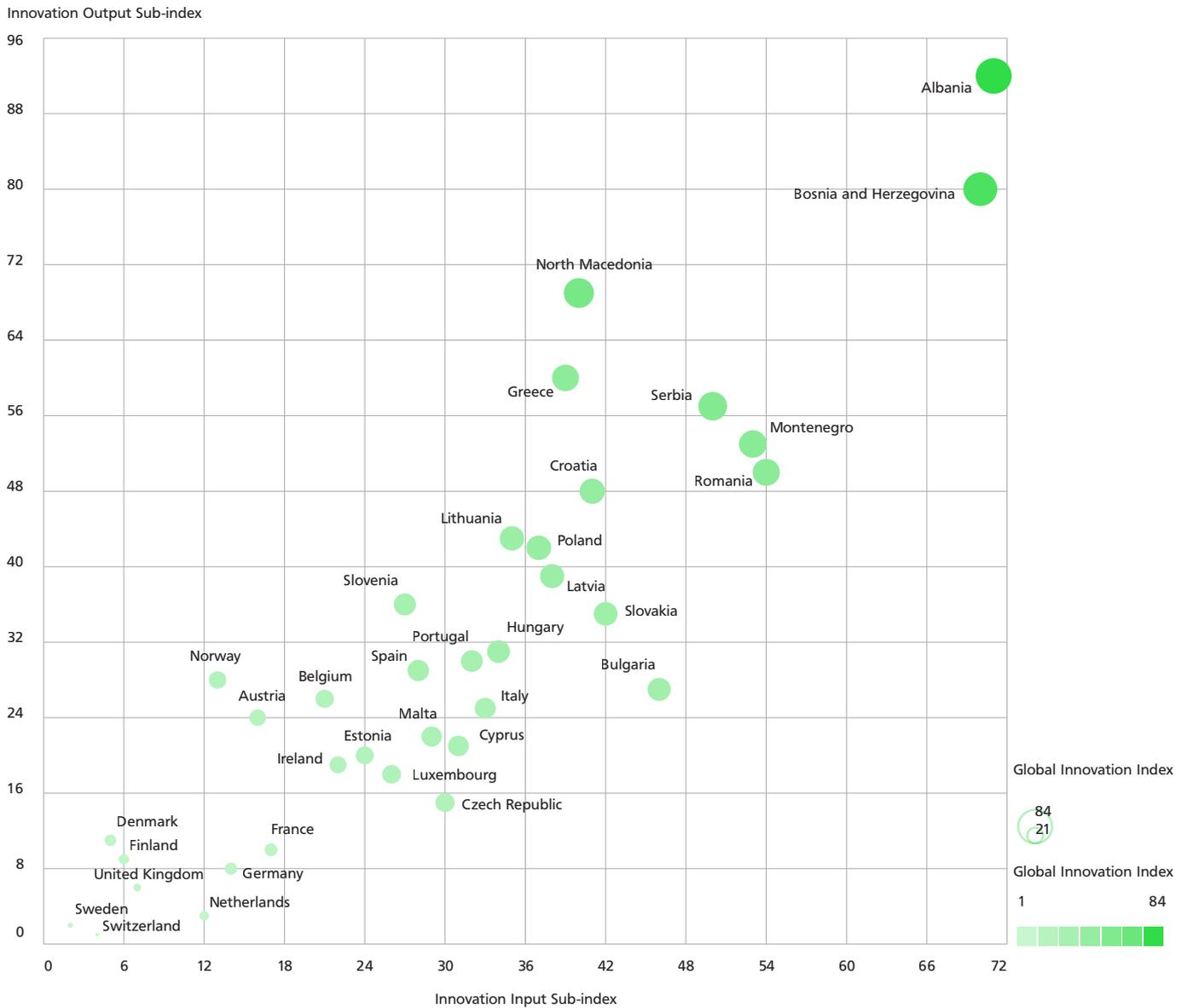


²³ Lorenz, Edward, and Jonathan Potter. 2019. "Workplace organisation and innovation in SMEs," *OECD SME and Entrepreneurship Papers* No. 17; Eurofound and Cedefop, 2020. "European Company Survey 2019 – Workplace practices unlocking employee potential," *European Company Survey 2019 series*, Publications Office of the European Union, Luxembourg.

²⁴ National Strategy for Small and Medium Enterprises 2021-2027.

²⁵ [Innovations in the workplace: measures for public support.](#)

FIGURE 10. GLOBAL INNOVATION INDEX, 2021



Source: Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis

Bulgaria’s performance in the Global Innovation Index confirms the results of the European Innovation Scoreboard of **low and deteriorating human resources indicators**. Against the background of growth of 2% on an annual basis on the total indicator for human resources and research, the change compared to 2013 is negative by 11%. In all other areas there is an increase in the gross indicators. As a result, Bulgaria ranks

74th in terms of secondary education indicators (including funding and PISA results), and 61st in higher education (population with higher education, graduates in STEM areas²⁶ and incoming student mobility).

Although improving, **market environment indicators remain among the country’s main shortcomings**. The access of enterprises to external financial resources, including lending,

microfinance, investments and venture capital, remains problematic.

According to the methodology of the Global Innovation Index, **Bulgaria traditionally has a better performance on the indicators of innovation activity**. This is largely due to the results in protected utility models, brands and designs, as well as the export of high-tech products, ICT services and the creative industries.

²⁶ STEM – science, technology, engineering, and mathematics.

Regional innovation profiles

The Regional Innovation Scoreboard 2021²⁷ provides an opportunity for a comparative analysis of the innovation development of the EU member states at regional level. It is not surprising that the most innovative regions in Europe are located in the countries of the group of innovation leaders, which have the highest performance in almost all leading indicators as a result of sustainable development of national and regional innovation ecosystems.

Good examples of regional innovation development can also be found in countries outside the group of innovation leaders and strong innovators. Regions achieving excellence can be found in Italy, Spain, Poland, Czechia, Serbia, Hungary, Greece and others. Of the Bulgarian planning regions, only the SWPR can be cited as an isolated good example. An increase in the innovation potential in 225 out of 240 regions of the European economy was reported in the period under consideration. The opposite negative trend of moving away from the average European pace of innovation development is observed in all planning regions in Bulgaria. For weaker economies such as Bulgaria's, maintaining this trend will only widen the gap with more advanced countries and make it more difficult to achieve national targets.

Although slowly, regional differences at the European level are narrowing, especially in more developed economies. However, Bulgarian planning regions fail to close the gap with European averages, and the innovation

potential of local companies remains well below the EU average.

All planning regions in Bulgaria fall into the same innovation group – that of emerging innovators. Three subgroups are distinguished in each main group, the regions of the upper third are marked with a positive sign (+), and the regions of the last one third are marked with a negative sign (-). Only SWPR falls into the upper subgroup (+), while NWPR and SEPR fall into the lower (-). SWPR marked the biggest jump in its innovative development in 2021 compared to 2014 (11.4%), followed by NEPR and SCPR. The minimum growth of 0.7% was by SEPR.

In the last few years, significant public resources have been invested in building regional scientific and technological infrastructure for innovation. This included support from EU funds for setting up centres of excellence and centres of competence in a network of partner organisations, including on a regional basis, thus enriching the national research and innovation environment.

The fourteen centres include centres of excellence, i.e., basic research institutions and centres of competence focused on the applied research and developments with a potential for absorption by industry. The centres will operate mainly in areas identified as priorities by the Innovation Strategy for Smart Specialisation of the country. The EU has invested a total of EUR 170 million in the centres under the OP Science and Education for Smart Growth for the period 2014-2020. The investments ranged

between EUR 7 and 35 million, with an average funding of a project of around EUR 13 million (see section *Entrepreneurship and innovation networks*)²⁸. It is important to note that regional actors, in most cases universities and academic units, are involved in setting up the centres either as a lead organisation or as supporting partners.

The development of strong regional innovation centres, based on the principles of green and digital transformation, is also supported by the Digital Europe Programme (2021-2027), which aims to expand and maximise the benefits of digital transformation for all European citizens, public administrations and enterprises mainly through the setting up of European Digital Innovation Hubs (EDIH). Their creation is expected to attract investment in key areas such as artificial intelligence, high-performance computing, cybersecurity, advanced digital skills, digitisation of public administration, interoperability and others. The innovative hubs will provide businesses and local administrations with innovative digital solutions and the opportunity to test new technologies.

As a result, 17 digital innovation hubs²⁹ have been approved at national level, located in all planning regions (see section *Entrepreneurship and innovation networks*). The established units are awaiting expert assessments by the EC, and the intention is for European funding to be directed to a maximum of 6 regional hubs, i.e., one in each planning region of the country.

²⁷ The Regional Innovation Scoreboard presents a comparative analysis of the innovation potential of the regions within the EU. It is based on some of the indicators of the European Innovation Scoreboard for which regional data are available. The 2021 edition covers 240 regions in 22 member states. The other five member states (Estonia, Cyprus, Latvia, Luxembourg and Malta) are included at national level, as their NUTS1 and NUTS2 levels coincide. Data for the United Kingdom, Norway, Serbia and Switzerland are also included. The survey is conducted every two years.

²⁸ *Strategic evaluation of the Bulgarian Centres of Competence and Centres of Excellence and recommendations for their further development*, Kert, K., Mosca, J. (ed.), European Commission, Brussels, 2021, JRC123084.

²⁹ For more information: *Процедура за подбор на проектни предложения за създаване на Европейски цифрови иновационни хъбове в България [Procedure for the assessment of applications for establishing European Digital Innovation Hubs in Bulgaria]*.

TABLE 10. POSITIONING OF THE PLANNING REGIONS OF BULGARIA WITHIN THE REGIONAL INNOVATION SCOREBOARD

NUTS II	Region	RII	Position	Group	Change*
BG31	NWPR	26.0	236	Emerging innovator (-)	4.7
BG32	NCPR	34.9	230	Emerging innovator	2.1
BG33	NEPR	35.5	229	Emerging innovator	8.4
BG34	SEPR	27.2	234	Emerging innovator (-)	0.7
BG41	SWPR	55.6	199	Emerging innovator (+)	11.4
BG42	SCPR	35.7	228	Emerging innovator	6.2

* The indicator of change reflects the performance of the regions in 2021 compared to the European average in 2014.

Source: Regional Innovation Scoreboard, 2021.

Box 4. INNOVATION PROFILES OF THE PLANNING REGIONS IN BULGARIA

North West Planning Region

In 2019, the region was a leader in several significant indicators of innovation activity such as product/process innovation of SMEs, SMEs with their own innovation activity and sale of new to the market or the company products. In 2021, the region had a significant decline in product innovation³⁰ and ranked last in the country. However, it retains a leading role and is second, right behind the innovation leader SWPR, in terms of process innovation at the SME level. The updated data on sales of new to the market and new to the company products for 2021 show that the region is third after the SCPR and SWPR with a small difference between them.

In 2021, NWPR leads in terms of non-R&D innovation expenditures, which could be attributed to the innovation activity of SMEs operating in its territory and the fact that it had been a priority region in the innovation programmes for the period 2014-2020.

The region has the lowest number of people with higher education, digital skills and employment in high-tech and science-intensive activities compared to the other regions. The demographic crisis is particularly noticeable in the NWPR, which limits the opportunities to start and expand a business there.

North Central Planning Region

The region was first in the number of patent applications in 2019, and for 2021 it has a slight retreat and occupies the second position after SWPR. NCPR is a leader in terms of employment in innovative SMEs, which is evidence of the existence and development of high-tech business and human resources. SWPR and SCPR are ranked second and third.

The region demonstrates sustainable development in a number of indicators and is second after the SWPR in terms of population having completed tertiary education, highly qualified and IT specialists in relation to total employment, registered product innovations, innovative SMEs in partnership, and the number of patent applications.

North East Planning Region

In general, the overall innovation activity of the region has average indicators for the country. The NEPR is a leading region in Bulgaria in terms of publications with the maximum number of citations, retaining its leadership since 2019. In 2021, it was followed by SWPR. The region is second after SWPR in one of the key indicators for regional innovation development – public sector R&D expenditures.

North South West Planning Region

The region where the capital Sofia is located is the most innovatively developed planning region in Bulgaria. This is mainly due to the fact that the scientific and technological potential of the country is concentrated there. Still, intra-regional differences in economic terms, and in particular innovative potential, remain significant. Intra-regional connectivity needs additional investments, which will create preconditions for the development of trans-regional and cross-border trade relations of local SMEs.



³⁰ In 2021, product and process innovations were separated into two distinct indicators.

Box 4. INNOVATION PROFILES OF THE PLANNING REGIONS IN BULGARIA (CONTINUED)

SWPR is the only planning region in Bulgaria that has a result above the EU average in a number of indicators of the Regional Innovation Scoreboard for 2021, including:

- percentage of the population between 25 and 34 years of age having completed tertiary education;
- share of people with above basic overall digital skills;
- SME innovation expenditure per employee;
- percentage of employed IT specialists and employees in high-tech and science-intensive activities in relation to total employment;
- number of trademark applications;
- number of design applications per billion regional GDP.

South Central Planning Region

The SCPR ranks second after SWPR in the number of joint public-private publications. The relatively high result for the country is due to the well-developed university and educational network in the second largest city in Bulgaria – Plovdiv. It is also second to SWPR in the number of design applications, the difference with the SWPR being minimal. In recent years, the entrepreneurial environment in Plovdiv has developed significantly with the attraction of FDI, thus becoming a role model for successful public-private partnerships.

South East Planning Region

Although two of its main cities, Burgas and Stara Zagora, act as a balancer of the economic development in Southeast Bulgaria, the region is among the least innovative regions in the EU. In recent years, innovative business communities have been developing rapidly in Burgas and Stara Zagora, and positive examples of promising high-tech start-ups are no exception. At the same time, an entrepreneurial spirit is emerging, and private business academies are being set up in intersections between business and science. Despite these efforts, SEPR is still the region with the lowest percentage of employed IT professionals compared to the total local employment for 2021.

Notably, the region around Stara Zagora is on the threshold of energy transformation in response to the requirements of the European Green Deal³¹, and the reforms are expected to contribute to qualitative changes in the regional innovation ecosystem for decades to come.

