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**SMART SPECIALISATION STRATEGY OF
THE REPUBLIC OF NORTH MACEDONIA**

**S3 - MK
2023 - 2027**

Fostering green and sustainable growth through embedding knowledge, innovation and technology, for creating high value-added products and services, competitive on international and domestic markets

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EXECUTIVE SUMMARY

Foreseeing the need for transition towards new growth opportunities and social progress, addressing economic challenges and delivering a better quality of life for all, North Macedonia, in 2018, launched the process of development of the Smart Specialization Strategy (S3), as a comprehensive model for research and innovation enabling sustainable economic growth build on the capacities of the endogenous industry, science and society.

Smart Specialization Strategy is of high importance for the future growth of the Macedonian economy, enabling further development by strengthening the research and innovation potentials, facilitating knowledge-based transformation, enhancing competitiveness based on knowledge and academia-business collaboration, diversifying existing industries and service activities, boosting growth of new and fast-growing industries and enterprises as well as stimulate green and digital transition.

The “Smart Specialisation Strategy of the Republic of North Macedonia 2023-2027” is a result of a detailed analytical and wide consultative process in the quadruple helix, that sought, in a bottom-up and open manner, to contribute to defining a strategic vision, priorities and respective transformative activities that accelerate the transition towards innovative and knowledge-based economy and society.

The rationale behind the S3 is to concentrate national resources and economic investments around a set of priority domains with a critical mass of knowledge, capacities, competencies and innovation potential to strengthen North Macedonia in global markets/value chains.

The S3 vision for North Macedonia emphasizes the connection of knowledge and innovation, with a special focus on combining technology to create greater added value, more qualified job opportunities, and more innovative/technology-based companies that stimulate green and sustainable growth. Thus, the vision is summed up in:

Fostering green and sustainable growth through embedding knowledge, innovation and technology for creating high value-added products and services competitive on international and domestic markets.

The Smart Specialization Strategy is unleashing smart growth by defining high-priority domains in which there is the highest economic, innovative and R&D capacity for creating new added value.

There are four vertical and two horizontal priority domains:

- Smart Agriculture and Food with Higher Added Value
- Information and Communication Technologies (ICT)
- Electro-Mechanical Industry – Industry 4.0
- Sustainable Materials and Smart Buildings

Energy for future and Tourism, as horizontal domains, have interrelatedness and cross-innovation with vertical ones.

In parallel, for achieving the overall S3 vision, visions of the vertical priority domains and their defined objectives, a proposed policy mix measures and activities are defined and grouped around strategic objectives focused on scientific excellence, innovation ecosystem, competitiveness and greening of businesses, human capital and digital transformation as well as crosscutting objective ensuring proper implementation and continuous Entrepreneurial Discovery Process (EDP) dialogue.

The governance model is based on introducing a multi-level governance system combining top-down policy coordination with bottom-up quadruple/quintuple helix participation.

The monitoring and evaluation system is structured to allow monitoring S3 implementation as well as mid-term evaluation (implementation evaluation) and a comprehensive, final evaluation (impact evaluation). Both evaluations are hence already included in the Policy mix with main milestones regarding the timeline.

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INTRODUCTION

THE S3 RATIONALE

Smart Specialisation Strategies (S3) are defined as integrated, place-based economic transformation agendas that focus on policy support and investments on key national/regional priorities, and encourage stakeholders' involvement while taking into account territorial strengths, competitive advantages and potential for excellence (Foray et al., 2012).

In the last decade, smart specialization became an important policy concept for regional development and innovation-driven competitiveness, fostering public support for the development of endogenous industry by prioritization of areas identified according to economic, innovation and scientific potentials.

Smart specialisation as an innovation policy concept developed by the European Commission offers a new, integrated set of principles guiding investment in innovation through prioritization and concentration of public resources, and mobilization of local assets and entrepreneurial capacity. The key advantage of the S3 concept is the participative role of all stakeholders in the process of design as well as implementation of the strategy.

The Republic of North Macedonia, as an EU accession country, launched the process for S3 development as a new research and innovation strategy, giving impetus to the smart, sustainable, green and digital transition. With the introduced Smart Specialisation Strategy, North Macedonia is joining the EU initiatives for knowledge and innovation-driven growth.

The S3 development process followed the methodology developed by the European Commission's Joint Research Center (DG JRC), which provided guidance and support throughout the process.

The national S3 for the first time set priorities that should concentrate and link research and innovation resources to a limited number of priority domains, thus building competitive advantage by connecting endogenous capacities in research and innovation with the needs of the economy.

In the process of S3 development, many new social, economic, and global challenges arose, that reinforced the importance of R&D&I as an impetus to growth, green and digital transition.

The S3 will create a base for further development of the innovation ecosystem, excellence in science, the competitiveness of the business sector, stimulating green and digital transition and should introduce a more efficient way of coordination and collaboration between stakeholders in quadruple helix.

A significant additional benefit of the S3 is the initiation of continuous open dialogue and building R&I strategic partnerships that should create a good base for the identification of growing opportunities in market development, achieve consensus on transformation roadmaps and build alliances to face new market and social challenges.

S3 should replace the expired Competitiveness Strategy 2016-2020 and the expired Innovation Strategy 2012-2020, add value to the national strategic framework and establish synergies with other relevant strategic documents such as the Industrial

Strategy 2018-2027, the Small and Medium Enterprise Strategy 2018-2023, the Growth Acceleration Plan 2022-2026 and other strategic documents related to research, development and innovation. It should also enhance the EU approximation process and facilitate the accession of national entities into the common European market, the common European Research Area, and the common European Innovation Area.

Integrating innovation and competitiveness strategies into S3 will help to avoid duplication and fragmentation of policies enabling coordination of institutions and instruments for support of research and development, innovation, business competitiveness, and green and digital transition, at the same time supporting the quadruple helix dialogue and creating partnerships.

By identifying key priority areas, S3 enables the concentration of research, innovation capacities and infrastructure. In this manner, a critical mass of researchers working on strategic topics is brought together in the public and private sectors, with a view to achieve research excellence, commercialize innovation and boosting the competitiveness of the economy in general.

The identified priority domains will be supported by targeted, comprehensive and tailored measures and activities, provided by the Government and business itself. They represent the national development roadmap and clear framework for EU and other donor support. This is especially important because the Republic of North Macedonia as other non-EU countries could not rely on EU structural funds for S3 implementation when designing the S3 strategy.

Therefore, different EU-available financial instruments and donor projects active in the country are seen as important partners in the implementation of the measures and activities.

SMART SPECIALIZATION POLICY FRAMEWORK

European framework for smart specialization

By following this European development paradigm, the national smart specialization would enable synergy between the European policies and sources of financing, complementing national and regional programs and private investment, leading towards integration of the national ecosystem in the Common European Market, European Research Area, European Innovation Area and the European Education Area.

This strategic framework should give new impetus to the system by focusing support on the further development of the research and innovation ecosystem, stimulating specialization, excellence, skills development, business-academia collaboration, green and digital transition and boosting competitiveness based on knowledge and innovation.

The overview of the relevant EU, regional and national documents shown below, demonstrates the interrelatedness and defines the position of S3 in the wider policy context:

The New European Innovation Agenda¹ aims to position Europe at the forefront of the new wave of deep tech innovation and start-ups. Guided by this strategy, innovation should develop new technologies to address the most pressing societal challenges and bring them to the market.

The European Industrial Policy² aims to strengthen the competitiveness of EU industry and to promote a more sustainable, resilient and digitalised economy that creates jobs. The aim is for the EU industry to become an accelerator and enabler of change, innovation and growth.

The European Green Deal³ aims to transform the EU into a modern, resource-efficient and competitive economy.

A Europe fit for the digital age⁴ strategy aims to make transformation work for people and businesses while helping to achieve its target of a climate-neutral Europe by 2050.

Horizon Europe 2021-2027, as the most ambitious Research and Innovation programme, offers a broad range of opportunities to researchers, innovators and companies of all sizes in the pursuit of new discoveries, scientific and technological advancement and innovation. Smart specialisation strategies are key to developing synergies between Horizon Europe and other EU smart growth-related instruments.

LIFE Programme aims to facilitate the shift towards sustainable, circular, energy-efficient, renewable energy-based, climate neutral and resilient economy to protect, restore and improve the quality of the environment, including the air, water and soil.

Digital Europe Programme (DEP) is a new EU funding programme focused on bringing digital technology to businesses, citizens and public administrations. It

¹ [The New European Innovation Agenda \(europa.eu\)](https://europa.eu)

² [EU industrial policy - Consilium \(europa.eu\)](https://europa.eu)

³ [A European Green Deal \(europa.eu\)](https://europa.eu)

⁴ [A Europe fit for the digital age \(europa.eu\)](https://europa.eu)

provides support in five crucial areas: supercomputing, artificial intelligence, cyber security, advanced digital skills and ensuring the wide use of digital technologies across the economy and society. It is designed to bridge the gap between digital technology research and market deployment, benefiting Europe's citizens and businesses, especially SMEs. Investment under the DEP supports the EU's twin objectives of a green transition and digital transformation while strengthening the union's resilience and digital sovereignty.

The Credible Enlargement Perspective for and Enhanced EU Engagement with the Western Balkans⁵ incorporates six flagship initiatives. To boost entrepreneurship and innovation, the document envisions a scheme supporting technology transfer and start-ups across the region and support efforts aimed at smart specialisation as well as the circular economy.

The Economic and Investment Plan for the Western Balkans⁶ aims to spur the long-term economic recovery of the region and foster regional economic integration. It will support a green and digital transition in the Western Balkans, the implementation of reforms required to move forward on the EU path, and bring the region closer to the EU Single Market, leading to sustained economic growth and job creation.

The Western Balkans Agenda on Research and Innovation and to Education, Training, Youth and Sport⁷ outlines a comprehensive, long-term strategy for cooperation of the EU with the region, including enhancement of smart specialization.

Common Regional Market Action Plan for 2020-2024⁸ aims to increase the attractiveness and competitiveness of the region, to bring the region closer to the EU markets and foster integration with the EU single market.

Green Agenda for the Western Balkans⁹ is a regional strategy focusing on a sustainable economy in line with the European Green Deal. The objectives of the WB Green Agenda are focused on moving to a circular economy; and building sustainable agriculture and food systems.

The Digital Agenda for Western Balkans¹⁰ aims to support the transition of the region into a digital economy and bring the benefits of digital transformation, such as faster economic growth, more jobs, and better services. This will be done by supporting the involvement and representation of the Western Balkans in EU initiatives and events and by boosting research and innovation, bringing world-class training for a new generation of researchers and engineers and promoting interdisciplinary collaboration across Europe.

⁵ Commission Communication "A credible enlargement perspective for and enhanced EU engagement with the Western Balkans" COM(2018) 65 final.

⁶ [EIP \(wbif.eu\)](http://wbif.eu)

⁷ [A Western Balkans agenda on innovation, research, education, culture, youth & sport - Publications Office of the EU \(europa.eu\)](https://publications.ec.europa.eu/en/press-corner/infographic/2020-07-07-western-balkans-agenda-on-innovation-research-education-culture-youth-sport)

⁸ [Regional Cooperation Council | Common Regional Market \(rcc.int\)](https://www.regioncooperationcouncil.europa.eu/regioncooperationcouncil/en/press-corner/infographic/2020-07-07-western-balkans-agenda-on-innovation-research-education-culture-youth-sport)

⁹ [green agenda for the western balkans en.pdf \(europa.eu\)](https://publications.ec.europa.eu/en/press-corner/infographic/2020-07-07-western-balkans-agenda-on-innovation-research-education-culture-youth-sport)

¹⁰ [Launching of Digital Agenda for Western Balkans \(europa.eu\)](https://publications.ec.europa.eu/en/press-corner/infographic/2020-07-07-western-balkans-agenda-on-innovation-research-education-culture-youth-sport)

National framework for smart specialization

Smart Specialization Strategy of the Republic of North Macedonia (S3 MK) is aligned with the strategic planning of the Government as well National Development Strategy in the process of development.

The **national strategic priorities**¹¹ correlate with S3 and are prioritizing sustainable and inclusive economic growth, competitiveness based on knowledge and innovation, increased investments in R&D&I, SME development, better-paid jobs, continuous skills development, further progress in the accession EU process etc. that are also addressed with this strategy. S3 will have a significant impact on the further development of the research infrastructure and innovation ecosystem, skills development, digital and green transition of companies, innovation diffusion, international collaboration etc.

Adoption and implementation of the Smart Specialisation Strategy, in collaboration with the business and scientific community, is listed among the short-term priorities under Chapter 20 - Enterprises and Industrial Policy and Chapter 25 - Science and Research of the **National Programme for Adoption of the Acquis Communautaire (NPAA)**¹².

The **IPA III Strategic Response**¹³ in Window 4 – Competitiveness and Inclusive Growth envisions alignment of the IPA support to the S3 within the “Thematic Priority 2: Private sector development, trade, research, and innovation”.

The **National Development Strategy of the Republic of North Macedonia (in draft)**¹⁴ is envisioned to become an overarching strategic document that will guide the national development on long-term coordinated by the Cabinet of the Deputy President of the Government of the Republic of North Macedonia, in charge of economic affairs, coordination of economic sectors and investments. S3 should be embedded in the overarching concept of the National Development Strategy.

The **Economic Reform Program (ERP)**¹⁵ contains medium-term macroeconomic projections (including for GDP growth, inflation, trade balance and capital flows), budgetary plans for the next three years and a structural reform agenda. The structural reform agenda includes reforms to boost competitiveness and improve conditions for inclusive growth and job creation in the following areas: Energy and transport markets, Sectoral development, Business environment and reduction of the informal economy, Research, development and innovation and the digital economy, Trade-related reform, Education and skills, Employment and labour markets, Social inclusion, poverty reduction and equal opportunities.

The **Plan for Economic Growth (PEG)**¹⁶ aims to introduce measures for enhancing investments, technological development and increasing competitiveness of the Macedonian companies.

¹¹ [Decision for Strategic priorities of the Government](#)

¹² [NPAA | Secretariat for European Affairs \(sep.gov.mk\)](#)

¹³ [IPA III STRATEGIC RESPONSE.docx \(live.com\)](#)

¹⁴ <https://www.nrs.mk>

¹⁵ <https://finance.gov.mk>

¹⁶ [Ekonomski rast infografik ANG 04 \(vlada.mk\)](#)

The Industrial Strategy of the Republic of Macedonia 2018-2027 with Action Plan¹⁷ aims to promote industrialisation by stimulating the growth and development of the manufacturing sector to boost productivity, create good jobs, raise incomes and strengthen human capital while addressing the challenges of the circular economy.

The Growth Acceleration Plan 2022-2026 (GAP)¹⁸ aims to finance the recovery of the economy affected by COVID-19 and to support accelerated and sustainable growth while maintaining fiscal stability by mobilizing private capital.

The National Small and Medium Enterprise Strategy (2018-2023)¹⁹ aims at fostering competitive SMEs by 2023 as drivers of inclusive economic growth and in the creation of more productive and decent employment.

Strategy for Education (2018-2025)²⁰ aims at the gradual improvement of the educational system following the established priorities. According to the Strategy vision, special attention is put on Vocational Education and Training as well as on Higher Education, Research and Innovation as sectors that directly influence the improvement of the educational system based on the labour market needs.

Vocational Education and Training Strategy (2013-2020)²¹ aims at improving the performance of the existing VET system from the perspective of quality of delivery and educational outcomes, effectiveness and relevance for learners (young and adult), as well as for the labour market and further education.

National Strategy for Sustainable Development (2008-2030)²² incorporates three interdependent and mutually reinforcing dimensions: i) The economic dimension (economic resources, development and growth); ii) The environmental dimension (natural resources, protecting and exploiting nature sustainably, and preventing and combating pollution); iii) The social dimension (social resources, solidarity, and combating poverty).

Strategic alignment should be done also with other relevant sector strategies for S3 domains (**Energy Development Strategy until 2040**²³, **Tourism Strategy**, **National Strategy for Agriculture and Rural Development 2021 – 2027**²⁴).

S3 will be in correlation with the strategic documents that are in the process of development related to: **Green transition, Digital transition, Climate change, Circular Economy, SME development, Export Promotion** and others.

¹⁷[FinalnaIndustriska Strategija.pdf \(economy.gov.mk\)](#)

¹⁸[Growth-Acceleration-Plan_final-1.doc \(live.com\)](#)

¹⁹[SME Strategy EN FINAL.pdf \(economy.gov.mk\)](#)

²⁰[Strategija-za-obrazovanie-ENG-WEB-1.pdf \(mrk.mk\)](#)

²¹[vet_strategy_en_final.pdf \(csoo.edu.mk\)](#)

²²<http://www.moepp.gov.mk/wp-content/uploads/2014/12/NSSD-1-EN.pdf>

²³[Energy Development Strategy EN \(economy.gov.mk\)](#)

²⁴[mac209144.pdf \(fao.org\)](#)

SMART SPECIALIZATION DEVELOPMENT CONCEPT

The Smart specialization strategy development process in the Republic of North Macedonia was initiated in 2018 by a Government's Decision and exchange of Letter of Commitment and Collaboration with the European Commission's Joint Research Center (JRC).

For transparent and inclusive coordination of the process for the development of the strategy, the Ministry of Education and Science forms an inter-institutional working group, composed of representatives of ministries, institutions, chambers and the academic community. This group is led jointly by the Ministry of Economy and the Ministry of Education and Science, as ministries that have been mandated to manage and coordinate the process.

The Republic of North Macedonia is seen as one region due to the market size and its governance structure thus the S3 is developed on a national level. Nevertheless, some initiatives may be implemented regionally according to the outcomes of the continuous EDP process.

S3 is a new research and innovation strategy, reconfirms the commitment to the creation of a knowledge and innovation-based economy, prioritizing public research and innovation investments for the economic transformation of the country building on competitive advantages and facilitating market opportunities.

From its outset, the process was regarded to be of utmost importance to the future growth of the economy, strengthening competitiveness based on the country's innovation potential and unleashing smart growth by defining high-priority domains in which new added value would be created. One of the key goals of this venture was to identify and apply smarter and more competitive solutions within the identified priority domains, taking into account new challenges for the digital and green transition, as well as challenges caused by the COVID-19 pandemic.

In the process of S3 development, many new social, economic, and global challenges arose (Covid, energy and food crisis, Ukraine conflict), that influence on the domains and their further evolution.

S3 as an innovation strategy defines the concept for further development of the innovation ecosystem, prioritizing and primarily fostering R&I capacities in the selected domains. This will be used as a role model for enabling green and digital transition and fulfilling SDGs in the process of dialogue and partnership between academia and business. The implementation of the smart specialization concept will support competitiveness enhancement of the business sector based on knowledge and innovation as well as addressing societal and other challenges

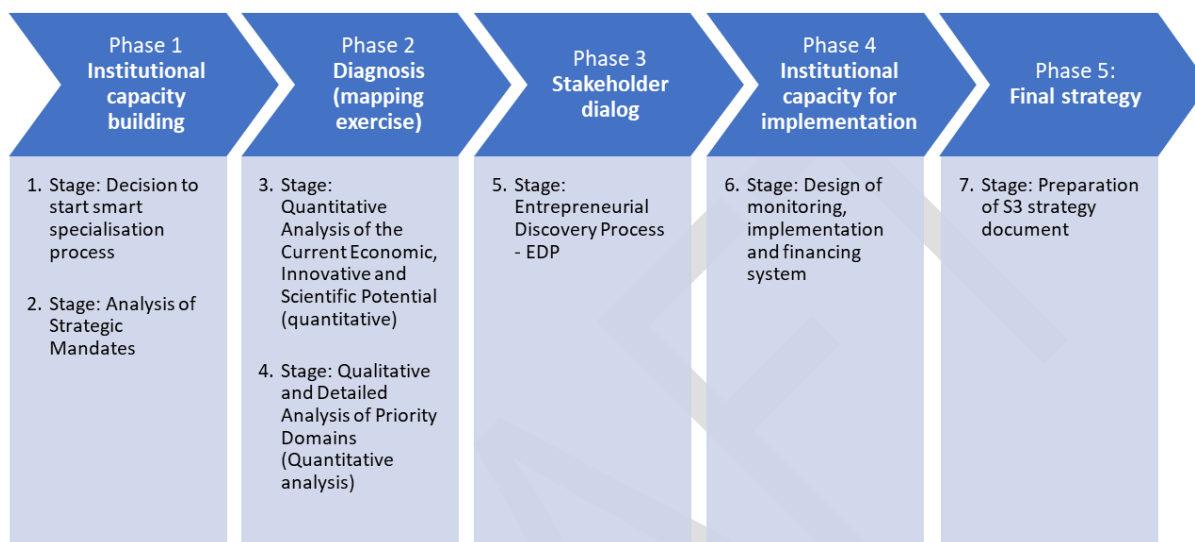
Methodology applied for S3 development

The process of S3 development has been based on the JRC S3 Framework methodology, designed by the DG JRC, presented in the "Smart Specialisation Framework for Enlargement and Neighbourhood Countries" as part of the document "Supporting an Innovation Agenda for the Western Balkans - Tools and

Methodologies” from 2018²⁵ and “Smart Specialisation Implementation Framework for the EU Enlargement and Neighbourhood Region”²⁶.

According to detailed methodological guidelines provided within this JRC S3 Framework, the whole process of S3 development consists of 5 phases (Figure5). The process can only move forward to the next phase when the previous phase is formally approved by DG JRC.

Figure 5: Phases and stages of the S3 design framework



Analysis of strategic mandates

The first phase **Analysis of Strategic Mandates**²⁷ related to S3 was completed in 2019 by the established inter-institutional Working group for S3 development.

Mapping of the strategic documents analysed the key characteristics of the existing national strategic documents, that create the framework enabling and leading the economic development, as well the link and possibility to add value in S3 (Figure 6).

The second phase of the S3 design framework “Diagnosis (mapping exercise)” is comprised of two stages:

- (1) Quantitative analysis of the economic, innovative and scientific potential²⁸
- (2) Qualitative and detailed analysis of priority domains²⁹.

Such a mixed method approach of quantitative and qualitative mapping makes the diagnosis both evidence-based and participatory.

²⁵<https://s3platform.jrc.ec.europa.eu/documents/20182/201464/Supporting+an+Innovation+Agenda+for+the+Western+Balkans+--+Tools+and+Methodologies/f7a54003-7e75-449f-8a66-f9caeadfc59e>

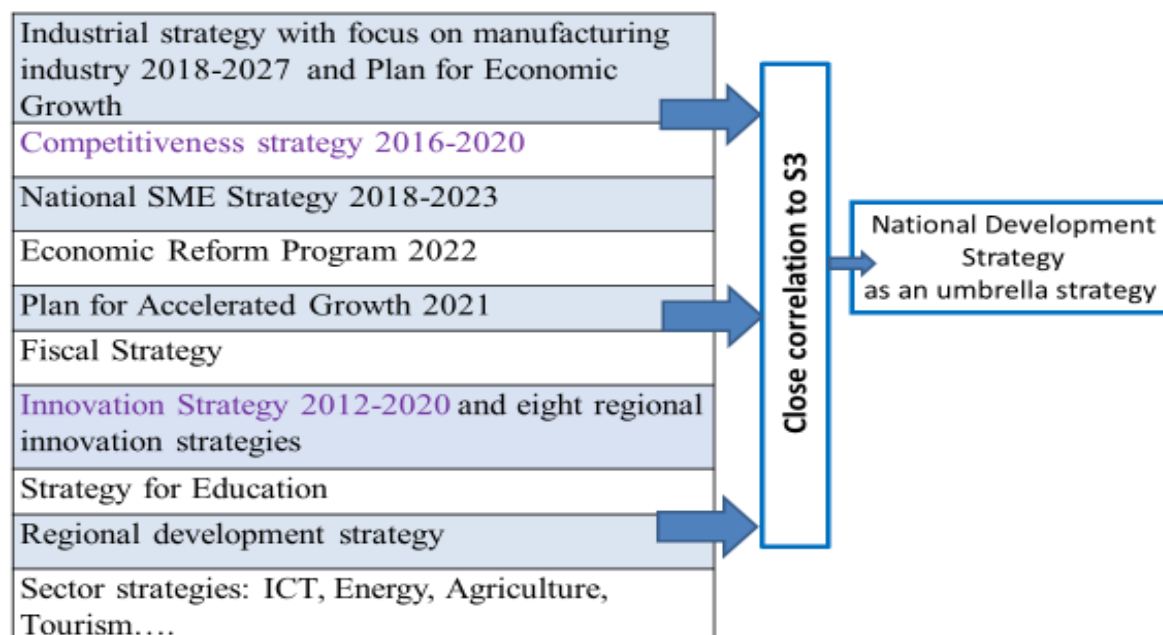
²⁶<https://s3platform.jrc.ec.europa.eu/en/w/smart-specialisation-implementation-framework-for-the-eu-enlargement-and-neighbourhood-region>

²⁷The Overview of the Existing Public Policy Documents which Relate to the Development of the Smart Specialisation Strategy of the Republic of North Macedonia

²⁸konkurentnost.mk/index.php/download/s3-quantitative-analysis/?wpdmdl=4971&refresh=652eff9e3b0621697578910

²⁹<https://s3platform.jrc.ec.europa.eu/w/qualitative-analysis-of-economic-innovation-and-scientific-potential-in-north-macedonia>

Figure 6: Mapping Strategic Documents linked to S3



Quantitative analysis of the economic, innovative and scientific potential

The quantitative mapping is based on statistical data and indicators analyses, applying different techniques for identifying specialisation fields in the form of preliminary priority areas. For the specific national context, the quantitative analysis implied an analysis of statistical data generated from the standard databases of the State Statistical Office, the State Office of Industrial Property and the relevant European and international databases.

The statistical analysis which was carried out by the application of JRC statistical methodology identified industrial priorities at NACE rev.2 – 3 digits level (industry groups) concerning the average figures of the 28 EU countries.

The economic and innovation analyses consist of two parts: descriptive analysis and statistical analysis.

The descriptive analysis identified the most represented industry sections among the top industry groups listed for the examined economic and innovation indicators (economic: number of enterprises, number of employees, wages, turnover, export and clusters; innovation: innovative enterprises in general, in respect to the product, process, organisation and marketing, collaboration and investment in R&D).

For identification of the industrial priorities in comparison to the EU average, the statistical JRC methodology was applied, which uses a combination of criteria, including critical mass, i.e. sufficiently high size measured by the number of enterprises, number of employees, average wages, export performance, cluster analysis and the degree of industry specialisation compared to the EU28.

