

Impact of digital technologies on green economic growth

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Abstract. The rapid development and implementation of digital technologies, in particular in the manufacturing sector, at the global and European level have become strategic priorities for achieving the global goals for sustainable development. The introduction of new generations of digital technologies is seen as a key element and leading factor for achieving a sustainable, competitive and green economy in the coming decades. The report presents the policy of the EU (and Bulgaria as part of the Union) aimed at achieving the implementation of the global goals for sustainable development. The degree and readiness of the Bulgarian industry to benefit from digital technologies and the tools of Industry 4.0 in support of sustainable, green economic growth of our society has been studied.

1 Introduction

In August 2015 in New York, during the 70th UN General Assembly, the world leaders of 193 countries (193 UN members, two observer countries and 11 other countries) agreed to achieve a better future for all and adopt a new global framework for sustainable development "The 2030 Agenda", also called - "Let's transform the world" [1]. It reflects the first international consensus that peace, security, justice and social inclusion for all should not be separate goals, but mutually reinforcing. The program is accepted as defining sustainable development worldwide. [18] The 17 Global Goals set in it with 169 specific sub-goals and tasks, and 238 indicators for their measurement, balance the integration of the three aspects of the concept of sustainable development — economic, social and ecological, and outline the way for the sustainable development of the Planet for the period up to 2030.

On the table 1 presents a comparison of the objectives in the previous program period 2000-2015 and the current period. The goals are universal, inclusive and apply to all countries in the world.

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Table 1. Comparison of the Sustainable Development Goals (2000-2015) and (2015-2030)

	Sustainable Development Goals (2000 – 2015)	➔	Sustainable Development Goals (2015-2030)
Aims	8	➔	17
Tasks	18	➔	169
Indicators	48	➔	238

2 Literature review

In support of the implementation of global goals for sustainable development and as the EU's response to the challenges of climate change and the environment, on 11.12.2019, the European Commission presented the European Green Deal, also known as the Green Deal, a year and half a year later, on 9 March 2021, the Commission announced the new Strategy for Europe's Digital Transformation to 2030, called the EU Digital Compass.

❖ **The European Green Deal** aims to transform the EU into a fair and prosperous society with a modern, resource-efficient and competitive economy in which there will be no net emissions of greenhouse gases in 2050 and economic growth does not depend on the use of resources [3]. The strategic elements of the European Green Deal are presented in figure 1.



Fig. 1. Strategic elements of the European Green Pact [17]

Although Europe is showing progress on its 2020 targets, the new strategy plans further targeted action towards each of the 17 global goals by 2030, while preparing for more ambitious targets [5]. The measures agreed in the Pact on the individual strategic elements are summarized in table 2.

Table 2. Goals and expected results until 2030 with a horizon of 2050 [4]

<i>Strategic element</i>	<i>Goals and Expected Results</i>
Mobilizing industry to transition to a clean, circular economy	<ul style="list-style-type: none"> ➤ Generating a net economic benefit of 1.8 trillion euros; ➤ Creation of over 1 million new jobs; ➤ The circular economy to play a central role in reducing emissions.
Conservation and restoration of ecosystems and biological diversity	At least 30% of the land area and sea basins of the EU become a network of well-managed protected areas.
Raising climate ambitions for 2030 and 2050	<ul style="list-style-type: none"> ➤ Reduction of greenhouse gas emissions by at least 40% by 2030, aiming to reach 50-55%, compared to 1990 levels. ➤ By 2050 - climate neutrality.
Providing clean, affordable and secure energy	<ul style="list-style-type: none"> ➤ Achieve a share of at least 32% of energy from renewable sources; ➤ Increase in energy efficiency by at least 32.5%; ➤ Electricity interconnection up to 15% between member states.
Construction and renovation in an energy and resource efficient manner	Doubling the annual rate of rehabilitated buildings in the EU by 2020 (varies from 0.4 to 1.2% across Member States).
Accelerating the transition to sustainable and smart mobility	Reducing carbon emissions from the transport sector: <ul style="list-style-type: none"> ➤ from cars by 37.5% compared to 2021 levels; ➤ from vans by 31% compared to 2021 levels; ➤ from trucks by 30% compared to 2019 levels. ➤ To achieve climate neutrality by 2050, a 90% reduction in emissions in the transport sector (road, rail, air and water).
Farm to Fork: Creating a Fair, Healthy and Sustainable Food System	<ul style="list-style-type: none"> ➤ Reducing the use of chemical pesticides; ➤ Reducing the use of fertilizers and antibiotics; ➤ Increasing the area of organic agriculture; ➤ Development of innovative ways to protect crops from pests and diseases; ➤ Using innovative and safe techniques to improve the sustainability of the food system.
Ambition for zero pollution and achieving a non-toxic environment	To achieve zero air, water and soil pollution: <ul style="list-style-type: none"> ➤ preventing the generation of pollution; ➤ cleaning and removal of the damage caused.