Source: Applied Research and Communications Fund, 2021.

Technological product

The technological product (protected and unprotected new technological knowledge) is the result of creative activities of various participants in the innovation process. It has unique characteristics and economic significance which make it attractive as an object of transfer. The analysis of application and patent activities, as well as the attitudes of Bulgarian and foreign persons in this field make it possible to assess an essential aspect of the innovation system operation and to seek ways of improving it.

During the crisis year of 2020 there was a **significant increase in the patent activity of Bulgarian inventors**.

The Patent Office of the Republic of Bulgaria (PORB) issued 216 Bulgarian patents, which is a new high after 2000 and a continuation of the growing trend of the patent activity of Bulgarian inventors after 2015.

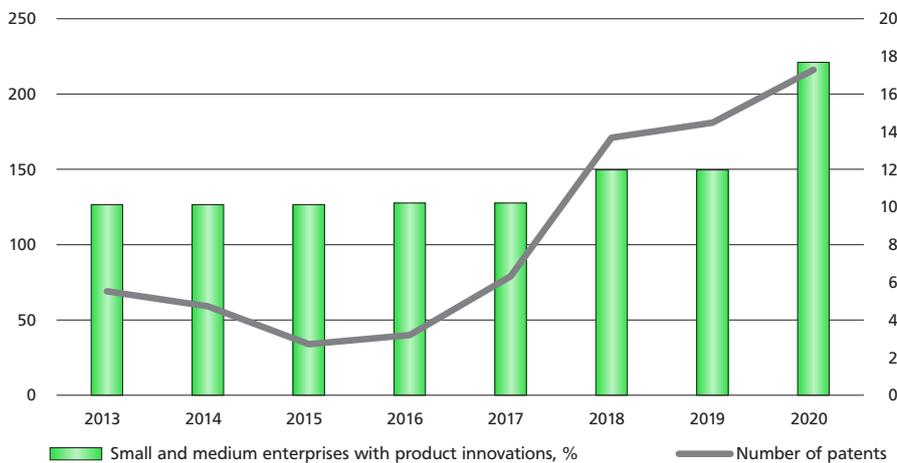
Patent activity is an important prerequisite for successful business innovation and the development of successful new products and processes. While the introduction of process innovations by small and medium enterprises in Bulgaria has been almost constant over the last eight years (between 16% and 19% of the total number of SMEs), product innovations are more closely linked to

patent activity. With a two-year lag between patent registration and innovation activity, **the growth of patents issued in 2015 was followed by an increase in the number of new products and services launched on the market.**

With 84 newly registered patents in the PORB in 2020, the business sector has the largest share in the country's patent activity (39%), followed by individuals (76.35%). The two sectors show almost equal positions in terms of their patent activity, which is a result of a long-term downward trend in the activity of individuals at the expense primarily of business,

³¹ The Green Deal is EU's new growth strategy, which aims at steering Europe on the path to transformation into a climate-neutral, just and prosperous society with a modern, resource-efficient and competitive economy. It represents EU's commitment to climate neutrality by 2050 made by leaders in the strategic agenda.

FIGURE 11. PATENT AND INNOVATION ACTIVITY OF SMES, 2013-2020



Source: Own calculations based on data of PORB, 2021. <https://www.bpo.bg/>; European Innovation Scoreboard 2021, <https://interactivetool.eu/EIS/index.html>

amounts to an overall of 233 patents, or just over 40% of all the 580 patents in the business sector for the period 2001-2020. These companies accounted for nearly 11% of all 349 patent holders for the period.

Just over half of the patent activity of business (53%) is concentrated in Sofia. Plovdiv (8%) and Varna (3%) remain far behind.

In the last three years there has been a **strong growth of patent activity by BAS**. In 2020, a record 51 patents were registered by eight institutes of the Academy, and for the last three years the patents have been 133 – over 52% of the patent activity of BAS for the entire 20-year period.

and to a lesser extent of the public sector (represented mainly by BAS institutes).

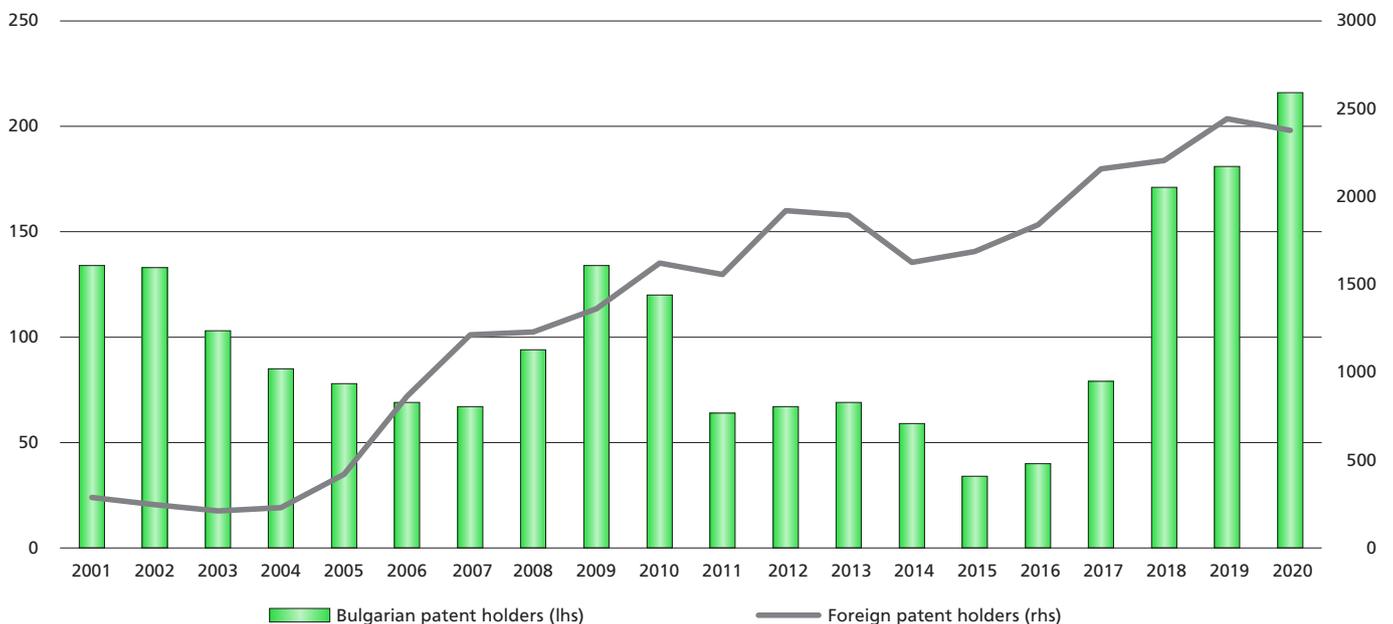
In 2020, 60 of the companies which had registered patents held one each, with 10 of them registered as European patents. For the period

2001-2020, 349 Bulgarian companies have registered a total of 580 patents. Only 17 of the patents of Bulgarian companies (2.93%) have been issued by the EPO.

Three and more patents are held by 38 Bulgarian companies, which

The Institute of Robotics³² has the highest result in the field of protection of intellectual property (IP) both within BAS and for the country. With all its organisational transformations, the Institute received 27 of the newly issued patents to BAS in 2020; it now

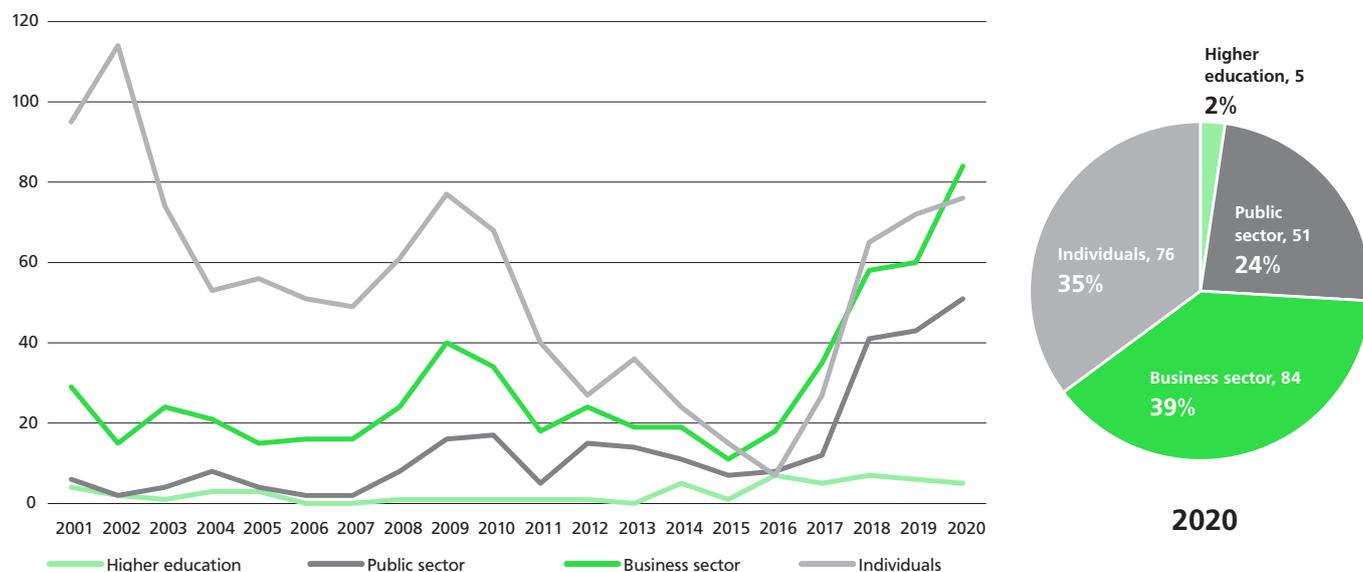
FIGURE 12. PATENT ACTIVITY ON THE TERRITORY OF BULGARIA, 2001-2020, NUMBER OF PATENTS



Source: Own calculations based on data of PORB, 2021. <https://www.bpo.bg/>

³² The Institute of Robotics at BAS is the legal successor of the Institute of Systems Engineering and Robotics, established in 2010 by the merger of the Institute of Control and System Research and the Central Laboratory of Mechatronics and Instrumentation.

FIGURE 13. INSTITUTIONAL AFFILIATION OF THE PATENTS ISSUED TO BULGARIAN HOLDERS IN BULGARIA, NUMBER OF PATENTS



Source: Own calculations based on data of PORB, 2021. <https://www.bpo.bg/>

Further steps need to be taken in this regard, as registered patents have not yet fully fulfilled their purpose and are still awaiting implementation in innovative developments. To this end, appropriate incentives will be needed

so that the research and innovation infrastructure could start producing results and using the variety of forms of technology transfer from science to business (see the section *Entrepreneurship and innovation networks*).

An exception is the National Science Fund. Although the Research Promotion Act provides for the Fund to promote IP protection, its efforts in this regard have been hampered by the Ministry of Finance. Such a mea-

TABLE 11. TOP-10 TECHNOLOGICAL AREAS (IPC CLASSIFICATION) OF PATENT ACTIVITY OF BULGARIAN HOLDERS, 2001-2020, (NUMBER OF PATENTS, %)

	IPC	Description	Number	%
1	A61	Medical or veterinary science, hygiene, dentistry, medicines	179	9.0
2	H01	Basic electric elements of equipment: cables, conductors, insulators, resistors, magnets, detectors, transformers, switches, resonators, etc.	177	8.9
3	G01	Measuring, testing	147	7.4
4	H02	Generation, conversion, or distribution of electric power	77	3.9
5	E04	Construction, elements of building structures, building materials	75	3.8
6	A01	Agriculture, forestry, animal breeding, hunting, fishing, pesticides, herbicides, disinfectants	53	2.7
7	A23	Food and food products, processing, milk, oils, coffee, tea, chocolate, confectionery	52	2.6
8	B01	Physical or chemical processes or apparatus in general	50	2.5
9	F16	Units and details of machines, methods and devices, ensuring the operation of machines and installations, thermal insulation	50	2.5
10	F42	Ammunition, blasting, pyrotechnics	46	2.3

Source: Own calculations based on data of PORB, 2021. <https://www.bpo.bg/>

sure can hardly be justified against the background of the increasingly blurred boundaries between basic and applied research and the priorities of European³⁴ and national³⁵ policies to promote the integration of scientific results into innovation practice.