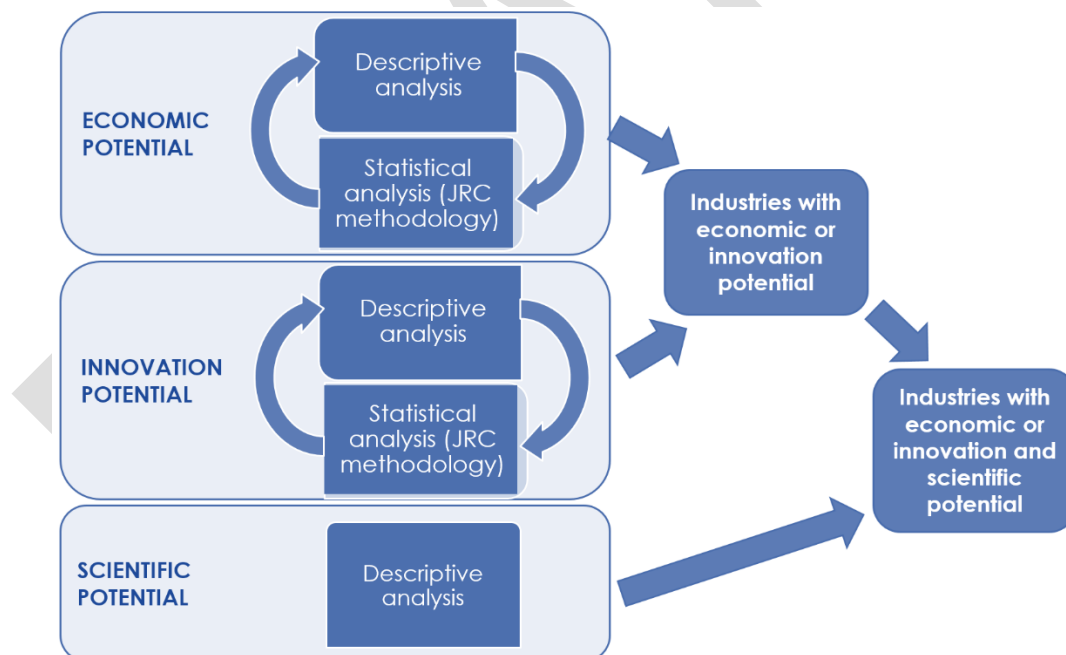
The economic potential, in addition to the degree of industry specialization compared to EU28, also covers the analysis of the **cluster associations** in the Republic of North Macedonia.

The resultant outcome from both, descriptive and statistical analyses, was then combined, or more precisely, the statistical result was refined with respect to the descriptive result. This means that the mapped industry groups by statistical analyses were refined with the mapped industry sections by descriptive analyses, for both, economic and innovation pillars.

The analysis of the scientific potential was based on different data sources: three scientific databases with scientific publications (Web of Science, Scimago Journal and Country Ranking and National University Library), as well as the data for patent applications registered at national and international level (State Office of Industrial Property SOIP and World Intellectual Property Organization WIPO). The description of the scientific areas or research fields varied among different data sources and the NACE classification, so it was necessary to match the areas in each data source with the NACE industry sections.

The conclusion of the quantitative analysis has been drawn from the cross-matching of the three separate analyses (economic, innovation and scientific) (Figure 7).

Figure 7: Cross-matching of the economic, innovation and scientific analysis



The quantitative analysis resulted in a set of industrial groups mapped with significant economic, innovation or scientific potential (Table1).

These preliminary priority domains could be promoted as a base for further identification of the key strategic domains and relevant stakeholders for discussion. The Manufacturing is the most dominant industry section represented by 11 subsequent industrial groups. The second most dominant section is ICT represented by 5 subsequent groups and the last section is accommodation and food service activities represented by two subsequent groups.

The detected industrial groups were organised in 5 priority areas subject to further refinement in qualitative analysis. Additionally, Energy for the future is added as a potential priority area due to the strategic importance and strong growth potential, despite the fact that it was not identified in the quantitative mapping.

Table 1. Grouping of the industrial sectors in domains for Qualitative analysis

Name of the proposed area for S3 qualitative analysis	Sustainable food and beverage production and value chains	Information and Communication Technologies	Electrical equipment and mechanical parts	Sustainable tourism and catering	Smart/Sustainable buildings and materials	Energy for the future
Industries identified in the quantitative analysis with economic/innovation/scientific potential	<p>Manufacture of grain mill products, starches and starch products.</p> <p>Manufacture of other food products.</p> <p>Manufacture of beverages.</p>	<p>Information technology service activities.</p> <p>Other telecommunication activities.</p> <p>Wireless telecommunication activities.</p> <p>Radio broadcasting.</p> <p>Sound recording and music publishing activities.</p> <p>Publishing of books, periodicals and other publishing activities.</p> <p>Reproduction of recorded media.</p>	<p>Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus.</p> <p>Manufacture of other electrical equipment</p> <p>Manufacture of metal forming machinery and machine tools.</p> <p>Manufacture of parts and accessories for motor vehicles and their engines.</p>	<p>Restaurants and mobile food service activities.</p> <p>Event catering and other food services.</p>	<p>Cutting, shaping and finishing stone.</p> <p>Manufacture of furniture.</p> <p>Manufacture of rubber products.</p> <p>Civil engineering</p>	<p>New area proposed for analysis.</p>

Source: Working material

Preparation of the Quantitative analysis was supported by GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH³⁰ and realized by a national team led by the National Center for Development of Innovation and Entrepreneurial Learning (NCDIEL) and methodologically mentoring by an EU expert.

³⁰GIZ, Mapping economic, innovative and scientific potential in the Republic of North Macedonia, NCDIEL, September 2019.

Qualitative analysis of priority domains

The statistical analysis was complemented by a qualitative analysis, conducted in order to better interpret and verify the findings of the quantitative analysis, thus validating the preliminary S3 priority areas.

Qualitative analysis enabled to better understand the exact position of the initially identified priority domains in global value chains, to reveal important opportunities and threats, and to overcome the inherent limitations of quantitative methodology.

In this process, according to the JRC methodology, several non-quantifiable methods were used like: in-depth interviews with selected stakeholders for each preliminary priority area, focus group meetings with key stakeholders from business, academia, government, institutions, civil society and the desk research of existing external studies.

Due to the negative socio-economic effects of the COVID-19 pandemic crisis, the JRC S3 methodology was amended. It resulted in changes in the way of collecting information and evaluating the impact of the crisis on the priorities of the companies and growth perspectives.

Main input in the mapping came from 100 in-depth interviews, performed in life or online, i.e. more than 15 interviews per domain with the main stakeholders, followed by six focus group meetings, one for each priority area.

Information on growth trends, development vision of key actors, potential niche markets, environmental circumstances, challenges and opportunities, interaction with other business sectors and development opportunities have been gathered through these interviews, which were later complemented by focus groups input and information from available studies. This resulted in a more comprehensive view of each of the proposed priority domains.

After processing all information obtained from a number of sources, four vertical priority areas with sub-areas as well as two horizontal priority areas were proposed to further elaboration within the EDP:

Vertical priority areas:

- 1) Smart agriculture and food processing with higher-added value
 - Smart agriculture (sub-area)
 - Food processing with higher added value (sub-area)
- 2) Information and Communication Technologies (ICT) sector
 - Custom software development (sub-area)
 - Advanced ICT services (potential sub-area)
- 3) Smart/Sustainable buildings and materials, consisting of two branches:
 - Smart buildings and
 - Sustainable materials
- 4) Electrical equipment and machinery parts.

The next two priority domains analysed in this phase should be further considered in the EDP as horizontal priority domains:

Energy for future should be considered horizontal due to its strong cross-sectoral relations with other proposed priority areas and in line with the process of greening the industry and protecting the environment (energy efficiency, eco solutions, renewable energy, climate change, decarbonisation, reduce emissions etc.).

Tourism should be considered horizontal due to its strong cross-sectoral relations with the ICT, the agri sector (ex. gastronomy, wine tourism), smart / sustainable buildings and materials.

In general, the information gathered confirmed the relevance and importance of the proposed areas for smart specialisation.

The EDP should also take into account the link between smart specialisation and the sustainability and inclusiveness dimension, including the digital and green transition of the economy; environmental, climate and energy challenges; societal challenges; and health challenges, in particular.

Adequate identification of S3 development priorities may enable the consolidation of research capacities and infrastructure, gathering a critical mass of researchers and innovators that would work together on strategically significant topics of research and development, to achieve research excellence and strengthen the potential of domestic products for commercialisation.

In addition, S3 may also enable the development of new economic sectors through investments in research and innovation in areas that contain strategic potential within the national framework.

To amplify the voice of the business sector, the qualitative analysis was conducted by the Economic Chamber of North Macedonia (ECNM), as a local partner engaged and supported by JRC. The qualitative analysis was performed in the period September 2020 – March 2021.

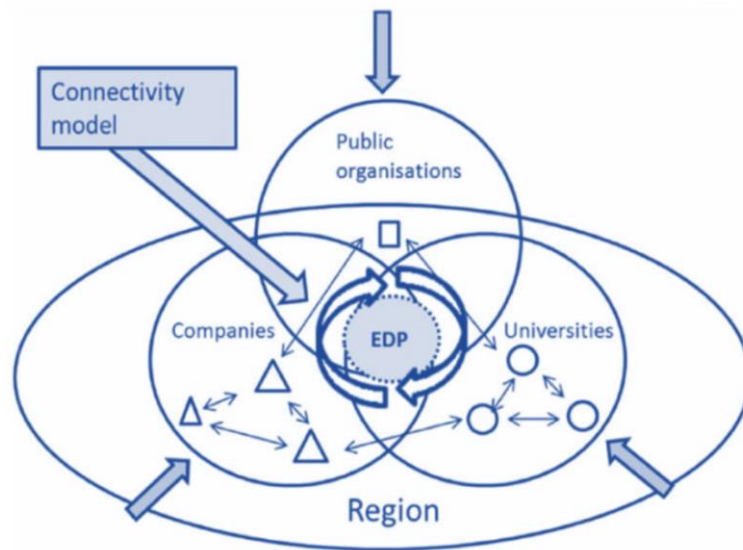
Entrepreneurial discovery process (EDP)

The EDP is considered a, - if not the - feature that distinguishes the smart specialisation approach from innovation strategies of the past and the one that lends these approaches their more 'bottom-up' character. (Rodríguez-Pose & Wilkie 2016).

This approach brings openness and transparency to the policy-making process by encouraging evidence-informed stakeholder dialogue focused on business and policy needs – the entrepreneurial discovery process (Matusiak and Kleibrink (ed), 2018).

The Entrepreneurial Discovery Process (EDP) is a key phase of the process of S3 development, enabling a bottom-up approach and stakeholder dialogue by gathering different actors from the quadruple helix in an interactive and participatory process (Figure 8).

Figure 8: Connectivity model



EDP process, as a complex dialogue with high standards, is relatively new experience in the strategy development for our country.

According to the JRC S3 framework, the EDP is the fifth stage in the process of S3 design consisting of 6 sub-stages:

Figure 9: EDP sub-stages according to the S3 Framework. Source: S3 Framework, 2018.



Once the EDP process of 'discovery' has been initiated, it is crucial to keep engaging stakeholders throughout the different stages of the policy-making process.

It is important that the EDP process continues during the actual implementation of the smart specialization strategy, initiating a continuous dialogue, encouraging new initiatives and partnerships.

This new dimension, which could be referred to as a continuous process, is necessary to ensure trust and commitment to the strategic objectives codified in the S3s, and hence the successful implementation of the strategy itself.

According to the JRC S3 Framework, EDP guidelines and Tailored EDP work plan for each priority domain, the stage-gate process was followed, and series of workshops were organized: (1) EDP kick-off conference presenting all priority domains, (2) SWOT analysis, (3) Vision for the future and final name of priority domain and (4) Policy mix objectives and actions with indicators

The EDP does not move to the next sub-stage before the previous sub-stage is completed, meaning that the process and the required outcomes are in line with the guidelines.

Key topics to be considered as EDP outcomes based on discussion and making joint decisions are the following:

1. **Name and final definition of the domain and sub-domains**, based on credible proposals and dialogue.
2. **SWOT**, developed at the level of the priority domain and sub-domains.
3. **Cross-innovation**, presents the most outstanding opportunities between vertical and horizontal domains and cross-innovation opportunities between vertical priority domains.
4. **Long-term vision**, as a final agreed statement on the long-term vision for the future of the priority area.
5. **Strategic objectives**, as final agreed strategic objectives leading to the long-term vision. These objectives should be SMART i.e. they are specific, measurable, achievable, relevant and time-based.
6. **Input to the policy mix**, including (1) specific objectives that support the strategic objectives (not measures, but SMART-specific objectives), (2) policy actions - indicating possible forms of policy measures that support the achievement of the objectives, and (3) key performance indicators - indicating measurable characteristics that allow monitoring during implementation.
7. **Action plan**, as desired action plan for the implementation of the policy mix or at least indicate priorities.
8. **Digital and green transformation**, as a list of possible applications in the field of digital and green transformation that offer opportunities and benefits for users.
9. **Impact on sustainable development and societal goals**, presenting the matrix of the contribution and impact of the strategic objectives to the Sustainable Development Goals or other national societal goals.
10. **COVID-19 & health-related issues**, presenting a list of possible COVID & health-related issues and opportunities.
11. **Continuation of EDP**, presenting stakeholders' preferences on continuing the dialogue after the EDP stage is formally over.

The EDP process involved more than 250 stakeholders taking active participation in at least two workshops in the EDP (in total 850 participants from all stakeholders).

The workshops were held in life and a hybrid mode, using many technical solutions and practising the World Café method as well as using padlet.com notes.

The process was supported by the JRC, GIZ, World Bank and the Swiss project "Increasing Market Employability". The process of debate between main actors during each of the pre-selected priority domains in order to identify the needs and innovative potential that can be empowered through the Smart Specialisation Strategy was led by a set of experts and facilitators of the workshops.

The EDP took into account the link between Smart Specialisation and the sustainability and inclusiveness dimension, including the digital and green transition of the economy; environmental, climate and energy challenges; societal challenges; and health challenges, in particular.

As per the JRC S3 framework, the results and conclusions of the EDP should be the main input for the smart specialisation strategy.

DEVELOPING LOGICAL FRAMEWORK FOR SMART SPECIALIZATION

Logical Framework as intervention logic leads towards further systematization and refinement of the set of Policy Mix proposed in the EDP individually for each domain, based on situation, vision, assessed transformation roadmap towards innovation, research and growth.

Based on the Smart Specialization implementation framework for the EU Enlargement and Neighbourhood Region, this process included the following steps:

- General agreement on intervention logic
- Policy mix mapping
- Policy mix gap analysis
- Agreement on revised intervention logic
- Preparing the implementation budget

The consultation process continued to map the current activities and instruments by institutions, and donor/IFI community, making the gap analysis and drafting the policy mix.

DRAFT

STATE OF PLAY

RESEARCH AND INNOVATION ECOSYSTEM

Current overview of the research ecosystem

Legal Framework: The Scientific and Research policies in the Republic of North Macedonia are regulated by a set of laws more specifically, the Law of Scientific Research Activity³¹; Law on Higher Education³² and Law on the Macedonian Academy of Sciences and Arts³³.

The institutional framework governing the above-mentioned regulative and policy includes the Ministry of Education and Science (MES), National Council for Higher Education and Scientific and Research Activity, Academy of Sciences and Arts of the Republic of North Macedonia, universities (6 state and 6 private), foreign higher education institutions (3), public (8) and private (26) scientific institutions and independent researchers (6).

According to the Law on Higher Education, a National Council for Higher Education, Scientific and Research Activity was established in 2021 and its work is in line with the adopted Work Program 2021-2025. The Council provides, evaluates, develops, and improves the country's quality of higher education and scientific and research activity.

The National Council for Higher Education, Scientific and Research Activity works on two main activities:

- 1) adopting several rulebooks and decrees linked to the higher education system and scientific research activities, including new provisions following the recommendations of the European Commission and international good practices.
- 2) revision of the funding model to increase the efficiency of the Higher Education System (HES), R&D, and innovation sectors and develop a new system of institutional funding of higher education based on baseline and performance-based budget lines criteria.

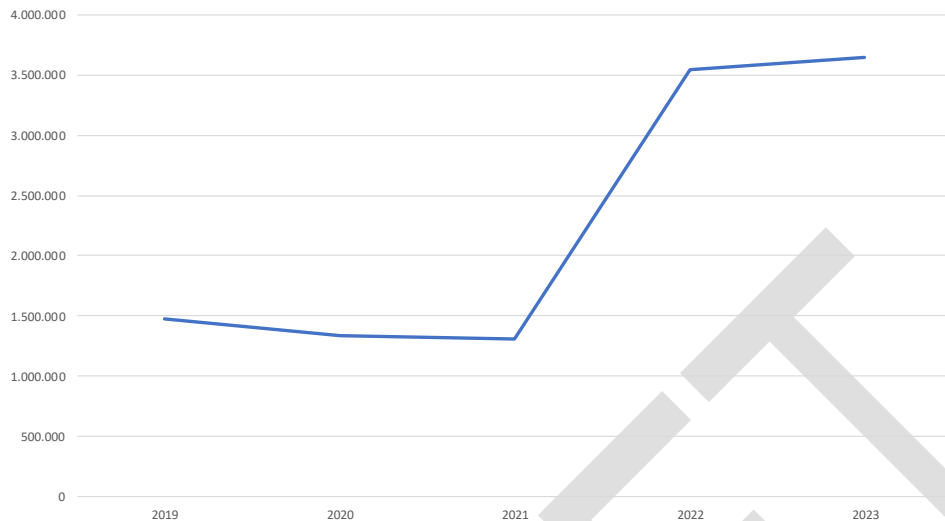
In 2021, to overcome the existing financial gap, the MES announced additional investments in R&D through grant, project, and program funding (Figure 1). Three new competitive calls were opened and the largest allocation of the budget (EUR 3.5 million for 44 projects) were directed toward financing scientific research projects to support the improvement of the research infrastructure in academia and public research institutes. Also, in 2021 the MES opened regular competitive calls for financing scientific research projects, programs of the public institutes, publishing scientific papers in journals with an impact factor, scholarships for young researchers, organization of scientific conferences in North Macedonia, and participation in international scientific conferences.

³¹[Zakon za naucno - istrazuvackata dejnost.docx \(live.com\)](#) Official Gazette of the Republic of North Macedonia" 46/08, 103/08, 24/11, 80/12, 24/13, 147/13, 41/14, 145/15, 154/15, 30/16, 53/16, 257/20 и 163/21

³² "Official Gazette of the Republic of Macedonia" No. 82/2018

³³ "Official Gazette of the Republic of North Macedonia" no. 13/96, 13/96, no. 5/2009 and 59/2012

Figure 1: Budget allocation for R&D per year



Source: MES, 2023

The total budget of the MES dedicated to science for 2023 is about EUR 6.7 million, out of which EUR 3.6 million is directed toward R&D project collaboration and other scientific activities.

North Macedonia's Gross Expenditure on R&D (GERD) as a percentage of GDP was 0.38% in 2021, slightly increased from 2018, when was 0.36%. In absolute numbers, GERD increased by 13%, from 39.1m in 2008 to 44.2m in 2021. The government sector is the main sector for funding R&D activities in North Macedonia with 47.55% of GERD in 2021, while the 73.92% of the R&D funding mainly comes from public sources. The private R&D funding was only 20.59% of GERD in 2021, decreased from 24.05% in the year 2018. The main weakness is the share of Business Expenditures on R&D (BERD), which was 22.00% of GERD in 2021, decreased from 2018, when was 30.57%. The leading performing sector in the country was the Higher Education Sector with a share of 58.00% of the GERD in 2018 and 66.40% of the GERD in 2021.

The total number of researchers in full-time paid employment (FTE) in 2021 by sector of performance was 140 in the governmental sector, 735 in the higher education sector, 142 in the business sector and 24 in the non-profit sector, or a total of 1042.

The Republic of North Macedonia has been actively engaged in international cooperation, primarily through bilateral and multilateral partnerships in Science, Technology and Innovation (STI).

In respect to the bilateral cooperation, the Republic of North Macedonia has signed 24 STI agreements out of which 12 with the EU Member States such as Austria, Germany, Spain etc.

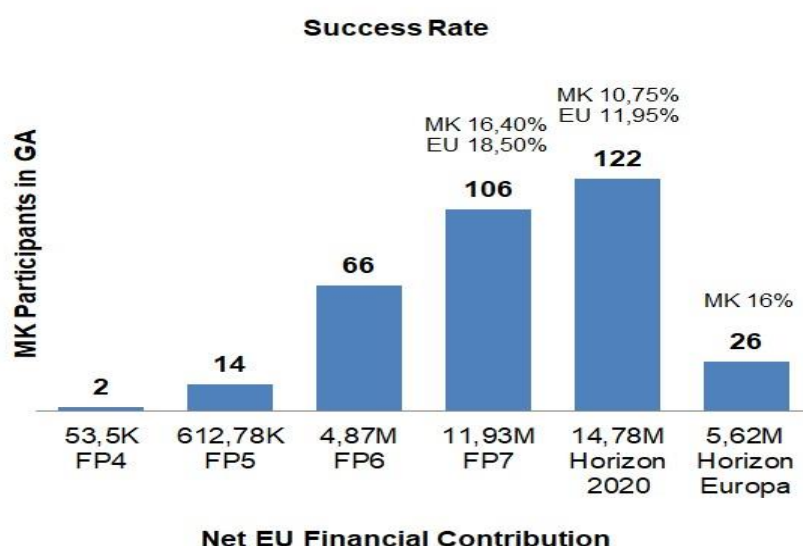
Regarding multilateral cooperation, North Macedonia participates in the following programs:

Horizon Europe Programme 2021-2027 - North Macedonia became an associated country to the Horizon Europe programme by signing an international agreement on accession in December 2021.

Similar to Horizon 2020, Horizon Europe comprises a three-pillar approach based on excellent science, industrial competitiveness, and innovation via the European Innovation Council.

Macedonian participation in the Framework Programs (FPs) through the years, although modest, still have an upward and successful trend (Figure2).

Figure2: Macedonian participation in FPs



Source: <https://cordis.europa.eu/>

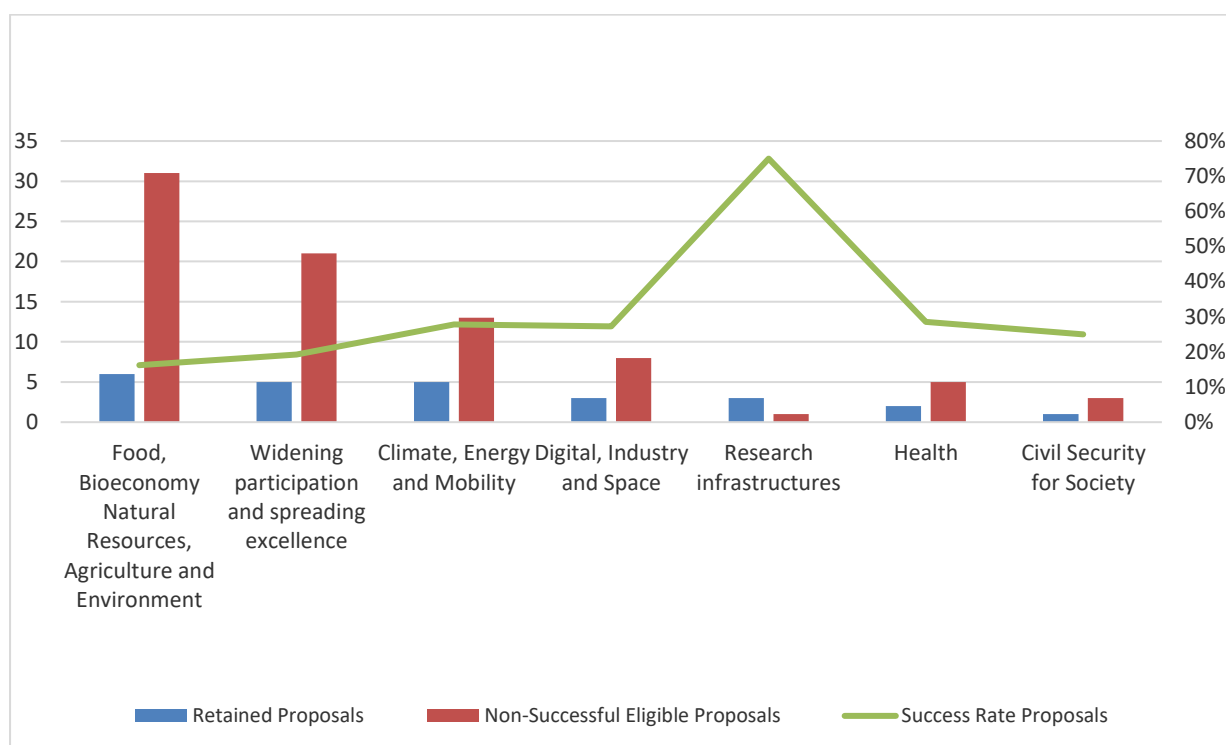
North Macedonia performed well in the previous two Framework Programs, FP7 and Horizon 2020, especially when adjusting for the size of our research base and the country.

Very good R&I results were also achieved in the first two years of Horizon Europe compared to the same period in Horizon 2020 when 20 projects were retained out of 126 applied project proposals with a success rate of 16 % while 11% was in Horizon 2020. These results are in line with the key strategic orientations of the Ministry of Education and Science for the first years of participation upon which we should continue to build forward.

Thematic priorities within Societal Challenges, Digital, Industry, and Space; Climate, Energy and Mobility; and Food, Bio-economy Natural Resources, Agriculture and Environment remain the most exploited areas by the research community in north Macedonia (Figure 3).

These HE thematic priorities and actions are complementary to the already defined national smart specialization priorities. It's an excellent reference point for developing synergies between Horizon Europe and the Smart Specialization Strategy thus maximizing the impact of national and EU investments in R&I in higher-performing areas of specialization.

Figure 3: Eligible and retained proposals by programme/thematic priority



Source: E-Corda, May 2023

The EIT Community RIS Hub – the first of its kind, was established in 2023 in the country by the European Institute of Innovation and Technology (EIT)

This hub is opened within the Business Accelerator at University Sts. Cyril and Methodius - Skopje, (BAU Accelerator UKIM). It will represent all the EIT's Knowledge and Innovation Communities (KICs) and focus on attracting and engaging an increasing number of Macedonian participants in EIT Community activities.

By connecting regional actors, innovators, and partners to Europe's largest innovation ecosystem, the new EIT Community RIS Hub will strengthen cooperation among leading business, education and research organisations while increasing the region's competitiveness and sustainable economic growth. The new Hub is part of the EIT Regional Innovation Scheme (EIT RIS) programme designed to tackle the persistent innovation gap in Europe.

The **Regional Cooperation Council (RCC)** published the **Research Infrastructure Roadmap of the Republic of North Macedonia**³⁴, which presents the existing

³⁴<https://mon.gov.mk/content/?id=4750>

research potential of the country, sets principles for future development, and proposes recommendations aimed at strengthening the research sector and societal development.

North Macedonia actively participates in the operations of several large European research infrastructures, including GEANT Pan-European Network, EOSC Association, CEESDA, EGI, OpenAIRE MAKE, EuroHPC JU, ESS, and SEEIST. The country has also participated in 21 international projects related to research infrastructure development, including three in Horizon Europe with a total value of 1.4 million euros, 11 projects within H2020, and seven projects within FP7. In September 2020, two projects, EuroCC and CASTIEL, were launched with financial support from the European High-Performance Computing Joint Undertaking (EuroHPC JU). The EuroCC and CASTIEL projects aim to build a European network of 33 national HPC competency centers, in line with EuroHPC JU's goal of developing a world-class supercomputing ecosystem in Europe.