❖ *Europe's digital transformation strategy until 2030.* The digital transformation strategy is based on four main pillars – skills, digital infrastructure, business and public administration (see Figure. 2).



Fig. 2. EU digital compass [2]

The measures agreed in the EU digital compass are summarized in figure 3

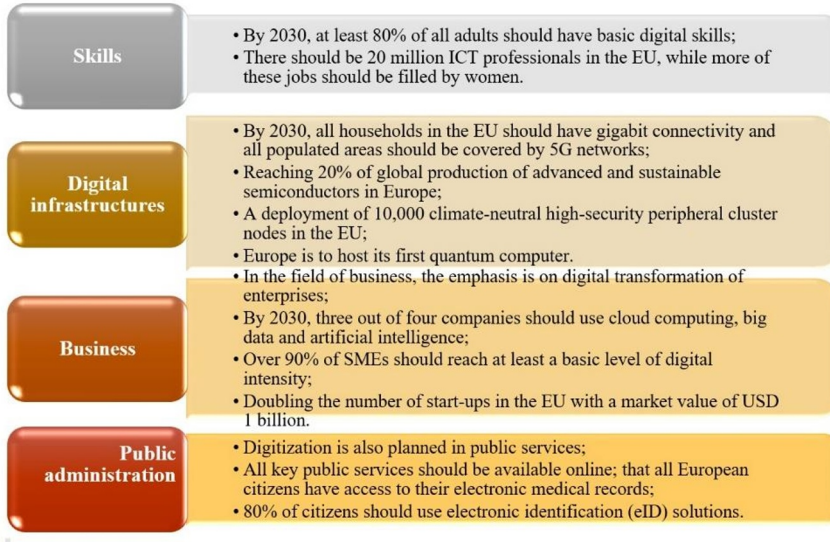


Fig.3. Expected results of EU digital compass [2]

To fulfill the goals in the digital transformation strategy [6], the development of technologies that led to the fourth industrial revolution in human history – Industry 4.0 – is relied upon (Figure 4). These include - technologies for the Internet of Things; big data processing technologies (Big Data); technologies for augmented and virtual reality; cyber security; cloud technologies; mobile technologies, blockchain technologies, 3D printing technologies; artificial intelligence [7]. Despite the fact that Industry 4.0 is at an early stage of its development and its main achievements can be expected in the current decade, the image of Industry 5.0 can already be outlined [18]. It involves the penetration of artificial intelligence into the daily life of human [8].

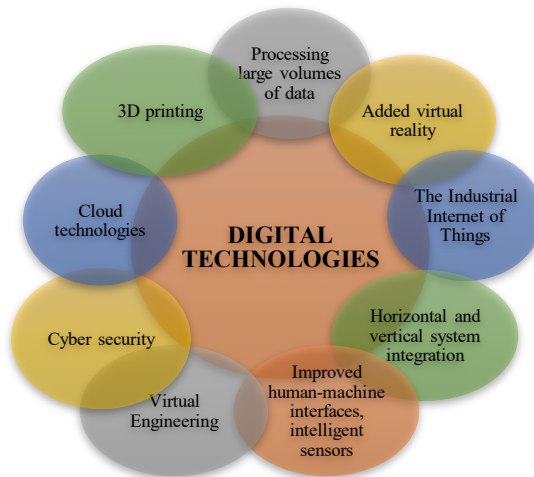


Fig. 4. Technological toolkit of Industry 4.0

3 Exploration

It should be noted that the development of an economy depends not only on its ability to create information and communication technologies (ICT), but on its readiness to apply them in the practice of industrial enterprises [9, 10, 11]. In this regard, a study was conducted related to the expectations of business and public administration for the technologies of Industry 4.0, which are about to have the strongest impact on their development in the next few years [7]. The results are summarized in figure 5.

