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Innovative Development and Competitiveness of the Industrial Sector in Bulgaria

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***Abstract*— This article presents methods for assessing the innovative development and compe-titiveness of the industrial sector in the Republic of Bulgaria. Guidelines and recommendations for their acceleration are indicated. A cross-section of the Bulga-rian industry is also made, assessing the innovative acceleration of the technologies used.**

Keywords*— *Competitiveness, Industrial sector, Innovative development.

I. INTRODUCTION

The processes we have witnessed in recent years have one common feature – the speed of ongoing changes, the transfer of knowledge, the competiti-veness of individual industries and productions on a global scale, the innovative obsolescence of techno-logies. A partial analysis of Key Enabling Techno-logies and their influence on the innovative deve-lopment of industry in the Republic of Bulgaria has been made, which is presented in Table 1. A key factor in the future will be innovative obsolescence and the timely response of companies.

In this paper, we present our analysis of the six KETs, presented in Figure 1 and Table 1, that are of para-mount importance for Europe's technological sove-reignty in the future. For each presented KET, we provide a definition, describe its main uses and its importance and potential for Europe, with respect to technological sovereignty, and social and economic impact. In this context, we will also outline the main challenges and requirements along the technological value chain. All information reflected in this chapter is based on desktop research and interviews with experts from industry and academia. Throughout this chapter we also present five different case studies that use or build on one or more KETs.

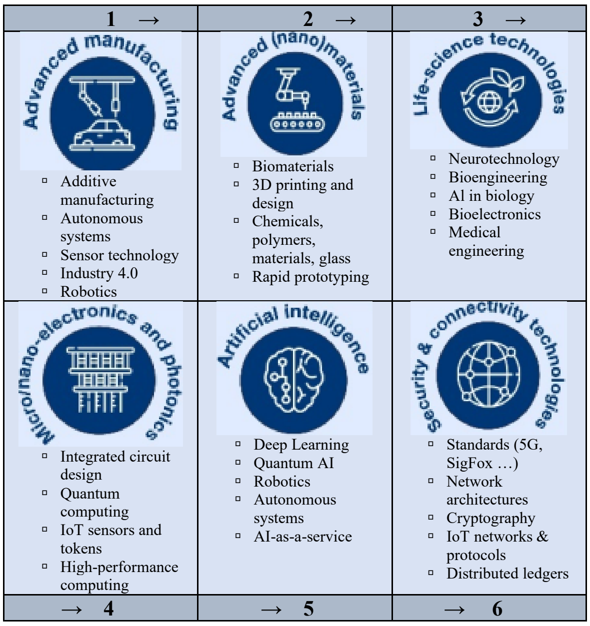

Fig. 1. Key Enabling Technologies (KETs) by 2024

TABLE 1 KEY ENABLING TECHNOLOGIES

KETS		Examples	Societal Challen ges	Missions
Production Technologies	**Advanced Manufactu-ring Technologies**	Smart, high performance, high precision and additive manufacturing and processes, Robotics, Process Industry, Green Propulsion Technologies, Integrated Bio-refineries	**ENVIRO MENT**	**Missions …**
	Advanced Materials and Nano-technologies	High performance, smarts sustainable materials, Nanomaterial's,	**ENERGY**	

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		Nanotechnology, Biomaterials, 2D Materials, Light Weight Technologies, New Chemistry		
	Life-Science Technologies	Industrial Biotechnology, High throughput biology, Automation for biology, Synthetic biology, Genomics (Genome Engineering/Synthetic Genomes) Cell & tissue engineering, Biologisation of manufacturing, Biosensors, Bio Activators, Bio Actuators, Lab on a Chip, New Chemistry, Neurotechnologies	**MOBILITY**	
Digital Technologies	**Micro-/Nano-electronics and Photonics**	IoT, Smart/Intelligent sensors, Quantum technology, Supercomputing (high power, high performance, neuro-computing, beyond CMOS), Displays (LCD, Plasma) & Lighting (LED, OLED), Photonics integrated circuits and Biophotonics	**HEALTH & WELLBEING**	**Missions …**
	Artificial Intelligence	Data generation and handling, Big data analytics, Machine learning and deep learning, Smart Robots, Virtual agents, Software Technologies, Decision making technologies	**FOOD & NUTRITION**	
Cyber Technologies	**Security and Connectivity**	Secure and Authenticated Communication, Avoiding identity thief, Data protection and privacy, IoT, Data/Connectivity Safety and Security, Human-Machine Interfaces, Hunan-Computer/ Robot Interaction, 5G, Baseband/processor platforms	**SECU-RITY** / **PRIVA-CY**	**Missions …**
		e-Governance, e-Administration, e-Voting, Cyber-Physical Systems, e-Safety and e-Security, Technology Assessment, Blockchain	**INCLU-SION & EQUALITY**	