North Macedonian collaboration with the **Joint Research Centre (JRC)** is through activities in data exchange, infrastructure and database utilization as well as development of a Smart Specialization Strategy (S3).

North Macedonia has been a full member of the **European Cooperation in Science and Technology (COST)** since May 2002 with total participation in 632 COST Actions and chaired 8 of them. COST participation within the past 5 years: 268 Actions mainly in the areas of Natural Sciences, Engineering and Technology, Social Sciences, Agriculture, Medical and Health Sciences and Humanities.

Furthermore, North Macedonia has also signed agreements for collaboration and has been involved in various international programs and initiatives aimed at advancing scientific research and improving research infrastructure as follows: **EUREKA** Programme, **NATO's Science for Peace and Security** Program, the European Organization for Nuclear Research - **CERN**, The International Atomic Energy Agency - **IAEA**, the United Nations Educational, Scientific and Cultural Organization - **UNESCO**, and the Central European Exchange Program for University Studies - **CEEPUS**, where 110 mobility of professors and 70 of students were realized from 2018 to 2023.

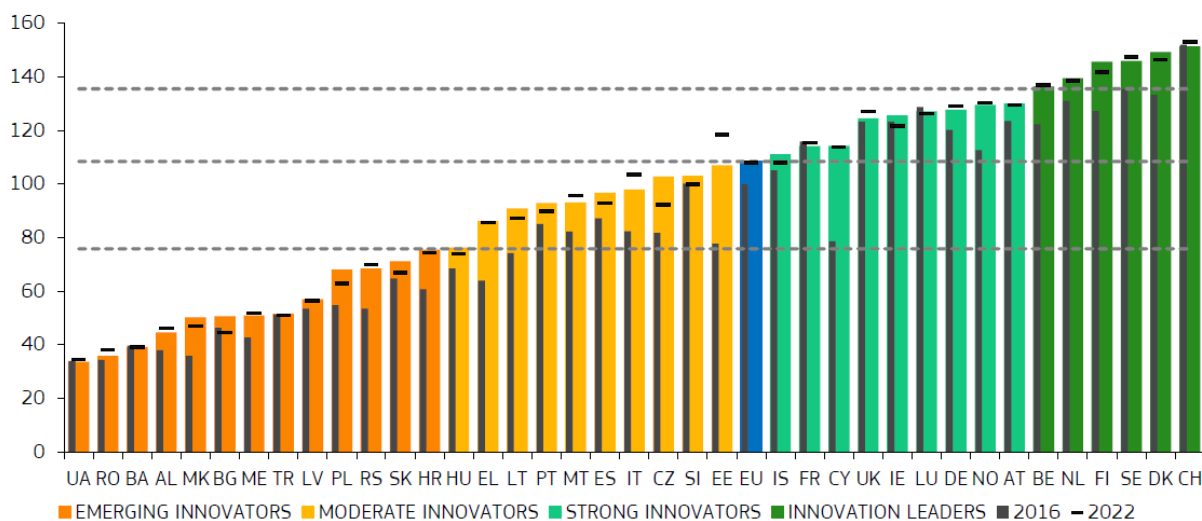
Current overview of the innovation ecosystem

The Republic of North Macedonia is an upper-middle-income economy with a GDP per capita of USD 6.591 in 2022. The services sector contributed for 57% of the GDP, the industry for 22.6% of GDP and the agriculture for 9.1% of GDP in 2020.

According to the statistical data, less than 0.4% of the GDP is invested in research and development.

The latest European Innovation Scoreboard 2023 (EIS) ranks North Macedonia as an “emerging innovator”, with a performance at 46.3% of the EU average (Figure 4). The overall performance is below the average of the “emerging innovators”, but it is increasing at a higher rate than the EU average (8.5% points), meaning that the performance gap to the EU is decreasing at a steady pace.

Figure 4: Situation as of EIS in 2023



Source: EIS2023

The EIS shows continuous progress in scoring over the years. The innovation performance started to increase in 2017 with an acceleration in 2022 and 2023, leading to an overall improvement of 40% between 2016 and 2023.

The EIS also identifies several economic structural differences with the EU relevant to the national ecosystem:

- North Macedonia has a lower per capita income than the EU average;
- Manufacturing takes up a larger share of the economy, with SMEs accounting for a larger share of turnover;
- FDI net inflows add positively to the innovation climate;
- Entrepreneurial Activity, top R&D spenders, and buyer sophistication add negatively to the innovation climate;
- Entrepreneurial training is above the EU average;
- Government procurement is below the EU average;
- Despite the very positive trend in environment-related technologies, information on climate change-related indicators is not available.

Other relevant policy assessments such as the Competitiveness Outlook and the SME Policy Index have noted a significant positive disruption of the innovation ecosystem mainly related to the strategic framework, the institutional framework and the sustainability of public funding for innovation with the establishment of the Fund for Innovation and Technology Development (FITD) in 2013. These assessments however also note a lack of data on the efficiency of public investment due to a lack of inter-institutional coordination, adequate monitoring mechanisms and evaluation.

The Innovation Strategy of the Republic of Macedonia for 2012-2020³⁵ is the first national strategic document directly addressing innovation as a driver of national economic transformation. The strategy expired in 2020 and the S3 should replace it providing continuation of the previous innovation strategy, with a focus on enabling economic growth through innovation, collaboration and knowledge sharing.

The regulatory framework for innovation and development practices is defined in the Law on Innovation Activity³⁶ as the main legal document regulating the instruments and the work of the Fund for Innovation and Technological Development (FITD), which is under the competence of the Ministry of Education and Science. Amendments of the law during time were widening the scope of the FITD activity.

Currently, within the process of reorganization of the Government and public institutions, there are activities for new changes in the Law on Innovation activity, actually an activity for the development of a new Law. Also, the need for a new Law on Innovation Activity has been reconfirmed during the development of the policy mix of the Smart Specialization Strategy, in order to open the floor for new instruments and create an environment for further development of the innovation ecosystem.

The leading institution in the innovation eco system is the Fund for Innovation and Technology Development.

Important stakeholders in the innovation ecosystem are also the innovation-led start-ups, accelerators, digital innovation hubs - DIH, Enterprise Europe Network - EEN office, EIT RIS HUB and others.

The Fund's mission is to "improve access to financial support for innovation and technological development and promotion and encouragement of innovation activity in North Macedonia".

The main goal of the Fund is to encourage the application of innovations in domestic companies, by providing additional sources for financing innovations, as a foundation for building a competitive knowledge-based economy.

The FITD goals include:³⁷

- improved access to financial services for innovations and technology development;
- promoting and encouraging innovation activity;

³⁵[ПРЕДЛОГ \(fitr.mk\)](#)

³⁶[Law-on-Innovation-Activity.pdf \(fitr.mk\)](#)

³⁷[Среднорочна-програма-на-ФИТР-за-2021-2023-година-финална_eng..pdf \(fitr.mk\)](#)

- establishing an efficient triple/quadruple helix innovation system by actively including and supporting all segments – public institutions, the academic and scientific community, the industry and the citizens;
- encouraging innovation activity through all levels of education and training;
- encouraging cooperation between the academic community and the industry to intensify the knowledge and technology transfer;
- raising awareness about the importance of innovations for the competitiveness of the domestic economy and social development.

FITD awards funds to SMEs using different instruments for support including:

- Co-funded Grants for Newly Established Enterprises: Start-up and Spin-off;
- Co-funded Grants for the Commercialization of Innovation;
- Co-funded Grants for Technological Development and Accelerated Economic Growth.

The projected annual budget for funding projects in SMEs for 2023 is approximately 16 million EUR. In addition to the instruments for financial support, FITD also invests in the development of the triple helix infrastructure, enhancing academia-industry collaboration and enhancing entrepreneurship and innovation among youth. Under its challenges, FITD finances projects fostering socio-economic impact such as green projects, digitalization, social innovation, etc.

PRIORITY DOMAINS

Each of the selected vertical priority domains is described through the current state of play in the domain and its potential, together with SWOT, definition of the domain, relation with other vertical and horizontal domains with possible cross-innovation opportunities and overall and strategic objectives of the domain as well green, digital and sustainable transition.

The following section presents an overview of priority areas that is the result of the mapping analysis and summary reports obtained from workshops conducted within the entrepreneurial discovery process.

Smart Agriculture and Food with Higher Added-Value

Modern agri-food supply systems and networks are expected to ensure competitiveness and profitability, supply and value chain coordination, providing quality, safe and affordable products to satisfy consumers' needs, as well as to improve environmental protection. Food production and consumption are rapidly changing. On one hand, achieving food security and safety is a major worldwide challenge; on the other hand, food waste and losses are also issues that must be addressed locally and globally. Agri-food systems are directly or indirectly related to the attainment of all 17 Sustainable Development Goals (SDGs), implying that improving food systems sustainability, resilience and comprehensiveness are central to achieving them. The food system challenge goes beyond only food production and nutrition security, with its important long-term contribution to ensuring sustainable livelihoods for everyone.

The significance of the agri-food sector in North Macedonia's economy, as described below, is paramount in supplying food for the local market and for export, as well as through its critical function of a social buffer in rural areas. Major challenges remain in the weak resource use, low productivity, insufficient level of cooperation and integration along the chain, adverse environmental effects, poor access to technologies, innovation and transfer of knowledge. Finding the right answers to these agri-food system challenges in North Macedonia depends on tailored inputs by research and collaboration with the business sector. Hence, research, development and innovation capacities need to be upgraded to support the transition and implementation of sustainable practices and overall development of the agri-food sector. Such capacities should accompany public and private sector support to address the low productivity and in exploring how cooperation along value chains can be improved.

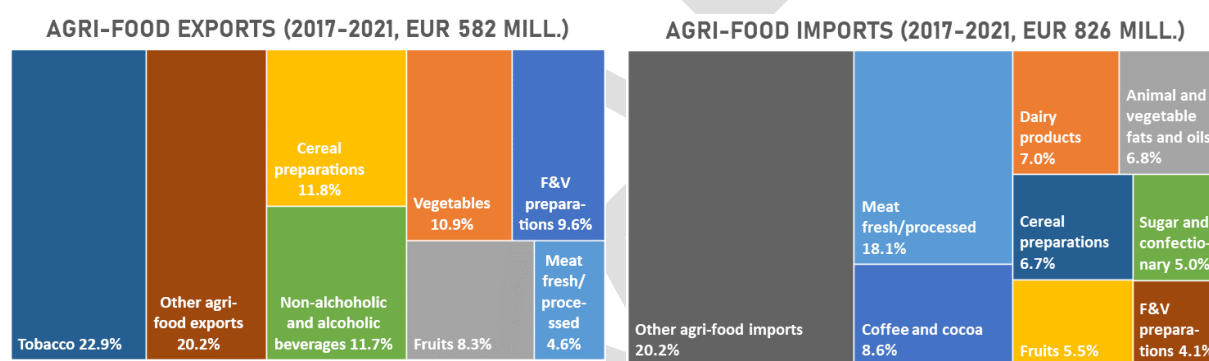
Significance and Potential of the Domain and Sub-Domains

The agri-food sector is one of the most significant in the country, contributing up to 10% of the national gross value added in primary production, or around 15% coupled with the food industry. The country has a long and well-established tradition of producing a wide range of agri-food products, with established internal and external export links. Primary agriculture and the food industry have always been strategic export sectors in North Macedonia. Although these sectors have seen a decrease in their relative share in the country's total exports over time, due to the growth in

exports of other sectors, still primary agriculture and food industry remain significant export sectors with great potential for further development.

North Macedonia has an open economy and is highly integrated into international trade, with European Union and Central European Free Trade Agreement (CEFTA) countries serving as major trade partners. While both agri-food exports and imports volume and value are rising over time, the country remains a net importer of agri-food products (Figure 11). There is a continuous growth in the past 10 years, with an increase in the export of agricultural and food products from 470 million euros in 2012 to 625 million euros in 2021. In the same period, imports have risen from 673 million euros in 2012, to 939 million euros in 2021. The main export products from North Macedonia are tobacco, lamb meat, fresh and processed vegetables and fruits, wine and cereal preparations (cookies, biscuits). The main imports are meat (including poultry, beef and pork), chocolates, confectionery, dairy products, oils and fats, processed foods and grains. The top trade partner for agricultural and food products is the European Union, which accounts for around half of both exports and imports. The Western Balkan countries take about one-third of both agri-food exports and imports.

Figure 11: Agri-food export/import



Source: SSO ³⁸

The most prominent value-added export segment is the fruits and vegetables processing industry. For this industry alone, the value of exports in 2021 amounted to a record 73.8 million euros, which is 5.3 million euros or + 8% more than in 2020, i.e. 14.1 million euros or + 24% increase compared to 2019. The structure of exports in 2021 is dominated by processed vegetables, which take part in value with 85%, compared to fruit processing, whose share is 15%. In volume terms, the total export of F&V processed products amounted to 50.3 thousand tons in 2021, i.e. +3.7% compared to 2020, or + 4.1% more compared to 2019.

The agri-food exports are realised through 109 companies exporting primary agricultural products, and 164 companies exporting food and beverages. Within the primary agriculture export, there are 49 companies with comparative advantage and

³⁸SSO (2023) MakStat database. State Statistical Office of the Republic of North Macedonia

³⁹MAP (2022) Export performance of the fruits and vegetables processing industry in 2021. Macedonian Association of Processors, Skopje.

69 products worth more than 200,000 Euros worth of exports, while within the food industry and beverage industry there are 40 companies with comparative advantage and 53 products worth more than 200,000 euros are exported. The export concentration of the first 10 export products is higher in the food industry (76%) compared to the primary agricultural sector (58%). The largest export companies include wineries beverage producers, the meat industry, dairy producers, the confectionery industry, the canning industry and primary agriculture.

Over the past period, the Fund for Innovation and Technological Development (FITD) has provided an important impetus to motivate agricultural and food sector beneficiaries to conceive and implement innovative solutions in their operations. In the period 2015-2020, 23 projects worth 1.6 million Euros (primary agriculture) and 20 projects worth 2.9 million Euros (food industry) were supported by FITD. This accelerated the penetration of new technologies for improved competitiveness, optimisation and cost reduction as well as adding value to traditional practices, such as remote agricultural monitoring and advisory systems, use of drones and IT tech in agriculture, new product development and commercialisation, and use of advanced digital marketing tools (neuro-marketing) for branding and packaging.

There are certain examples of product innovations and market launching, including boutique wines and wine ice cream, healthy food products, organic products, functional food products, smoothies, vegetable spreads and other foodstuffs previously not produced here, some of which were supported by FITD. In this way, local companies deploy import substitution strategies which are effective on the domestic market and can trigger export potentials.

There is a relatively well-spread geographical coverage both in primary agriculture and in the food industry. The primary production sector in North Macedonia has been traditionally dominated by a large number of individual family farmers (around 178,000) and a small number of agricultural enterprises (less than 300). However, recently there has been a trend of new start-ups and SMEs led by professional farmers that invest and innovate to focus on more cash crops (raspberries, hazelnuts) or modernize the production on the farms (such as automated milking on cow farms, use of harvesting equipment, use of solar dryers to extend the commercial value of the crops).

There is evidence of some examples of entrepreneurial SMEs implementing new technologies such as the preparation and distribution of fresh-cut products in consumer packaging, even using modified atmosphere for prolonged shelf life, responding to the changing consumer trends for convenience. However, the EDP processes through the SWOT analysis and discussions identified a lack of systematic approach and enabling environment to further stimulate start-ups and further scaling up of successful applications.

A feasible path for increased competitiveness in the regional and international markets is repositioning the sector as a recognisable supplier of typical and niche products. The food industry for example is most successful in the segment of processed traditional products (especially in fruit and vegetable processing) gradually increasing its performances by volume and value. This market segment proved to be resilient in market distortion conditions, such as the COVID-19 crisis. Still, the average exports of the industry point at selling commodity-type products, where the future direction should be focused on branded, higher value-added

exports offered in mainstream retail networks (rather than the ethno segment) as premium products.

The major missing elements of the value chain are recognised in the research and development part (research/academia-business collaboration is scarce, as confirmed through the EDP workshop), lack of permanent, functional and easily accessible knowledge transfer channels, as well as innovation and commercialisation of new produces, processes and services. The small size of companies, characteristic of both the primary and processing sectors, the lack of financial capacities and reliance on traditional production processes, hinder the process of rapid advancement and adoption of innovative solutions, while the atomistic structure of the primary production acts as a major impediment for grouping/joining resources for increased bargaining position in the chain. This is present both on the primary production level (producers versus industry), and also in the industry/export segment where the bargaining power of the buyers is prevailing. In this context, the adoption of ICT tools and practises is underused and far from its cross-innovative potential (recognised also during the EDP workshops). This is mainly due to the small farms and firms' size (larger companies tend to adopt ICT technologies sooner), education (understanding the benefits of ICT in the production processes) and age of key value chain actors (elderly farmers or business managers are less inclined to learn about ICT benefits).

At the moment, domestic processors seem to be heavily dependent on intermediate dealers (importers and wholesalers) when exporting their products abroad, although some of the processors already started to negotiate and cooperate directly with the retail chains and/or to establish partnerships with specialized food products distributors. Domestically, they distribute their products directly to the retailers (in particular to the retail chains) or use intermediaries (wholesalers/distributors) with developed distribution networks to cover numerous small retail shops.

Although domestic products enjoy a positive reputation among regional and international food importers, currently most exports are marketed with relatively small export values. Producing and selling under own brands is lower than selling under private labels. As a result, currently, the industry is building its export strategy primarily through competitive prices, rather than supplying higher value-added products.

Another path, which was stressed during the final EDP workshop, is in finding alternatives to the conventional methods used in the sector - which rely heavily on the application of various synthetic chemicals, such as pesticides and fertilizers – in order to address the issues facing agriculture today and in the future in a way that is more efficient and more sustainable⁴⁰. In this respect, the domain should also encourage the development of bio-based alternative products of microbial and non-microbial origin (such as those related to biofertilizers, biostimulants, or biocontrol) that positively influence the plant physiological functions, such as growth and yield, improving crop quality and nutritional value, disease resistance, and resilience to environmental stressors. This would encourage the scientific community, in strict

⁴⁰ Recent regulation (EU 1009/2019 in the EU) encourages the use of biostimulants in agriculture and opens the market for new and innovative solutions.

interaction with the industry, in the continuous development of new bio-based solutions for modern agriculture.

The need for strengthening the research and innovation potential, especially in academia has been highlighted through increased research staff, international publications, intellectual property rights, the number of international competitive projects won, cases of successful collaboration with industry or successful spinoffs, and emphasis on collaboration with the business sector through applied research. The agri-food sector participates with only 4% in the patents and 5% of published papers (298 - WoS 2010-2018; 874 - SJR 1996-2017) in the country. Macedonian researchers produce almost twice as many scientific publications compared to Albania and Montenegro, as well as BiH, but significantly less than Serbia. There is intensive cooperation with donors, while currently, only 9 projects in H2020 have been successful (11% success). This trend is however improved with the recent Horizon Europe applications, where around 16% are successful.

The agri-food sector was among the few sectors in North Macedonia, alongside the ICT, that grew during the COVID-19 crisis. The COVID-19 crisis and subsequently the global crisis in food, energy and finance caused by the war in Ukraine pronounced the importance of a stable food system that operates in all circumstances and can provide consumers with a sufficient and continuous supply of quality food at affordable prices. Although there were some drawbacks and distortions in markets, transport and logistics in the initial waves of the COVID-19 crisis, there were also some new opportunities that in some segments pushed the sector into faster transformation, notably in the area of using ICT tools and solutions. Nevertheless, the crises expose the existing weaknesses of the sector. The current trend of substantial increases in the prices of inputs puts high pressure on the production costs of all actors in the chain, with limited purchasing power of the domestic consumers. The following issues were raised during the EDP discussion:

- The stakeholders in the sector are perseverant and the food industry in particular has demonstrated resilience to the consequences of the COVID-19 crisis
- However, the global crisis has challenged the structural shortcomings in the sector with a vast number of very small family holdings with limited production capacity deepened the existing problems, and especially affected the most vulnerable farmers who are on the edge of sustainability.
- Nevertheless, opportunities arise from the COVID-19 crisis, such as demand-driven growth in e-commerce, home delivery, individual consumer packaging, etc. Digitalisation and use of ICT tools and practices are increasingly recognised as a path to follow.

The threats of market distortion as a result of the COVID-19 crisis are currently prolonged by the crisis on food, energy and finance caused by the war in Ukraine, with a significant increase in prices of primary raw materials and prices of inputs (energy, fertilizers, protection, animal feed, packaging, etc.), coupled with the reduced purchasing power, especially on the domestic market. The share of household expenditure on food and beverages has risen from 39.7% in the period

2010-2019, to 45.0% in 2020, and 47.1% in 2021 (SSO, 2023⁴¹), alerting to the increased prices of food items. This increasingly burdens the household budget, with major foodstuffs consumer prices soaring over the last period (for instance, from November 2021 to November 2022 bread and cereals prices have increased by 42.5%, meat by 29.1%, milk, cheese and eggs by 39.1%, oils and fats by 30.8%, SSO, 2023⁴²).

SWOT

Figure 12: SWOT analysis of the “Smart agriculture and food with higher added value” priority domain

Strengths	Weaknesses
<ul style="list-style-type: none"> • Favourable conditions for development of agri-food production • Solid technical-technological basis and entrepreneurship in food industry • Established markets for agri-food products • Recognized importance and support of the sector • Existing structural, educational, scientific research and advisory basis <p style="margin-left: 20px;">Increasing cross-sectoral connectivity</p>	<ul style="list-style-type: none"> • Structural shortcomings and disadvantages in production and technology in the agri-food sector that lead to low yields, low value and unstandardized production • Weak market penetration • Insufficient cooperation between the main actors in the sector • Lack of information, know-how and knowledge transfer hamper modernization and innovation in the sector
Opportunities	Threats
<ul style="list-style-type: none"> • New markets, new products development and recognition • Application of new technologies, innovations and digitalization for increasing productivity • Improving the business environment and education, knowledge-transfer and cooperation can increase viability of the agri-sector and attract young professional farmers • Encouraging cross-sectoral synergy to add value through additional non-ag activities 	<ul style="list-style-type: none"> • Growing market competition and shifting global trends • Technological-production related challenges arising from urbanization and climate change • Lack of strategic planning and effective public policy implementation • Diminishing workforce

Digital, Green and Sustainable Transition

Agriculture and the production of food play an important role in the global economy and have a vital role in the transition to a greener economy part of which consists of using up-to-date digital solutions and devices.

The depletion of natural resources makes the improvement of agri-food production even more important. Depending on natural resources as a core production factor, the sector can cause both environmental harm and/or provide environmental benefits. Globally, it contributes to around one-fourth of greenhouse gas emissions,

⁴¹SSO (2023) MakStat database. State Statistical Office of the Republic of North Macedonia

⁴²Ibid.

which can be significantly reduced by applying good management practices, creating environmental services, and producing renewable energy, while also attaining food security. The agri-food sector can support economic development, with balanced resource use, and the creation of green jobs, while ensuring food and nutrition security.

The S3 needs to foster green transition, digital transformation and better embracement by farmers and other actors in the value chain through, for example, increased use of precision agriculture tools and techniques by using the "internet of things" (e.g., for simplifying and streamlining collection, inspection and distribution of agricultural goods and resources using sensors on equipment and materials), drones (e.g., for crop monitoring, to predict soil quality, for seed planting patterns, for spraying chemicals etc., which can help combat drought and other harmful environmental factors on crops), robotics and artificial intelligence (to improve productivity resulting into higher and faster yields, for instance spraying and weeding robots, plant transplanting or harvesting/fruit-picking robots, and food processing), sensor tracking systems across the chain from farm to fork, machine learning and analytics (e.g., for analysing purchasing patterns of consumers and predicting demand).

Many of the digital tools and practices contribute to green transformation and less waste, which is being recognised as one of the major challenges in the sector. Another potential for green transformation is 3D printing, with many parts or equipment being produced and assembled locally (e.g., mini meteorological stations, irrigation equipment, and another part for farming and industry), hence no international transport is needed. This is also why the cross-sectoral innovation potential of agri-food production especially with ICT was so stressed.

The circular economy is another concept that needs to be fostered, referring to the physical and material resource aspects of the economy — water, fuel, biomass, minerals, focusing on recycling, limiting and reusing the physical inputs to the economy, and using waste as a resource, leading to reduced primary resource consumption.

The lists of possible applications in the field of digital and green transformation that offer opportunities and benefits for users were presented and are in line with the Green and Digital agenda of the EU aiming to improve the well-being and health of citizens and future generations. Digital and green transformation is also at the core of the Green Agenda for the Western Balkans, following the paradigm of the EU Green Deal. There is substantial funding for these goals available also to RNM stakeholders which they should see as an opportunity to accelerate the transition of the priority domain towards the long-term vision.

The Smart Agriculture and Food with Higher Added Value domain objectives are directly tied to most of the SDGs: SDG2 (Zero hunger), SDG 12 (Responsible consumption and production), and SDG 15 (Life on land) and can indirectly contribute to the following SDGs: SDG7 (Affordable and clean energy), SDG 9 (Industry, innovation and infrastructure), SDG 11 (Sustainable cities and communities) and SDG 13 (Climate action). However, the solutions fostered by the S3 actions may also limit some options of an SDG target, as they stem from the compromise made for the energy-water-food nexus.

Cross-Innovation Potential and Opportunities

The Smart agriculture and food industry with higher value-added products domain has plenty and diverse opportunities for cross-innovation, with both vertical and horizontal domains. In fact, the smart specialisation of the domain is closely dependent on the synergetic effects in connection to the other domains. These interactions were first recognised during the qualitative analysis followed by acknowledgement and more precise identification within EDP.

Cross-innovation matrix indicating identified concrete opportunities between Smart agriculture and food with higher added value and other vertical and horizontal domains:

Smart agriculture and food with higher added value and ICT

The new developments in ICT offer a unique opportunity to bring enhancing technologies to the agricultural sector and food industry, empowering the use of modern technology and innovation and accordingly ensuring cost-effective and profitable operations. The use of ICT results in better resource use and hence improvement of productivity, while also reducing the time needed for farms/food processors management, marketing, logistics and quality assurance. Increasing requirements for food safety and quality would benefit from the expanded application of new digital technologies in food production and food supply. In a wider sense, rural development is also enhanced through improved digital access to information and digital communication channels. The ICT's extensive reach to even the remotest locations in rural areas can also help address important socio-economic issues.

Different digital technologies like Artificial Intelligence, big data, robotics, drones, sensors, and communication networks, connected through the Internet of Things have the potential to be successfully applied to the farm or food processors production systems. Information sharing platforms including prices of inputs and products, weather forecasts, availability of seasonal labour, equipment usage, new diseases occurrence, and expert advice are also important, in using ICT tools and practices.

The advantage of adopting ICT for the digitalisation of operations and connectivity to relevant institutions is also key, enabling better administration and communication with stakeholders. For policymakers, information sharing would enable a better understanding of the situation at the ground level, which will contribute to the designing and implementation of policies that benefit the end users.