Although these policies and measures taken by the MES are aimed at higher education institutions, the results are not yet available. The total number of patents registered by PORB in the higher education sector is 54. Nearly a quarter of them

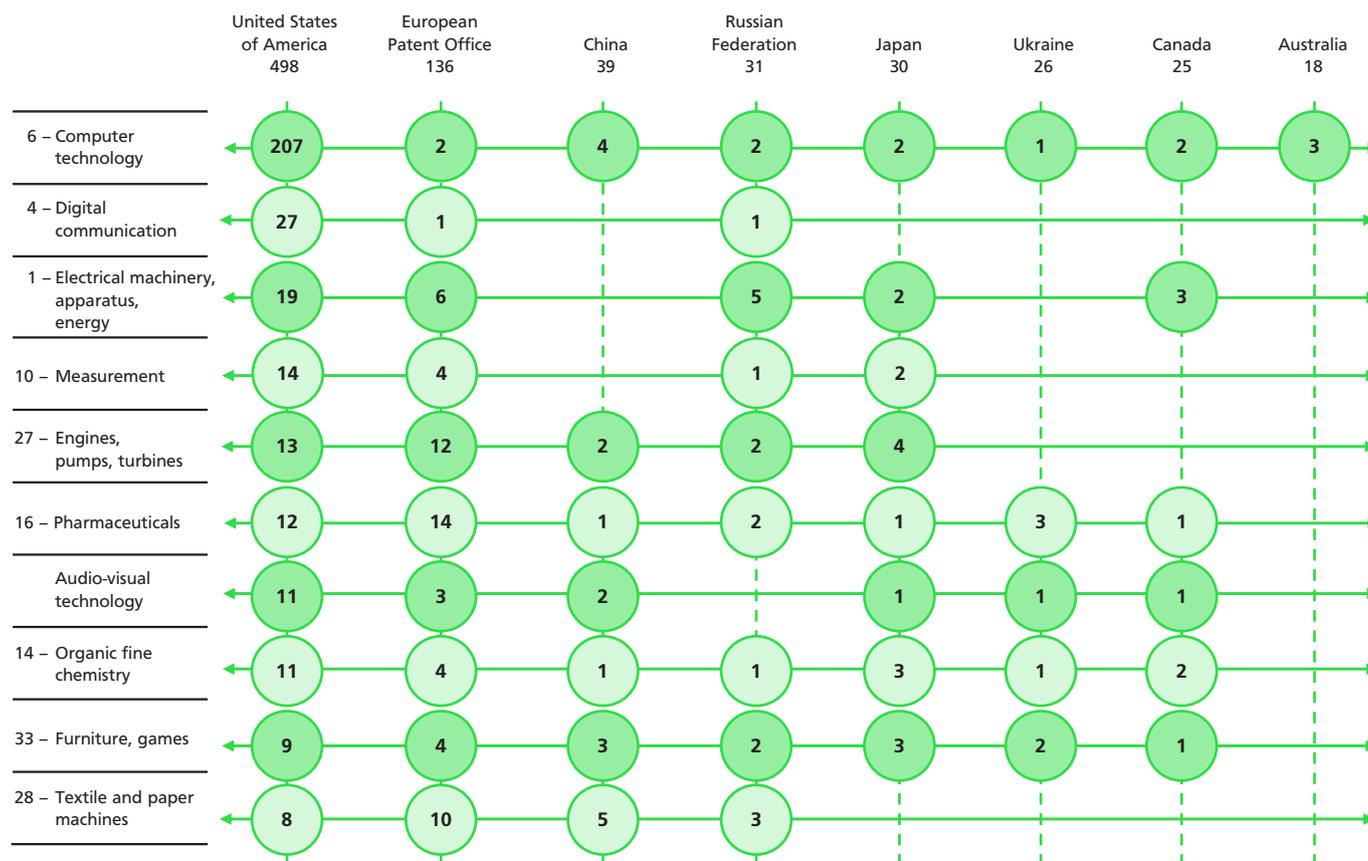
belong to the Technical University of Varna (13 patents), followed by the Technical University of Sofia with 10 patents. Only four universities had a registered patent for an invention in 2020 – the Technical University, Varna with 2 patents, as well as Technical University, Gabrovo, the University of National and World Economy and the Higher School of Telecommunications and Post with one patent each.

Almost half of the patent activity of Bulgarian patent holders for the period 2001-2020 has been concentrated in ten technological areas according to

the International Patent Classification (IPC). The interest of the inventors is focused on the areas of Human Needs (Class A) and Electricity (Class H).

The slight decline – by less than 3% on an annual basis – in foreign patents is unlikely to have a negative impact on the upward trend since 2004. A special feature of foreign patent holders is their interest in the European economy as a whole. Usually, very few are issued nationally by PORB. In 2020, this is the case with only 11 patents from four countries (six from Denmark, two from Germany and

FIGURE 14. PATENT ACTIVITY OF BULGARIAN PATENT HOLDERS IN FOREIGN PATENT OFFICES, MAIN TECHNOLOGICAL AREAS, 2000-2019, NUMBER



Source: WIPO IP Statistics Data Centre, 2021.

³⁴ By decision of 23 July 2021, the European Commission extended the scope of the General Block Exemption Regulation (GBER), which will allow member states to apply certain aid measures without prior Commission scrutiny. The revised rules concern aid granted by national authorities for projects financed through certain EU programmes under the new multiannual financial framework; and certain state aid measures that support the green and digital transition and are important for recovering from the economic consequences of the Covid pandemic.

³⁵ Decree № 61 of the Council of Ministers of 02.04.2020 regulates the conditions and the order for establishment of commercial companies by state higher schools for the purpose of commercialising the results of scientific research and objects of the intellectual property. The same matter is regulated by the BAS Act and the Agricultural Academy Act.

Russia, and one from Saudi Arabia). Their share amounts to a negligible below 0.5% against the background of the remaining 2,366 patents validated by the European Patent Office (EPO). The share of foreign patents registered under national law on the territory of the Republic of Bulgaria for the period 2001-2020 is even smaller – less than 0.2%.

According to the WIPO, in 2019 Bulgarian inventors received a total of 294 patents, of which 182 from PORB and another 112 patents registered in 18 intellectual property offices abroad. Since 2007, the interest of Bulgarian patent holders abroad has been focused mainly on the United States market. Thus, of the protection documents provided in 2019 outside Bulgaria, half (exactly 50%) are registered with the United States Patent and Trademark Office. Far behind are the 14% of patents issued by EPO, followed by the patent offices in China (6%), Russia (5%), South Korea and South Africa with 4.5% each, and Japan with 4%.

As of 2019, there were 43 countries in which Bulgarian inventors maintain patent rights. Most are in Bulgaria – 536 patents of Bulgarian origin are in force on the territory of the country. Next comes the U.S. where the current patents of Bulgarian inventors are 466. Far behind with

59 patents is the United Kingdom. The group includes 18 EU member states, as well as China (38), Switzerland (31), Japan (24) and Russia (22). The markets of two countries in the Western Balkans are also of interest to Bulgarian patent holders – North Macedonia (3) and Serbia (2).

In 2020, utility models remain the preferred tool for protecting new technological knowledge. The applications for utility models to PORB during the year amounted to 542 (of which 3 were filed by foreign applicants) and exceeded twice the number of patent applications (246). The growth on an annual basis is nearly 20%, which is a continuation of a strong upward trend in applications for utility models for the last three years (doubling compared to the values of the same indicator for 2018). For the first time since 2015, there has been an increase of nearly 30% in patent application activity.

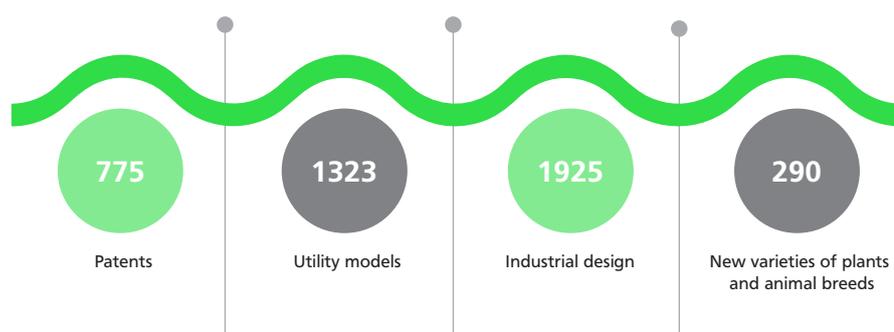
The requests for new varieties of plants and animal breeds increased by only 2 in 2020, reaching 27. However, these values are far from the peak achievements in the period until 2010, when the requests are up to 85 per year. Based on the expertise of the Executive Agency for Variety Testing, Approbation and Seed Control and the Executive Agency for Selection and Reproduction in Animal

Husbandry, the issued certificates are 21.

The current system for monitoring and evaluation of the implementation of the Innovation Strategy for Smart Specialisation of Bulgaria and the financial instruments that support the achievement of its goals do not aim to establish the number, type, territorial scope and technological areas of the intellectual property rights requested and registered in the framework of publicly funded projects. Thus, **in monitoring and evaluation procedures the attention of the relevant public institutions continues to be focused on the number of funded projects and the amount of utilised funding**, without analysis of the actual effect and the long-term impact of the implementation of these projects.

PORB continues to be a passive observer within the national innovation system with the main function of administrator of fees for IP protection services. Despite the significant funds spent by the Office on increasing its administrative capacity, there is still no functional register of IP objects in Bulgaria, as well as the application activity of Bulgarian IP rights holders in the country and abroad. Such a register would inform the relevant public authorities about the situation in this area and allow the development of evidence-based policies and incentive mechanisms. In addition, the dynamic development of technology in recent years raises a number of issues on IP protection in the context of the internet, artificial intelligence, green and digital technologies, bitcoin and others, which are the subject of a number of discussions within WIPO and EPO, while remaining an uncharted territory in Bulgaria.

FIGURE 15. OBJECTS OF INDUSTRIAL PROPERTY WITH EFFECT ON THE TERRITORY OF BULGARIA, 2020



Source: PORB, 2021. <https://www.bpo.bg/>

Research product

New scientific knowledge is an important condition for enhanced innovation activity in the country. The analysis of the dynamics and structure of the process of research creation reveals the potential of Bulgaria to successfully fit in the global scientific networks, its comparative advantages in various fields of knowledge and its ability to compete on the market for intellectual products.

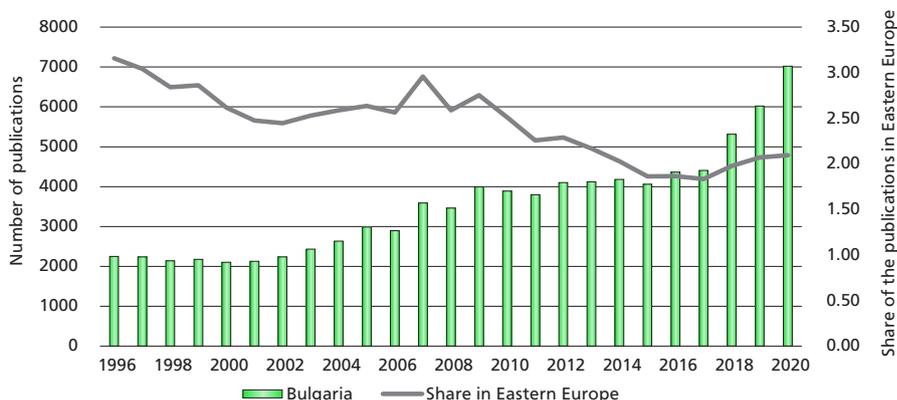
The number of scientific publications with the participation of scientists from Bulgaria continued to grow in 2020. With 7,021 new documents, the Bulgarian presence in the Scopus collection increased by 17% compared to the previous year. This ranks the country 55th in the world ranking of 240 countries. Within Eastern Europe, Bulgaria ranks 11th (23 countries in total) both in terms of the number of documents referred to in the database and the H-index³⁶, which assesses both the productivity and relevance of publications.

Over the last 20 years, **Bulgaria has not changed its position in relation to other EU member states**, ranking 22nd in the number of scientific publications. However, there is a setback when taking into account the qualitative criteria for citation – 23rd place for H-index and only 26th place for the number of citations per document, with a minimal difference only ahead of Slovakia and Poland.

In 2020, the research interest of the scientific community in the country is concentrated in five scientific fields:

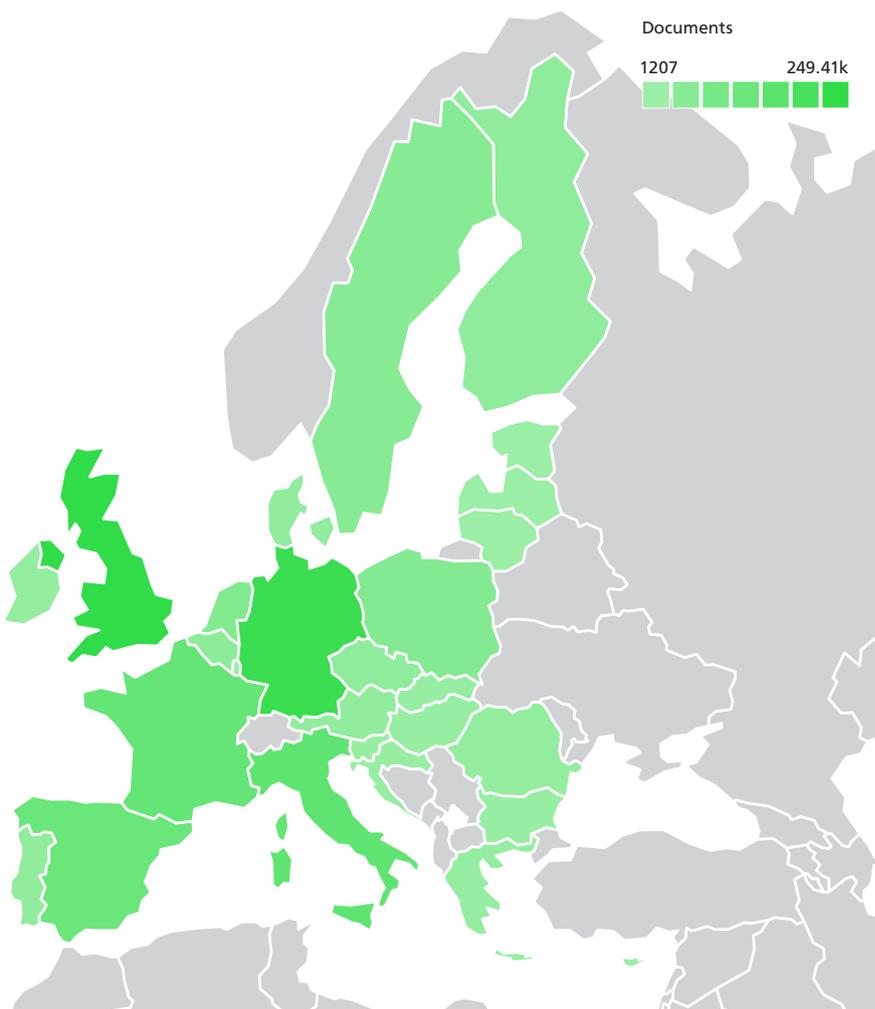
- The field of medicine registered the largest number of publications – 1457. For the entire study period 1996-2020 the number of

FIGURE 16. PUBLICATION ACTIVITY IN THE SCOPUS DATABASE, 1996-2020



Source: SCImago (2007). SJR – SCImago Journal & Country Rank. Retrieved September 16, 2021, from <http://www.scimagojr.com>