II. Materials and Methods

After conducting a SWOT analysis of the innovative development of industry in the Republic of Bulgaria based on data from the National Statistical Institute and on-site research on key elements (technology, efficiency and regulators), we decided to conduct an analysis on the following key elements: Advanced manufacturing, Materials, Life-science technologies, Micro/nano-electronics and Photonics, AI. We define European technological sovereignty as the ability for Europe to develop, provide, protect, and retain critical technologies required for the welfare of European citizens and prosperity of businesses, and the ability to act and decide independently in a globalised environment [11, 12]. This definition encompasses three key elements:

- Technological – the development of European R&D competencies by maintaining a strong knowledge base, strong industry, and strong networks in the critical technologies [14, 15];
- Economic – the achievement and preservation of a position of leadership in KETs, the ability to turn R&D into market products, and having access to a diversity of resources along the value chain with the aim of reducing dependence on third countries;
- Regulatory – the development of adequate policies and standards to influence global regulation, standards, and practices that reflect European values.

Advanced manufacturing describes the use of innovative technologies and methodologies in the manufacturing domains to improve existing products or create new ones. The main ambition is to enhance the output of manufacturing through improved and more efficient processes as well as high-performance production facilitated by digitalisation, i.e. production and manufacturing activities that build on data, computational results, automation, or sensing. Thus, advanced manufacturing and related technologies can boost productivity by increasing flexibility and making it viable for more and more manufacturers to offer highly customised products to customers. In addition, manufacturers can produce in smaller batches for specific customers or more easily adjust their production to design changes [22]. Advanced manufacturing encompasses different topics and applications, including but not limited to:

- Additive Manufacturing;
- Industry 4.0 concepts;
- Industrial-IoT;
- Manufacturing process optimization;
- Sensor technology;
- Interconnectivity between factories and manufacturing sites;
- 5G and 6G;
- Intelligent robotics;
- Autonomous systems;
- UAV technology
- Telecommunications;
- Operating systems for various nodes.

The applications of this KET target all manufacturing processes and domains. Given the current challenges of EU Member States in terms of declining population, increased automation in production and manufacturing could help address labour shortages expected in the coming decades. Furthermore, processes in factories and production should be further optimised and improved to increase the competitiveness of the European economy. This KET will increase the overall quality of products as well as the responsiveness to market changes, allowing manufacturers to quickly adapt their manufacturing processes to the market situation. The necessary time to market, as well as unit quantities, can be reduced, so manufacturers could have a competitive advantage compared to manufacturers using solely traditional manufacturing methods. Advanced Manufacturing also allows manufacturers to produce high-quality goods made to buyers exact specifications.

Efficient processes and production facilitated by digitalisation require interconnectivity between factories, exchange of relevant data sets, using sensor networks to gather necessary manufacturing data, and using new technologies (e.g. Augmented or Virtual Reality) to train new workers. Workers need to acquire specialised digital and technical skills to be able to make use of the full potential of advanced manufacturing. Our research and the interviews we conducted indicate, however, that there is still a struggle within the established industrial community to understand the overall expected benefits of advanced manufacturing in the manufacturing domain, leading to disadvantages in the context of remaining competitive on the market. Advanced manufacturing will pose a challenge to the job market, as some jobs will be at risk due to automation, e.g. in the context of 'predictive maintenance' or assembly lines. A gradual introduction of ICT in traditional manufacturing can minimise the negative impact while maximising the expected positive aspects. This should be combined with corresponding trainings in order to meet the required skill levels of the workers [18, 19, 20].

Materials impact humans in almost every single aspect of life and have a huge impact on the environment, economy and society in general. This KET includes the research on advanced smart materials for the fabrication and production of a new generation of products. Generally speaking, advanced materials refer to materials (e.g. polymers, metals and alloys, glass, ceramics, composites, etc.) with new or improved properties that increase their performance over conventional products and processes. Advanced materials can facilitate the transition to more sustainable technologies with improved characteristics and enhanced performance. This is strongly aligned with Europe's goals in the context of the European Green Deal and industrial strategy [22].