Several cross-innovation opportunities were more concretely formulated during the EDP:

- Collection and processing of a large number of data in function of various stakeholders for their decision-making (agricultural production planning, data on quantities and prices, registers, etc.)
- Digitisation of agricultural services - huge opportunities (electronic platforms, online sales, electronic auctions, sharing of various resources such as machinery, labour)

- ICT tools and digital transformation of the processing industry in order to increase competitiveness
- Digitalization of institutions and the public sector (many of the procedures can be done much more efficiently and simply through proper digitalisation)

Smart agriculture and food with higher added value and Smart/Sustainable buildings and materials

- Connections with Smart/Sustainable buildings and materials are possible for the design of agricultural and food processing and storage buildings with a higher degree of sustainability, employing for instance natural, reusable or recyclable materials. Much-needed cold-storage facilities can extend the freshness of fruits and vegetables while reducing energy costs through adequate use of insulation and reliance on renewable energy sources. Utilization of biological waste as insulation/construction material is one of the possible applications.

Smart agriculture and food with higher added value and Electrical equipment and mechanical parts – Industry 4.0.

- Different equipment is needed for operations at all levels of the agri-food chain. The competitiveness of the stakeholders at all levels is closely linked with the application of new, modern and innovative technologies, including machinery and equipment. Opportunities can arise in adapting machinery to new operations, precision agriculture, or custom solutions in both primary production and food processing levels, as well as triple cross-innovations with the ICT domain

Smart agriculture and food with higher added value and Energy for the future

- Many opportunities may be found for synergistic action between the domain Smart agriculture and food processing with high added value and the domain Energy for the Future. Reducing and optimizing energy consumption in the agri-food domain is a key driver and catalyst for practice change, demanding a deeper understanding of efficient and renewable energy technologies that improve productivity and resilience in the sectors. This is especially important with regard to climate change; the primary agricultural sector in particular is one of the most vulnerable to the effects of climate change. In addition, decreasing the emissions in this sector in an economic way requires significant changes in the way of farming, processing and consumption. Moving away from fossil fuels and becoming enablers of the energy transition is possible either by up-taking renewable energy sources or by providing feedstock so that other sectors may generate energy sustainably. Using the large amount of available waste/biomass with potential for utilisation from agriculture and food processing, it is possible to generate energy (e.g. biowaste-to-energy) and fuels for supplying the energy needs of agricultural producers, food processors as well as local communities.
- The following opportunities were more specifically formulated during the workshops:
 - Introduction of new and innovative technologies, especially in the field of energy efficiency and energy savings
 - Bio-economy and energy from biological waste (thermal energy, electricity,

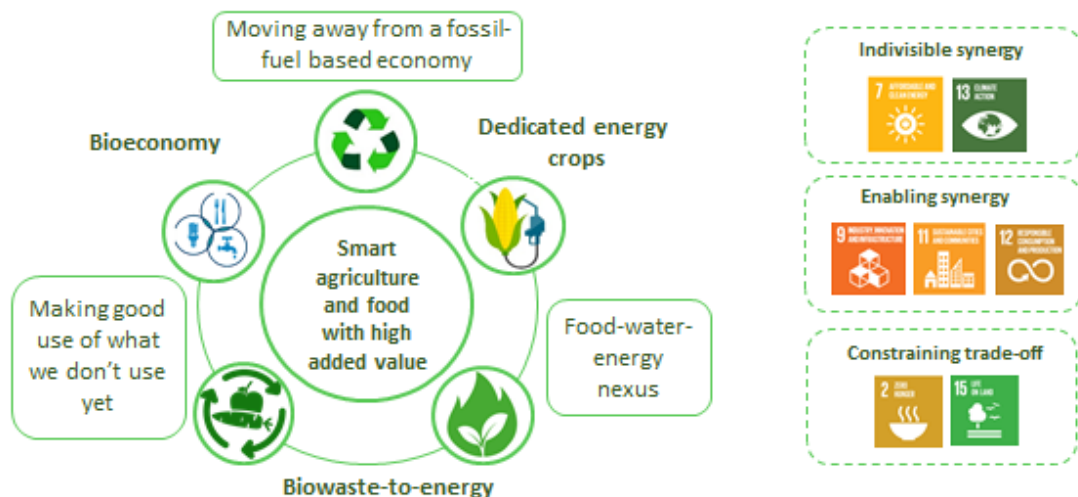
biogas)

- Increased use of renewable energy sources for processing value-added products, as well as on-farm in the primary segment

Globally, one-fourth of the Greenhouse gas emission comes from the agriculture sector. When thinking of ways to tackle climate change, many opportunities may be found for synergistic action between the domain “Smart agriculture and food processing with high added value” and the domain “Energy for the Future”. But, bringing the emissions in this sector to zero in an economic way will require us to make significant changes to the ways we farm, process and eat. We need to move away from fossil fuels and become enablers of the energy transition, either by up taking renewable energy in our own energy needs or by providing feedstock so that other sectors may generate energy sustainably. By making use of what we don’t use yet, such as agriculture and food processing residues, it is possible to generate energy (e.g. biowaste-to-energy) and fuels for supplying the energy needs of farmers, factories and local communities.

Such activities and measures are directly tied to the Sustainable Development Goal (SDG) 7 (Affordable and clean energy) and SDG 13 (Climate action), while also partly contributing to SDG 9 (Industry, innovation and infrastructure), SDG 11 (Sustainable cities and communities) and SDG 12 (Responsible consumption and production). Nevertheless, we need to be aware of possible trade-offs, especially in terms of the energy-water-food nexus and SDG 2 (Zero hunger) and SDG 15 (Life on land).

Smart agriculture and food with higher added value



Smart agriculture and food with higher added value and Sustainable tourism and catering

Agri-tourism is an emerging opportunity as agricultural producers try to diversify, searching for new sources of revenue to increase profits. Agri-tourism links agricultural production and/or processing with tourism in order to attract visitors onto farms and agricultural businesses to visit their operations in rural areas, for the

purposes of providing recreational, gastronomic, entertaining and/or educational experiences to visitors and generating income for the farm, ranch, or business owner. Agri-tourism allows visitors to feel and experience a lifestyle related to agricultural activity, local food and beverages, as well as local customs and culture. Some examples of agri-tourism activities include accommodation in rural areas, production and serving of local food and beverages, involvement in agricultural activities (for example, harvest, food preparation, etc.), recreational activities (hiking, cycling, etc.), cultural and entertainment activities in rural areas (customs and festivals), direct farm or food business sales, etc. Wine routes or gourmet routes are a particularly interesting activity (marked and advertised roads with special signs, along which include natural, cultural and environmental values, associated farms and processors open to the public).

Building on the strength of already initiated successful models in agri-tourism and wine tourism, the following opportunities in potential synergies were more specifically recognised during the EDP:

- Opportunity to diversify into different agri-tourism activities
- Initiatives for inclusion of agri-tourism and production of traditional products in tourist offers (for instance, wine routes, gourmet routes, on-farm visits, and food preparation, combined with recreational, cultural and entertainment activities in rural areas)

Information and Communication Technologies (ICT) Sector

The ICT priority domain was singled in the qualitative and quantitative analysis as the only one showing potential for smart specialisation in all three - economic, innovation and scientific/research - components. As a result, the domain is determined as a pillar of the smart specialisation strategy of North Macedonia in both vertical and horizontal sense. The domain can be structured to specific sub-areas that will further strengthen its position and ensure its growth while at the same time offering key enabling technologies to stimulate societal and industrial digital transformation. It can also serve as a role model for other priority domains in terms of the usage of novel and innovative methods for doing business based on ICT tools and solutions.

Significance and potential of the domain and Sub-Domains

The ICT industry in North Macedonia has very high growth potential and the ability to create more sustainable and better-paid jobs, while it has demonstrated resilience through global crises, such as COVID-19 and the energy crises. Currently, there are around 2.000 operational companies in the ICT sector employing approximately 19.000 people. According to the NBStat Portal of the National Bank of the Republic of North Macedonia⁴³, the export of telecommunications, computer and information services in 2021 (330M euros in total) exhibited a growth of 37% as compared to 2020, whereas there is a 36% from 2019 to 2020. Actually, 19% of the entire

⁴³<https://nbstat.nbrm.mk/pxweb/en/>

services export of the country comes from the ICT sector⁴⁴. This clearly shows the ICT sector growth trend. Lately, there have been favourable tax movements in the sector that can further stimulate its growth. ICT is by all means the fastest-growing sector of the Macedonian economy.

According to the latest available report from the biggest and the most influential ICT business association in the country - MASIT⁴⁵ on ICT - Workforce assessment (2020), 86% of the Macedonian ICT companies operated internationally, selling their products and services in 60 different countries. Moreover, 66% of the ICT companies have the international market as a main revenue source, where part of them are directly exposed and part of them through partner networks. Many of the ICT companies have offices internationally and solid links and exposures to international markets. This positions the local ICT industry well within the global value chain.

A significant number (38%) of ICT companies focus predominantly on developing their own products or both, own product development and outsourcing services (38%), which is a positive trend in improving their competitiveness and innovation. There are examples of companies with 15+ years of experience providing fintech solutions for world-renowned banks, subsidiaries of big Western ICT companies that develop custom eHealth/mHealth solutions locally, but for international markets, ICT companies that design and operate custom cloud-based services for different verticals, such as agriculture and textile industry. There are also local ICT companies that develop custom, mostly IoT-based, solutions for smart applications.

The dialogue among ICT companies within the EDP showed that the majority of them feel their service portfolios can be absorbed internationally since the local Macedonian market exhibits limitations and financial weakness. The **key competitive advantages of the Macedonian ICT companies** on the international market (as discussed in both SWOT and VISION EDP workshops) are the **skilled, yet cost-effective personnel, agile deliverance of tailored cloud-based services/products for international partners and profound experience in collaboration with global ICT companies**. This is also backed by the **excellent national ICT infrastructure**. The justifications for this competitiveness are seen through the constant increase of export of ICT services, the emergence of export of own products (vs. outsourcing) and the substantial share in the country's GDP of the ICT domain.

The **focus on own products** in the last couple of years led to the emergence of many start-ups that offer services both locally and globally in the area of **data analytics** for cross-sectoral applications (e.g., agriculture, energy management, transportation, smart buildings). The explosive growth of the need for data-driven products can allow them solid market positioning and the stakeholders already agreed in the SWOT workshop that **there exists a critical mass of innovative start-ups in the country**. Most of the new innovative start-ups come from the ICT sector (25.6% or 171 out of 669 start-ups and innovative companies supported by the Fund for Innovation and Technological Development come from this sector). The innovation ecosystem should be carefully structured in the near future with appropriate measures to allow scaling of these start-ups and faster access to

⁴⁴https://masit.org.mk/publications_post/izvoz-na-telekomunikaciski-komp-uterski-i-informaciski-uslugi/

⁴⁵https://masit.org.mk/wp-content/uploads/2020/09/export_report_masit_v1.00.pdf

international markets. The growth rate can be further stimulated if there is a push to public Software as a Service (SaaS) services to incorporate open Application Programming Interfaces (APIs). This will strongly affect the development of innovative data-driven products in niche markets (such as fintech, eHealth/mHealth, agribusiness, energy management etc.) allowing a significant market advantage of local companies. The open data concept through open APIs is a prerequisite for unleashing the potential of local companies in regional and international markets (as the knowledge and expertise are already in place).

To conclude, ICT sector is the fastest-growing one significantly contributing to the country's exports and GDP. It still lacks approximately 620 experts⁴⁶ annually to support the growth. Therefore, strong efforts shall be put to ensure that the supply and demand side are well aligned. Both formal and informal education can contribute towards this goal, but there should be a clear distinction of competencies and expertise. The latest wave of reducing employees in the ICT companies worldwide should be a lesson to invest in highly skilled, academically profiled, engineers who can propose and solve complex ICT problems rather than professionals trained with short courses with limited capabilities for personal and sector growth in the future.

SWOT

Figure 13: SWOT analysis of the "Information and Communication Technologies" priority domain

Strengths	Weaknesses
<ul style="list-style-type: none"> • Basic requirements (human resources, ICT infrastructure, accredited academic programs, associations) for expansion of the ICT domain in place • Emergence of innovative and high value added products 	<ul style="list-style-type: none"> • Low overall competitiveness (outsourcing, lack of specialization) • Poor access to new and diversified knowledge, and collaboration with academia • Inadequate policy measures for innovation and digitalization • Insufficient financing for innovation • Lower level of broader business experience and skillset • Small and unsophisticated domestic market
Opportunities	Threats
<ul style="list-style-type: none"> • Need for novel or customized solutions/products/services/applications in public sector and industry • Access to human capital with 	<ul style="list-style-type: none"> • Depleting human capital • Changing markets • Business environment not conducive

⁴⁶<https://masit.org.mk/>

<p>specialized skills and business and scientific networks</p> <ul style="list-style-type: none"> • Public awareness and institutional support for innovation • Need for institutional capacity building in support of ICT innovations • Access to international and regional markets • Novel business environment imposed by the pandemic 	<p>to innovation and digitalization</p> <ul style="list-style-type: none"> • Poor perception of the country among foreign clients and partners
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Green, Digital and Sustainable Transition

The topic of digital transformation is inherently associated with the ICT priority domain (foreseen as the cornerstone of the process). The EC's Digital transition⁴⁷ and the European Green Deal⁴⁸ offer a plethora of opportunities for the ICT domain. As for the European Green Deal, ICT is both a contributor and an enabler.

As an enabling technology, ICT can further provide solutions (e.g., in terms of IoT and cloud-based services) for precision agriculture, intelligent transportation and energy management in the public, residential and industrial sectors.

Workshop participants specifically discussed how the ICT domain can contribute to EC's Digital transition and agreed upon the feasibility and the urgent need for:

- Usage of digital identity services to facilitate easier identification and exchange of information among different governmental/other agencies (quintessential for citizens having their data diversified inconsistently);
- Open data / public availability of data (e.g., energy consumption) to yield innovative companies coming up with novel solutions for problems, thus helping citizens in the way;
- Provisioning eHealth/mHealth solutions to increase citizens' satisfaction and trust in the healthcare system;
- Usage of IT business models/processes to increase competitiveness level of domains/sectors that are not performing sufficiently;
- Usage of ICT solutions for solving citizens' problems such as heavy air pollution;

⁴⁷https://ec.europa.eu/reform-support/what-we-do/digital-transition_en

⁴⁸https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

- Boosting the institutional cooperation between academia and industry to better reflect business needs in the university curricula;
- Promotion of life-long training in novel technologies.

ICT can contribute to lowering the carbon footprint by enabling:

- Green networking (e.g. optimized communication protocols that put radios to sleep when not necessary) allowing decreased usage of electricity thus lowering the carbon output; and
- Increased level of shared (thus optimal) usage of IT resources through cloudification and virtualisation, thus fostering lower carbon output for the same (and often increased) results.

The ICT priority domain is directly tied to the following SDGs: SDG 7 (Clean and affordable energy), SDG 13 (Climate action), SDG 9 (Industry, innovation and infrastructure) and SDG 11 (Sustainable cities and communities). Taking in consideration the inherent role of ICT in data driven transformation and the significance of connectivity, the ICT priority domain is also indirectly linked to the majority of the remaining SDGs.

Cross-Innovation Potential and Opportunities

Cross-innovation matrix indicating identified concrete **opportunities** between ICT and other vertical and horizontal domains:

ICT and Sustainable food and beverage production and value chains
<ul style="list-style-type: none"> - Imminent need for precision agriculture solutions (primarily based on IoT); - Rapid rise of the technology of “printed sensors” applicable to agriculture (cheaper and faster prototyping of novel and innovative solutions); - Need for automated climate management in greenhouses, storage houses and production facilities; - Modernization of the domain using ICT tools (e.g., IoT devices, drones etc.) and ICT practices (e.g., mobile applications, information sharing platforms for various resources, modern ERP systems etc.); - Need for increasing the ecological efficiency of the domain by minimizing use of water, fertilizers and pesticides based on sensor data and automated systems.
ICT Smart/Sustainable buildings and materials
<ul style="list-style-type: none"> - Need for monitoring and regulating various ambient parameters in buildings/homes (using IoT devices/solutions); - Automation of processes (e.g., ventilation).
ICT and Electrical equipment and mechanical parts – Industry 4.0.
<ul style="list-style-type: none"> - ICT is a crucial cornerstone of Industry 4.0 enabling connectivity, reliability and automation; - Recent launch of commercial 5G networks in the country can support the concept

of Industry 4.0;

- Tailored IoT devices for specific industries can be locally designed and manufactured.

Energy for the future

- Development of novel, efficient, prediction algorithms for optimal energy usage or monitoring the price of electricity operating in (almost) real-time;
- Development of IoT devices and system solutions for reliable monitoring of energy consumption in real-time;
- ICT as a matching tool between energy demand and energy supply (specially with the more extensive proliferation of renewables in the grids) thus enabling smart grids;
- Fostering real-time observation and remote control of energy grids;
- Development of IoT devices and system solutions enabling intelligent transportation towards smart cities.

The potential cross-innovation comes from digitalization of the energy sector with suitable tools and products and by applying new algorithms and computational techniques to optimize the operation of the energy system and reduce uncertainty. This is well in line with the two sub-areas - "Custom software development" and "Data-driven ICT solutions", agreed by consensus in the ICT priority domain.

It is expected that in the following years, the energy sector will undergo a significant transformation, as it continues to integrate greater shares of renewable energy and phases out old generators based on fossil-fuels. However, renewable energy sources, such as solar and wind, are variable and introduce uncertainty in the operation of the energy system which should be considered as of great interest both from a technical and from an economic point of view. As a result, there is notable potential for ICT businesses based on data-driven analytics and decision making in the energy sector. Examples of such businesses are those dealing with the forecasting of electricity demand, electricity generation, market prices etc.

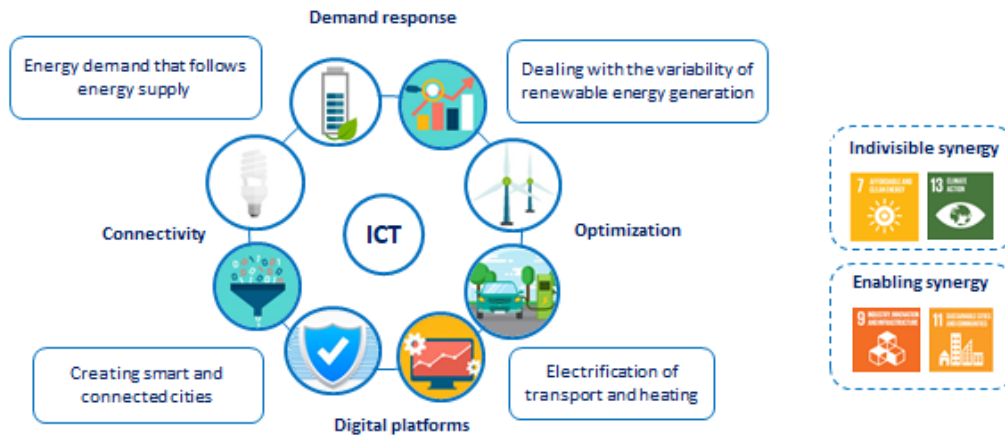
The shift towards a carbon-neutral future rely heavily on the "ICT" domain, which is a key enabler that can foster the uptake of these technologies through digital innovation.

In this framework, energy systems will be connected and smart, with decisions being made experts using optimization algorithms, machine learning techniques and artificial intelligence, either at edge devices or in the cloud. By creating cities smart, connected appliances, and by leveraging on the increased use of electric vehicles, heat pumps and energy storage, business opportunities will be found in so called "demand response" actions, where energy demand is controlled so that it follow energy supply from renewables.

Moreover, ICT may also greatly help the operators of the energy systems, both in the planning phase and in real-time, by making energy grids more observable and remotely controlled. All of these activities, and other similar to them will contribute to SDG 7 (Clean and affordable energy) and SDG 13 (Climate action) and partly to SDG 9 (Industry, innovation and infrastructure) and SDG 11 (Sustainable cities and

communities).

Cross-cutting: ICT vs. Energy for the future



Sustainable tourism and catering

- Development of eCommerce solutions for better exposure of local offers;
- Development of Augmented/Virtual Reality (AR/VR) based solutions for virtual tours and live feeds from museums and other landmarks and attractions;
- Usage of the solid national ICT infrastructure to enable remote work thus attract digital nomads;
- Development of custom software solutions for the wellbeing industry (niche market).

Efforts towards growing a digital economy create synergetic effects among the ICT domain and all vertical and horizontal ones, with following common opportunities:

- Need for custom software solutions/tools in other domains with a special emphasis on niche markets within;
- Need for data management agility exposing the added value of data-driven services in different domains utilizing tailored data analytics;
- Need for digital transformation of all domains with key ICT-related enablers being IoT and cloud-based services;
- Global need and solid local knowledge of DevOps (and Software-as-a-Service – SaaS in general) solutions implementation and maintenance;
- Increasing productivity in other domains by mimicking IT companies' operational models/processes (lessons learned from IT and applied elsewhere);
- Need for automation in other domains utilizing novel innovative technologies (e.g., Distributed Ledger Technologies – DLT) that provide market advantage

Electro-Mechanical Industry - Industry 4.0

In the development of the overall Macedonian economy, the Electro-mechanical industry has one of the most important places. The rapid development of the industry is one of the main drivers of the entire economic development, the change of social-economic relations, the way of living of the population, the increased interest in technical progress, etc.

Significance and potential of the domain

Macedonian mechanical and electrical industry has been traditionally developed in the production of basic metals and the metal-processing industry comprises a significant entity for providing basic and raw materials and an important, economically complementary and rounded technological branch. The share of basic metals production (ferrous and nonferrous industry) in the industrial production volume is 12.16%. The sector also employs around 12% of the people working in this field. The basic metals production in the Republic of Macedonia is comprised of complex technical and technological stems for production, modern equipment and technologies used by a number of world-famous producers, thus proving its significance as a strategic sector. The privatisation process led to a series of restructuring activities, which included foreign investments in the production of cold-rolled, hot-rolled and coated sheets, ferroalloys, moulds and pipes, steel reinforcements and other types of products.

The electro-mechanical industry sector in North Macedonia includes manufacturers of metal products, machines, devices, companies in the electrical industry – electrical products and components as well as producers of transportation vehicles etc. The equipment and the technology used come from the EU and the USA and the products meet European quality standards.

The metal and electrical industry (production of metal products in the metal-working phase, production of machines and devices, production of transportation vehicles and production of electrical machines and devices), for which the production of basic metals provides a solid base of raw materials, is an economically complementary and rounded technological whole in the national economy that plays an important role in the country's development. The Metalworking and Electrical Manufacturing Industry Association within the Economic Chamber of Macedonia has about 120 members with nearly 5,000 employees.

The primary metal production created stable grounds for more dynamic development of the metalworking complex as its concurrent production structure. Moreover, products of the metal and electrical industry are durable consumer products with investment significance or consumer goods.

This sector has a number of capacities for advanced processing of basic metals like: (i) special tool machines – robots; (ii) different types of machines, tools and their parts; (iii) steel constructions, bridges and their parts; (iv) process non-standard equipment for energy facilities, metallurgy, chemical industry, food industry and other industries; (v) products for the building industry (steel framework networks, aluminium windows and doors, protective doors, wire products); (vi) devices that use solid fuels and burners; (vii) liquid pumps and spare parts for liquid pumps; (viii)

devices for households, hotels and restaurants, (ix) medical equipment and aids, (x) energy equipment (different types of transformers, energy cables, solar energy collectors, panels, benches, racks, contactors and relays), (xi) telecommunications equipment, (xii) different types of boilers – galvanized, enamelled, made from stainless steel spare parts for motor and railroad vehicles, (xiii) transport equipment, (xiv) starting lead batteries, (xv) machines and filtering devices for purifying liquids and gases, (xvi) electronics and parts used in the automotive industry, (xvii) buses and additional devices attached to business vehicles, (xix) equipment and spare parts for motor and railroad vehicles, other products, (xx) equipment and spare parts for motor and railroad vehicles, other products.

The metal and electrical industry's GDP share at basic prices is 12.71% and at total number of employees is approximately 9.6%.

These industries have a 10.88% share in the total volume of industrial production at the level of industry and mining. More specifically, the metalworking sector's share is 2.65%, the manufacturing of machines and devices 4.97%, manufacturing transport devices 0.92% and manufacturing electrical machines and devices 4.34%.

These sectors account for 18.5% of the total import of Macedonia. These figures are due to the fact that each import of machines, equipment, electrical and energy devices and machines used in any industry and mining, as well as household appliances, all types of vehicles, light vehicles, buses etc. is entered as an import made in one of these sectors. These data do not provide a realistic account as they show the sectors as import-dependent.

The following items had the largest share in exports: gas and liquid filtration and purification machines and devices, automotive electronics, boards, panels, benches and racks, motor vehicles and car body parts, steel constructions, lattice shape structures and spare parts for them, boilers, electrical conductors, cables, wire products, solid fuel burners and heating devices, batteries and cells, brake systems for railway vehicles, pumps and spare parts, transformers, electrical current protective devices, different machines, printed circuit boards and other products. The products are mostly sold to EU countries, Central Europe, the USA and former Yugoslav republics.

The 40% of stakeholders who were involved in the EDP process have been participating in the open calls from the National Fund for Innovation and Technology Development, such as calls for financing technology improvement in SMEs and/or technology innovation as well as technology commercialisation. Some examples are: TEP Rade Koncar, Smelting Veles, Brako Veles, Solar Skopje, Atom Kocani, RuenKocani, VEDA Skopje etc. These projects have been realised in cooperation with research institutions and Universities from North Macedonia, or in cooperation with other companies as partners in the value chain of the domain.

The scientific research conducted at the Universities and research institutions as company projects or as pure science has produced 1.271 scientific papers published in 2021, 1531 scientific papers published in 2020, and 1352 papers published in 2019 (Agency for Statistics, Macedonia). The Ministry of Education and Science has invested in scientific–research projects in the past three years in the amount of 0.7 million euros in national and bilateral projects with Austria, EU, Croatia, Serbia, and Montenegro. The Horizon 2020 program has caused high publicity and the success rate is 12% in the past three years, which is the WBC's average percentage.

SWOT

Figure 14: SWOT analysis of the “Industry 4.0” priority domain

Strengths	Weaknesses
<ul style="list-style-type: none"> • Easy access and ability to communicate with sophisticated buyers • Competitive products on the EU market • Understanding of the need to modernise production processes • Strong business associations provide knowhow, training, linkages with the education system, market linkages 	<ul style="list-style-type: none"> • The available workforce does not meet the modern needs of the companies • Available financing does not meet modernisation and growth needs • Low competitiveness on tenders/bids requests • Lack of culture of cooperation
Opportunities	Threats
<ul style="list-style-type: none"> • GVC/FDI integration: • New product development: • Digitalisation and automation of the industry: • Continuous investment in skills for the future following modern industry • Increase cooperation among businesses: • Strong incentives and enablers for companies in the industry domain to improve competitiveness and productivity 	<ul style="list-style-type: none"> • Consensus • Emigration of professional staff (brain-drain) • Inefficient public administration • Covid-19 negative effects: • Volatility of energy and commodity prices

Source: EDP

Green, Digital and Sustainable Transition

Digital solutions implemented in SMEs will open up new opportunities for businesses, promote the development of trusted technologies, drive process interconnectivity, enable vibrant and sustainable business development, and improve business sustainability and competitiveness.