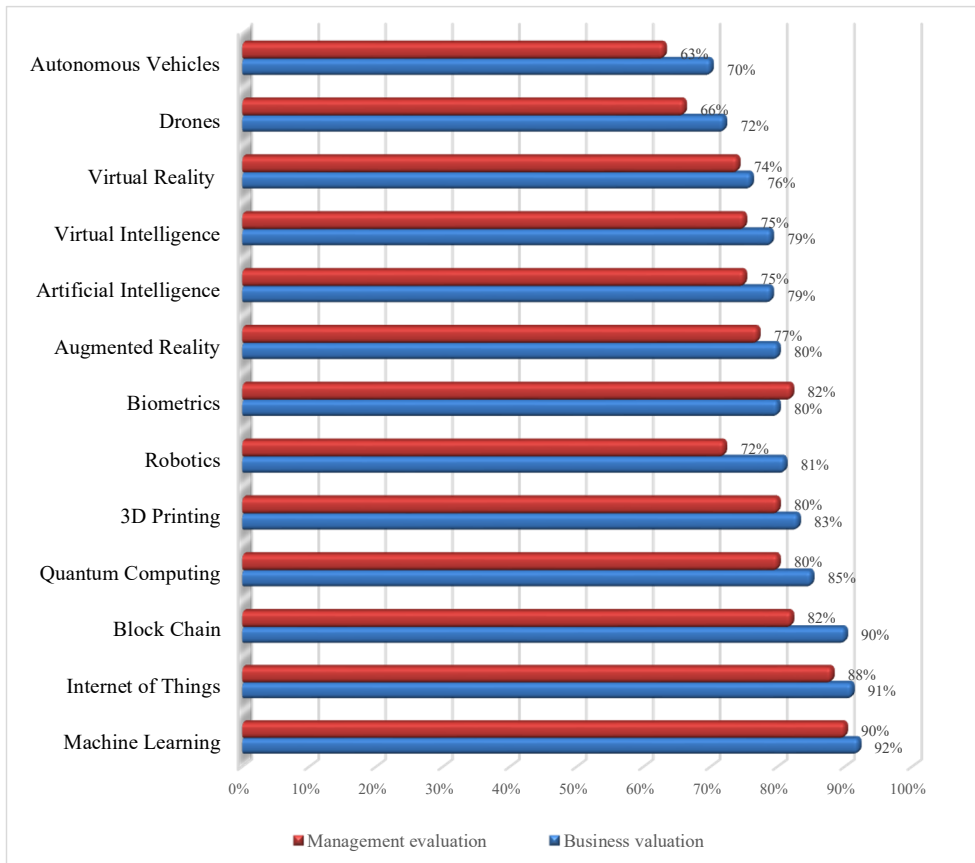


Fig. 5. Ranking the technologies with the most impact in the next decade (Own calculations)

A survey conducted among business and public administration put artificial intelligence and the Internet of Things in the first places, followed by blockchain technologies, quantum computing, 3D printing, robotics and biometrics, augmented and virtual reality, followed by the application of drones and autonomous vehicles in the industrial sector and public practice [14]. It should be noted that the development and implementation of modern ICTs depends not only on the readiness and ability of an economy to create them, but also to apply them in practice [12,13]. According to the EC's latest 2022 report on the DESI (Digital Economy and Society Index - DESI) index, Bulgaria managed to climb to the penultimate place among EU member states. The result shows a significant lag in the digitization of the economy. Only Romania is behind us. The dynamics of the index for Bulgaria in the last six years shows stable growth, but unfortunately at values far below the average for the EU. The five indicators included in the index report an increase in values, but the most significant positive

development is observed in the field of connectivity and digital public services offered to our society [15].