R&D in this area will enable advanced processes and products to be provided by the European industries while reducing the negative environmental impact and positively influence European societies. Advanced materials in the automotive sector will directly lead to reduced emissions having a positive impact on Europe's goal towards a sustainable future, which is directly related to the European Green Deal. According to the US Office of Energy Efficiency & Renewable Energy: 'Advanced materials are essential for boosting the fuel economy of modern automobiles while maintaining safety and performance. Because it takes less energy to accelerate a lighter object than a heavier one, lightweight materials offer great potential for increasing vehicle efficiency. A 10% reduction in vehicle weight can result in a 6% - 8% fuel economy improvement.

Future advancements in material-related research will increase the competitiveness of European products and companies on the global stage (e.g. automotive, aero-space industry, energy sector, etc.) thereby also creating new jobs in the corresponding industries. Main challenges and requirements along the technological value chain Similar to advanced manufacturing, securing access to necessary raw and processed materials is of utmost importance for the development of this KET. The transition towards a sustainable circular economy has the potential to help overcome the resource challenge. It will maintain the value of products and used raw materials for as long as possible, while at the same time minimising the generation of waste. Since materials are so fundamental for the global economy, they have a heavy impact on supply and value chains. The main challenge is to focus on flexible and lean supply chains thereby enabling rapid prototyping and faster adjustments to market changes facilitated by digital enablers and other relevant developments. Europe should try to shape a viable path towards the creation of technological eco-systems that are socially and economically just. Improved technological ecosystems would lead to new jobs for the European economy. However, these jobs will require specialised digital skills that are currently in shortage.

In general, ***life-science technologies*** can be seen as an intersection of engineering and life sciences dealing with the technical use of findings related to life science, especially in the interrelation of biology, automation and digitalisation. On the one hand, the profound understanding of the functioning of living systems enables the production of new or improved products as well as processes for e.g. the pharmaceutical/chemical industries or for environmental technology [10]. On the other hand, knowledge related to engineering is needed to integrate biological systems into technical processes (e.g. the production of pharmaceutical ingredients in sufficient quantity and quality). The Covid-19 pandemic has shown that the sufficient production of high-quality vaccines is a very complex task, influenced by many different stakeholders and dependent on different raw materials, reinforcing the importance of this KET with respect to technological sovereignty. This is strongly aligned with Europe's goals in the context of Horizon Europe (especially in the health cluster).

Based on the most promising use case scenarios in the context of life-science technologies, Europe can transition to a resilient and healthier European society in terms of new medical achievements and applications such as optimised pandemic responses, innovative products based on conducted research or technological implementations. For example, lab-on-a-chip is envisioned to facilitate automation and high-throughput screening which is especially relevant in the context of the Covid-19 pandemic. The positive impacts are not limited to health only, they can also be expected in the domains of agriculture, medicine, pharmaceuticals and food science [13].

Life-science technologies use specialised raw materials (such as lipids, cells) for research and for high-quality and high-quantity production. Similar to other KETs, here we observe a strong dependence on non-European suppliers, which became especially acute during the Covid-19 pandemic. For example, appropriate trade agreements and diversified supply chains are required to address pricing policy, price pressure, and other challenges.

The ***micro/nano-electronics and photonics*** relate to all types of digital and computing technologies in the magnitude of high-performance computing and communication based on micro/nanoelectronics. The major goal of micro/nano-electronics is to improve the performance of electronics, while at the same time reducing their size, weight and/or power requirements. Thus, micro/nano-electronics play a fundamental role in further digitalisation or technological advancements in general. The micro/nano-electronics and photonics also relate to computing based on photonic principles – i.e. optical/photonic computing - that use photons produced by lasers or diodes for computational aspects, in order to provide an alternative computing approach with improved characteristics related to bandwidth, signal loss, etc. compared to traditional computing [16, 17].