The digitalization of the industry intrinsically possesses substantial growth potential for steering companies from the electro-mechanical industry toward new innovative solutions for integrated CAD/CAM/CAE systems, additive manufacturing for rapid prototyping and development of new products. These digital solutions can open up new opportunities for businesses, encourage the development of trustworthy technology, foster networking processes, and enable a vibrant and sustainable

company's development, as well as the company's sustainability and competitiveness.

Digital technologies offer enormous growth potential to empower SMEs in the electro- mechanical industry with:

- new technologies for the digital transformation of production processes,
- new innovative solutions for integrated CAD /CAM/CAE systems in SMEs,
- additive manufacturing for rapid prototyping and development of new products,
- implementation of modern software solutions to solve processes from idea to final product,
- virtual production process principles (use of virtual engineering by using advanced ICT solutions in mechanical and electrical engineering process design),
- modern techniques of 3D printing, 3D scanning or reverse engineering techniques, i.e. additive production,
- and new product development.

Climate change and environmental degradation have a profound impact on the electro-mechanical Industry in the Republic of North Macedonia. One of the biggest challenges of the industry is to advance resource-efficient production and adopt clean technologies. This process aims to improve the well-being and health of citizens and future generations by providing: (i) fresh air, clean water, healthy soil and biodiversity; (ii) renovated, energy-efficient buildings; (iii) healthy and affordable food; (iv) cleaner energy and cutting-edge clean technological innovation; (v) longer lasting products that can be repaired, recycled and re-used; (vi) globally competitive and resilient industry. Green networking and energy management in the industrial metal and electrical sectors is also a way to decrease the carbon footprint and air pollution by usage of renewable energy sources. Hence, it is especially important for the industry to invest in green technologies and processes and apply the 5P principles of Lean Six Sigma with zero waste in production processes, such as recycling, reuse, use of alternative energy sources, and transition to sustainable materials usage.

New solutions for energy efficiency and the use of renewable energy were highlighted as contributing to the strengthening of the green economy in the electromechanical industry in Macedonia. SMEs would benefit greatly through green transformation implementation:

- application of the 5P principles of Lean Six Sigma with zero waste in production processes,
- resource efficiency as recycling, reuse, use of alternative energy sources, transition to sustainable materials usage,
- clean production technologies,
- Green networking energy management in the industrial metal and electrical sectors

The Industry 4.0 priority domain may contribute to the following SDGs: SDG 7 (Clean and affordable energy), SDG 8 (Decent work and economic growth), SDG 9 (Industry, innovation and infrastructure) and SDG 13 (Climate change).

Cross-Innovation Potential and Opportunities

The need to expand cooperation in the field of research and development between Macedonian companies in order to build capacity to place new products on the domestic and international market is one of the important elements for further development. Some positive examples, such as Green Machines (outdoor sweeping machines), HiTech (circuit boards), VEDA (innovation), and VanHool (bus producer, FDI), demonstrate that Macedonian companies can penetrate specific vertical subdomains of the electrical and automotive industry with application of new modern ICT solutions, development of new materials, new innovative design solutions and products. Furthermore, the application of new technological innovations can contribute to the circular economy and sustainable industrial development.

The establishment of multidisciplinary teams, networking with domestic and foreign companies and cooperation with academia is extremely important for cross-innovation. At the same time, the application of sustainable/efficient systems and renewable energy sources for their own needs is a clearly stated goal, which will help to overcome the energy crisis, which many companies are facing in recent times.

Cross-innovation matrix indicating identified concrete **opportunities** between **Electrical equipment and mechanical parts – Industry 4.0** and other vertical and horizontal domains:

Electro-mechanical industry– Industry 4.0. and ICT
<p>Information and communication technology continues to positively impact many stages of the manufacturing environment, especially in the metal and electrical industry sector.</p> <p>Intelligence is about to be shared from the start to the end of the supply chain. The Internet of Things (IoT) is adding intelligence to endpoints, big data is becoming the new way of running a business and Cloud Computing (CC) is becoming a new data centre for the metal and electrical industry and the supply chain organisation.</p> <p>The advancement that this new digital technology brings to manufacturing is fundamentally changing individual companies and transforming market dynamics. The fourth industrial revolution (Industry 4.0) is all about including contemporary technologies for processes of automation and real-time data exchange in manufacturing organisations.</p> <p>The important issue is the definition of the basis for designing the communication layer of the ecosystem's value chain depending on the usage scenario within the Industry 4.0 concept. In addition, depending on the usage scenario, different service classes are grouped and coverage of the currently available communication networks in the Republic of North Macedonia.</p>
Electro-mechanical industry– Industry 4.0. and Sustainable food and

beverage production and value chains

- The modernisation of agriculture depends on the increased use of various farm equipment. The enlargement of farms and their improved investment/purchasing power (supported by various agriculture development funds like IPARD) will create additional opportunities for domestic producers of such equipment (solar fruit/vegetable dryers, attachments for tractors). As the food-processing sector is growing, it will continue to need customised production lines and various equipment. While the Industry sector has not been focusing on this segment so far, the rise of opportunities may direct companies to investigate such possibilities.

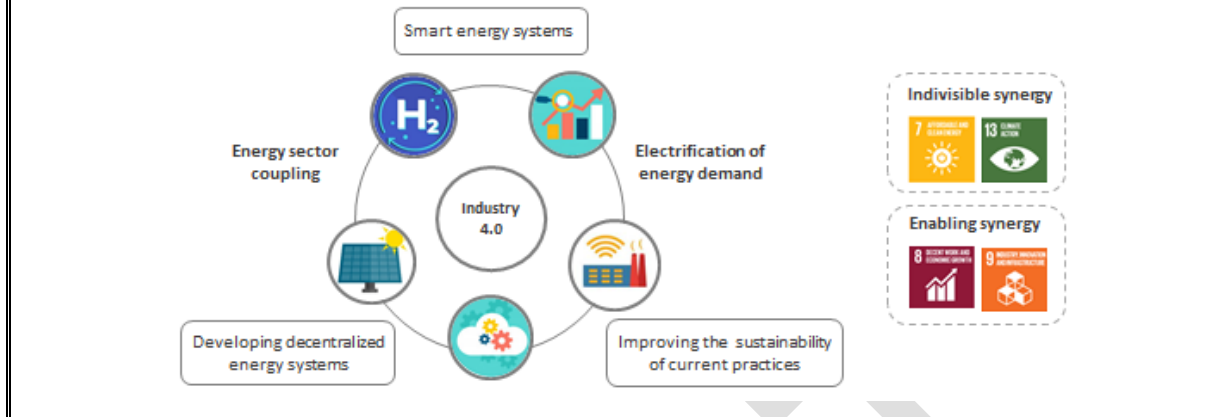
Electro-mechanical industry– Industry 4.0. and Energy for the future

- Electrification in rural areas by decentralised mini-grids with ICT will stimulate rural development and create new markets for producers of energy production and transition equipment
- Interlinkages between digital manufacturing and sustainable energy;
- Energy crises increased demand for the production of renewable energy and more efficient heating systems, which can stimulate increased domestic production of thermal and photovoltaic panels, and pellet stoves.

In order to tackle the challenge of climate change, the European Union has introduced the European Green Deal – a strategic vision of making the European economy net-carbon neutral, resource-efficient and competitive by 2050. Throughout this mission, the “Industry 4.0” domain and the “Energy for the Future” domain overlap in multiple ways.

For instance, the manufacturing-oriented definition of “Industry 4.0” indicates that its synergies with “Energy for the future” are related to the energy-saving opportunities that digital and interconnected manufacturing offers. Indeed, improved production methods and the emergence of digital manufacturing technologies such as intelligent robotics, digital twins, assistive technologies, and additive manufacturing offer seismic opportunities. But, while improving the sustainability of current practices in this way will be important, there are many more avenues where innovation provides even greater synergies. By installing local renewable energy generation, phasing out fossil fuels (e.g. by introducing electrification or hydrogen instead of oil, for high-temperature processes), using simple measures to reduce energy demand or advancing smart energy management systems, more immediate and notable impacts can be made in the factories of the future. These activities and the use of interconnected and interoperable appliances should additionally foster the contributions to SDG 7 (Clean and affordable energy) and SDG 13 (Climate change), but also to SDG 8 (Decent work and economic growth) and SDG 9 (Industry, innovation and infrastructure).

Cross-cutting: Industry 4.0 vs. Energy for the future



Characteristics and capabilities of Industry 4.0 offer efficient business in the fields of logistics, manufacturing, tourism and smart cities. In addition, with increased connectivity, it is possible to build smarter supply chains, processes and end-to-end ecosystems

In the further process of support, the stakeholders would like to draw attention to policy recommendations for:

Manoeuvring the innovation race

- Suitable regulations for innovation to expand them to newly developing digital branches
- Protecting existing social and environmental standards.

Increasing the agility of governments

- Faster pace of Industry 4.0 technology development driven by the economic sphere, and Slower pace of formulation of policies by governments
- More agility in adopting the right type of policies to avoid the adverse effects

Preventing the deepening of global inequalities

- Possibility of global inequalities If the Global South cannot tap into the digital development benefits
- Regulatory frameworks on the national, regional and global scales to ensure equal access and distribution of Industry 4.0 technologies.

The cross-innovation could provide (i) a Knowledge-sharing and project development platform (collect and analyse relevant data, Catalyse funding opportunities for project development), (ii) Assist SMEs on two development paths, based on the level of industrialization (Retrofitting established industrial systems with Industry 4.0., Leapfrogging technology waves with Industry 4.0 Partnerships among the private sector in both development paths, Drive technology standards, provide financial solutions and target incentives to accelerate transition).

Sustainable Materials and Smart Buildings

Construction and building sectors are a cornerstone in the country directly related to climate neutrality, resource efficiency and circular economy. As far as this is the energy-intensive sector, it needs to recycle materials waste (C&D), use secondary materials and develop more energy-efficient solutions. In addition, sustainable construction and buildings have to provide quality, safe and secure products and services for residential, commercial and industrial customers. Materials challenges present the key issue for improving energy efficiency, increasing sustainability and circularity, decreasing carbon footprint as well as allowing new functionality of the buildings. Moreover, the advances in digital technologies (IoT devices and solutions, Building Information Modelling (BIM)) are seizing the opportunities in all aspects of construction and building value chain. The synergies between sustainable materials and smart buildings (based on IoT devices and solutions as well as renewable energy) can foster the development towards urban living in Smart cities. More importantly, many of these synergies contribute to 17 Sustainable Development Goals (SDGs), Green Deal and Circular Economy Action Plan stimulating research, innovation and new business model creation for the needs of national and international niche markets.

Significance and Potential of the Domain

"Sustainable materials and smart buildings" mainly support the construction and building value chain in the country. The construction and building sector in the Republic of North Macedonia as the foundation of the basic needs of citizens (spending around 90% on buildings and infrastructure that connects them) presents the best prospect industry sector for the country concerning the market overview and trade data. For more than a decade, the construction industry has contributed between 5-8% of annual GDP. In the period 2006-2016, building construction prospered rapidly, but in 2017 the sector slowed down. COVID-19 pandemic costed outbreak in 2020. In 2021, the construction sector encompassed between 6 to 7% of the total number of active business entities and employed 11% of the total employees in the country⁴⁹. The participation of construction in the total value of GDP in 2021 was 4.96%. The industrial production of other non-metallic mineral products (glass products, ceramics, tiles and baked clay products, cement and plaster, including the production of shaped and finished stone) contributes to 4.8% of the total industrial production. In 2021 it records a growth of 12.6% compared to 2020, while in 2020 compared to 2019 there is a decrease from 8.1%. In the part of the trade exchange at other non-metallic mineral products, there is a continuous trade deficit exchange. Thus, in 2021 the export of other non-metallic mineral products reached 90.8 million USD, while imports were 605.7 million USD, where the deficit is 514.9 million USD⁵⁰.

During the EDP process, stakeholders agreed that the **key advantage** in the domain is highly qualified human resources, strong construction and building industry (recognized also as an exporter of construction services), established internationally recognized research and upgraded University curricula (relating to energy efficiency,

⁴⁹<https://www.trade.gov/country-commercial-guides/north-macedonia-construction-and-building-material>

⁵⁰ Brief overview of the situation in the construction industry, March 2022, Economic Chamber of North Macedonia, Association of the construction industry of building materials and non-metals, March 2022

materials, new technologies) as well as available international recognized technical standards which have been used for construction. In recent years, the construction and building industry has been mainly oriented towards domestic markets as far as the industries are mainly oriented to satisfy domestic needs (residential, touristic objects, industrial buildings, roads...). Most of the companies are many oriented to develop their own products or services for the needs of the domestic market, but the companies producing innovative tailor-made construction products (researched and developed in their own companies) have been competing with similar companies from micro-regions and globally (to satisfied the needs of the niche markets). Also, the domain has a solid **base for applying sustainable and smart solutions** with respect to earthquake damage prevention, energy efficiency, greening, and digitalization. The suitable geographical position and climate enable renewable energy solutions in this sector. The domain presents a solid base for supporting the ICT sector for smart/digital solutions in construction/building management.

Construction and building industries belong to the **least digitalized industries**, but it is facing rising challenges in adopting the digitalization processes to increase productivity and competitiveness. In 2022, only 8% of the total number of digitally mature originated from the construction sector⁵¹. Starting in November 2022, the Economic Chamber of North Macedonia in the frame of the DIG-IN-KPI project will develop indicators at a trilateral level that will measure the extent and level of digitalization of construction companies, aiming at stimulating digital transformation in the construction sector in line with the Construction 4.0 technology trends⁵². The fast-growing ICT sector enables innovation (IoT devices and solutions) towards smart buildings and smart cities thus contributing to lowering Greenhouse gasses (GHG) and environmental footprint. In addition, the Economic Chamber of North Macedonia has been supporting several initiatives for promoting and introducing new technologies, increasing energy efficiency and productivity and creating benefits in the construction and building industries⁵³. Due to the increase in electricity prices, there is increased interest in energy efficient (EE) building solutions and solar rooftop panels for both industry and residential facilities. The concept of energy self-sustainability i.e. energy-independent buildings in industry and residential is in line with the actual energy crises.

In this regard, there is room for utilizing sustainable materials and IoT (solutions and devices) for the **renovation of old public and residential buildings** to be energy-efficient, safe and environmentally friendly; the renovation using sustainable and smart solutions can develop appropriate innovation partnerships and business models and in that way can open the niche markets in the value chain. Both smart building technologies (building integrated PV, advanced insulation, smart lightening, façade systems, smart windows, thermal energy storage, passive cooling systems, solar panels...) and materials with and for increased sustainability and circularity (green and eco-friendly concrete, eco-friendly ceramics bricks, additives...) can play the vital energy-efficient role for the renovation of old buildings (only in the case where there is no seismic and energy consumption risk) as well as building the new ones.

⁵¹https://www.telekom.mk/content/Digitalen%20index_Istrazuvanje_2022-new.pdf

⁵²<https://www.mchamber.mk/Default.aspx?mId=3&evid=110573&lng=2>

⁵³<https://seetheskills.eu/>

The construction and building industry relies mainly on **regional supply chains**, e.g., for cement. Successful development and implementation of circular practices into the sector would contribute to technology and materials sovereignty. Using circular practices, huge quantities of different wastes (industrial, construction & demolition, agriculture, textile, electronic, agriculture waste, etc.) can produce new or value-added products, thus supporting **industrial symbiosis practices** with other industries.

The **transition towards circularity** in the domestic economy is foreseen in the number of national strategic documents based on EU support. During the EDP dialogue, the concept of circular economy was discussed to straighten the capacity of the country for **circularity i.e. transition from a linear towards a circular society** supporting the issues for cleaner and more competitive society. The need for sustainable materials is closely related to supporting the redesign, recovery, recycling, and reuse of different wastes/residues/by-products in order to extend the life of the product. According to the relevant documents for the West Balkan i.e. Sofia Declaration on the green deal agenda for the Western Balkans (November 2020), Guidelines on the circular economy for the countries of the Western Balkans and Turkey (2020)⁵⁴, Regional Circular Economy Status Report Written Contribution from Western Balkans and Turkey (January 2021)⁵⁵ and the new National Waste Management Plan (NWMP) 2020-2030 which are in line with the Circular Economy Action Plan⁵⁶ of the EU Green Deal⁵⁷, construction and buildings as energy-intensive industries, among others (electronics and ICT, batteries and vehicles; packaging; plastics; textiles; construction and buildings; food; water and nutrients) represent the sectors that use most of the resources, hence the potential for circularity is high. However, there are limited capacities of public waste collection systems for separation of household waste. Most of the companies still collect and deposit waste and do not treat waste as a source of value. Generally, the waste recycling is undeveloped. Namely, there are initial recyclers (glass, paper, plastic, apparel, batteries, vegetable oils and fats, pallets production, etc.) but on a limited scale of production of final products. Construction and demolition waste (C&D) shows huge potential for circularity, but there is no system for collection, separation and processing. Current practice showed that C&D wastes have been informally collected and illegally dumped. There is no evidence data for the generated and used amounts of C&D, but it shows high potential for reuse, recycling and recovery. Eurostat⁵⁸ reports an average C&D waste (refer to non-hazardous mineral C&D waste) recovery rate of 90% in 2018. There are realistic opportunities in the country for effective circular activities of this waste stream. The utilisation of C&D waste as secondary raw materials is only used as base materials in road construction, but there is a great hidden potential for more competitive and innovative usage and initiatives. During the EDP, the other discussed wastes i.e. industrial waste (fly ash, metallurgical slag...), textile, glass, plastics, electronic, and agriculture waste present the base for the circular transition of our society. **Bio-economy based on the**

⁵⁴https://eeb.org/wp-content/uploads/2021/01/guideline-WBT_INCIEN_final.pdf

⁵⁵<https://www.co-plan.org/wp-content/uploads/2021/08/Circular-Economy-2020.pdf>

⁵⁶<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN>

⁵⁷https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

⁵⁸https://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=cei_wm040

utilisation of agriculture waste supports the design of bio-based building materials as an alternative to conventional materials not only due to the reduction of energy emissions and CO₂ footprint but also to the thermal comfort with less energy consumption. Bio-based building materials are an augmentation towards eco-friendly, sustainable and effective multifunctional materials with potential for developing niche markets in the country. On the other hand, biowaste (biomass) can be successfully used for energy production (energy from waste).

Based on the global successful examples, the available waste streams could be transformed into competitive sustainable materials/products and energy resources by enabling: (i) secondary raw materials for industrial use, (ii) energy from waste and (iii) extraction of high economic value materials (critical raw materials - CRM).

The needs of the **global market and trends in strategic technologies** for e-mobility, renewables as well as defence and space, depend on materials for design microprocessors, chips, batteries, etc. Utilisation of rare earth elements (REE) for supporting green and digital transition is crucial. EU is now oriented to the utilisation secondary raw materials (mine and industrial waste) for valorising REE. Special technologies are used in the process of REE extraction and the remained inorganic waste has the potential for developing innovative construction materials/products (like new low CO₂ clinkers, cements, mortars, concretes...). Also, electronic waste can play a significant role in this manner. REE from secondary raw materials present the potential for future R&D&I of domain and base for new niche markets.

In addition, during the EDP, it was also discussed, the possibilities for utilizing sustainable materials, smart buildings and digitalization for the needs of **cultural heritage** in the country. All of them can play a vital role in the protection and conservation of cultural heritage as well as country promotion.

The **major shortcomings** as seen by stakeholders can be described as lack of/weak knowledge transfer, insufficient funds for R&D&I, poor national financial support of the research at universities, poor friendly used and supportive legislation, not so developed infrastructure for waste collection, separation and utilisation as starting point for applying circular economy in country, gap for patenting in the actual law for intellectual properties at university level, reduction of workers in this sector, lack of initiative for change, insufficient awareness and knowledge for modern business models, low absorption capacities for EU funds for business and academia etc. The major gaps in the value chain, recognized during EDP, **were innovation based on research and development (R&D)** and poor institutional support for EU project application.

Covid -19 crisis followed by the global crisis became a real threat to this domain, due to the raw materials' increased prices, difficulties relating to the **import of materials** and an **increase in prices** in the building sector as well. On the other hand, the rising **ICT possibilities** towards SMART solutions have been opening a **new perspective** for innovation, products, services and consequently new markets.

In the last years, the instruments of the **Fund for Innovation and Technological Development (FITD)** have been supporting the innovation of domestic companies to improve the green and digital transition of the economy. There are several successful start-ups (from the food sector, glass recycling, pallet production, bio-fuel production and similar) which promote the innovation in circularity of resources, companies supporting energy efficiency solutions by using renewables as well as companies that support digital solutions of the domain.

The **solid network** (supporting education, research, development and innovation) among the stakeholders, presented during the EDP, serves as a base for future activities relating to knowledge transfer, new solutions and innovation (based on R&D and new business models) to fulfil the gaps and develop niche markets in the frame of the value chain.

SWOT

Figure 15: SWOT analysis of the “Sustainable Materials and Smart Buildings” priority domain

Strengths	Weaknesses
<ul style="list-style-type: none"> - Basic needs for knowledge based growth of this domain are fulfilled; - Strong potential for applying Smart and Sustainable solutions. 	<ul style="list-style-type: none"> - Construction sector still focuses on traditional methods and struggles with inputs and labour; - Development of sustainable materials is in infancy stage; - Underdeveloped system for recycling waste; - Formal and informal education system does not develop skills for sustainable solutions; - Low public awareness of modern trends in sustainable development and resistance to change; - Limited funds for innovation and sustainable development; - Poorly developed innovation ecosystem.
Opportunities	Threats
<ul style="list-style-type: none"> - New market opportunities emerging from increased focus on sustainability, circular economy and energy efficiency; - Global and national commitments to address climate change and sustainable development offer significant financial and technical resources for development of the domain. 	<ul style="list-style-type: none"> - Diminishing human capital; - Complex and out-of-date regulatory framework does not stimulate innovation, circular economy, and green/sustainable growth; - Public capital investments are based on conservative construction practices.

Source: EDP

Green, Digital and Sustainable Transition

Sustainable materials and smart buildings have an important role in the green and digital transition of the domestic economy.

Sustainable materials have a key role in resource efficiency. The utilisation of secondary raw materials (wastes/by-products from industry, construction & demolition, agriculture, textile, electronics, etc.) shows the high potential for reduction of the use of natural raw materials, enhances the recycling possibilities and reduces environmental pollution. Also, innovative sustainable materials open possibilities for lowering CO₂ emissions and enhancing energy efficiency. The concept of circular economy serves as a base for innovation in new products, upgrading the actual products (adding value), introducing new business models and opening niche markets. Furthermore, the new renewable energy sources and smart grids present the base to manage energy consumption in buildings and facilities.

Digital transformation in the construction and building supports faster pace, high quality of construction design and execution, reduces energy consumption and improves the quality of life. Digital transformation should cover the entire life cycle of the construction products (from 3D models up to demolition). In addition, digitalization supports the active exchange of information among different stakeholders. Stronger implementation of Building Information Modelling (BIM) will effectively support the digital transition in construction.

In conclusion, Sustainable materials and smart buildings' priority domain may directly contribute to the following SDGs: SDG 7 (Clean and affordable energy), SDG 11 (Sustainable cities and communities) and SDG 13 (Climate action). It may also indirectly contribute to SDG 9 (Industry, Innovation and Infrastructure) by enhancing innovation and new business model creation in the respective industries. It should be noted, nevertheless, that actions in the building sector should be made cautiously, due to the potential trade-offs with SDG 1 (No poverty), since enhancing the building stock may increase the prices of housing.

Cross-Innovation Potential and Opportunities

There are the following opportunities with different vertical and horizontal domains:

Cross-innovation matrix indicating identified concrete **opportunities** between **Sustainable materials and Smart Buildings** and each of the other vertical and horizontal domains:

Sustainable materials and Smart Buildings and ICT
<ul style="list-style-type: none"> - Utilisation of IoT devices and solutions for monitoring and regulation of different ambient parameters in buildings (temperature, energy, CO₂ emissions...); - Digital solutions in the construction sector to increase productivity and competitiveness; - Stronger implementation of Building Information Modelling (BIM) for design, construction and maintenance; - Custom software development for particular niche needs of the domain.
Sustainable materials and Smart Buildings and Electrical equipment and mechanical parts, Industry 4.0.
<ul style="list-style-type: none"> - Application of new technologies, automation of the processes, upgrading of the actual production lines; - Utilisation of sustainable materials, especially advanced materials (composites,

polymers, nanomaterials, and ceramics).

Sustainable materials and Smart Buildings and Smart agriculture and food with higher added value

- Smart buildings for agriculture purposes and food processing;
- Utilisation of agriculture waste for innovative sustainable materials/products; Bio-based building products;
- Energy from agricultural waste (biomass).

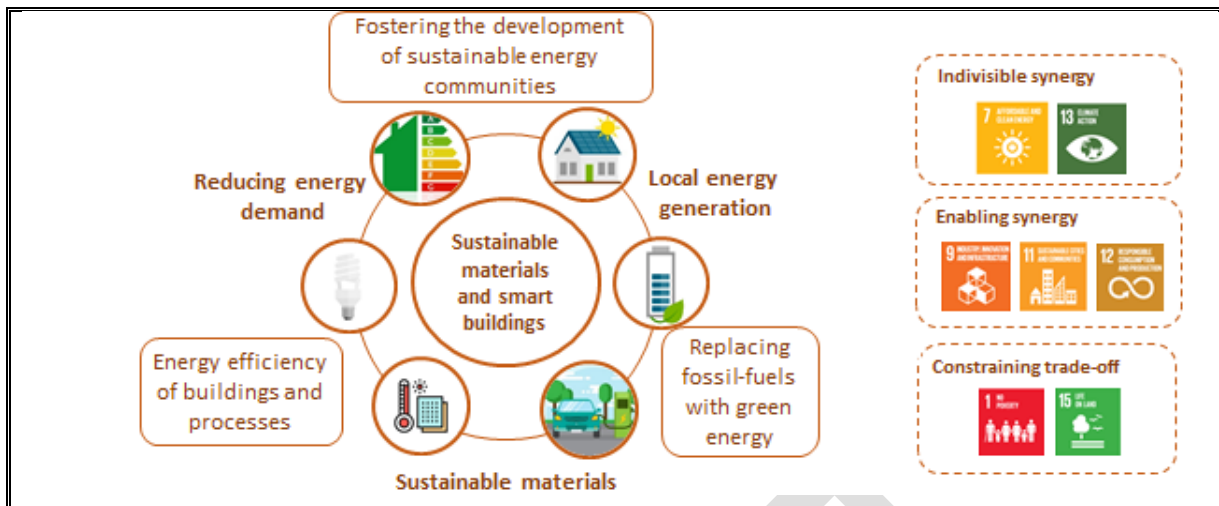
Sustainable materials and Smart Buildings and Energy for the future

There are many opportunities for synergy effects between Sustainable materials and smart buildings and “Energy for the future”, especially in reducing energy consumption. The key roles in this regard are renewables, new technologies, and waste utilization. The following opportunities were formulated:

- Widespread utilisation of renewable energy for reducing actual energy demand;
- Introducing new innovative technologies in line with energy efficiency and energy saving (introducing the concept of energy self-sustainable buildings);
- Utilisation of sustainable materials that will reduce energy consumption;
- Potentialities to utilise wastes as a source of energy

“Sustainable materials and smart buildings” are the cornerstone of the “Energy for the future”. Currently, in the European Union, buildings are the single largest consumer of energy, with about 40% of the total energy use and 36% of the greenhouse gas (GHG) emissions. However, there are many synergies between these two sectors! More importantly, today, many of these synergies are considered “low-hanging fruits” that can easily be transformed into lucrative business models. By reducing energy demand, and using renewable energy and sustainable materials, our domain (“Sustainable materials and smart buildings”) can spearhead the energy transition, foster the development of sustainable energy communities and phase out fossil-fuels. To achieve these strategic goals, considerable thought should be put when planning renovation measures, so that in the end, the building sector is connected and smart, with the suitable digital and physical infrastructure to foster the use of enabling technologies, such as electric vehicles, district heating, rooftop solar generators, energy storage etc.