By conducting a survey among 322 industrial enterprises from leading industries of the country in the period July 2022 - November 2022, we were able to track the changes in the technological intensity of industrial enterprises in Bulgaria and their level of digitalization for the last five years. The results are presented in figure 6.

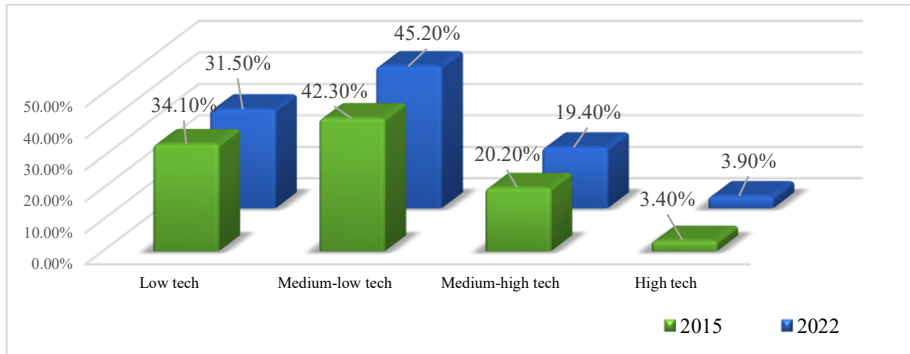


Fig. 6. Change in technological intensity of industrial enterprises in 2015 and 2021

Technological intensity of production indicates the degree to which production is directed to high or low technology products [16] In this regard, Eurostat distinguishes four separate groups of production, in accordance with the international classification of economic activities (NACE Rev. 2):

- Low-tech - food and beverages, tobacco products, textiles, clothing, leather products, wood products (including furniture), paper, etc. (Down 2.6%).
- Medium-low technological - production of coke and refined petroleum products, rubber and plastic products, base metals, metal products (without machinery and equipment), etc. (Growth by nearly 3%).
- Medium-high technology - production of chemicals and chemical products, electrical equipment, machines, means of transport and other transport equipment; (Down 0.8%).
- High-tech - production of basic pharmaceutical products and preparations, computer, electronic and optical products, etc. (Growth of 0.5%). Regarding the use of automated management systems in the surveyed enterprises, the data show that this practice is still not widespread (figure 7).

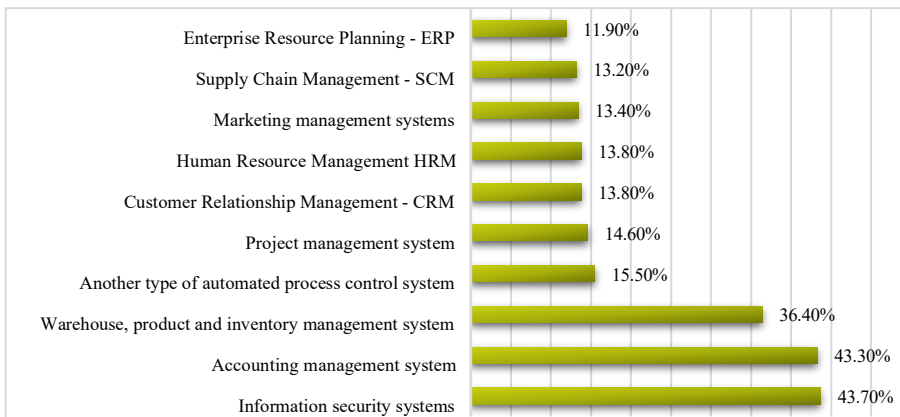


Fig. 7. Automated control systems used by industrial enterprises

The results show that information security systems (43.7% of businesses report using such systems), accounting management systems or accounting programs (43.3%) and warehouse management systems, products are most often implemented and stocks (36.4% declare the presence of such). Between 12 and 16% of enterprises indicate that they use other types of automated systems (CRM, HRM, SCM, ERP, etc.).

Figure 8 summarizes the data on the degree of digitization of enterprises according to their size according to various criteria.