Micro/nano-electronics play a fundamental role in many different application domains in our everyday life as well as in support of other KETs. Their range of application is enormous: smartphones, laptops, automotive, aviation, robotics, industrial automation, health, medicine, lab on chip, sensor networks, additive manufacturing, smart cities, logistics, pandemic prevention and more. Advancements related to micro/nano-electronics directly influence the lives of every European citizen and are of paramount importance in order to stay competitive on the global market. In addition, a special focus should also be put on the future application of quantum technology, in order to maintain and improve the competitiveness of the European industry and society. Furthermore, the overall digitalisation pushed by such technologies is a game changer on a global scale.

The highly specialised domain of micro/nano-electronics and photonics require highly educated researchers and industrial experts, who are in deficit in Europe. In addition, the supply and value chains in these domains often encompass non-European suppliers and know-how carriers, and European research results are mostly commercialised in third countries. The dependency on nonEuropean manufacturers puts Europe in a weaker position in the global geo-political competition. The main challenges are, therefore, to bring back some of these supply/value chain parts and know-how to Europe and to foster a new generation of experts, who not only have the potential for research-related breakthroughs but also for the commercialisation of research, strengthening the position of Europe. Quantum computing hardware is experiencing challenges on the fundamental-science level, i.e. instability of the basic computing units (qubits), which compute results that are still heavily influenced by noise and are hence imprecise. Targeted research on fault-tolerant computing is required to reduce error rates [8, 9].

AI is the science and engineering of developing intelligent systems which perform tasks that typically require human intelligence. It comprises intelligent decision making based on automated choices, which are obtained by algorithms processing predefined rules or analysing large amounts of data, learning the decision models and applying these models in particular situations. Modern AI-based algorithms and systems are mainly driven by huge amounts of data. The superordinate goal is to detect patterns in the available data, which are later used during the decision-making process. Therefore, the increasing availability of data and the tremendous advances in computing power are key drivers of the current success and boom of AI [4].

Large amounts of data are available over IoT platforms and Open/ Big/ Commercial Data Platforms across the EU. Utilizing such data sets and processing them with state-of-the-art AI techniques will lead to new products, optimised processes and improved industrial processes in many domains. It will increase the quality of life across Europe. AI has the potential to revolutionise manufacturing by improving or automating many industrial processes. This can help to counteract the shortage of skilled labour and strengthen European industry. AI can also be used for predictive maintenance to increase the lifetime and reliability of industrial facilities and production lines. The use of AI in the field of mobility and autonomous driving holds enormous potential for Europe. It can help to reform the European car industry by developing new technologies and business models to make this industry more sustainable and future-proof. In mobility, AI can disrupt the traffic and public transport sector in many European cities. Automation and intelligent transport systems can reduce costs and enable the implementation of cleaner transport systems. The high amount of traffic in many European cities can be reduced through the additional demand-oriented usage of shared selfdriving cars. These actions will result in a sustainable reduction in environmental pollution and noise levels. In the long-term, this will increase the quality of life and make European cities more attractive to live in. AI has a great socio-economic potential. AI can be used to develop new business models and help to counteract the shortage of skilled labour. AI can be applied in the medical sector and healthcare systems which will result in an increase in the quality of life. For example, AI can be used to develop new medications and treatment therapies, to improve diagnostics and prevention of diseases and to support trained medical professionals. Finally, AI can contribute to the mitigation of climate change through intelligent energy and waste management and automated analysis of climate data.

III. RESULTS AND DISCUSSION

For the purpose of the discussion, we have presented some of the results obtained, which are summarized and graphically illustrated in the following figures, including a comparison in the time period 2019 - 2023 for the industry in Bulgaria and data for the EU are presented.

Since AI algorithms are driven by data, the availability, quality, and integrity of datasets is one of the most challenging requirements associated with AI. Availability of data to all EU citizens through Open Data portals, Geo-Information Systems, IoT networks, and various one-stop-shop platforms is critical. The use of AI in safety-critical areas such as manufacturing, medicine, energy management, or autonomous driving means that safety and functionality must be ensured at all times. Explainability, accountability, and transparency of AI-based algorithms and applications is another crucial challenge, which has not yet been solved and must be a focus of further research. Black-box AI systems cause uncertainties in automated decision-making and entail not only security risks but also legal challenges. Explainability and transparency are also basic requirements for the standardisation and certification of AI algorithms and applications – which is another significant challenge. Standardisation and certification should ensure both the quality and dependability of AI systems as well as their compliance with the EU's ethical requirements. This is an area where the EU has the potential to take a leading role internationally. The recruitment of highly skilled researchers and workers experienced in mathematics, stochastics, and computer science needs to be ensured and the current brain drain reversed. Europe struggles to attract and retain international talent, and European companies (especially SMEs) suffer from the lack of financial resources to establish internal teams of experienced AI experts, which currently prevents businesses from using AI for business model innovation. The emerging cloud-based AI-as-a-Service (AIaaS) helps to address this challenge as it requires less experienced personnel and therefore gives SMEs a fair chance to use AI.