Sustainable Materials and Smart Buildings



Sustainable materials and Smart Buildings and Sustainable tourism and catering

- Eco-labelling of touristic objects (eco-hotels, eco-restaurants, etc.);
- Utilisation of smart and sustainable solutions in cultural heritage.

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STRATEGIC FRAMEWORK

PRIORITY DOMAINS AND S3 VISION

S3 overall vision

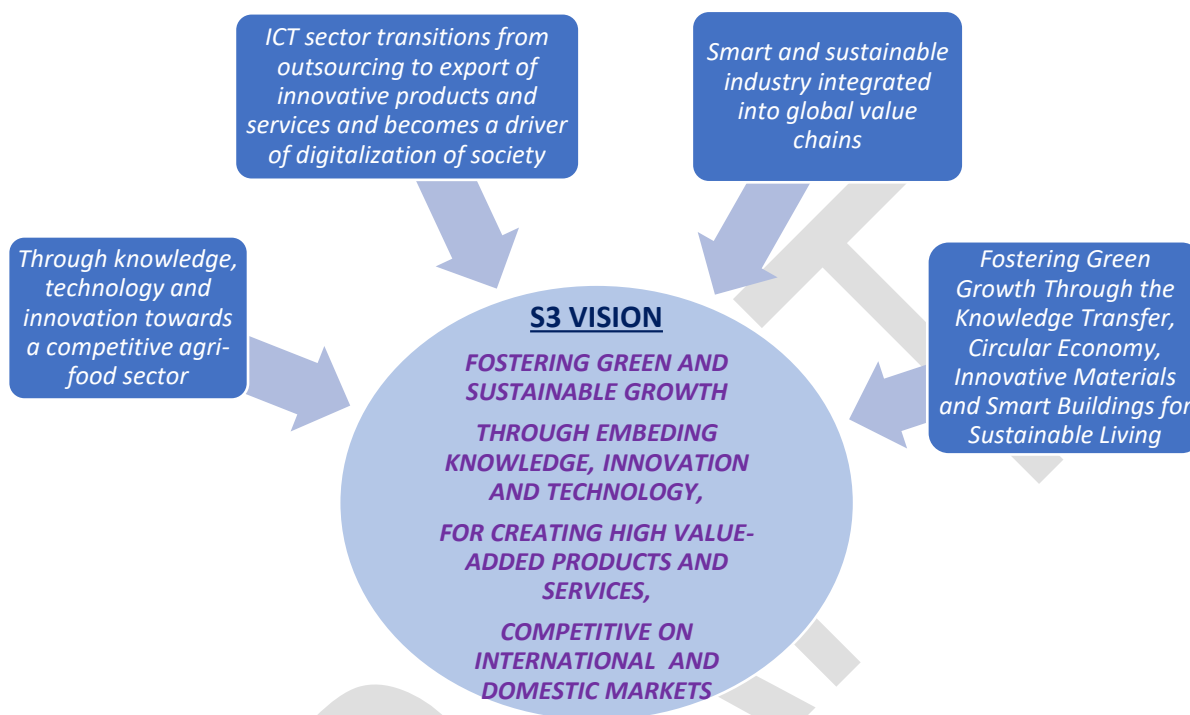
As a result of all above presented analyses: quantitative and qualitative analysis and the EDP broad consultative process of the quadruple helix, the following priority domains are identified having the highest economic, innovative and R&D capacity for creating new added value:

Table 2: Identified S3 priority domains

VERTICAL PRIORITIES			
Smart agriculture and food with higher added value	ICT sector	Sustainable materials and smart buildings	Electro Mechanical Industry - Industry 4.0
<i>Sub-domain: Smart agriculture</i>	<i>Sub-domain: Custom Software Development</i>	<i>Sub-domain: Sustainable materials</i>	
<i>Sub-domain: Food with higher added-value</i>	<i>Sub-domain: Data Driven ICT solutions</i>	<i>Sub-domain: Smart buildings</i>	
HORIZONTAL PRIORITIES			
Energy for the future - cross sector interrelatedness, energy efficiency, eco solutions, renewable energy, climate change, decarbonization			
Tourism - cross sector relatedness with ICT and Agro and Sustainable materials and Smart buildings			

During the EDP process, each domain independently defined its vision for knowledge-based growth that will contribute to economic transformation (Figure 10).

Figure 10: S3 priority domains visions and S3 overall vision



These visions shared a lot of similarities that were easily combined into a common vision:

S3 VISION

Fostering green and sustainable growth through imbedding knowledge, innovation and technology, for creating high value-added products and services, competitive on international and domestic markets

Visions by S3 priority domains

Smart Agriculture and Food with Higher Added-Value

Based on analysis and dialogue in the S3 process and given the significance of the agri-food sector, one of the key priority domains for smart specialisation is “Smart agriculture and food with higher added value”, with two subdomains: “Smart agriculture”, and “Food with higher added value”. The focal room for improvement both in primary production and other segments of the agri-food chain is in adding value, emphasising innovation, testing, and marketing of products, in order to provide businesses with a competitive edge and ultimately to increase customer value.

Smart agriculture and food with higher added value	
Sub-area 1: Smart agriculture	Sub-area 2: Food with higher added value

Based on the conducted analysis, the vision for this domain highlights the key directions for its development, to improve the competitiveness of the agri-food sector through increased collaboration and the use of knowledge, technology and innovation.

The formulation of the agreed vision statement among the EDP participants for this priority domain, with relevant strategic objectives is as follows:

VISION
Through knowledge, technology and innovation towards a competitive agri-food sector
STRATEGIC OBJECTIVES
SO1: Promoting collaboration and partnerships towards smart agriculture and higher value- added food
SO2: Placing diverse, high quality and higher value-added food products on existing and new markets
SO3: Developing professionally led and knowledge-based agri-food sector
SO4: Ensuring sustainable use of resources through innovative solutions
SO5: Encouraging and facilitating modernisation and digitalization to increase productivity in the agri-food sector value chain

Information and Communication Technologies (ICT) Sector

The final name of the domain remains Information and Communication Technologies (ICT); With two sub-domains “**Custom software development**” and “**Data-driven ICT services**”.

There are several key enabling technologies in the domain, i.e., cloud-based services, IoT, embedded technologies, ledger technologies and security technologies, that foster cross-sectoral innovations.

Information and communication technologies (ICT)	
Sub-area 1: Custom software development	Sub-area 2: Data-driven ICT solutions
Key enabling technologies	Cloud-based services IoT Embedded technologies Ledger technologies Security technologies

Source: EDP Summary report for priority domain “Information and Communication Technologies (ICT)”

The sub-area “Custom software development” targets fintech, eHealth/mHealth and cross-sectoral solutions. The cross-sectoral ICT solutions should focus on agriculture, energy management, intelligent transportation and smart buildings (all utilizing Internet-of-Things – IoT). Efforts should be made to ensure that all public SaaS platforms use an open API to support custom software development of novel and innovative products.

The sub-area “Data-driven ICT services” encompasses contemporary ICT solutions that rely on tailored data analytics using Artificial Intelligence (AI), Machine Learning (ML), Deep and Federated learning mechanisms etc. This is backed by a plethora of innovative start-ups and international academic projects in the area. There is unequivocal support from the public and the private sector about the urgent need for digital, innovative and advanced solutions utilising data analytics as well as the need to position the ICT domain on time in the regional and global value chains with novel products/services that target data analytics (preparations on-time for the data-driven era).

At the same time, the ICT priority domain pinpoints several Key Enabling Technologies (KETs) that foster cross-sectoral innovations. These are *cloud-based services*, *IoT*, *embedded technologies*, *ledger technologies* and *security technologies*. The KETs are quintessential for the horizontal expansion of ICT

solutions, thus facilitating smart solutions in other domains and digital transformation overall. Table 1 summarizes sub-areas and KETs in the ICT priority domain.

The formulation of the agreed vision statement among the EDP participants for this priority domain, with relevant strategic objectives is as follows:

VISION ICT sector transitions from outsourcing to export of innovative products and services and becomes a driver of digitalisation of society
STRATEGIC OBJECTIVES SO1: Increase the ICT sector turnover and the export of ICT solutions SO2: Increase the excellence level for scientific research and development SO3: Strengthen the innovation ecosystem SO4: Improve the competitiveness level of local industries through digitalisation SO5: Increase the human potential in the ICT domain SO6: Digitalisation of the public sector

The overall objective clearly shows the direction to be taken by the ICT domain in the foreseeable future, i.e. move away from being an ICT outsourcing economy **towards an innovative ICT economy** where various products and solutions are being developed and exported.

At the same time, the ICT domain, as the one with the highest potential from all other verticals in the S3, should significantly contribute to the digital transformation of society.

Electro-Mechanical Industry - Industry 4.0

In definition of this domain was taken the direction for change and transformation of the whole industry towards industry 4.0. This is a very wide and comprehensive approach that requires many interconnections so it stays as an umbrella approach and there are no specific subdomains.

The long-term vision for the future of the Electro-mechanical industry domain is to express the greater compactness and clarity of the area. Industry 4.0 emphasises the ambition of the Macedonian electrical and mechanical industry to use and develop, as well as to implement advanced technologies toward building smart

factories for the future and to build a wider range of industries related to modern production.

The formulation of the agreed vision statement among the EDP participants for this priority domain, with relevant specific objectives is as follows:

<p>VISION</p> <p>Smart and sustainable industry, integrated into global value chains</p>
<p>STRATEGIC OBJECTIVES</p> <p>SO1: Formal and informal education systems develop high-quality human resources that meet the needs of the industry</p> <p>SO2: Diversification of financial instruments for modernisation and expansion</p> <p>SO3: Development of high-quality domestic products</p> <p>SO4: Increased competitiveness and integration in GVCs</p> <p>SO5: Highly developed scientific research and knowledge-sharing infrastructure</p>

The overall debate on the strategic view among the stakeholders was mainly focused on the following key points: innovative and/or smart industry, creating world sophisticated final products and sustainable industry.

Sustainable Materials and Smart Buildings

Based on the qualitative and quantitative analysis as well as the entrepreneurial discovery process (EDP) followed by the JRC Methodology for developing the Smart Specialisation Strategy, the domain **Sustainable Materials and Smart Buildings (SMSB)** was identified as one out of four domains, recognising thus its potential for research & innovation and final commercialisation of products at domestic, regional and global market.

The actual domain consists of two sub-domains: (i) "Sustainable materials" and (ii) "Smart buildings. Material development is foreseen to be a key enabling technology, which drives innovation throughout the economy and cuts across industries with a trend towards full convergence and integration.

<p>Sustainable Materials and Smart Buildings (SMSB)</p>	
<p>Sub area 1:</p> <p>Sustainable materials</p>	<p>Sub area 2:</p> <p>Smart Buildings</p>

Key enabling technology	Materials development
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The sub-area” Sustainable **materials**” targets innovative building materials supporting the principles of circular economy in the way to increase energy efficiency, safety and resiliency in construction and buildings.

The sub-area” Smart **buildings**” is oriented to create self-energy efficient buildings, but also buildings that will lower greenhouse gases (GHG) and environmental footprint. This sub-area is strongly supported by the fast-growing ICT sector enabling innovative business models based on utilization of IoT devices and solutions.

Materials development as a key enabling technology is about new materials design or products with added value based on the utilization of polymers, metals, ceramics, composites and nanomaterials. Advanced materials, can play a crucial role in construction and building value chain, but also for the aims of Industry 4.0.

The formulation of the agreed vision statement among the EDP participants for this priority domain, with relevant strategic objectives is as follows:

<p>VISION</p> <p>Fostering Green Growth Through the Knowledge Transfer, Circular Economy, Innovative Materials and Smart Buildings for Sustainable Living</p>
<p>STRATEGIC OBJECTIVES</p> <p>SO1: Building strong partnerships to strengthen the innovative ecosystem</p> <p>SO2: Modernization of the education system to support innovation (greening and digitalization) and entrepreneurship</p> <p>SO3: Strengthening scientific excellence</p> <p>SO4: Competitive companies through environmentally sustainable business models</p> <p>SO5: The business environment imposes recycling, energy efficiency and the use of renewable energy sources</p> <p>SO6: Opening new markets and internationalization</p>

The vision and the strategic objectives agreed upon the EDP participants are overarching for both sub-areas of this priority domain: sustainable materials and smart buildings and they have been discussed taking into consideration the key enabling technology” materials development”.

S3 STRATEGIC OBJECTIVES

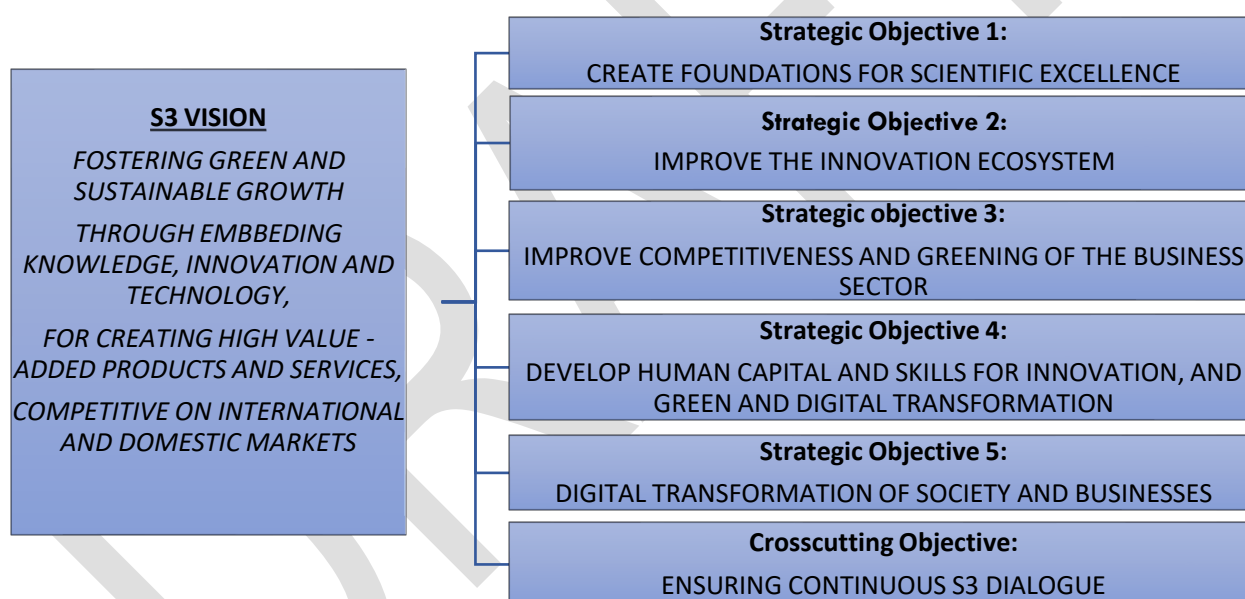
The strategic and specific objectives for each domain identified by the stakeholders from the quadruple helix during the EDP were more general than sector-specific ones, which was to be expected due to the novelty of the S3 innovation-based development approach.

The proposed main strategic objectives are valid for all domains focusing on scientific excellence, improving the innovation ecosystem, improving competitiveness and greening of businesses, development of human capital and digital transformation (Figure 16).

Some vertical (domain-specific) activities are included under the strategic objectives, but the general approach is to develop horizontal policy measures that would particularly target firms from the priority domains.

The cross-cutting objective aims to ensure proper implementation of the strategy, ensure a continuous EDP dialogue and good governance.

Figure 16: S3 Strategic objectives



SO1: Create foundations for scientific excellence

Promoting scientific excellence in the areas of specialisation, as a driver for knowledge generation and knowledge valorisation in favour of societal and economic challenges, is of key importance for reaching the S3 goals. Excellence would also help in other parts, including internationalisation, and skills development.

Within this SO instruments are contributing to reaching few specific objectives: enhance human resources for R&D, improve research infrastructure, enhance research activities for green and digital transformation, increase academic internationalization, and harmonise regulations in line with S3.

Research infrastructures are strategically important for economic development. The S3 strategy offers an opportunity to review the role of the national science system in the generation of competitive advantages based on Smart Specialisation, and the engagement of the universities and research centres in the implementation of S3 and continuous EDP.

This objective responds to a continuing need for investing strategically in research infrastructure including e-infrastructure, in order to ensure that research becomes and remains competitive at regional and EU level while at the same time ensuring their shared access and opportunity for integration into great European research infrastructures.

Increased knowledge transfer and internationalization, as a basis for achieving scientific excellence in S3 domains, will build more connected and efficient research ecosystems, and will increase participation in the European R&I Framework programme and its Partnerships, Missions and other R&I initiatives thus contributing to strengthening European Research Area.

Increased investment will be followed by improved policies and processes for R&D funding to ensure impact, also enabling new ways for inter- and multi-disciplinary research and supporting increased business-academia collaboration.

This objective will also contribute to enhancing R&D human resources i.e. equipping researchers, especially young researchers, with new knowledge and skills through bottom-up and excellence-driven research in the framework of PhDs, Industrial PhDs, PostDoc, researcher positions and providing them with international and inter-sectoral exposure in the areas where the country demonstrates competitive advantages.

For this strategic objective, the responsible body for implementation is mainly the Ministry of Education and Science, together with the academy.

SO2: Improve the innovation ecosystem

An essential precondition for the transition to an innovative economy is strengthening the innovation eco-system of the country, eliminating its shortcomings and promoting interaction among all subjects of the innovation system – business, science and education, as well as the improvement of the institutional environment.

All the policy instruments proposed within SO2 are directed toward creating a favourable innovation eco-system ready to support the country's S3 vision enabling economic growth.

The policy mix within this objective is comprised of measures for the development of institutional infrastructure, stimulating R&D&I in SMEs, development of the innovation start-up ecosystem as well as adjusting the national legislation to support involvement of R&D&I.

The principle of green, digital, and sustainable transformation will be integrated into all measures of support.

For this strategic objective comprised of a variety of instruments to be undertaken, responsible bodies for implementation shall be: the Fund for Innovation and Technology Development – FITD, Development Bank, and different line ministries

(such as economy, education and science, environment, and agriculture) that can support projects targeting specific sectors like circular economy and precision agriculture.

SO3: Improve competitiveness and greening (environmental sustainability) of the business sector

Competitiveness as a business imperative in an improved innovative ecosystem will turn investments in scientific and technical innovation within S3 domains, creating new business opportunities that drive jobs, develop new markets, and new competitive products thus creating economic prosperity.

The policy mix within this strategic objective supports increasing efficiency and productivity as well as green and digital transition. The instruments consist of providing grants, credit lines and technical assistance to boost productivity, diversify production towards higher value added products and services, facilitate market integration, reduce energy consumption, increase environmental compliance, and digitalization.

Company internationalization agenda and participation in value chains are also supported through increased funding for export readiness, supplier development and market linkage programs.

The main responsible body for this strategic objective shall be the Ministry of Economy, Agency for Entrepreneurship Support, Agency for Foreign Investments and Export Promotion, Directorate for Technology Industrial Development Zones, Fund for Innovation and Technology Development as well as other stakeholders and donors.

SO4: Develop human capital and skills for innovation, green and digital transformation

One of the key drivers for transformation and excellence includes human capital and skills providing knowledge and expertise to a workforce.

Social and economic development requires a multidisciplinary approach for further development, up-skilling and excellence in skills, enabling innovation, and green and digital transformation.

Human capital strengthens the capacity of an entity to absorb and develop new knowledge and as such it is an essential part of both frontier and catch-up innovation.

This SO supports upgrading skills and innovative activities, with the aim to improve productivity, either directly or indirectly.

Important partners for this SO are the universities, VET and other training centres. Their role should be to improve the relevancy of the programs to the private sector needs and sustainability-related challenges, offering effective multidisciplinary programs, and fostering skills for new technologies and processes, required to enable green and digital transition.

This strategic objective involves a variety of instruments to be undertaken with support by MoES, MoE, other implementing agencies as well as universities, VET Centres and various training institutions.

SO5: Digital transformation of the society and the businesses

Digitalization of the public and private sector and development of innovative digital solutions including improving institutional interoperability, are of key importance for sustainable economic growth.

Digital transformation is crucial in all spheres of life ranging from education to business decisions.

For catching-up with the global digitalization trends, there is a need for investments in creating favourable preconditions and business development.

This is not only needed to improve the competitiveness and productivity, but also to address the current labor shortage through automation of processes.

This strategic objective involves a variety of instruments to be developed and promoted to boost financing in needs assessment, advisory and investments.

The instruments will be implemented with support by MISA, MoES, MoE, Development Bank, other implementing agencies as well as universities, DIH and various stakeholders.

Crosscutting objective: Ensuring continuous S3 dialogue

The most important precondition for future success of S3 is ensuring the continuous dialogue among stakeholders through EDP. This continuous dialogue in strategy design as well as in the implementation is the core difference with other strategies.

Continuous EDP will foster culture of dialogue, enable trust, stimulate strategic partnership, share knowledge, create commitment for transformation roadmap for each domain as well as increase transparency and awareness raising.

By establishing multilevel governance and S3 monitoring & evaluation system, an efficient S3 implementation on regional and national level is ensured.

POLICY MIX

The 'S3-relevant policy mix' is the combination of policies from various levels and various domains, which together contribute to achieving the objectives and priorities set in the strategy, as a direction for change and intervention needed for addressing different challenges related to smart specialization.

The proposed policy mix follows the EU orientation and need for green transition of its economy and society with strong and overarching use of digital solutions for the economy and society at whole, however adapted to the Macedonian most vivid and urgent needs on one side and economic and development potential with critical mass of competences on the other.

Beside strong orientation towards green transition of Macedonian economy on selected priority domains and empowering of one of its main future drivers - ICT sector, the proposed policy mix measures and investments reflect the needs to empower and modernise research capacities and competences which were neglected over a longer period of time, linking them (the knowledge institutions/academia and research institutes) much stronger with the economy, fostering deep-tech approach, establish and develop a modern and effective innovation and entrepreneurial ecosystem while at the same time strongly invest in knowledge and skills of its citizens needed for successful S3 implementation and twin transition.

Hence, proposed Policy mix matrix seeks to achieve Macedonian sustainable development goals through fostering its support to innovation-driven, low-carbon, digital and knowledge-based transformation, combining for the first time its development investments from different relevant policies under the same single document and contributing at the same time to the EU development goals in particular those related to green transition and digital transformation.

The proposed structure is perfectly aligned also with the structure of S3 policy mix measures that regions and/or EU member states are using when supporting their endeavours for achieving Smarter Europe policy objective goals: RDI (strategic objective 1), digital transformation (strategic objective 5), entrepreneurship (strategic objective 3 and 2) and skills for smart specialisation (strategic objective 4).

The scope of policy instruments for fulfilling the overall vision and the visions of domains, are grouped per strategic objectives, valid for all domains: focus on scientific excellence, innovation ecosystem, competitiveness and greening of businesses, human capital and digital transformation.

Due to the importance of the green and digital transition, in the final policy mix green, digital and sustainable transition are considered as horizontal principles and as an overarching objective presented in the common vision.

The proposed policy mix instruments (Table 3.) are open for further improvement and modification, based on current circumstances, stage of development, capacities and provided finances, including adjustments towards vertical aspects based on EDP input given in Annex 1.