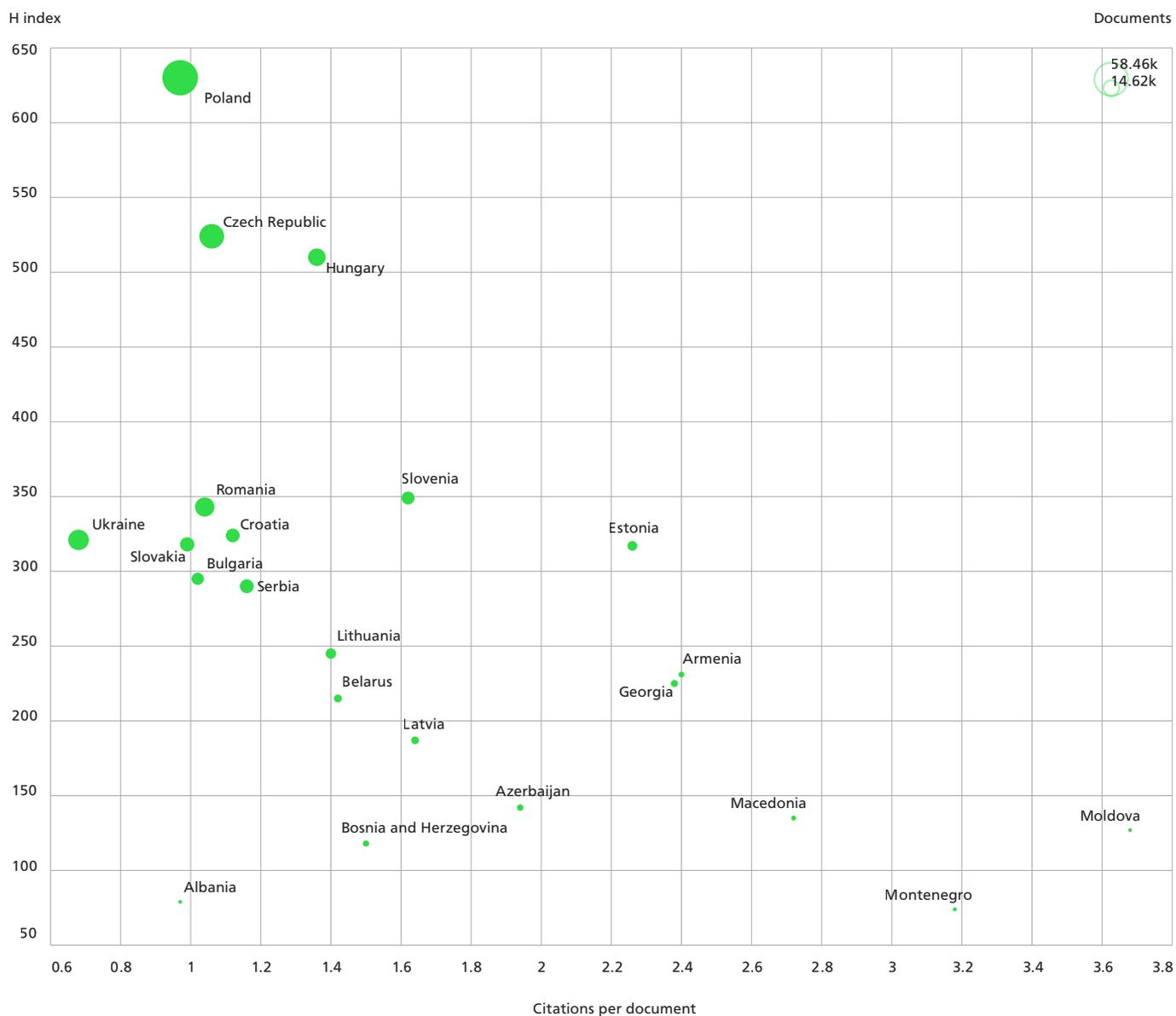
FIGURE 17. PUBLICATION ACTIVITY IN THE SCOPUS DATABASE, EU-28, 2020



Source: SCImago (2007). SJR – SCImago Journal & Country Rank. Retrieved September 16, 2021, from <http://www.scimagojr.com>

³⁶ The scientometric indicator h-index is known as the Hirsch index, named after the Californian physicist Jorge E. Hirsch, who launched its use in 2005. It assesses both the productivity and the relevance of the publications made by a particular scientist, group or institution. The value of the h-index is determined on the basis of the most cited publications: those h in number that have been cited at least h times are counted among them. The H-index is the only number that meets this definition.

FIGURE 18. PUBLICATION ACTIVITY IN THE SCOPUS DATABASE, EASTERN EUROPE, 2020



Source: SCImago (2007). SJR – SCImago Journal & Country Rank. Retrieved September 16, 2021, from <http://www.scimagojr.com>

documents with Bulgarian participation is 20,450, which generated a total of 303,197 citations with an average of 14.83 citations of documents. The positions of the Bulgarian scientific community regarding international cooperation remain relatively stable – nearly 50% of the publications are prepared by mixed teams with Bulgarian and foreign participation. However, there has been a negative trend since 1996 of a decline by almost 50% in the share of publications in the field

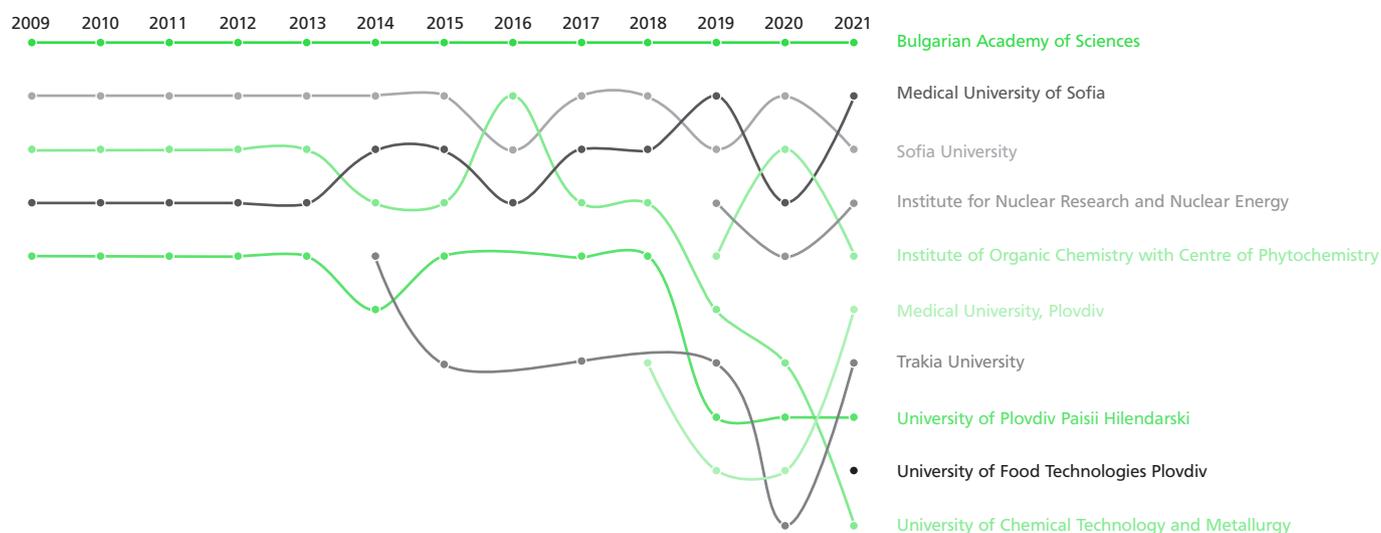
of medicine within Eastern European countries to 2.58%. The contribution compared to the EU member states marked a slight increase of up to 0.44%.

- The field of physics and astronomy is in fourth place in terms of the number of scientific publications referred to in the Scopus database (1,034), but is leading in all other indicators for the period as a whole: H-index – 181, number of documents – 21,811, number of citations – 410,957, and citations per document – 18.77.

The fields of medicine and physics and astronomy are traditionally leading for Bulgaria. This is due to the slow but steady increase in publication activity throughout the study period.

- Rapid growth of publishing activity has taken place in the **engineering sciences** (nearly three times in the last ten years, to 1,408 publications in 2020) and **computer science** (just over three times to the level of 1,275 publications in 2020). In both areas, the growth of publishing activity

FIGURE 19. TOP-10 OF THE BULGARIAN ORGANISATIONS INCLUDED IN SCOPUS DATABASE, 2009-2021³⁹



Source: SCImago (2007). SJR – SCImago Journal & Country Rank. Retrieved September 16, 2021, from <http://www.scimagojr.com>

is accompanied by a decline in the international participation of research teams.

- In fifth place among the 27 scientific fields in which scientific knowledge is grouped in Scopus is the field of **agricultural sciences and biology**. The scientific publications in 2020 are 841, and the share of the Bulgarian contribution in the total number of publications in this field in Scopus (0.34%), within the EU (1.21%) and Eastern Europe (4.07%) – significantly better relative performance compared to the previous four scientific fields.

The SCImago institutional ranking includes research organisations (academia, higher education, business and NGOs) ranked on the basis of a composite indicator composed of three indices: research, innovation performance and social impact, measured by their visibility on the inter-

net³⁷. The edition of the ranking for 2021 includes 23 research organisations and universities from Bulgaria, five more than in the previous year³⁸. BAS participates in the ranking both with the general data about the Academy and the independent presence of nine of the institutes that are part of it. In addition, 13 Bulgarian universities are already covered by SCImago Lab (a total of 7,409 organisations worldwide).

The Bulgarian Academy of Sciences is an undisputed leader within the scientific community in the country. The main contribution to the relatively high overall rating of 28 points (out of 100 possible) is due to the social impact (9 points) and the volume and quality of scientific production (14 points). The results of the research rank the Academy in 19th place in the EU-28 and in 4th place among the countries of Eastern Europe. BAS notes the strongest presence on the

international scientific scene in the thematic areas of energy and Earth and planetary sciences. The comparative advantages of the Academy within Eastern Europe are in the fields of energy and physics and astronomy, and in relation to the EU-28 the Academy is a leader in the veterinary and energy fields.

At the same time, however, the significantly weaker result registered by BAS in terms of innovation potential is impressive – 71 points out of 100 possible. According to the Scopus methodology, patent applications and citations of scientific publications made in already registered patents are of major importance in this ranking.

Two of the medical universities in the country, those in Sofia and Plovdiv, and Sofia University have leading positions among the Bulgarian universities in the Scopus database. The latter almost entirely copies the performance of BAS – a similarly high rating in terms of social impact and a dominant role of research over innovation potential. The Thracian and Plovdiv universities, and to a lesser

³⁷ SCImago Institutions Rankings (SIR) is a product of SCImago Lab and uses data from the Scopus database.
³⁸ According to the methodology, the ranking includes institutions that have at least one hundred publications in the Scopus database in the last year of the study period (in this case 2019).
³⁹ For each of these years, the ranking is based on information for a five-year period with a two-year delay (for example, data for 2021 reflect the period 2015-2019).

Entrepreneurship and innovation networks

Entrepreneurship is one of the binding elements of the national innovation system. It is embodied in newly-established companies and in the means of interaction and exchange of information, know-how and technologies among stakeholders in the innovation economy. Entrepreneurship is crucial for the robustness, adaptability and flexibility of the national innovation system. A high spirit of enterprise and a culture of innovation should underline the national objectives of innovation policy.

Entrepreneurship and small business in a time of crisis

Covid-19 mobilised the efforts of the European Commission and national governments in their attempts to reduce the negative impact of the crisis on business and, above all, on entrepreneurs and SMEs. The relatively low number of bankruptcies so far is due to the comprehensive measures taken and the variety of traditional and innovative approaches (grants, debt and equity financing, tax holidays, etc.) to improve companies' access to finance.

Monitoring by the European Commission of the access of SMEs to financing in 2020 shows that 84% of the enterprises in Bulgaria (83% for the EU-27) consider the measures taken to provide **debt financing** relevant to their needs. Instruments such as credit lines, overdrafts, credit cards, leasing and others are among the most common, although their positive anti-crisis effect on business is the shortest.

Of the 501 Bulgarian enterprises included in the survey in 2020, the share of those using external sources of financing is as follows:

- credit line, bank overdraft or credit overdraft – 28% (32% on average for the EU-27);
- bank loans – 14% (18% on average for the EU-27);
- leasing or instalment purchase – 13% (19% on the average for the EU-27);

Box 5. ONDO SMART FARMING SOLUTIONS – THE BULGARIAN START-UP WITH SOLUTIONS FOR THE DIGITALISATION IN AGRICULTURE

Ondo Smart Farming Solutions⁴¹ is a Bulgarian start-up company that provides solutions to the problem of low level of automation in agriculture through innovative technologies. The company offers production monitoring systems and products for precision irrigation, fertilisation and climate control. In 2021, Ondo also worked on the creation of an Educational Hub, which will provide farmers with know-how in the fields of agronomy, automation and digital cultivation. „We are working on models for growing plants at each stage of their development, while adapting them in real time, on the basis of the collected data on agricultural areas and cultivated crops. The children of experienced farmers are taking over the business with new modern visions and with an increasing openness to automation and digital technologies“, says the executive director of Ondo Smart Farming Solutions Iliya Yordanov.

Ondo's system works successfully in greenhouses and open agricultural areas in Bulgaria and North Macedonia. The company participates in one of the most influential agricultural hubs in the world – EIT FAN in Haifa. Ondo has been selected to participate in the second edition of the programme for stimulating and promoting the growth of Bulgarian companies – BeamUp lab. The initiative is of the Bulgarian Stock Exchange, under the auspices of the Ministry of Finance and is implemented in partnership with the Fund of Funds, the Bulgarian Development Bank, the European Bank for Reconstruction and Development, the Bulgarian Association of Licensed Investment Intermediaries and the Bulgarian Start-up Association.

Source: Applied Research and Communications Fund, 2021.



⁴¹ Ondo Smart Farming Solutions is the winner in the category "Innovative start-up" in the Innovative Enterprise of the Year 2020 Award.

entrepreneurs were success-oriented by reacting quickly to the needs of a new niche market and responded with product offerings innovative at world level. Similar readiness is expressed by 21.3% of students-emerging entrepreneurs (up to 3 months from starting a new business), as well as 33.1% of students-owners of new business (between 3 months and 42 months from starting a new business)⁴⁷. The study of student entrepreneurial activity in the country GUESS 2021 found that student entrepreneurs adapt very quickly to the changing business environment, and some of them create new business precisely in response to the pandemic.