The security and connectivity technologies are a fundamental enabler and building block for other KETs and for digital transformation. These technologies are ubiquitous due to the ongoing digitalisation and growing deployment of IoT devices.

Technologies based on this KET will lead to increased connectivity, digitalisation, and cybersecurity in Europe and result in a larger set of optimised processes, increased quality of life, and better services for European citizens. Therefore, the use and further development of these technologies support the EU strategies towards advanced Connectivity for a European Gigabit Society and Cybersecurity.

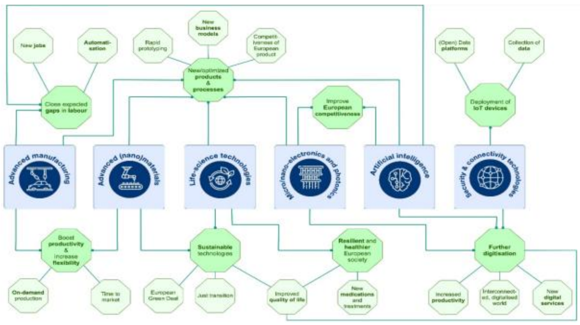

Fig. 2. Positive impacts and light green indicates

Specifically, this KET will enable the development of new, better, and more secure digital services with high quality for European citizens. These can increase quality of life and will additionally enhance the attractiveness of Europe by accelerating digitalisation. Security and connectivity technologies will intensify and speed up the deployment of IoT devices, which will also boost the development of (open) IoT platforms. This wide-spread roll-out of IoT devices will enable the autonomous and secure collection of data on a larger scale.

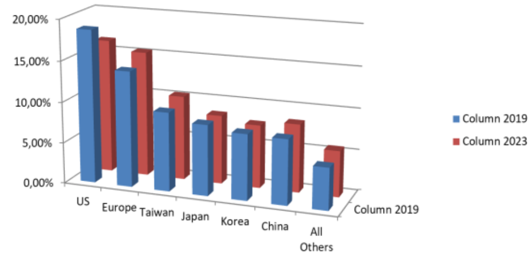

Fig. 3. Evolution of R&D intensity in 2019 (blue) and 2023 (red) in the semi-conductor industry

Such a strategy would itself consist of a multitude of actions, some of which we have proposed for various areas relevant to the development and deployment of KETs in Europe. These actions aim to address economic and technology elements of technological sovereignty. Specifically, we have grouped additional policy options around the four identified challenges.

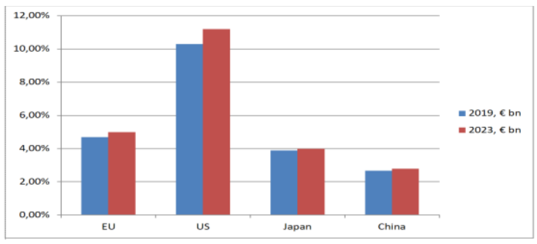

Fig. 4. R&D investment growth of the top 2 500 companies, in %, 2019-2023

Although European countries strive to achieve a common goal - to make Europe the most competitive knowledge-based economy, and although they work together to build a common research area, both the approaches to shaping science and technology policy applied at the national level and the registered achievements from its implementation remain extremely diverse, due to cultural differences.

In Bulgaria, in mid-2024, the European Innovation Center and the sociological agency "Vitosha Research" surveyed 1053 manufacturing enterprises in order to establish their technological potential and their need for new technologies.

Manufacturing enterprises have the largest share (just over 40%), followed by those providing services with 38%. The study also covers 61 engineering and 5 research organizations, as well as one technology incubator. According to the form of ownership, the largest number of private enterprises (889 or 84%), owned by local individuals. They are followed by enterprises with state or municipal ownership (4.3%). The same number (35 or 3.3%) are enterprises with mixed ownership (state and private or private by Bulgarian and foreign persons). The smallest share are enterprises with entirely foreign ownership – only 26 or 2.5% [1, 2, 3].