Table 3: Policy instruments per Strategic Objectives

Strategic Objective 1: CREATE FOUNDATIONS FOR SCIENTIFIC EXCELLENCE IN S3 DOMAINS			
Specific Objectives	Inputs/instruments	Outputs	Outcomes
1.1 Enhance human resources for R&D	Funding for PhDs, Industrial PhDs, PostDoc and researcher positions	PhDs and researchers working on S3 domains research	Increase in: doctorate graduates and researchers; International scientific co-publications (Scientific and technical articles); R&D expenditures in the public sector;
1.2 Improve research infrastructure	Funding for establishing or upgrades of laboratories in university and research institutions (URI) and infrastructure for field experiments and trials	labs offering new services to companies, URIs capable for verification, validation and demonstration of new products and technologies, Companies using lab services	
1.3 Enhance applied research activities for green and digital transformation	Funding for applicative research projects, especially those that received Seal of Quality from EU calls, including publishing research papers and participation in scientific conferences Co-financing for SMEs and academia participation in international applied research projects	Applied research projects implemented and firms informed of recent research and scientific knowledge business/academia research projects with regional partners	
1.4 Increase academic internationalization	Introduction of joint and double degree programs Membership in international professional organizations and research infrastructures	academic institutions implementing projects with international partners	

<p>1.5 Harmonize relevant regulations in line with Smart Specialization Strategy</p>	<p>Policy reforms in Higher Education, Science and Research</p> <p>Establish/strengthen project implementation offices in universities</p>	<p>Better regulation of Industrial PhD, postdoc and research positions,</p> <p>Academic career progression based on research,</p> <p>Technology transfer/IPR framework and project implementation offices in universities and Public Research Organizations</p> <p>Increased cooperation between private sector and academia</p>	
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Strategic Objective 2: IMPROVE THE INNOVATION ECOSYSTEM FOR S3 DOMAINS			
Specific Objectives	Inputs/instruments	Outputs	Outcomes
2.1 Develop institutional infrastructure and platforms for innovations, knowledge and technology transfer	Financing for establishment and or/operations of: <ul style="list-style-type: none"> innovation hubs, technology centers and/or Centers of Excellence (CoE) National Technology Transfer Office Science and Technology Park 	operational institutions in the innovation ecosystem have a plan for sustainable business model SMEs that gain access to new industry specific technologies, research and skills patents registered	R&D expenditures in the business sector Venture capital availability Growth of innovative companies
	Increase investment readiness and fundraising capacities in national entities		
2.2 Improve Research, Development and Innovation (R&D&I) in SMEs	Innovation vouchers for MSMEs	MSMEs introducing product or process innovations.	Patents registered
	Grants/loans for custom product development and close-to-market innovation and commercialization for mature SMEs Grants for collaborative/demonstration projects in collaboration with academia	business/academia projects supported technologies/patents transferred from academia to enterprises	
2.3 Support development of innovative start-ups	start-up grants	innovative start-ups supported	
	Start-Up Acceleration programs and incubators/accelerators Investment co-financing facilities with business angels and VCs	innovative start-ups raising equity capital start-ups exporting innovative products and services	
2.4 Adjust national legislation to support company R&D&I	Policy reforms in taxation, innovation, waste management, energy, public procurement and standardization to stimulate innovation and green growth	improved accounting and introduced tax exemptions for R&D&I spending, Innovation Law better defines	

		<p>innovation and innovative start-ups and provides greater flexibility in designing instruments,</p> <p>Regulations to facilitate and stimulate Circular Economy, waste management, recycling, smart buildings/energy efficiency and production of renewable energy laws,</p> <p>Public procurement regulations to allow for innovative solutions,</p> <p>Harmonization of the national regulations (rulebooks) of the Institute for Standardization with the EU regulations for domain purposes</p>	
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Strategic objective 3: IMPROVE COMPETITIVENESS AND GREENING (ENVIRONMENTAL SUSTAINABILITY) OF THE BUSINESS SECTOR WITHIN S3 DOMAINS

Specific Objectives	Inputs/instruments	Outputs	Outcomes
<p>3.1 Improve productivity and efficiency of companies in S3 domains based on green and digital transformation</p>	<p>loans/guarantees/grants (in exceptional cases) for green and digital investments</p> <p>vouchers for certifications and Business advisory services for business improvements, market expansions, greening</p>	<p>firms investing in expansion based on green and digital transformation,</p> <p>firms introducing new business practices, marketing, process or organizational innovations,</p> <p>firms with IPR protection,</p> <p>firms obtaining certifications including CE mark, environmental (ISO 14001), Energy management (ISO50001), eco-labelling,</p> <p>firms applying full application of the 5P principles of Lean Six Sigma with zero waste in production processes, measuring and reducing GHG emissions, implementing circular economy concepts and/or reporting on ESG practices,</p> <p>firms using alternative energy sources and improving energy efficiency.</p>	<p>Increased productivity of firms</p> <p>firms meeting ESG and EE standards</p> <p>Firms improving international compliance</p> <p>Increased complexity of exports Knowledge-intensive (including ICT) services and high-tech goods</p> <p>new exporters and firms entering new export markets</p>
<p>3.2 Support company internationalization and participation in value chains in S3 domains through innovative, green and digital approaches</p>	<p>Export/investment readiness programs</p> <p>GVC/supplier development programs with grant component</p> <p>market linkages programs and platforms</p>	<p>firms improving market readiness by adopting EU market requirements</p> <p>firms using innovative/green/digital approaches entering new markets and GVCs</p> <p>firms participating in market linkage programs</p>	

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Strategic Objective 4: DEVELOP HUMAN CAPITAL AND SKILLS FOR INNOVATION, AND GREEN AND DIGITAL TRANSFORMATION IN S3 DOMAINS			
Specific Objectives	Inputs/instruments	Outputs	Outcomes
4.1 Improve relevance of academic programs for S3 domains	<p>multidisciplinary programs supporting S3 domains (ex. ICT in Ag)</p> <p>Increase practical content (through private sector participation) and focus on sustainability and digitalization in existing academic programs and secondary education</p>	<p>new or updated HEI curricula meeting the private sector needs for workforce with multidisciplinary skills</p> <p>Graduates of new or updated S3-related degrees</p> <p>% of graduates employed in S3 companies in 1 year after graduation</p>	<p>Improved skillset of graduates</p> <p>Increased employment in knowledge-intensive activities and innovative enterprises</p> <p>Females employed with advanced degrees,</p>
4.2 Enhance skills and knowledge of employees in S3 companies and farms	<p>Delivery of specific courses for managers and employees in companies and farms in S3 domains on:</p> <ul style="list-style-type: none"> - industry trends and skills in S3 domains - business/financial management - advanced digital literacy - green transition, sustainable development and circular economy 	<p>Enterprises/farms investing in skills for S3</p> <p>Enterprise/farm staff completing training for S3-related skills</p> <p>employees trained in advanced digital skills</p> <p>firms and farms participating in events related to sustainable development (recycling, circular economy, energy efficiency)</p>	<p>improved investment readiness of firms</p> <p>improved firm capacity for innovation, green and digital transformation</p>

Strategic Objective 5: DIGITAL TRANSFORMATION OF THE SOCIETY AND THE BUSINESSES IN S3 DOMAINS			
Specific Objectives	Inputs/instruments	Outputs	Outcomes
5.1 Support innovations through digitalization in the public domain	<p>Open data made available to companies, Universities and research centers for innovative products and services</p> <p>Open public research networks/platforms</p> <p>Support to companies, Universities and research centers to use public data for new products/services (funded through measures in innovation area)</p> <p>digital public services (implemented through ICT strategy)</p> <p>Legal reform for digitalization (e-signature, e-invoice, e-commerce, cyber security)</p>	<p>public institutions offering data for public use;</p> <p>open research/knowledge sharing networks supported by public institutions</p> <p>solutions developed using open data from public institutions;</p> <p>analysis of necessary digitalization policy reforms</p> <p>new policies adopted and implemented</p>	<p>Increased e-participation</p> <p>Legal framework's adaptability to digital business models</p> <p>firms reach high digital intensity</p>
5.2 Support digitalization of companies and agricultural holdings in S3 domains through ICT tools and practices	<p>support development and implementation of innovative digital solutions for S3 domains</p> <p>co-financing for firms (and agricultural holdings) in S3 domains to implement advanced/innovative digital solutions</p> <p>development a digital innovation hubs as a support to businesses</p>	<p>new digital services, products and processes developed and used by enterprises in S3 domains</p>	

Crosscutting Objective: ENSURING CONTINUOUS S3 DIALOGUE			
Specific Objectives	Inputs/instruments	Outputs	Outcomes
6.1 Enable environment and introduce digital tools for S3 process continuation and monitoring	Introduce S3 governance structure Sufficient annual budget for S3 implementation Develop / update a platform for sharing information on S3 implementation Public outreach campaigns to increase awareness of innovation led growth and visibility of activities Establish M&E system Possible incentives for high performers	Functional governing structure effectively manages S3 implementation, web platform provides monthly updates on S3 implementation; media coverage and social media posts on S3 activities StateAid MIS provides a one-stop-shop for applications for S3 calls and information on beneficiaries and their performance; Mid-term evaluation assesses efficiency and quality of implementation and estimates the progress towards goal attainment end-term impact evaluation measures effectiveness and impact and captures lessons learnt for next strategy	Commitment and buy-in from domain stakeholders from the quadruple helix Increased awareness/ knowledge on innovation-led growth and green and digital transformation Adequate progress in S3 implementation Implementation of S3 adjusted based on lessons learned through mid-term and end evaluations Timely preparation of next S3 strategy
	6.2 Foster national, regional and international cooperation among S3 stakeholders	Organization and funding of functional and sustainable S3 EDP working groups by domains	S3 EDP working groups have annual meetings to assess action plans and progress of implementation Thematic events on S3 topics conducted among the relevant stakeholders with strong participation from public, private and academic sector Relevant reports on S3 topics produces collaborations/partnerships formed among the relevant stakeholders;

		Substantial uptake of S3 instruments media coverage and social media posts on S3 activities	
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GOVERNANCE STRUCTURE

The existence of a sound governance configuration with vertical and horizontal coordination mechanisms is considered an important enabling condition for the effective implementation of the objectives of the Smart Specialization strategies.

Governance for Smart Specialisation implies the ability to: coordinate within and across public administrations and agencies, engage the private sector and intermediate organisations and ensure continuity of policy through electoral cycles.

Smart Specialisation requires organisations responsible for the management of the strategy with a clear mandate and political support to effectively implement, monitor and evaluate the policy.

Three main framework conditions can be considered generally relevant for effective governance:

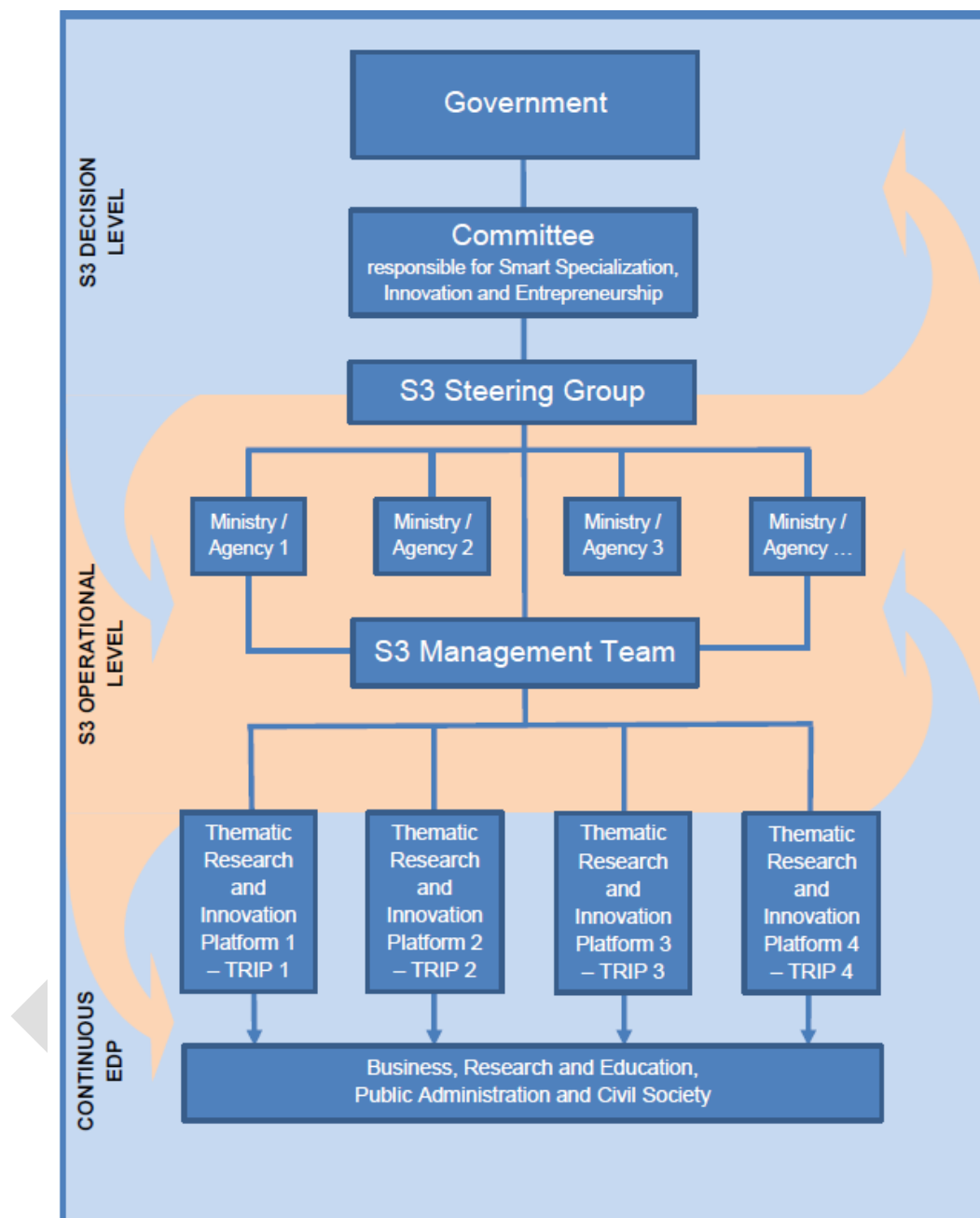
- **Clear attribution of responsibilities and political support** to the institutions responsible for the management of the S3
- **Horizontal and vertical coordination mechanisms and links** for collaboration with the private and public actors need to be ensured.
- **Availability of adequate skills and resources** in both public authorities and relevant stakeholders.

Governance of the S3 should aim at facilitating the establishment of both vertical and horizontal linkages between development players, with a special focus on the continuous stakeholder dialogue within the Entrepreneurial Discovery Process (EDP), which paves the way to identify local priorities and growth strategies.

For efficient facilitation of the governance needs, the implementation framework proposes the division of the governance system into three levels:

- **S3 Decision level** (government, Committee for Smart Specialization, Innovation and Entrepreneurship as part of National Development Council, Steering group led by MES and ME)
- **S3 Operational level** (National Office for S3 as management team for coordination and monitoring (MES and ME) with implementation structure led by FITD, as well other ministries and institutions that implement measures)
- **Continuous EDP** through creating Thematic Research and Innovation Platforms (TRIPs), thus enabling continuous dialogue among quadruple helix per domain, defining transformation roadmaps and initiating strategic partnerships.

Figure 17: S3 Governance structure



The current arrangement and main actors in the innovation ecosystem in North Macedonia that are relevant for the new governance structure needed for successful S3 implementation are as follows:

S3 Decision level / Policy level / High-level dialogue:

- **The government**, as an overall decision maker and policy creator, enact the strategy, approves the action plan and related programs for implementation of measures and follows the realization.
- **The Committee responsible for Smart Specialization, Innovation and Entrepreneurship acting as an Advisory Council**⁵⁹ should be composed of ministers responsible for S3 implementation and representatives of stakeholders (e.g. academia, research organisations, chambers of commerce, employers' organisations, workers' unions, start-up organisations, technology parks and incubators, technology centres, clusters, NGOs active in the domain, coordinators of TRIPs per domain, Council for Higher Education and Research and Scientific Activities etc.).

This Committee can be aligned with the National Development Council, especially the working group responsible for the creation of a competitive and innovative economy.

The Committee would meet, to discuss plans for implementation of S3, results of implementation based on monitoring and/or evaluation outcomes, and issues arising in the innovation ecosystem as well as good innovation practices from foreign innovation communities. It can also suggest additional analyses or studies to be conducted.

- **S3 Steering Group** (hereinafter SG) consists of state secretaries (or higher officials) from different responsible ministries and institutions in order to provide a close, operational, and smooth implementation of the S3 policy mix measures falling under different ministries' responsibility, by considering the competencies and resources of each participating institution while at the same time observing the needs for funding in initiating reforms. The Steering Group shall be chaired jointly by the State Secretaries of the Ministry of the Economy and the Ministry of Education and Science. The other members of the SG come from key in-line ministries (Ministry of Information Society and Administration, Ministry of Agriculture Forestry & Water Economy, Ministry of Environment and Physical Planning, Ministry of Labour and Social Policy, Ministry of Finance, Ministry of Transport and Communication, etc.) as well as other relevant institutions (Fund for Innovation and Technology Development, The Agency for promotion of Entrepreneurship, Agency for foreign investment and export promotion, Directorate for Technological and Industrial Development Zones, National Agency for European Education Programs and Mobility, Development Bank of North Macedonia and other relevant institutions, State Statistical Office, State Office of Industrial Property, etc).

The main tasks of the SG would typically include maintaining alignment with the national strategy, setting performance objectives and overseeing their achievement, supervising the action plan, providing political and institutional support, and liaising with the Government and donors.

⁵⁹ In line with the Law on Innovation Activity, Committee for Innovation and Entrepreneurship

In parallel, the SG acts as a monitoring structure ensuring that the findings and recommendations made at a lower governance level are realized.

S3 operational level:

- The management team for coordination and monitoring is led jointly by MES and ME respectively. In the process of establishing the S3 governance structure will be created a **National office for S3**. Due to the process of reorganization of the Government, and merging the FITD and APPRM, in future can be considered the option that the management is within ministries or it can be shifted to the newly created institution.

The S3 Management Team is responsible for coordination and monitoring of the implementation on the operational level, as well as enabling the flow of information between TRIPs and the Steering group.

They offer support to the Steering Group and Committee in organizing meetings, as well as transferring the needs and providing information flow from the implementation structure and thematic platforms. They should participate as observers in the S3 Committee.

- **At operational level the Implementation structure** consists of ministries (ME, MES, MTC, MEPP, MAFWM, MISA) and institutions that implement S3 policy mix measures.

It is expected the Fund for innovation and Technology Development to be the main implementation institution due to its scope of work.

The responsible institutions are as follows:

- **The Fund for Innovations and Technology Development (FITD)**; despite being the youngest among the following implementation organisations its role and importance in supporting innovation activity and technology investments, especially for SMEs with special attention to green transformation is rapidly growing.
- **The Agency for Promotion of Entrepreneurship (APPRM)** has the mandate to implement governmental SME policies and programmes to support entrepreneurship, competitiveness and innovation.
- **The Agency for Foreign Investment and Export Promotion (ASPIRM)** has the mission to encourage foreign direct investments and business cooperation with local suppliers and promote the export potential of local companies to foreign markets.
- **The Directorate for Technological and Industrial Development Zones (DTIDZ)** conducts activities related to the establishment, development and monitoring of the free economic zones. DTIDZ incentivizes the networking of companies in the free economic zones with domestic suppliers.
- **The National Agency for European Education Programmes and Mobility**; its mandate is to deal with the promotion and implementation of European programmes in the field of education, training, youth, and sports in North Macedonia.
- **Development Bank of North Macedonia** is the only state-owned bank in charge of managing state and donor funds and bringing them closer to enterprises through the banking system enabling improved access to finance.

S3 CONTINUOUS EDP

The governance model implemented during the strategy design process, emphasised the need for 1) multi-institutional coordination and cooperation (an inter-institutional working group) and 2) promoted stakeholder dialogue in quadruple helix for each domain of smart specialization (EDP group) as a bottom-up perspective.

EDP needs to be part of the entire policy cycle where stakeholders are involved from the identification of priorities to their implementation.

To provide S3 continuity, the established EDP groups should continue their functioning and engagement in implementation phase.

The EDP groups will continue their work as Thematic Research and Innovation Platforms (TRIPs).

The role of these TRIPs is to support S3 implementation in their domain by:

- fostering dialogue and cooperation between actors in the quadruple helix for the domain in realisation of the objectives and vision;
- drawing up initial roadmaps for stimulating innovation in their domain including human resources development,
- stimulating the launch of projects in response to the identified objectives for their domain;
- identifying new or changed opportunities and suggesting changes to priorities in the medium term, or even revision of the S3
- acting as a sounding board for the Management Team and Steering Group concerning the specifics of S3 implementation in their domain.

The final aim of TRIPs is to create functional partnerships of stakeholders interested in long-term development, built around four priority domains.

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MONITORING AND EVALUATION SYSTEM

S3 MONITORING

An effective system of monitoring and evaluating S3 implementation is essential for identifying the progress made towards achieving the desired change, achieving the indicators set and evaluating the results and impacts of the activities undertaken hence answering whether S3 is being implemented effectively, efficiently and adequately.

In order to be a proper and effective policy tool, the S3 monitoring system should reflect the logic of intervention of the strategy. In particular, the indicator system should be linked to specific objectives and expected changes explicitly defined and identified for each and all S3 priority areas.

In the context of innovation strategies for smart specialisation, monitoring mechanisms perform three fundamental functions:

- (1) inform about what the strategy achieved and whether implementation is on track and making this information available to decision-makers;
- (2) clarify the logic of intervention of the strategy and make it comprehensible to the broader public;
- (3) support the constructive involvement and participation of stakeholders through transparent communication and promote trust building.

The Republic of North Macedonia should begin to develop its internal capacities and experience starting with simple indicator system.

S3 monitoring and evaluation shall focus on:

- the implementation of the S3 policy mix (i.e. the whole set of measures with its output indicators as well as outcome indicators),
- the processes in the context of the follow-up undertakings on further prioritisation of the four S3 priority domains in terms of continuous EDP and effectiveness of the governance system

As described in the Governance section, the S3 management team – will be responsible for coordinating and monitoring the North Macedonia S3 Strategy at the administrative/working level together with the Steering Group.

The first report on S3 implementation is to be prepared after n+1 year from the day of the start of S3 implementation⁶⁰. After that, reports on the S3 implementation will follow regularly each year. The reports will be prepared in close cooperation with the implementation institutions of the S3 policy mix.

In following tables are given the set of indicators that shall be monitored, presented in a structured way:

⁶⁰Each report will include data on last day of the current year and be prepared and adopted until 30.4. of the following year.

Table 4: S3 Indicators

Impact indicators S3-MK					
“Fostering Green and Sustainable growth through embedding knowledge, innovation and technology for creating high value added products and services competitive on international and domestic markets”					
Impact indicators	Baseline	Baseline year	Source	Target value 2027	
Summary Innovation Index	46.3	2023	EIS ⁶¹	52	
Medium and high-tech goods exports	111,8	2023	EIS	135	
Innovative SMEs collaborating with others	46	2023	EIS	55	
R&D expenditures in the business sector	3.5	2023	EIS	5.5	
Employment in knowledge-intensive activities	18.1	2023	EIS	23	
Ecological sustainability	50.9	2022	GII ⁶²	55	
Innovative business entities rate ⁶³	37,4 %	2016	Eurostat	≥ 45%	
Research and development expenditure (public and private) over GDP ⁶⁴	0,37 %	(2019)	Makstat	≥ 1%	
Research & Development expenditure per inhabitants (Euro / inhabitant) ⁶⁵	17,30	(2017)	Makstat	≥ 50	
Export companies' rate ⁶⁶	5,97 %	(2017)		≥ 8%	
European innovation scoreboard index ⁶⁷	39,9 %	(2018)		≥ 50 %	
Business Sector	Total:	(2017)		Total: ≥1500	

⁶¹ EIS (European Innovation Scoreboard) values represent performance relative to EU

⁶² Global Innovation Index

⁶³ Source: <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

⁶⁴ Source: <https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS>

⁶⁵ Source of numerator: <http://www.stat.gov.mk/Publikacii/2.4.18.14.pdf> (Table T 12 Total R&D)

Source

of

denominator:

http://makstat.stat.gov.mk/PXWeb/pxweb/en/MakStat/MakStat_Naselenie_ProcenkiNaselenie/115_Popis_RM_1Star_Dec_eng.px/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef (Select: Column 1: age; Column 2: relevant years; Column 3: total)

⁶⁶ Source: SSO additional calculation.

⁶⁷ Source: https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

employees working in Research & Development ⁶⁸	550 Female: 307 Male: 243			Female: ≥750 Male: ≥750
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Outcome indicators for SO1				
Creation of foundations for Scientific Excellence in S3 domains				
Outcome indicators	Baseline	Baseline year	Source	Target value n+5
R&D expenditures in the public sector	25.0	2023	EIS	30
International scientific co-publications	25.5	2023	EIS	30
Rate of employed people in R&D ⁶⁹	0,25 %	2017	Eurostat	≥ 0.8

Outcome indicators SO2				
Improving the Innovation ecosystem				
Outcome indicators	Baseline	Baseline year	Source	Target value n+5
Innovation linkages	13.4	2023	GII	17
University-industry R&D collaboration	23.2	2023	GII	30
Patents requested per 1,000,000 inhabitants ⁷⁰	25,06	2017	IPPO Database	≥ 50

⁶⁸ Source: <http://www.stat.gov.mk/Publikaciji/2.4.18.14.pdf> T-01: Persons in paid employment in R&D by type of employment and sector of performance, 2017. Data related to the number of employees in the Business sector (sum of persons in paid employment and external collaborators).

⁶⁹ Source: <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

⁷⁰ Source of numerator: <http://www.ippo.gov.mk/docs/xFiles/articles/Godisen%20izvestaj%202017/Godisen%20izvestaj%202017.pdf>

BERD	0.08	2021	Makstat	
Business Sector employees working in Research & Development ⁷¹	Total: 550 Female: 307 Male: 243	2017	Makstat	Total: ≥1500 Female: ≥750 Male: ≥750
Rate of employed people in R&D ⁷²	0,25 %	2017	Eurostat	≥ 0.8

Outcome indicators SO3				
Improving the competitiveness and environmental sustainability of the business sector				
Outcome indicators	Baseline	Baseline year	Source	Target value n+5
Innovators	60	2023	EIS	65
Resource productivity	38.2	2023	EIS	45
Business process innovators (SMEs)	69.5	2023	EIS	73
Value of export of Agriculture products ⁷³ .	624,503,315 Euro ⁷⁴	(2019		≥835,000,000 Euro.
Environmental sustainability	87,3	2023	EIS	90
Sales impact	68.8	2023	EIS	70
BERD	0.08	2021	Makstat	

Source of denominator:
http://makstat.stat.gov.mk/PXWeb/pXweb/en/MakStat/MakStat_Naselenie_ProcenkiNaselenie/115_Popis_RM_1Star_Dec_eng.px/?rxid=46ee0f64-2992-4b45-a2d9-cb4e5f7ec5ef (Select: Column 1: age, Column 2: relevant years; Column 3: total)

⁷¹ Source: <http://www.stat.gov.mk/Publikaciji/2.4.18.14.pdf> T-01: Persons in paid employment in R&D by type of employment and sector of performance, 2017. Data related to the number of employees in the Business sector (sum of persons in paid employment and external collaborators).

⁷² Source: <https://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>

⁷³ Source: Trade Data is according WTO classification of Agricultural products ANNEX I – Agreement on Agriculture + fish and fish products – Calculation of the MAFWE, Tab 16 Uvoz, t24_u

⁷⁴ Trade Data is according WTO classification of Agricultural products ANNEX I – Agreement on Agriculture + fish and fish products

Outcome indicators SO4				
Investing in human capital and skills for innovation, green and digital transformation				
Outcome indicators	Baseline	Baseline year	Source	Target value n+5
Knowledge workers	36.3	2023	GII	40
People with above basic overall digital skills	18.4	2023	EIS	30
Participation in Lifelong learning ⁷⁵	2,4 Total: 2,4% Male:2,4%, Female: 2,3%	2018	Eurostat	≥5.5 Total: ≥5.5%, Male: ≥5.5%, Female: ≥5.5%

Outcome indicators SO5: Digital transformation of the economy and society				
Outcome indicators	Baseline	Baseline year	Source	Target value n+5
Information and communication technologies (ICTs)	69.6	2023	GII	72
Software spending, % GDP	0.1	2023	GII	0.12
People with above basic overall digital skills	18.4	2023	EIS	22
Rate of SMEs selling on-line ⁷⁶	2,1 %	(2018)		≥ 10%
Use of information technologies	32.8	2023	EIS	

⁷⁵ Source: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190517-1>

⁷⁶ Source: <http://www.stat.gov.mk/pdf/2018/8.1.18.31.pdf> (T.3.)

S3 EVALUATION

Evaluations are intended to increase knowledge of what works and what does not and in which context in order for decision makers and other stakeholders to make timely decisions to support implementation and to draw conclusions for policymaking.

It should look at the wider perspective and provide an independent impartial and unbiased judgement of the situation based on the evidence available.

S3 Evaluation plan - at least two outsourced evaluations are planned, a mid-term evaluation (implementation evaluation) and a comprehensive, final evaluation (impact evaluation).

Both evaluations are hence already included in the Policy mix with main milestones regarding the timeline, providing precise information about success rate of the Policy mix.