Research and innovation infrastructure

The analysis of the business environment in Bulgaria shows that a developed entrepreneurial ecosystem (start-ups, established business, local authorities) is present primarily in Sofia city, where most start-ups, serial and academic entrepreneurship are concentrated, as well as the sources of public and private risk financing related to their support. In other planning regions these factors are only partially present. The businesses in the cities of Plovdiv, Stara Zagora, Gabrovo, Haskovo are relatively active but remain isolated and uncoordinated in their efforts to achieve a sustainable synergistic effect. The main difficulties are related to the lack of human resources with appropriate qualification and expertise in niche areas, the low level of digitalisation and initiative for optimising business processes, low administrative capacity in local government and lack of an active role in supporting entrepreneurial initiatives and linkages among them.

A well-developed and regionally specific research and innovation infrastructure is one of the key elements of the entrepreneurial and innovation ecosystem, and a factor for the transformation of research results into practical solutions to market needs. A study of entrepreneurial activity in the agricultural sector confirms the role of synergies and innovation networks (in this case in the form of value-added technology chains) for the success of start-ups⁴⁸. During the previous programming period 2014-2020, the creation of a number of bodies started, which will begin to work in cooperation and at full capacity driven by the initiatives planned for the next seven years. The main ones include:

- Centres of excellence and centres of competence

Six centres of excellence, including two co-financed centres under the Horizon 2020 Framework Programme, and ten centres of competence with a total budget of over EUR 220 million (ERDF and national) have been set up and funded under the Operational Programme Science and Education for Smart Growth. After the completion of the research infrastructure of the centres, efforts will be focused on its full use through capacity building, stimulating the demand for scientific results by business, attracting additional funding through participation in research programmes and technology transfer. The centres combine the efforts of over 60 institutes of BAS, universities, scientific and business organisations. The overall long-term goal is to improve the capacity of the national research and innovation system and the competitiveness and innovation potential of the economy.

- European digital innovation hubs (EDIH)

European digital innovation hubs are a new EU tool focused on bringing digital technologies, businesses, citizens and public administrations together on the basis of the Digital Europe Programme (DIGITAL). It is envisaged that most of the hubs will be developed on existing clusters or include member organisations of the Enterprise Europe Network. DIGITAL provides support in key areas such as supercomputers, artificial intelligence, cybersecurity and others, while ensuring the widespread dissemination of digital technologies in the economy and society, including through the EDIH. The programme has a planned total budget of EUR 7.5 billion and is part of the Multiannual Financial Framework 2021-2027.

The programme aims to accelerate economic recovery and support the digital transformation of European society and economy. EDIHs provide an opportunity for SMEs and public institutions to experiment and test new technologies according to their specific needs. The main beneficiaries will be SMEs, but the results of their support are geared towards the benefit of society as a whole, including through the development of green technologies and increasing the efficiency of resource use. DIGITAL will complement funding provided through other EU programmes, such as Horizon Europe for Research and Innovation, the Mechanism for Reconstruction and Sustainability and the Structural Funds.

- Regional innovation centres

In 2019, a procedure was launched for the establishment of regional innovation centres as a tool to stimulate business-oriented research and the links between business and science in the regions outside the capital Sofia. The establishment of the centres was supposed to support the

⁴⁷ Hadjitchoneva, J. (2021). *Student Entrepreneurship 2021: Insights from Bulgaria*. Retrieved from GUESS website: <https://www.guesssurvey.org/>

⁴⁸ Yalamov, T., Vutsova, A. & Arabajieva, M. (2021). "Economic performance of agricultural enterprises in Bulgaria". *Bulgarian Journal of Agricultural Science*, 27 (No 5) 2021, 819–828.

implementation of the objectives of the Innovation Strategy for Smart Specialisation under the auspices of the Operational Programme Innovation and Competitiveness and with funds transferred from the Operational Programme Science and Education for Smart Growth. However, following the Covid crisis, the procedure was terminated, despite significant interest from regional stakeholders. The intention of SARI is for the regional innovation centres to receive financial support during the new programming period.

- Industrial zones

In the last few years, significant efforts have been made in the construction and rapid modernisation of regional industrial and economic zones. New ones are being created around the regional centres and the big cities, and the existing ones are renewing their infrastructure and expanding the services for the busi-

ness. From the beginning of 2021, a new Industrial Zones Act is in force. The law provides a legal definition of the concept of industrial zones and parks, regulates their construction and development, and defines a framework for the management of operators. The improvement of existing and the construction of new industrial zones will continue during the new programming period with the financial support of the Operational Programme Regional Development 2021-2027. Given their function to ensure the interaction between research units and business, the industrial zones will also be supported under the new Operational Programme Research, Innovation and Digitalisation for Smart Transformation.

- Technology transfer offices

The technology transfer offices (TTOs) in the country have been established within various initiatives. Their goal is to stimulate the link

between science and business and to support the practical application of scientific results. Almost all TTOs are structural units of higher schools and institutes of BAS and the Agricultural Academy. Despite efforts to raise awareness of the importance of technology transfer, TTOs have failed to achieve significant results in the field of intellectual property protection and the application of scientific results. The main challenges facing them include lack of administrative capacity and sufficient human resources; fragmentation and lack of coordination with the main scientific unit and external stakeholders; insufficient funding; lack of clear IP policies; discrepancy between scientific results and business needs; inherited mistrust between the private sector and research institutes; lack of qualified specialists in the management and commercialisation of technology transfer. SARI's plans for the new programming period also include support for addressing these challenges.

Box 6. COOP⁴⁹ MOBILE STORES SERVE HARD-TO-REACH PLACES IN BULGARIA

The Central Cooperative Union (CCU) is a national union of consumer cooperatives, which unites 113,000 cooperative members, 665 cooperatives and 27 regional cooperative unions. They implement important social projects and serve over 2,754 settlements across the country.

In May 2020, CCU ordered the construction of 10 fully equipped mobile stores, which after delivery and the necessary registrations started operating in early 2021. Their task is to supply basic foodstuffs to remote, inaccessible and mountainous settlements in eight districts.

Under the same project, a mobile clinic was purchased and equipped, managed by the cooperative enterprise Zdrave EAD, Bankya. Through it, members and residents of mountain and hard-to-reach settlements in different regions of the country receive specialised mobile services in the field of cardiology, neurology, endocrinology and internal medicine.

„Mobile shops are a chance to show that cooperatives are always close to people, especially in difficult times. Without media advertising campaigns for eight months we managed to achieve the best ‘advertising’ – the gratitude, trust and kind words of people who had been left without health care and supplies of basic food,“ said Vanya Boyuklieva, Deputy Chairman of the CCU.

In 2021, the Union launched a project to promote the cooperative model and entrepreneurship among young people. The pilot stage envisages the establishment of educational herbal gardens in schools and kindergartens in the city of Sofia and cooperation with the “Todor Vlaykov” Vocational School of Economics, Klisura within the extended professional training, which already includes subjects on cooperatives.

Source: Applied Research and Communications Fund, 2021.

⁴⁹ The organisation was awarded in the category Social Innovation in the Innovative Enterprise of the Year 2020 Award for its project for mobile stores COOP, part of the Development Strategy COOP 2030.

- Sofia Tech Park (STP)

Sofia Tech Park is the first science and technology park in Bulgaria, established in 2015 as a public-private partnership. STP supports the commercialisation of scientific results, initiatives in the field of education and incubation of companies in sectors such as ICT, energy, biotechnology and others. STP consists of several units, including a business incubator, laboratories and exhibition spaces. However, even after the first seven years, STP management suffers from a lack of a vision for long-term development, a sustainable business model and clear commitments to key stakeholders.

- Clusters

Over the last decade, clusters have defended their role in strengthening the competitiveness of SMEs. Against the background of dozens of clusters created with the sole purpose of absorbing European funds and lasting until the completion of publicly fund-

ed projects, a group of about 20 clusters have consolidated their positions in innovation centres, including in the priority areas for smart specialisation.

- Enterprise Europe Network (EEN)

The activities of the Network during the new programming period will be aimed at improving the competitiveness and innovation potential of SMEs, increasing the degree of digitalisation and sustainability, integration into clusters, industrial ecosystems and global value chains. The ultimate goal is to achieve a tangible and measurable impact on the state of the SME sector, as well as support to overcome the negative consequences of the challenges facing entrepreneurs and small business. The Network will continue to offer Bulgarian SMEs a full range of services aimed at improving their performance within the EU single market (through transnational cooperation) and third country markets (through internationalisation). The main ones include the provision of consulting

services, the creation of partnerships and capacity building, and cover all stages of the life cycle of entrepreneurs – the creation, growth and entry into new markets. In addition to SMEs, the EEN target groups include all participants in the national innovation system, including business clusters and incubators, research organisations, business associations and alliances, national and regional administration involved in the preparation and implementation of innovation policies, green technologies and digital transformation.

The units of the research and innovation infrastructure in the country and the planned initiatives in this field should next become a favourable basis for the creation of lasting partnerships and networks, among which to share ideas and technological knowledge, which in turn to be embodied in new products and services. Only then will the investment achieve its goal of helping to address social challenges and achieve sustainable development priorities.

Investment and financing of innovation

Spending on research and innovation is a measure of the investment in the creation, use and dissemination of new knowledge in the public and business sectors. It is considered an indirect indicator of the innovation capacity of the national economies. A high ratio of R&D financing to GDP is a factor fostering dynamic economic growth and competitiveness.

R&D spending

In 2020, R&D spending showed a timid increase of 2% on an annual basis (against the background of a minimal decline in GDP), which is almost entirely the result of private sector efforts – nearly 3% growth in enterprise R&D spending and slightly above 9% growth by the non-governmental sector. The additional BGN 14 million invested in research and development by the public sector is almost entirely offset by the BGN 11 million reduction in the R&D budget of higher education institutions, which are mostly publicly funded.

Thus, R&D spending as a share of GDP in 2020 amounted to only

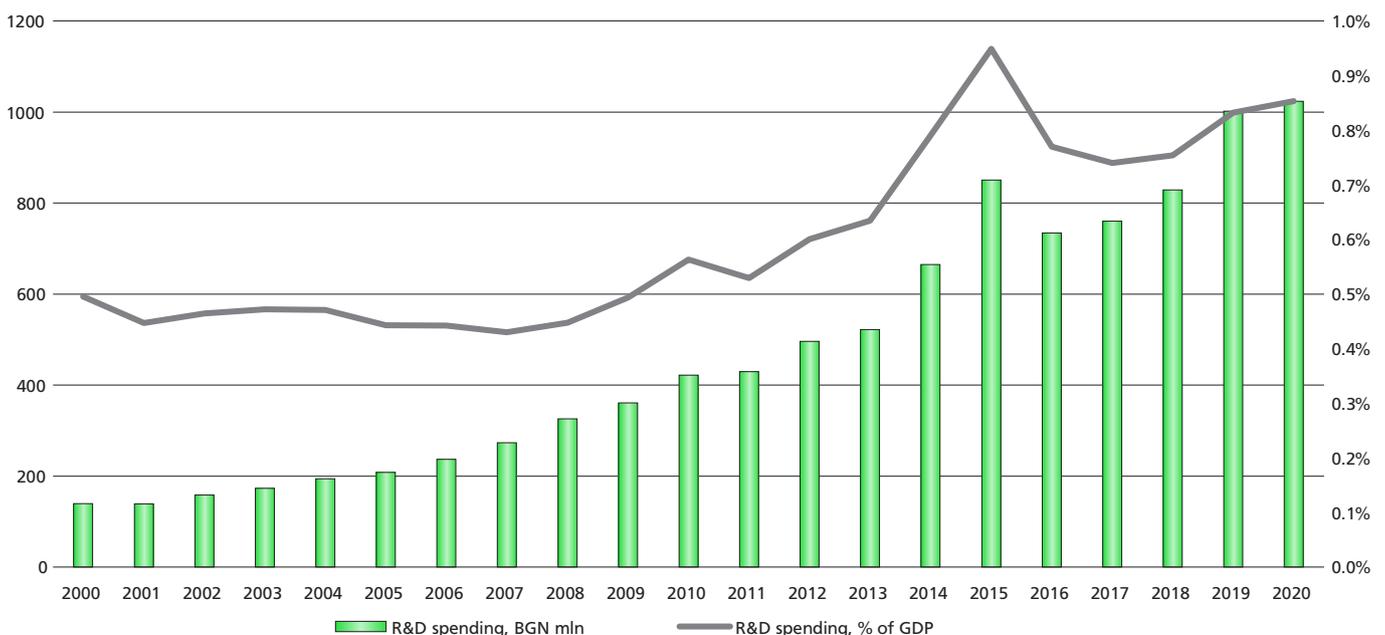
0.85% – significantly below the 1.5% set in the strategic and programme framework of the country for the seven-year period. This makes the catch-up development of the country's innovation potential over the next seven years extremely difficult, all the more so against the background of the new more ambitious plans of the innovation leaders.

Based on the relatively faster growth of business R&D spending, the enterprises sector retains leading positions in the indicator both in absolute terms and as a share of GDP – respectively BGN 691.08 million, or 0.58% share of GDP in 2020. The R&D

spending in the public sector reached 0.22% of GDP, and the higher education sector – 0.05%.