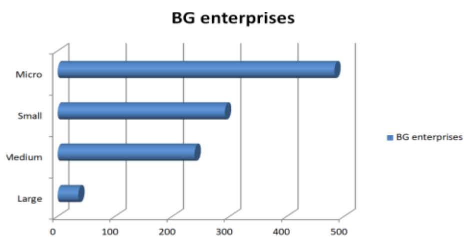

Fig. 5. The distribution of enterprises according to the total number of employees

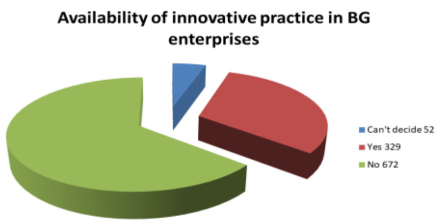

Fig. 6. Availability of innovative practice in Bulgarian company

These results correspond to the specified operational planning horizon with a horizon of up to 6 months – 330 (31%) enterprises, up to 1 year – 394 (37%), 145 enterprises have a planning horizon of up to 3 years, 54 – up to 5 years, and only 28 indicate that they carry out planning activities up to and over 10 years. This gives them the opportunity to use the results of technological forecasting. It is also known that the implementation of innovative activity requires an analysis of technological development trends in the relevant area and the setting of strategic goals, which, on the other hand, is associated with a greater long-term planning [5, 6].

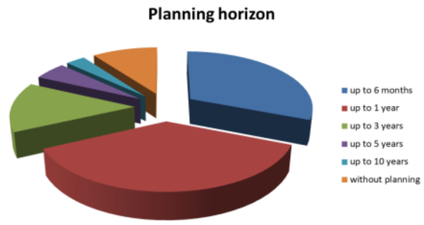

Fig. 7. Distribution of Bulgarian companies according to the adopted planning horizon

Bulgarian enterprises have their own explanation for the reasons that make it more or less difficult for them to implement innovation policy and plan it. As holding factors with the greatest impact on innovation activity, they point out: the lack of appropriate sources of financing, lack of incentives from the state, high economic risk, high costs, organizational obstacles, lack of qualified personnel, lack of markets, the COVID crisis, the wars in Ukraine and the Middle East, as well as the delay in the process of joining the Eurozone.

Bulgaria stands out from other EU countries in two sectors – IT and manufacturing. In these sectors, Bulgarians have the highest shares of people wanting to start a business – 15%, compared to an EU average of 13% in the IT sector and 8% compared to an EU average of 4% in the Manufacturing sector. In 2023, a new trend is observed in the entrepreneurial ecosystem, namely the focus on smaller settlements outside the traditional top-5 cities (Sofia, Plovdiv, Varna, Burgas and Ruse), and in particular where there are no universities or limited outsourced training at established universities. Innovation networks in Bulgaria, including new business associations, international business networks and academic networks, are increasing their intensity and interconnectedness. The Bulgarian Enterprise Europe Network continues to be among the leaders in Europe, with activity indicators above the EU average despite the lack of a national co-financing mechanism, which exists in one form or another in all other EU member states. Financing Research and development (R&D) spending in Bulgaria reached BGN 1,266 million (according to the latest available data for 2022), which represents an increase of nearly 18% compared to the previous year. However, as a relative share, R&D spending accounts for only 0.75% of GDP – a decrease of 0.02 pp on an annual basis, a significant retreat from the "record" 2015. Enterprises carry out more than two-thirds of R&D spending in the country (68%) [7]. The total amount of business investments in research and development amounted to BGN 858 million, which is an increase of 21% on an annual basis. The achieved increase allows business to maintain the share of R&D spending in GDP at a level of 0.51%, which, however, remains significantly below the peak values of 2015. The share of R&D expenditure in GDP of the Higher Education sector has also remained unchanged – 0.05%, which is a result of an increase in the amount spent by higher education institutions on science and technology transfer by 14% on a year-on-year basis. The exception is the Public Sector, where there is a decrease in the share of R&D expenditure in GDP by 2 pp to 0.19%. The amount spent on scientific research development by public research organizations is BGN 322 million, with a year-on-year growth of nearly 11%.