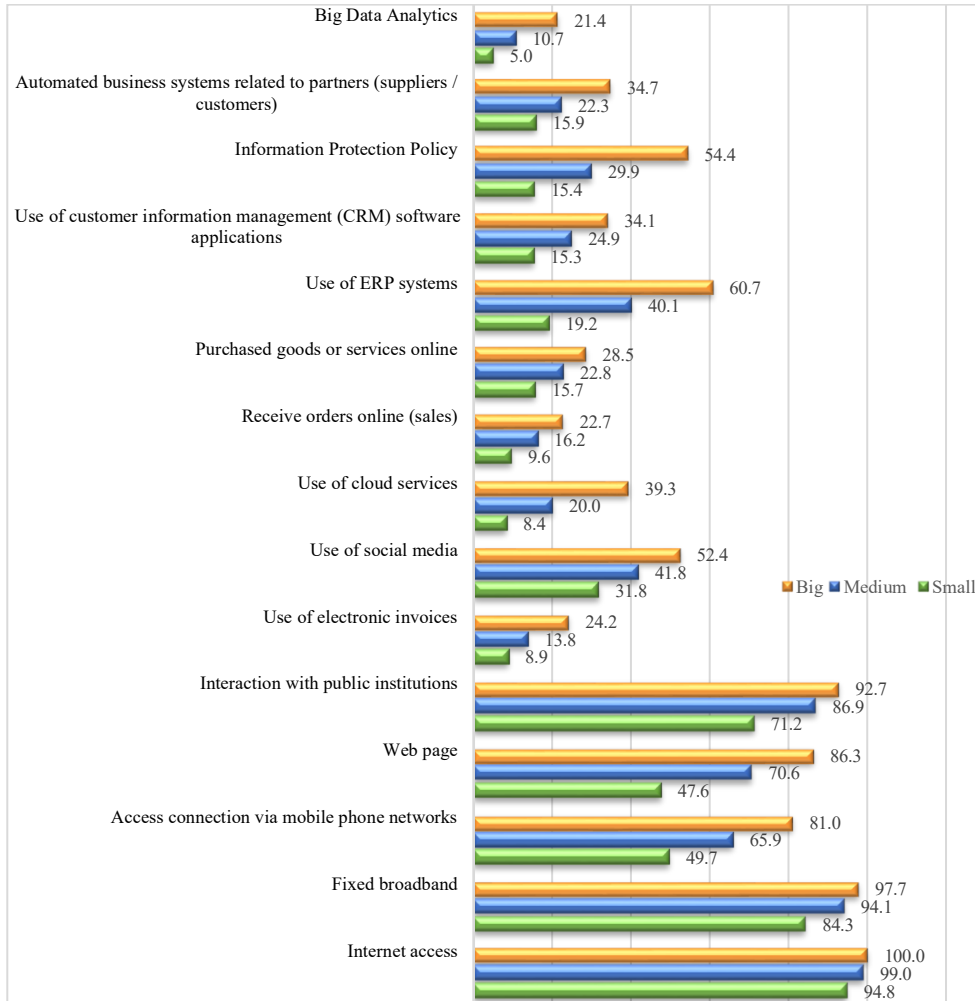


Fig. 8. Degree of digitization of industrial enterprises (own calculations)

From the data it can be concluded that the level of digitization in Bulgarian industrial enterprises is still relatively low. For many companies, the presence of a website or Facebook page is a sufficient condition for its digitalization, and those who carry out online commerce feel the most digitalized. At the same time, the use of market and resource management software is extremely low.

4 Conclusions

Industry in Bulgaria, as a sector of the economy that provides a relatively high share in the country's GDP, on which the achievement of green economic growth and the fulfillment of the global goals for sustainable development of modern society directly depends, does not take advantage of the opportunities provided by digital technologies of Industry 4.0.

5 Acknowledgment

This report is funded from the Science Fund of the University of Food Technologies – Plovdiv, contract No 3/22-H “TECHNOPOLIS UFT” - a center for qualitative scientific research in the field of academic entrepreneurship and green innovations to achieve high university competitiveness in the conditions of accelerated digitization”.