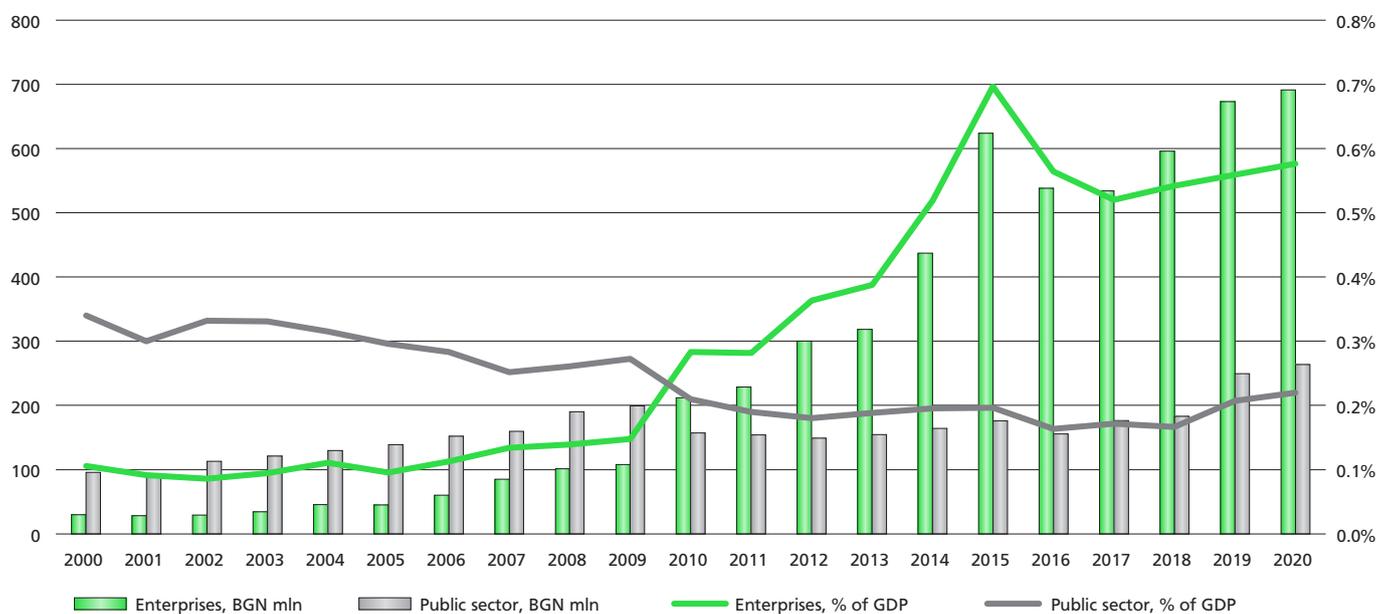
Despite the good examples of small and medium enterprises with innovative activity in the context of a pandemic and the flexible behaviour towards emerging market opportunities, some of which were presented in the *Innovation.bg 2020* report, the **SME sector as a whole is finding it more difficult to cope with the consequences of the crisis. In 2020, only large companies could afford to increase R&D spending.** In all other categories – micro, small and medium-sized enterprises – there was a

FIGURE 21. R&D SPENDING IN BULGARIA, 2000-2020



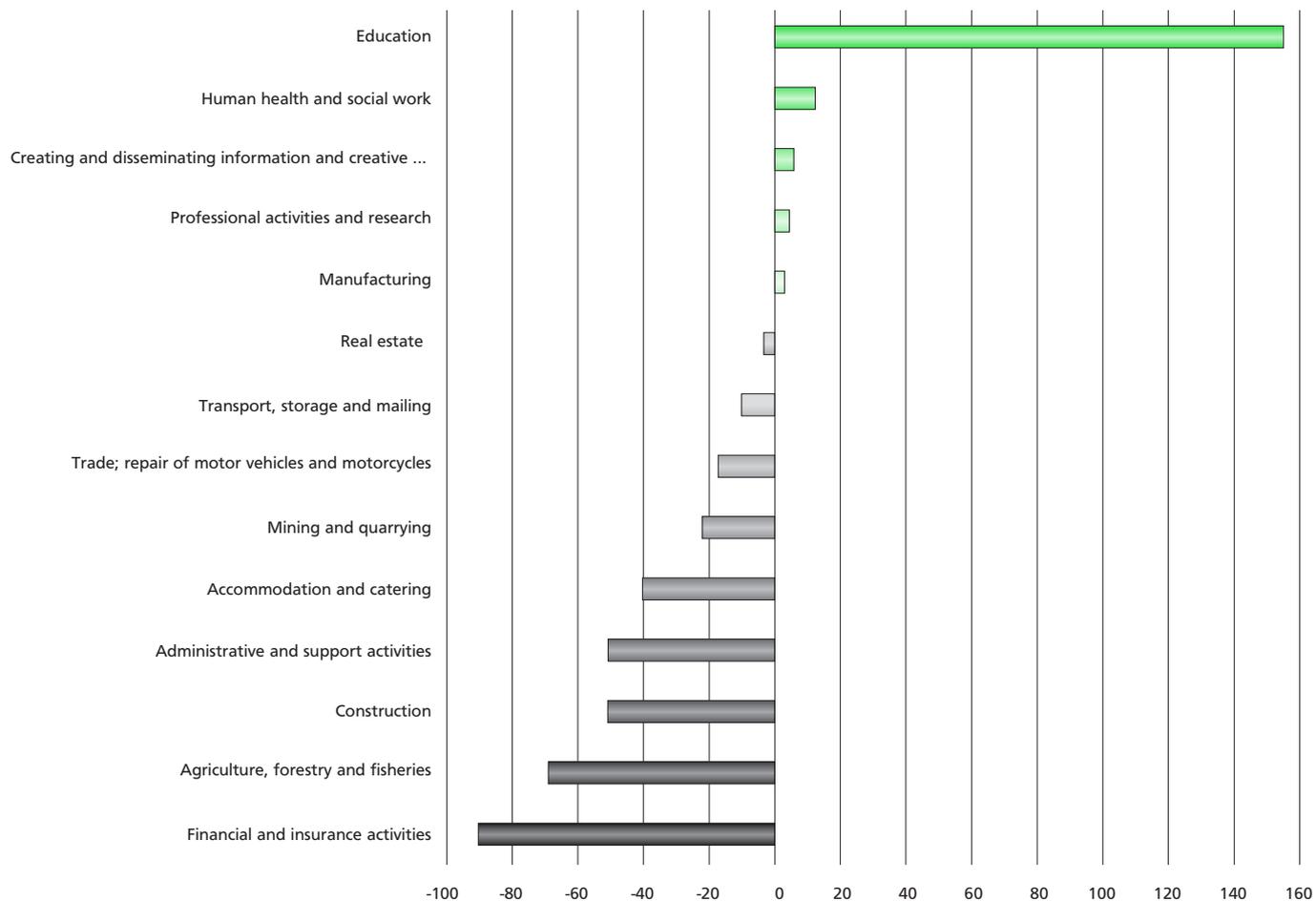
Source: NSI, 2021.

FIGURE 22. R&D SPENDING BY THE ENTERPRISES AND THE PUBLIC SECTOR, 2000-2020



Source: NSI, 2021.

FIGURE 23. ANNUAL GROWTH OF R&D SPENDING IN THE ENTERPRISES SECTOR BY ECONOMIC ACTIVITIES (CEA 2008), 2020, %



Source: NSI, 2021.

budget cut for research and innovation. This contraction is most drastic among the self-employed (16%) and small enterprises (10%).

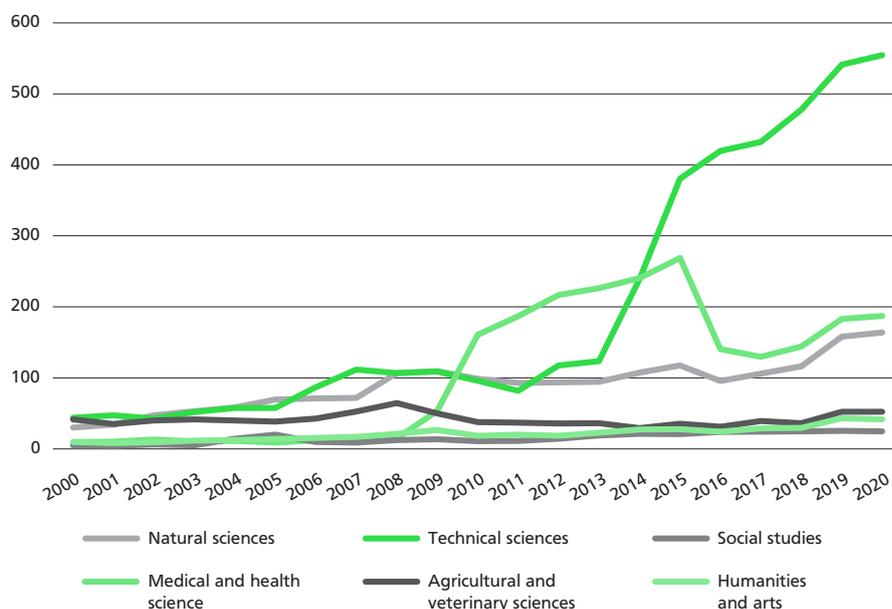
Despite the significant investments made in recent years in research infrastructure related to the establishment of centres of excellence, centres of competence, national research programmes and others, **the majority (over 90%) of R&D expenditures are spent on meeting current needs**, primarily for remuneration of researchers and technical staff, operational repairs, consumables and maintenance. Only 10% of the R&D funds are of an investment nature.

The structure of spending in the public sector and the enterprises sector differs significantly. After the period 2016-2018, when almost all funds (over 97%) for R&D in the public sector were spent on a current basis, by 2020 investment costs increased to 10%. In business, such structural shifts have not been observed. The average level of current R&D spending in enterprises for the period follows the general trend and varies around 90% of the total R&D spending.

Apart from higher education institutions and non-governmental organisations, which have extremely reduced their budgets for research and development (in the range of BGN 2.2-2.6 million in 2020 and the highest values after 2014), the remaining three sectors – enterprises, public sector and foreign sources – have somewhat levelled off their positions in terms of R&D funds. Since 2010, when funding from abroad (EU) became the major factor in promoting science, technological development and innovation, it has amounted to an average of 40% of all R&D spending in the country.

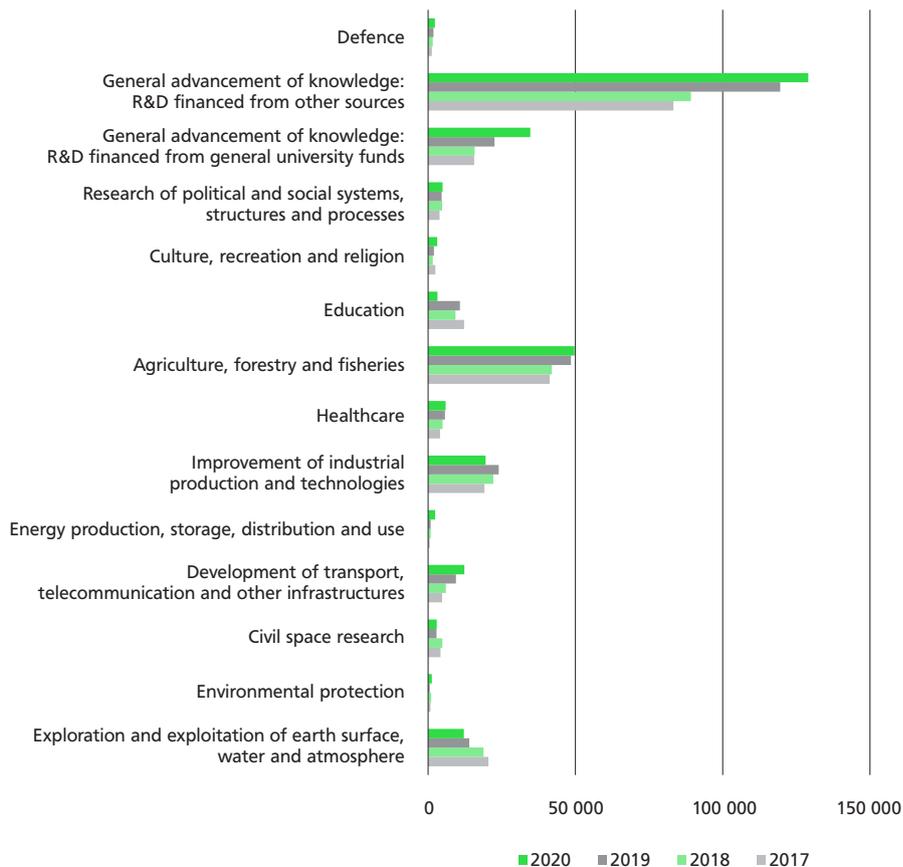
Foreign sources had the highest values immediately after the end of the first programming period of Bulgar-

FIGURE 24. R&D SPENDING BY SCIENTIFIC FIELDS, 2000-2020, BGN MLN



Source: NSI, 2021.

FIGURE 25. SPENDING ON R&D BY SOCIO-ECONOMIC OBJECTIVES, BGN THOUSAND



Source: NSI, 2021.

ia's full membership in the EU – 51% in 2014. In 2020, their share was just under 39%, or nearly BGN 40 million. The majority of them (90%) are enterprise-oriented, including European and national funding distributed directly through European and national instruments, as well as in the form of foreign direct investment. The foreign funds attracted by the public sector and higher education institutions were 5% and 4%, respectively.

In 2020, enterprises provided 36% of R&D funding (17% in 2010). Over 90% of them remained within the same sector, used in their own R&D units and to a lesser extent for covering technology transfer costs. A little over 6% of the business funds for R&D are directed to the institutes of BAS and the Agricultural Academy in the form of commissioned research.

The public sector is the source of 25% of R&D funding in 2020 (at 70% in 2000 and 43% in 2010). For the most part (85%), the funding remains locked within public sector units. Another 12% focus on higher education through joint projects.

R&D remains confined to the individual institutional sectors. The lack of cash flows among them testifies to the almost complete lack of interaction between science and business and to the low level of application of scientific products created in the country. The result is weak innovation activity of business and a low-tech focus of those who manage to innovate (with a 99% share of SMEs, most of which do not have the capacity to develop new technologies). The enhanced support for research and innovation infrastructure and technology transfer provided for in the Programme "Research, Innovation and Digitalisation for Smart Transformation" aims to address this problem and promote research-based business innovation.