IV. Conclusions

In conclusion, the EU can combine its academic, technological, and industrial strengths with a high-quality digital infrastructure and a regulatory framework based on its fundamental ethical and moral values to act as a forerunner in innovation in the data economy and its related AI-based applications, as envisaged in the European strategy on artificial intelligence. In 2023, the European economy improves its innovation potential. The growth (change in the value of the Innovation Index on average for the EU-27) for the last seven-year period is 8.5%, and for the last one year – 0.51%. However, the gap of the European Union economy from the USA, China and Japan remains significant and worrying, especially against the background of a series of global and regional crises and challenges. The reasons for this comparative lag are mainly rooted in the EU's inability to fully use the scale of its common market, to concentrate public and private resources effectively in scientific research and innovation, and to create companies capable of competing on a global level. These limitations were particularly evident in the EU's inability to rapidly increase the capacity of its defense industry and to help Ukraine counter Russian aggression. Given the long-term deterioration of the security environment at the EU borders, the long-term development of the community will increasingly depend on the ability of economies to collectively create and sustain technologies and innovations that are ahead of their main strategic competitors, Russia and China. In addition, this is a necessary condition for the EU's long-term goal of strategic autonomy and geopolitical weight to be achieved.

Bulgaria recorded the most significant improve-ment in its innovation performance on a year-on-year basis within the EU-27 – nearly 14%, followed by the Czech Republic (11%) and Poland (8%). However, the country's higher innovation index values over the past year are not enough to make up for the gap with the EU average. Bulgaria remains in the penultimate place in the group of emerging innovators (ahead of Romania) at 46.7% compared to the EU-27 average and even below the group's average performance of 54%. In 2023, Bulgaria recorded the most significant improvement in the following areas compared to 2016, selected as the baseline in the latest report of the European Innovation Scoreboard: share of inno-vative enterprises that interact with partners with-in the innovation process (growth of 51.8%); increased number of joint publications between representatives of the public and private sectors; process innovations with growth of 45% and share of innovative enterprises with product innovations (82.2%); employment in innovative enterprises (growth of nearly 41%); emissions of fine dust particles from industry, as well as development of technologies rela-ted to reducing the negative environmental footprint, in respect of which Bulgaria recorded positions equal to the EU-27 average. Thanks to the strongly deve-loping ICT sector, Bulgaria recorded a more tangible approach to the average European levels in the indicators of the number of specialists in the field of ICT (83%) and export of knowledge-intensive servi-ces (75%). According to the European Regional Inno-vation Scoreboard, all Bulgarian regions fall into the last group of emerging innovators. The only indi-cation that the South-West Planning Region (SWP) is doing relatively better than the national average is the positive sign (+) added to the category. The lack of (significant) progress for Bulgaria demonstrated in the European Innovation Scoreboard and the additional analysis at regional level are also confirmed by the data of the Global Innovation Index for 2023. In the company of 132 countries, Bulgaria drops four positions year-on-year to 38th place. Measured by the index values, the difference is 0.5 points in the direction of decline (or an innovation index of 39, which is the lowest for the country in more than 10 years). However, within the EU, Bulga-ria ranks 22nd, ahead of Poland, Greece, Croatia, Slovakia and Romania. In the group of countries with high average income per capita, Bulgaria ranks third, one position lower than in 2022, after China (12th overall) and Malaysia (36th overall). Technological and scientific product Bulgaria ranks 24th within the EU-27 with 45 patent applications to the European Patent Office (EPO) (2 more than in 2021), ahead of Cyprus, Croatia and Latvia. In terms of the number of patent applications per 1 million people (6.6 patents), Bulgaria is ahead only of Romania (2.4 patents). For comparison, patent applications to the EPO origin-nating from Sweden are 481.8 per 1 million people (1st in the EU-27), and from Slovenia – 58.4 (1st among the countries of Central and Eastern Europe). Only 22 patents were granted to Bulgarian companies and organizations by the European Patent Office (EPO) (1 less than in 2021), which puts us only ahead of Cyprus and Lithuania. In 2022, the patents issued by the Patent Office of the Republic of Bulgaria (PORB) to Bulgarian patent holders were 87, which is less than half of their number in the previous year. A decrease in the number of patents granted is present in all institutional sectors.

In the future, research will be focused on innovative obsolescence of technologies and its management through alternative solutions.

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