References

1. European Commission. The Bioeconomy Strategy. Research & Innovation: Bioeconomy (2017)
2. European Commission, COM, Brussels, 9.3.2021, <https://eur-lex.europa.eu/legal-content/> (2021)
3. V. León-Bravo, A. Moretto, R. Cagliano, F. Caniato, Innovation for sustainable development in the food industry: Retro and forward-looking innovation approaches to improve quality and healthiness, Corporate Social Responsibility & Environmental Management, pp.26 (2019)
4. European Commission, European Green Deal, Brussels, 11.12.2019
5. W. Haas, et al., How Circular is the Global Economy? An Assessment of Material Flows, Waste Production, and Recycling in the European Union and the World in 2015 - Journal of Industrial Ecology, Volume **19**, N 5, (2015) www.wileyonlinelibrary.com/journal/jie , p. 765
6. K. Valeva, T. Gigova, T., V. Nikolova-Alexieva, V., Software Systems and Technologies in the Conditions of Industry 4.0 – International Conference Automatics and Informatics, ICAI 2021 Proceedings, pp. 223–226, <https://ieeexplore.ieee.org/abstract/document/9639636> (2021)
7. T. Gigova, K. Valeva, V. Nikolova-Alexieva, Digital Transformation – Opportunity for Industrial Growth, International Conference on Creative Business for Smart and Sustainable Growth (CREBUS), <https://doi.org/10.1109/CREBUS.2019.8840102Y> , (2019)
8. T. Gigova, V. Nikolova-Alexieva, K. Valeva, Digital Transformation of Bulgarian Enterprises in the Conditions of Industry 4.0 International Conference on Creative Business for Smart and Sustainable Growth (CREBUS), <https://doi.org/10.1109/CREBUS.2019.8840065>, (2019)
9. I. Kulova, Business Development in Bulgaria through the Prism of Digital Marketing, Journal of the Technical University – Sofia, Plovdiv branch, Bulgaria “Fundamental Sciences and Applications”, Vol. **26**, pp. 91-98 (2020)
10. I. Kulova, Digital Transformation in Companies of Food Industry in Bulgaria: Challenges and Trends, Proceedings of International Conference on Technics, Technologies and Education ICTTE 2019, DOI: 10.15547/ictte.2019.07.066, pp. 494-497 (2019)

11. T. Gigova, V. Nikolova-Alexieva, K. Valeva, Application of Business Crisis Forecasting Models in Bulgaria - IOP Conference Series: Materials Science and Engineering, **618(1)**, 012071, <https://iopscience.iop.org/article/10.1088/1757-899X/618/1/012071> (2019)
12. I. Kulova, Methodology for building system processes in companies for successful international business // International scientific journal "Internauka". Series: "Economic Sciences" — №12. <https://doi.org/10.25313/2520-2294-2020-12-6791>, pp. 9-14 (2020)
13. I. Kulova, Research on project and product management in technology industry in the digital era // International scientific journal "Internauka". Series: "Economic Sciences" — №1. <https://doi.org/10.25313/2520-2294-2021-1-6814> , pp. 33-36 (2021)
14. N. Dimov, The Environment - From Environmentalism to Freedom, EH.Mak, Sofia, pp.395, 2012
15. V. Nikolova-Alexieva, I. Alexieva, K. Valeva, M. Petrova, Model of the Factors Affecting the Eco-Innovation Activity of Bulgarian Industrial Enterprises. Risks. 2022; 10(9):178., <https://doi.org/10.3390/risks10090178>
16. B. Hadzhiev, V. Nikolova-Alexieva, I. Bachvarova, "Creating the Conditions for Broadband Business Entrepreneurship to Ensure Lasting Success for the Bulgarian Society", Journal of Economic Studies ; Issue: 5/2018; pp.92-105, (2018)
17. European Commission, European Green Deal, Brussels, 11.12.2019, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
18. P. Yordanova – Dinova,, Green accounting – management instrument of the enterprise`s sustainability development, KNOWLEDGE - International Journal, **49(1)**, 127–131 (2021)