Despite the Covid pandemic and the healthcare crisis, which put the whole society to the test, **R&D spending in the medical sciences in the crisis year 2020 increased by 2% compared to the previous year.** Funding for research in the natural and technical sciences has grown at a similar pace. Therefore, medical science has in no way been privileged as a result of the serious challenges posed by the pandemic and the high mortality rates in the country. Another important fact is **that 85% of the budget for medical research was covered by enterprises.** Medical universities have provided another 11% of funding for medicine, and only 4% of R&D spending on medicine was shared between the non-governmental and public sectors. It includes primarily the institutes of BAS and the scientific units of the Ministry of Health.

Enterprises provided most of the spending for R&D in technical sciences – a little over 90%. Far behind is the public sector with nearly 7% and technical colleges with nearly 3%. The public sector, however, is responsible for 94% of funding for agricultural sciences and 74% of R&D spending in the natural sciences.

Results of the distribution of European funding

Bulgaria is one of the countries that relies most on EU financial support. EU funds are an important factor in tackling structural challenges while promoting growth and competitiveness. The contribution of the European structural and investment funds in Bulgaria is expected to be measured by a growth of 5.5% of GDP in the period 2014-2020 and the creation of 200,000 new jobs. In 2020, additional funding of EUR 636 million has been provided to mitigate the effects of the crisis caused by the Covid-19 pandemic and to accelerate recovery (REACT-EU).

Within the programming period 2014-2020 Operational Programme Innovation and Competitiveness provides the largest resource in support of the innovation potential of business. As of July 2021, the contracted funds under the programme amount to BGN 4.375 billion, of which BGN 2.526 billion are European funding, BGN 446 million is national funding and BGN 1.403 billion is own financing by companies. The actual payments to beneficiaries amount to BGN 1.913 billion. The funds under priority axes have been absorbed as follows:

- Technology development and innovations – 87.13%;
- Entrepreneurship and SMEs growth capacity – 56.48%;
- Energy and resource efficiency – 98.79%.

Due to the relatively low level of absorption of funds under the Operational Programme Science and Education for Smart Growth by December 31, 2020, the effects of its implementation have been limited. The programme is expected to affect economic growth in two main directions – reducing the mismatch between supply and demand of labour as a result of improving the quality of education and reducing the number of dropouts from the education system and the development of high-tech sectors as a result of investment in the development of science.

Within the **new programming period 2021 – 2027**, the innovation of business will be supported by **two main financial instruments**:

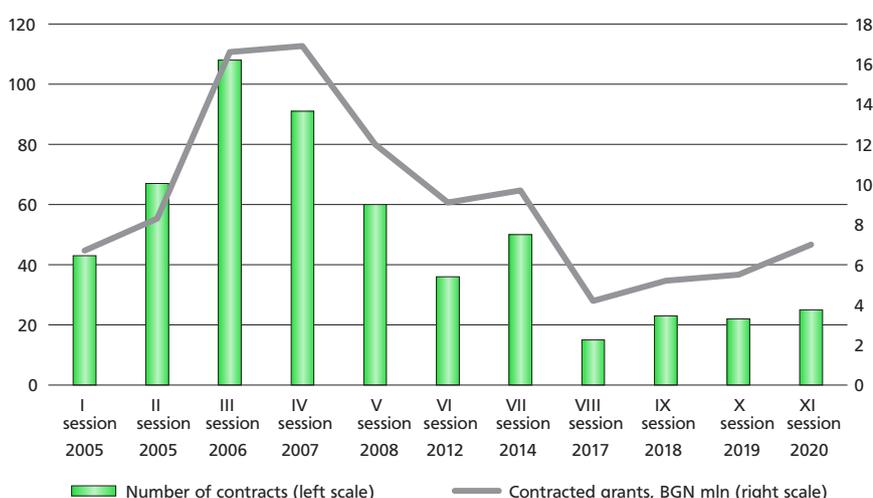
- Programme "Innovation and Competitiveness of Enterprises 2021-2027"

The programme will be managed by the Ministry of Economy and will be aimed at achieving smart and sustainable growth of the Bulgarian

Box 7. THE NATIONAL INNOVATION FUND – SMALL BUT SUCCESSFUL PLAYER ON THE NATIONAL INNOVATION SCENE⁵⁰

The National Innovation Fund (NIF) was established in 2004 as a programme managed by the Bulgarian SME Promotion Agency (BSMEPA) in implementation of the first Bulgarian innovation strategy with a wide range of potential beneficiaries. From the beginning of the programming period 2014-2020, together with Operational Programme Innovation and Competitiveness, NIF became one of the tools of the Innovation Strategy for Smart Specialisation. As such, it follows the priorities identified in the strategy, including mechatronics and clean technologies, ICT, wellness industry, creative and recreational industries.

The main goal of the Fund is to promote research and development in the business sector and thus increase the competitiveness of enterprises. The NIF finances the development of technological innovations with the exception of the last phases of the product life cycle and the launch of new products on the market.



NIF is financed by the national budget, which is adopted by the National Assembly on an annual basis. The existence of a financial instrument that uses entirely national public funding is an important element of the national innovation system. On the other hand, the limited budget of NIF and the lack of a long-term schedule for conducting the sessions creates uncertainty for business and does not encourage long-term planning of innovation.

For the last four sessions of the Fund after 2017, contracts worth a total of BGN 45,038,552.78 have been concluded, of which BGN 21,971,343 are grants and BGN 16,272,169.56 are co-financing from business (36% of the amount). The total number of supported innovation projects is 85. The interest in NIF is great, mainly from Sofia-based business. Although the share of the rest of the country has increased over the years, in 2020, 60% of the financed companies were from the city of Sofia (15 out of 25 companies). By comparison, in 2017 their share was nearly 88%, with only two of the 16 funded companies located outside the capital.

Source: Applied Research and Communications Fund based on data of BSMEPA, 2021.

economy. It supports two main EU priorities for: 1) a more competitive and smarter Europe by promoting innovative and smarter economic transformation and regional ICT connectivity; 2) a greener, lower-carbon transition to a zero-carbon economy and a sustainable Europe by promoting the transition to clean and fair energy, green and blue investments, a circular economy, climate change mitigation and adaptation, risk prevention and management, and sustainable urban mobility. The programme is funded by the European Regional Development Fund and has an indicative budget of EUR 1,699 million, which is being approved by the European Commission.

- Programme “Research, Innovation and Digitalisation for Smart Transformation”

During the third programming period of full EU membership, Bulgaria started a new programme in the field of science and innovation. Its indicative budget is expected to amount to EUR 883.29 million, sourced from the European Regional Development Fund. The funds will be distributed according to two main priorities: sustainable development of the Bulgarian scientific and innovation ecosystem and digital transformation.

⁵⁰ The Applied Research and Communications Fund is implementing a project under the 11th session of NIF through its consulting unit ARC Consulting Ltd.

Human capital for innovation

Staff engaged in R&D together with those employed in scientific and technological activities comprise the human resources directly responsible for the creation, application and dissemination of new knowledge in the area of technologies. The indicator of employment in high-tech sectors characterises the country’s specialisation in sectors with a high level of innovation.

Talent as a factor for green and digital transformation of the economy

The long-term goals of economic and social development of Bulgaria are closely linked to the European priorities for green and digital transformation. The measures envisaged in the Recovery and Resilience Plan are aimed at increasing the innovation potential of the economy and the capacity of businesses to absorb new technologies, transition to a digital, low-carbon and resource-efficient knowledge-based economy. In turn, the Innovation Strategy for Smart Specialisation considers economic transformation, including in priority

areas, as a prerequisite for the balanced development of the regions and for bringing the country closer to the average European levels in terms of innovation and prosperity.

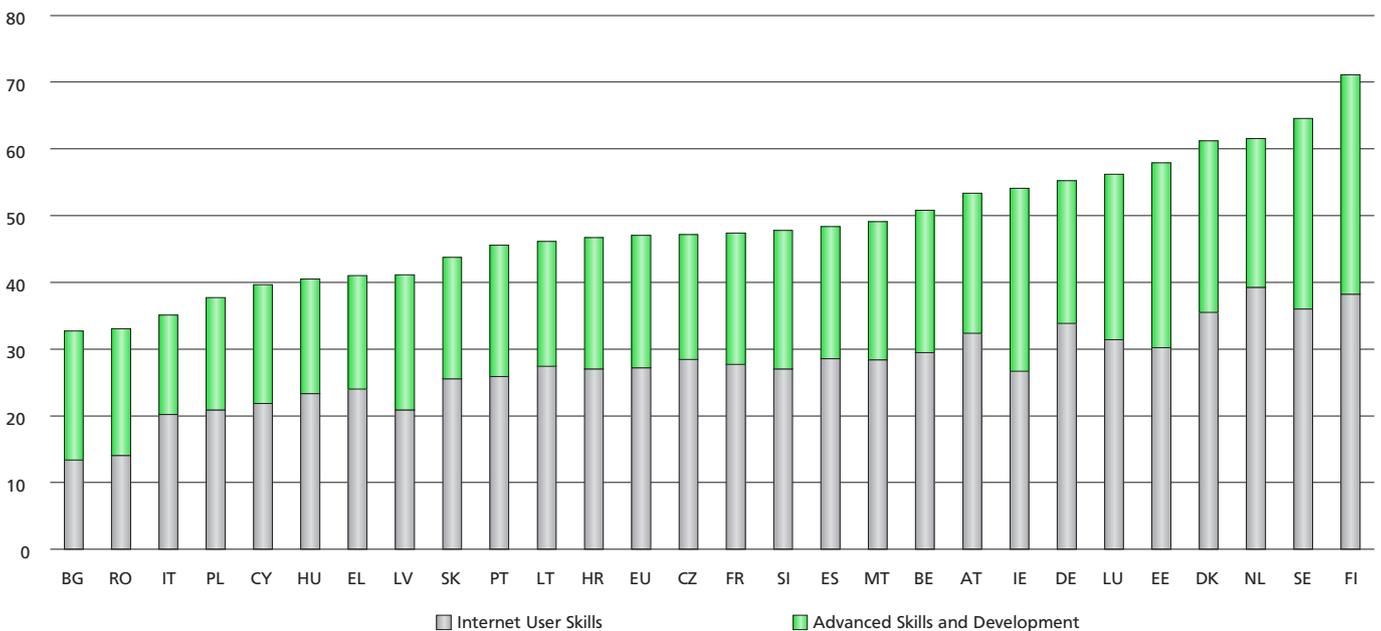
However, the increased funding envisaged in the strategic and programme framework of the country to achieve the ambitious goals will face a **deepening shortage of human resources** and discrepancies between the available and the needed skills and competencies on the labour market. The deteriorating indicators for

talent development put to the test both the practical implementation of the variety of measures and the effective use of the financial resources.

The main challenges facing the country include the following:

- There are demographic and structural problems of the population (negative rate of natural increase of -10 ‰; depopulation of rural areas – 73% urban population; deteriorating age dependency ratio – 57%). These are further exacerbated by the ongoing pan-

FIGURE 26. EU’S DIGITAL ECONOMY AND SOCIETY INDEX, HUMAN CAPITAL, 2021



Source: The Digital Economy and Society Index (DESI), 2021.

Box 8. FIRST ONLINE MBA PROGRAM FOR CEE COUNTRIES WITH BULGARIAN PARTICIPATION

In October 2021, Venrize Academy, a member of the Health and Life Sciences Cluster Bulgaria, and BBI Business School Cambridge signed a partnership agreement for creating the first online MBA program in biotechnology and health sciences for entrepreneurs and scientists from Southeast Europe – Bulgaria, Romania, Serbia, Montenegro, North Macedonia, Albania, Kosovo, Bosnia, Slovenia, Croatia, Greece and Turkey.

Starting in January 2021, the programme will run for one and a half years. It will allow for partial scholarships. BBI Business School Cambridge will offer the programme on its campuses in Cambridge and Barcelona. In them, students will be able to work on the development of new drugs, technology transfer, and business development in international markets. BBI Business School Cambridge has a team of teachers with extensive knowledge of innovation, management and business, which are applied in the dynamically developing fields of biotechnology, medicine, digital healthcare, pharmaceuticals. The programme unites the efforts of internationally recognised scientists, entrepreneurs, business leaders, and investors.

Venrize Academy offers online training opportunities for students and professionals from the countries of Southeast Europe. As a member of the Health and Life Sciences Cluster, the company creates an opportunity to share international experience for the development of startups, SMEs, and established companies in the region.

“The biotechnology and health sciences sector are among the fastest growing in Bulgaria. Since its foundation, the cluster has supported the acquisition of professional competencies by entrepreneurs and experts in the field, in particular internationalisation, innovation and planning. Therefore, for our ecosystem this MBA program is a huge opportunity. Joining forces with Venrize Academy and BBI Cambridge, we will provide for well-trained leaders in the sector, giving them an access to business skills and critical scientific thinking”, said Kristina Eskenazi, Chair of the Health and Life Sciences Cluster Bulgaria.

Source: Applied Research and Communications Fund, 2021.

demic and inadequate measures to deal with its consequences against the background of the unenviable state of the health system in the country⁵¹.

- There is a growing gap between supply and demand in the labour market in the emergence of new professions and the need for niche competencies. There are no indications that this disbalance is being overcome – the education system is adjusting slowly (significant untapped potential in the field of dual and vocational training), while business refuses to recognise the problems as its own and to contribute, for example, with on-the-job training.
- The digital skills of the population in Bulgaria continue to be among the lowest in Europe, which hin-

ment and the implementation of the technologies of Industry 4.0 by enterprises.

The level of digitalisation of public services in Bulgaria is 11 percentage points below the European average, but the most significant difference is in terms of their application – almost 31 percentage points below the European average.⁵² This entails missing out on ICT opportunities and poor use of the factors of the environment, such as digital skills, quality, connectivity and digital technologies in the private sector, which further slow down the effectiveness of e-government.

R&D staff

In the last three years, the number of R&D employees has remained al-

were added to this category of staff, despite the increased funding for research and innovation and the measures taken by the government to attract young scientists and researchers from abroad. The ratio of researchers to technical staff engaged in R&D is also preserved – two-thirds in favour of researchers. About 1% is the positive change in the number of R&D employees in enterprises and universities, which, however, is almost entirely offset by the decline in researchers in the public sector.

At the regional level, however, the changes are more drastic and lead to an even greater concentration of research capacity in SWPR (59%) at the expense of NEPR, NCPR and to a lesser extent SEPR. This concentration is most pronounced in the public sector – a little over 75%. In higher

⁵¹ The data is for 2020. Source: NSI, 2021.

⁵² eGovernment Benchmark 2021, Entering a New Digital Government Era.

Box 9. (UN)PREPAREDNESS OF HUMAN CAPITAL IN BULGARIA FOR A DIGITAL TRANSITION



29% of the population aged 16 to 74 have at least basic digital skills, compared to the EU average of 56%. Only 11% of people have above-basic skills, which is just under a third of the EU average. The overall level of basic digital skills in Bulgaria is the lowest in the EU (DESI, 2021).



ICT professionals account for 3.3% of total employment. This indicator is an increase compared to 2019 (equalling the values of 2018), although it is small as a share of the labour force given the labour market shortage and the faster increase in the EU average (which is now 4.3%) (DESI, 2021).



Women, however, are 28% of all ICT specialists, which makes Bulgaria a leader in this indicator in the EU (DESI, 2021).



68% of e-government services are digitised compared to 81% on average for the EU-27 (eGovernment Benchmark 2021).



42% of services are accessed with the use of an electronic identification solution, compared to 64% for the EU-27 (eGovernment Benchmark 2021).



Bulgaria is one of the EU countries with the highest levels of the index for the employment of overqualified workers. These levels are highest in trade (46%), transport and logistics (45%) and industry (35%) (Eurostat, 2021).



The share of employees with different educational training compared to the requirements of the profession is the highest in agriculture – 65% compared to 50% on average for the EU-27. There is also a significant discrepancy in the field of STEM and engineering (44%), humanities and arts (51%) (Eurostat, 2021).



12.8% of people aged 18-24 dropped out of formal education in 2020 compared to 10.5% in the EU-27. According to this indicator, Bulgaria ranks 6th among the member states. The share of people who do not look for work is 6%, compared to the EU-27 average of 2.3% (Eurostat, 2021).



32.2% of the population aged 15-34 participated in formal and non-formal forms of education and training in 2020, compared to an average of 41.7% for the EU-27. Among employees, their share is only 2.6% compared to the EU-27 average of 27.2%. According to this indicator, Bulgaria is ahead only of Romania (Eurostat, 2021).



14 per 1,000 people are STEM graduates in higher education, compared to 20.8 on average for the EU-27 (Eurostat, 2021).



16% of the population in Bulgaria in 2020 was employed in science and technology, compared to the EU-27 average of 21.7 % (only ahead of Greece and Romania) (Eurostat, 2021).



34% of employees in all enterprises in the non-financial sector use the internet, compared to the EU-27 average of 56%, ranking the country last in Europe (Eurostat, 2021).



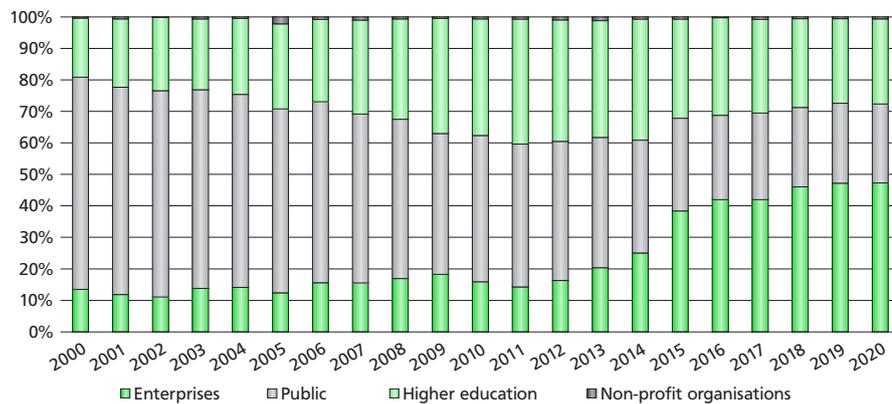
24% of the population in Bulgaria in 2020 used cloud services, which is the last place in Europe, along with Poland. The average level for the EU-27 is 35% (Eurostat, 2021).



7% of enterprises in Bulgaria in 2020 offered their employees the opportunity to participate in training – penultimate place before Romania, compared to an average of 20% for the EU 27. This includes small enterprises – 5% (EU-27 15%), medium-sized enterprises – 13% (EU-27 37%), large enterprises – 39% (EU-27 68%) (Eurostat, 2021).

Source: Applied Research and Communications Fund, 2021.

FIGURE 27. R&D STAFF, BY INSTITUTIONAL SECTORS, 2000-2020, %



Source: NSI, 2021.

education, the regional structure of R&D staff is most balanced – 38% located in the SWPR, followed by the SCPR and the SEPR with about 20% for each of them. The higher education sector demonstrates a more balanced structure of R&D staff from the point of view of different age groups.

Information and communication technologies

Information and communication technologies (ICT) are one of the most important engines for innovation in enterprises and growth of economies. ICT enter enterprises as general purpose technologies which are integrated in the new production and management processes. ICT also change the organisational boundaries and transform the models for adding value, competitiveness, and consumption. The effects of their use include decreased relative transaction costs, shortened product life cycles and structural changes in markets (convergence, concentration and power of bargaining).

The expenditure for R&D, patent activity and risk financing in the ICT sector exceed substantially that in the other sectors in the OECD countries. R&D, focused on ICT, nanotechnologies and new materials is among the most important driving forces leading to product innovations. The driving forces are connected to the health and leisure industries (including electronic games). The modern processes and marketing innovations cannot exist without ICT. The internet and web-based services have caused **important social innovations**, including such in the sphere of political processes and government. The ICT infrastructure is already considered an essential element of the critical infrastructure of each country, while the issues of digital security are of primary importance for the policy of each country or corporation.

The boundaries of economic sectors, cross-sectoral balances, employment and value chains continue to change under the influence of ICT. For the second year in a row, 21 of the 100 largest companies in Bulgaria (providing 21% of employment) are from the ICT sector.

The vertical segments of the outsourcing of business processes for customer service (internal and external) and software such as telecommunications, electronics, information services are developing in a balanced way with increasing added value. The pandemic has had varying dynamics and effects. Companies such as Sitel achieved significant growth of over

20% in employment in 2021, others had more modest growth such as Callpoint New Europe by 7%, while Telenor had a small decline of 2-3%⁵³.

The growth in exports of a number of IT hardware companies has also led to **the expansion of production capacity and diversification of products** and the entry into new verticals. One example worth following is EGT Bulgaria, which looped the production cycle in gaming machines, management software and online betting platforms and in this way positioned the company as one of the largest players in this market internationally.

IT services: the big winner in a pandemic

The telecommunications, computer and information services sector is the big winner with a growth of 35% among services in the last two years of the pandemic (with a total decline in services by 27%)⁵⁴. It increased its share in the revenues from all services from 10% in 2011 to 24% in 2021 and is estimated at **around EUR 2.2 billion in revenue per year**. The export of telecommunications, computer and information services is growing integrally (international hosting, data centres and artificial intelligence and customer service through various channels – e-mail,

chat and voice) and is increasing its importance, measured as a share of exports of IT services to the whole export of physical products by over 18% in the two years since the beginning of the pandemic.

Greater external demand for information services **draws other markets and niches** – through labour migration from West to East and North to South in Europe, construction of high-end office buildings and housing market development to the development of dynamic competencies in the local consulting market (especially in the field of flexible and human resource management) and in education. **Most ICT companies collaborate with universities** to attract the staff they need, from financing capital expenditures and offering internships to providing real-world data to developing rapid prototypes of new services. This type of collaboration between business and universities will naturally grow into joint research and publications.

Bulgaria has established itself as a **key centre of competence for customer service** in various fields such as fintech and insurtech, gaming (classic and gambling), artificial intelligence applications (Schwartz IT), big data (Experian) and semantic analysis (Ontotext⁵⁵) and analysis

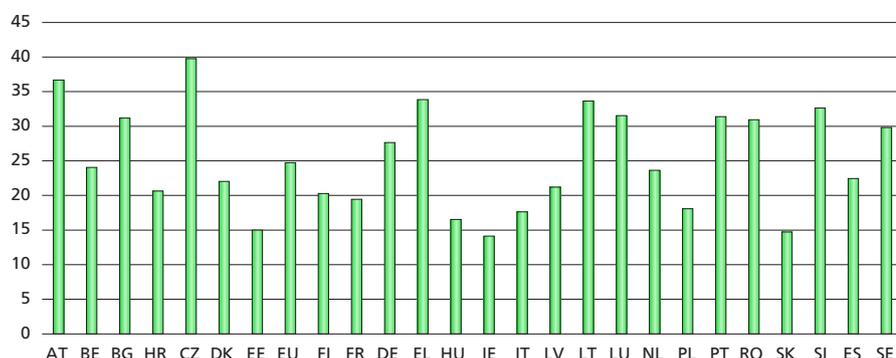


⁵³ Measured by the average monthly socially insured persons for the first 9 months of 2021 compared to the average monthly for the whole 2020.

⁵⁴ BNB balance of payments data.

⁵⁵ Winner of the 2014 prize in the Innovative Visionary category of the Innovative Enterprise of the Year Award 2014 of the Applied Research and Communications Fund.

FIGURE 29. SHARE OF ENTERPRISES WHICH USE AT LEAST TWO ARTIFICIAL INTELLIGENCE TECHNOLOGIES



Source: Index DESI, 2021.

However, there is also a lag behind European averages in three artificial intelligence technologies. This is due, on the one hand, to the lack of freely available quality technologies for **word processing in Bulgarian**. This is directly related to the lower use of such technologies for sentiment analysis and the contextual connotations of key expressions. On the other hand, an additional factor affecting the latter technology is that the domestic market is too small to develop algorithms that work only in Bulgarian. In Bulgaria, however, there is a sufficiently rich ecosystem of companies with their own technologies in these areas, which sell products on the international market (Ontotext, A Data Pro).

In this regard, the Bulgarian government could support **the adaptation of international ICT products in the local language**, which will increase their use by the population and companies.

Barriers to the development of artificial intelligence

Barriers to the development of the information society and the digital economy in the country are more often associated with the need to **change the laws and their implementation** (37% for Bulgaria compared to 29% for the EU) and the lack of sufficient trust from the population and consumers (34% for Bulgaria and 28% for the EU). In all oth-

er external barriers, Bulgarian companies feel better prepared to cope than their European counterparts.

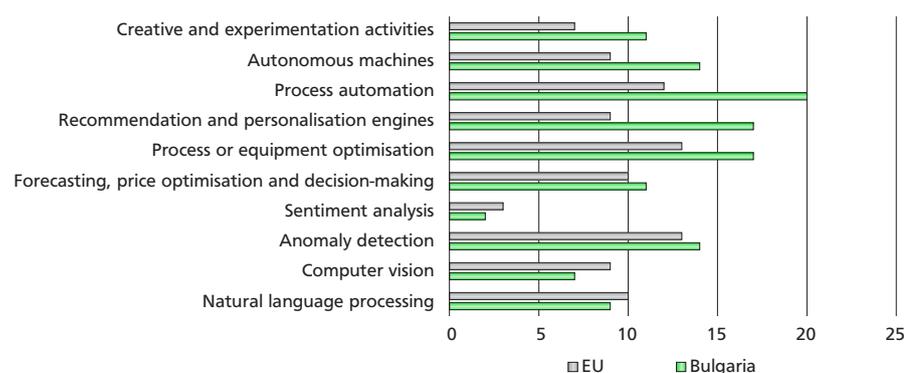
According to the availability of **open data**, Bulgaria is at the average European level (index = 0.777 for Bulgaria and index = 0.781 for the EU). In some specific niches, however, the availability of such data in Bulgaria prompts faster prototyping and piloting of services, which are later implemented at the international level⁶¹.

To a much greater extent, Bulgarian companies see the reason for not planning more applications of artificial intelligence technologies in themselves – mostly lack of funding and staff. However, these factors can easily change if companies see a clearer business need and market demand. Large companies such as Schwartz IT are already implementing partner master’s programmes (for example with the Faculty of Economics at Sofia University “St. Kliment Ohridski”) for the application of artificial intelligence in business. IBM’s academic programs also include similar support, which is expected to increase the number of staff with knowledge in the field of artificial intelligence.

E-commerce

In 2021, Bulgaria is still at the rear of the European Union in terms of the share of turnover of enterprises realised through e-commerce (3.03% compared to 11.7% for the EU and 18% for Czechia, the best performing country in Eastern Europe). The country also occupies the same place in terms of cross-border e-commerce (3.21% compared to 8.43% for the EU and 15.3% for Czechia). However, in 2021 there is a very strong development in the field of e-commerce.

FIGURE 30. SHARE OF ENTERPRISES USING SPECIFIC ARTIFICIAL INTELLIGENCE TECHNOLOGIES



Source: Index DESI, 2021.

⁶¹ Biz Portal is an example of commercialisation of research and development in the non-governmental sector, piloted on Bulgarian data and provided as a global service.

APPLIED RESEARCH AND COMMUNICATIONS FUND

The Applied Research and Communication Fund (ARC Fund) is a European think-and-action tank in the area of innovation, business support, and knowledge and technology transfer, established in 1991. For this purpose, ARC Fund:

- Develops **policies and strategies** in areas crucial for advancing innovations;
- Analyses development trends and policy options for supporting **entrepreneurship and innovation** for smart specialization and industrial transformation;
- Applies innovative educational methodologies to enhance the digital and media literacy of young people and create a **safer internet** environment.

The Applied Research and Communication Fund is part of the **Enterprise Europe Network (EEN)** – the largest EU network for supporting SMEs, and coordinates EEN’s activities in Bulgaria for technology transfer and facilitating internationalization.

ARC Consulting EOOD is the consulting arm of the Applied Research and Communications Fund, specializing in the implementation of international projects.

ARCFUND

Applied Research and Communications Fund
5 Alexander Zhendov St., 1113 Sofia, Bulgaria
tel. +359 2 973 3000
arc@online.bg
www.arcfund.net