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**ANNEX I - POLICY MIX INPUT FROM EDP PER
DOMAIN**

POLICY MIX INPUT: SMART AGRICULTURE AND FOOD WITH HIGHER VALUE-ADDED

Strategic objectives	Specific objectives	No	Measures	Indicators	
Strategic objective 1. Promoting collaboration and partnerships towards smart agriculture and higher value added food sector	1.1. Improving collaboration between business sector and science/research to introduce innovation	1.1.1	Establish a Centre for Agri-food innovation and technology transfer - Centre for Excellence (AgHub) to enhance interaction between academia, students and the business sector	One centre established and functional by 2025	
		1.1.2	Support business-academia collaboration through regular events for exchange on developments in research and innovation	Two events per year organized in the period 2023-2027	
		1.1.3	Foster strategic partnerships for business-academia research and innovation through joint meetings, organized sessions, panel discussions	Number of signed memorandums/collaboration agreements between academia and businesses	
		1.1.4	Establish cooperation, technical assistance and strategic partnerships with foreign entities to transfer knowledge and experience to academia and local businesses	Number of visits/meetings with foreign entities Number of signed memorandums/collaboration agreements with foreign entities	
		1.1.5	Direct support for cluster development and cluster management and support for their operations for strengthening the cluster association for mediation between science and business sector and supporting joint initiatives and innovations in the interest of overall agriculture, joint policymaking	Number of clusters supported (existing and newly established) Number of newly established clusters	
		1.1.6	Support the establishment of Operational groups for agricultural innovative partnerships (in accordance with NARDS 2021-2027)	Number of established operational groups	
		1.1.7	Conduct a feasibility study (cost-benefit analysis) on smart agro industrial park to create and share smart technologies, prototypes, materials, infrastructure etc., leading to establishment of a National Agri-tech park	A feasibility study (cost-benefit analysis) on smart agro industrial parks prepared by 2024 Establishment of National Agri-tech park by 2027	
	1.2.	Improving cooperation of business sector and science/research with policy makers and use of development	1.2.1	Establish a Working Group for Smart agri-food specialization (continuation of the S3/EDP process)	Working group established by 2023, meeting on regular basis 3-4 times per year, EDP members
			1.2.2	Establish a Coordination	Coordination

	support measures		committee (intra-ministerial between MAFWE, ME, MES, MEPP and other governmental bodies and representatives of the Working group) for initiating, coordinating and monitoring policies and measures related to the S3 agri-food domain	committee established and functional by 2023
		1.2.3	Create a platform for integrated information on policy instruments and measures in order to inform regularly potential beneficiaries on options and calls related to the S3 agri-food domain	A web platform with integrated information on policy instruments and measures related to S3 agri-food domain established in 2023 and updated regularly
		1.2.4	Open days for the promotion of smart technologies in agricultural production and food throughout the country; panel with policymakers	Number of organised open days and panels
	1.3. Improving collaboration between farmers and processors to advance the whole value chain (contract farming, cooperatives, technical knowledge transfer, access to finance support etc.)	1.3.1	Stimulate cooperation between farmers' cooperatives and other forms of farmers' organizations and buyers/processors (promoting contract farming for the purchase of agricultural products between agricultural associations and cooperatives, and buyers and processors)	Number of contracts and value of contracts
		1.3.2	Support the implementation of measure 125 in the national Programme for Financial Support of the Rural Development - Cooperation for the development of new innovative products, processes and technologies in the agricultural and food sector (integrated projects)	Multi-annual budget provided for the measure 125 Number of approved beneficiaries and funds
		1.3.3	Establish a guarantee fund or provision of available low-interest loans both for farmers (for input supply and small on-farm investments) and processors (especially for pre-financing of the buyout)	A guarantee fund established and favourable loan conditions for farmers and processors
		1.3.4	Stimulate cooperatives and other producers groups/organizations to create membership packages (offer services for the members in the introduction of innovations, transfer of knowledge, link with research and advisory services, the introduction of standards)	Number of cooperatives. producer groups/organizations that offer membership service packages for introduction of innovative products
Strategic objective 2. Placing diverse, high quality and higher value added food products on existing and new	2.1. Developing diverse offer of innovative as well as traditional (niche) value added products (linked to the local gastronomy,	2.1.1	Support quality schemes - protected designations/indications for brined white cheese, yellow cheese, Tetovo beans, lamb and Kocani rice	PDO/PGIs for selected products, gradually in the period 2023-2027
		2.1.2	Promote traditional (niche) value added products with local branding, and also through local	Campaign to promote local food

markets	authentic food/indigenous varieties and breeds, organic production, including the agri-tourism prospects) tailored to the new market demands (domestic market and export to targeted markets)		gastronomy and rural tourism	
		2.1.3	Measure to encourage short supply chains and marketing of "farmgate" products - connection to the market (catering, tourism, etc.)	Number of registered small-scale food operators Registered volume of products marketed through short supply chains
		2.1.4	Support for the production of food with higher added value: attention to indigenous varieties and breeds for their preservation and producing typical local products	Number of products derived from indigenous varieties and breeds
		2.1.5	Stimulation for the increased production of industrial crops demanded on the market (e.g. medicinal and aromatic plants, cannabis, hemp, etc.)	Increase in area under specific industrial crops
		2.1.6	Development of new varieties and breeds attractive to the market (research programs)	Initiated research for developing new varieties/breeds
		2.1.7	Introduction of innovative technologies in the production of baby/kids food that is in demand in foreign markets	Increased volume/value of baby/kids food
		2.1.8	Support rural producers to market their products through development of digital platforms (e-shops)	Number of e-shops developed/producers selling via e-shops
		2.1.9	Establish a Centre for modern shepherds and managers of sheep cheese dairies	A Centre initiated and established by 2025
		2.1.10	Introduce categorization of accommodation facilities in rural areas (mirroring a model from Brajcino)	Categorisation of rural accommodation facilities introduced by 2026
		2.1.11	Support production of innovative organic fresh and processed products in line with the increased market demand	Increased promotion of the locally produced organic products, Increased export of organic products Increased number of organic operators producing attractive and diverse organic products
				SME development programs including, among other things, increased awareness of export promotion programs, the ability to access an instrument for pre-accession assistance in rural development funding, designing supplier development programs,

			promoting e-commerce	
	2.2. Creating quality and safe products from farm to fork (from field to table) by implementing marketing/quality/safety standards (GlobalGap, organic certification, higher quality and safety standards ISO 22000, IFS, BRC, etc.), advanced market driven pre & postharvest practices and packaging, and promoting integrated food control systems across the chain	2.2.1	Support for innovative for pre- and post-harvest practices and packaging	Number of practices/packaging innovations
		2.2.2	Support for implementation of food safety and quality system certification programs/vouchers (e.g. (GlobalGap, organic certification e.g. BioSuisse, FairWild standards, higher quality and safety standards ISO 22000, IFS, BRC, etc.)	Number of new certifications
		2.2.3	Promote integrated food control systems across the chain through a Pilot project on block-chain based traceability system, enabling final customers to trace the product from field to fork (with ICT solution)	Pilot project on block-chain based traceability system, enabling final customers to trace the product from field to fork (with ICT solution) by 2025
	2.3. Penetrating new markets by preparing adequate marketing strategies (targeting and positioning of new markets, new products, innovative packaging, design and visibility, branding, promotion, commercialization) and providing export support (B2B meetings, market presence, export support, selling in foreign markets)	2.3.1	Prepare regular foreign markets research reviews (based on Euromonitor, CBI, international statistics) for key subsectors and market trends of innovative products of existing and new markets	Foreign market research reviews prepared for key subsectors on regular basis, starting from 2023
		2.3.2	Support for participation (covering part of the costs) in food and technology fairs, B2B meetings, Macedonian week, promotions, support for group and individual stands	Number of supported participation in fairs, B2B meetings, Macedonian week events, group and individual stands
		2.3.3	Establish and maintain an online directory of Macedonian agri-food exporters	An online directory of Macedonian exporters established in 2024 and updated regularly
		2.3.4	Develop tools to incentivize innovative agriculture financing instruments and insurance, particularly leveraging digital solutions or reverse factoring, invoice discounting	Increased development and use of innovative agriculture financing instruments and insurance
		2.3.5	Improve the support through the development bank intended for factoring and reinsurance of exports	Increased use of factoring and reinsurance of exports
		2.3.6	Foster enterprise connecting and internationalization through the European Enterprise Network (EEN)	Number of connections/services through EEN
		2.3.6	Foster enterprise connecting and internationalization through the European Enterprise Network (EEN)	Number of connections/services through EEN
Strategic objective 3. Developing professionally led and knowledge-based agri-food	3.1. Increasing national research funding, supporting participation in international projects and promoting research driven by the needs	3.1.1	Competitive funding for applied research projects linked to smart agriculture and food with higher value added (20 projects x 10 000 Euros) supported through MAFWE, in accordance with NARDS 2021-2027 (also involving master and doctoral students)	Number of implemented projects

sector	of the economy (applied science and commercialization of innovation)	3.1.2	Competitive funding of national research projects connected to S3 objectives (20 projects x 10 000 Euros) supported through MES (also involving master and doctoral students)	Number of implemented projects
		3.1.3	Competitive grants/co-financing of academia with business projects, supported through FITR	Number of implemented projects
		3.1.4	Support for international projects preparation, for developing project idea, objectives, plan, networking, entering a consortium (10 projects x 3 000 Euros) supported through MES	Number of project applications Number of successful applications
		3.1.5	Support for high-ranking applications for international projects that have been internationally reviewed, entered the final lists but have not been funded (received at least 80% of the possible points), with partial funding	Number of implemented projects
		3.1.6	Provide infrastructure support for faculty experimental field to increase its exploitation for educational, research and extension purposes	Faculty experimental field infrastructure improved
		3.1.7	Organize annual competitions and awards for the best agri-food innovation project	Awards for best agri-food innovation project 2023-2027
		3.1.8	Information, awareness-raising and support for the innovation process, proof of concept, intellectual property rights, patents, preparation of requirements, and guidance throughout the process	Number of proofs of concepts and protected property rights (patents)
		3.1.9	Support to the development of national research infrastructure and enhanced participation in international programmes by academia, business and CSOs (facilitate the treasury operations of universities for international projects; establishing an Office for international projects support that will provide information, trainings and assistance for projects application, administration and implementation, especially on the Horizon Europe programme)	Research infrastructure improved: Facilitated treasury operations and administration Established office for international projects
		3.1.10	Support for the development of laboratories and research equipment	Number/value of laboratory and research equipment

3.2. Improving the human resources base through quality formal and informal education and training (flexible and entrepreneurial approaches) and life-long learning	3.2.1	Support the development of human resources through master, doctoral and post-doctoral grants to support research related to the S3 agri-food domain (enhancing applied practices and innovations through research; scholarships or co-funding for candidates coming from all four helixes)	Number of master, doctoral and post-doctoral grants
	3.2.2	Support to developing innovation and entrepreneurship skills of researchers, business managers, students through tailor-made training programs	Number of training programs developed Number of trainees
	3.2.3	Support to vocational training (life-long learning) agri-food production, management and marketing (and agri-tourism) with an innovation/research dimension	Number of training programs developed Number of trainees
	3.2.4	Support twinning opportunities for knowledge transfer related to the S3 agri-food domain (for co-mentors, or a distinguished foreign academia member in master and doctoral committees, or distinguished foreign specialists are mentors in the business sector)	Number of mentors, co-mentors or members of master and doctoral committee Number of experts in businesses
	3.2.5	Support the development of a specialized Master program in Digital Agriculture (interdisciplinary studies, double degree with renowned international academic partners)	Master program developed by 2025 5 scholarships per year supported
	3.2.6	Establishment of a publicly available list of experts from academia and industry for transfer of knowledge and skills related to the S3 agri-food domain	List composed, publicly available and regularly updated
	3.2.7	Establish legal framework for industrial doctorates and post-doctoral studies	Adopted legislation for industrial doctorates and post-doctoral studies
	3.2.8	Increased number of visiting experts from the business sector included in university courses, field visits and internships of students	Number of visiting experts/business sector in academia, practice field visits and internships
	3.2.9	Facilitate the setup and capacity building of industry associations to advocate for improvements in the sector in order to mobilize collective investment and knowledge sharing.	Number of new industry associations Improved capacity of industry associations
3.3. Jointly creating conditions for retaining young agricultural/ food	3.3.1	Prioritize the S3 agri-food domain in existing schemes for scholarships (e.g. MES calls for awarding scholarships for studies	S3 domain put among the priority fields of study for awarding scholarship

processing and marketing professionals in rural areas		abroad)	
	3.3.2	Foreign language, business communication and entrepreneurial skills courses for students	Number of students attended Number of certificates awarded
	3.3.3	Specialized summer schools on S3 agri-food domain topics for undergraduate and graduate students	Number of students attended Number of certificates awarded
	3.3.4	Enhanced internalization and more intensive use of student mobility programs through better information, encouragement and ECTS recognition (Erasmus+, CEEPUS etc.)	Number of international student mobilities
	3.3.5	Student contests for best innovation project/S3 agri-food domain related idea (awards/grants for best projects/ideas)	Number of student contests, applications and awards
	3.3.6	Develop and implement “young leaders” internship program intended for young producers and/or graduates to upgrade their technical skills, innovative capacity and gain new knowledge	Number of internships for young leaders
	3.3.7	Campaign for raising the awareness about the importance of the agri-food sector, links with environment, cross-cutting possibilities with ICT, tourism and other domains, for attracting young population to study and work in this field	Various activities for promotion of the sector
	3.3.8	Open career day for students and potential employers from the business sector, for promotion of the profession and connection with smart agriculture	Number of open career days
3.4. Intensifying existing and establishing new models of know-how, innovation and technology transfer in the agri-food chain (academia – business – companies and farmers) – strengthening national and private extension/advisory services – strengthening the role of CSOs in knowledge transfer)	3.4.1	National measure for transfer of knowledge from advisors (NEA and private advisors) for individual farms, cooperatives, associations (needs assessment, preparing advisory packages, method of knowledge transfer) on S3 agri-food topics, e.g. innovative adaptation to climate change, digitalization in agriculture, organic agriculture	Number of advisory packages
	3.4.2	Trainings of trainers for advisors (with foreign assistance) aimed at upgrading the knowledge about the new technologies (e.g. on innovation and digitalisation in agriculture) and the functioning of the new advisory system with pilot measure for advisory services starting in 2023 through the rural	Number of trainings of trainers

		development program	
		3.4.3 Regular education and training of agricultural producers financed by processors, and MAFWE (e.g. innovative agri-technical measures, harvesting and post-harvesting techniques, storage, packaging etc.) (also can be supported by the Project modernisation of advisory services/MAFWE, with previous needs assessment facilitated by NFF)	Number of trainings of farmers
		3.4.4 Co-financing of technical/advisory services and investment support from processors to farmer - supplier deal	Number of advisory services Value of investment support from processors to farmers
		3.4.5 Web platform for information on register of advisors (NEA and private), and the training offer, advisory and other services to farmers and industry (Project modernisation of advisory services/MAFWE)	A web platform with information on training offer, advisory and other services to farmers and industry related to S3 agri-food domain established in 2023 and updated regularly
Strategic objective 4. Ensuring sustainable use of resources through innovative solutions	4.1. Introducing and encouraging broad use of innovative solutions for sustainable resource use (eco-efficiency, water management, renewable energy sources, waste management, circular economy, etc.)	4.1.1 Support systematic data entry for undertaken agro-technical measures, used pesticides, fertilizers, etc. - farm level records	Number of producers keeping records
		4.1.2 Control and traceability of import, sale and use of plant protection and fertilizers - national level records	System established by 2025 for keeping regular records of plant protection and fertilizers use on national level
		4.1.3 Transparent and timely sharing of information on EU plant protection regulation (allowed plant protection materials) on an annual basis (information published on MAFWE website)	MAFWE website regularly updated with EU pesticides list
		4.1.4 Raising awareness of producers for the use of compost fertilizers as an alternative to mineral imported fertilizers, or other organic fertilisers and plant protection	Campaign for raising awareness of alternative organic plant nutrition and protection
		4.1.5 Pilot projects to test and promote the concept of circular economy	Number of pilot projects
		4.1.6 Tax reduction for companies that reduce waste across the agri-food chain or reuse waste	Value of tax reduction
		4.1.7 Harmonization of waste management and management regulations in agricultural production and food	Harmonized legal framework

	4.2. Mitigating and adapting to the adverse effects of climate change	4.2.1	Support for the development of pilot projects for agrovoltatics (introduced in EU regulation)	Number of pilot projects
		4.2.2	Establishing new meteorological stations (regular and mini)	Number of new regular and mini meteorological stations
		4.2.3	Establishing a system for monitoring and early warnings against diseases and pests based on agri-meteorological conditions, supplemented with specific recommendations from agronomists	System for monitoring and early warning from diseases and pests
		4.2.4	Establishment of a centre for testing and transfer of innovative, climate smart digital technologies in agriculture (smart agriculture) - Climate smart agriculture centre	Climate smart agriculture centre initiated and functional by 2026
Strategic objective 5. Encouraging and facilitating modernization and digitalization in the agri-food sector value chain to increase productivity	5.1. Improving the digital literacy of farmers and other actors in the chain (for own management purposes, as well as for improved integration in global value chains, communication, e-commerce, virtual participation in fairs, presence on social media for commercialization etc.)	5.1.1	Provide tools and deliver trainings for improved digital literacy across the agri-food chain	Number of trainings/trainees Guidelines/publication s/videos on digital literacy
		5.1.2	Digital development in agriculture and food sector, through data management, integrated collaborative forecasting and product tracking, and introduction of RFID (radio frequency identification) - based technologies for fresh product traceability	Number of digital applications and practices supported
	5.2. Increasing digitalization/automation/modernization for smart agriculture, better farm and processing companies' management	5.2.1	Support the use of drones in agricultural production	Number of drones in use (100% increase by 2027)
		5.2.2	Implementation of a special program for digitalization in agriculture from the Fund for Innovation and Technological Development - specialized to co-finance digital solutions for automation/modernization of processing facilities	Number and value of co-financed projects
		5.2.3	Support BSOs to provide advanced digital services to the membership base: marketing planning tools, food safety and quality manuals available in digital formats, interactive portals for information gathering and sharing.	Number of advanced digital service provided
		5.2.4	Digital development in agriculture and food sector, through data management, integrated collaborative forecasting and product tracking, and introduction of RFID (radio frequency	Number of digital applications and practices supported

		identification) - based technologies for fresh product traceability	
5.3. Stimulating local development and application of custom solutions for digitalization of agriculture and processing (in cooperation with ICT domain)	5.3.1	Support to primary producers through development and deployment of IT (Enterprise Resource Planning - ERP) solutions designed to integrate multiple source data and to enable users to handle agricultural resources more productively and efficiently. These digital solutions allow real time control; could be configured for complete tracking of product growth, development, harvesting and post-harvest handling	Number of digital solutions
	5.3.2	Support cooperation of food processing companies and the domestic IT sector for development and deployment of tailor-made ERP solutions that will include: Client relationship Management (CRM), financial planning and reporting, product specifications and costing, production planning and traceability.	Number of digital solutions
	5.3.3	Design and implement precision agriculture and smart technologies in agriculture programs (pilot projects), including spacious resolution technology in particular that relies on use of satellites and drones for monitoring vegetation index of plants, relative growth of plants, relative ripening of crops; preparation of fertilization plans based on vegetation indexes, etc.	Number of pilot projects
5.4. Developing and using digital public e-services for all stages/actors in the chain	5.4.1	Develop a digital public e-services platform for all phases/actors in the value chain	Digital public services e-platform developed
	5.4.2	Digitalization of the procedures in MAFWE, e.g. farmers to be able to submit applications electronically and receive documents digitally	MAFWE procedures, applications and outputs digitalised by 2025
5.5. Utilizing of ICT technologies to improve the quality of life in rural areas (e.g. development of ICT infrastructure for remote work - IT nomads in rural areas, smart villages, etc.)	5.5.1	IT platform and mobile application intended for agricultural producers as info point for activities and measures by relevant institutions (e.g. for accredited laboratories issuing approvals, phytocertificates; vocational training programs and all services offered by MAFWE and related institutions) (Project modernisation of advisory services/MAFWE)	IT platform and mobile application functional by 2023

POLICY MIX INPUT: ELECTRO-MECHANICAL INDUSTRY - INDUSTRY 4.0

Strategic Objective 1	Specific Objectives	Policy actions	Indicators
Formal and informal education system develops high quality human resources that meet the needs of industry	Better harmonized academic and professional programs to provide relevant hands-on experience for students	<ul style="list-style-type: none"> • Introduction of compulsory volunteer work, more practical training within the educational process in companies that meet certain standards • Accreditation of master and doctoral studies for the needs of industry • Introduction of Industrial MA and Ph.D. studies • Promotion of lifelong learning with micro-credits • Introduction of specialized trainings for new technologies • Financing of VET centres 	<p># Accredited study programs</p> <p># Specialized trainings</p>
	Introduce government-funded educational programs to improve managerial skills and access to information on new technologies, standards, and industry trends	<ul style="list-style-type: none"> • Establishment of bodies for certification of professional staff e.g., welders • Review by the MES of the existing state scholarships to meet the needs of the industry • Improving the absorption of scholarship staff in companies and the education sector • Subsidies for training of employees for certificates • Strengthening student mobility - new mechanisms 	<p># Financed VET centres</p> <p># Scholarships staff in companies</p> <p># Student mobility</p>
	Support for professional development of company employee	<ul style="list-style-type: none"> • Accreditation of professional development programs (VET providers) • Review and modernization of professional standardized programs needed for the economy • Financial education for the management of small and medium enterprises • Establishment of new trainings related to Industry 4.0 	<p># Accredited bodies for certification</p> <p># New training related to I 4.0</p>

Strategic Objective 2	Specific Objectives	Policy actions	Indicators
Diversification of financial instruments for modernization and expansion	Improved design of Government financial support programs	<ul style="list-style-type: none"> Improved information and support for academia and firms to apply for EU projects, public finances, other sources and unused funds 	# Governmental financial programs
	Improved conditions of bank loans for industrial development	<ul style="list-style-type: none"> Financial support with green loan, loans for new technology development Financial support to testing and calibration and accreditation for companies with the advantage of domestic laboratories 	#Credit lines for industrial development
	Increased utilization of companies by international innovation funds	<ul style="list-style-type: none"> State funding of applications that have not received funding from EU funds for individual applicants Awarding prizes / grants for application of project ideas 	# Innovative grants # Established digital platforms for SME's
	Increased availability use of IPOs and private equity funds	<ul style="list-style-type: none"> Creating a one-stop-shop for state aid Digital platform for sharing programs to support the economy from various sources Promotion of GEF program and other green finance programs 	# Patents

Strategic Objective 3	Specific Objectives	Policy action	Indicators
Development of high-quality domestic products	Larger investments of companies in production of final products (instead of inputs)	<ul style="list-style-type: none"> State sector advertising of Macedonian companies in foreign media 	# Advertisements abroad
	Improved marketing and support for access to new markets	<ul style="list-style-type: none"> Creating a lab overview available to companies (Lab dashboard) 	#Available Labs
	Increased international recognition of Macedonian products at international markets	<ul style="list-style-type: none"> Subsidizing laboratory tests for companies in existing laboratories 	# Laboratory tests
	Greater cooperation of companies from different sectors to develop more complex products	<ul style="list-style-type: none"> Support for the development of key technologies and services for decarbonisation of the energy system and industry Incentives for company R&D and new product development 	#of new agreement for cooperation

Strategic Objective 4	Specific Objectives	Policy action	Indicators
Increased competitiveness and integration in global value chains - Global Value Chains (GVCs)	Increased competitiveness through automation of production processes, implementation of advanced technologies and industry standards	<ul style="list-style-type: none"> Support for more active participation in fairs and B2B contacts Financial support for standardization Connecting with the EU platform for the Enterprise Europe Network - EEN 	# Fairs participations # EU platforms available
	Increased participation of Macedonian companies and digital platforms for connecting companies	<ul style="list-style-type: none"> Promotion, support for application development and support for networking to effectively use the opportunities offered by EIC and other European funds Support of industrial projects for digitalization of industrial processes Support in the implementation of various standards - systems - QMS, LIM 	# Promotions # Networks # Industrial projects #Implemented QMS

Strategic Objective	Specific Objectives	Policy action	Indicators
Highly developed infrastructure for scientific research and knowledge sharing	Increased public funding for research and development	<ul style="list-style-type: none"> • Basic science support • Establishment of strategic continuous partnerships between companies and institutions - STRIPS • Subsidizing joint research and development between firms and companies • Optimizing coordination between institutions on research and development related measures • IP promotion and support • Reactivation of the EUREKA program • Establishment of Centre for Industry 4.0 and digital transformation 	# Prototyping projects
	Establishment of centralized platforms for monitoring tenders in industry, new technologies, systems and standards	<ul style="list-style-type: none"> • Creating a database of experts for Industry 4.0 (practitioners) after prior standardization • Establishment of an Industry 4.0 Expert Certification Body • Subsidizing the services provided by Industry 4.0 experts • Tax incentives for research and development investment • Vouchers to support collaboration between companies and academia 	# Certification bodies #Taxation subsidies
	Increased cooperation between scientific research centres and laboratories and industrial companies	<ul style="list-style-type: none"> • Connecting all laboratories dispersed in different universities through a science and technology park • Establishing a system of subsidies for team leaders and students for scientific research projects in cooperation with the economy • Annual increase of 10% of state support for research and development for approximation to EU standards • Financial support for prototype development - physical or software 	#Experts in data base #Eureka projects

POLICY MIX INPUT: INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT)

Strategic objectives	Specific objectives	Policy actions	Indicators	
Strategic objective 1. Increase the ICT sector turnover and the export of ICT solutions	1.1. Increase the ICT sector export (custom innovative products)	Facilitate participation at specialized ICT exhibitions and fairs	# of ICT companies exhibiting on fairs # of companies finding new buyers	
		Facilitate integration of local ICT industry in regional and global value chains	# of signed agreements of local ICT companies with regional and international partners # of ICT companies opening offices in other countries # of networking events organized by Embassies and/or chambers in other countries presenting the local ICT sector	
	1.2. Increase the number of ICT companies (SMEs & start-ups) working in selected areas from the SWOT (fintech, eHealth/mHealth, AgriTech, AI, IoT, Smart City, data-driven solutions etc.)	Provide finance schemes (loans/grants) for custom product development (TRL2-4)	# of new proof-of-concepts developed by ICT companies / academia	
		Provide finance schemes (loans/grants) for close-to-market innovation (TRL4+)	# of new products tested on markets	
		Organize conferences/knowledge transfer/networking events and platforms on emerging subjects/trends	# of events/platforms # of participants	
		Attract private capital to invest in selected verticals (through co-financing, tax incentives, improved business environment, improved company investment readiness)	# of new and existing financial instruments for attracting private capital established/expanded (e.g., business angels, crowdfunding, IPOs, PE/VC funds etc.) # of investment-ready companies pitching to private investors Value of private investments in verticals	
		Provide necessary regulatory changes of accounting and tax systems to support company R&D (e.g., VAT exemption/reduction for research services)	Adoption of necessary changes	
		Improve access to advanced business support and development services (e.g., market research, business and financial planning, IPR, certifications etc.)	# of engaged business support and development experts # of companies utilizing business support and development services	
	Strategic objective 2. Increase the excellence level for scientific research and development	2.1. Introduce competitive funding for scientific research	Grants for scientific projects conducted by academic staff at universities and Public Research Organizations (PROs)	# of scientific projects supported # of scientific papers in relevant journals published
			Collaborative grants for academic research consortia	# of scientific projects among various academic stakeholders supported
2.2. Increase and strengthen human resources for scientific research by a factor of 5		PhD scholarships for domestic and international students studying at local universities with focus on S3 domains and selected verticals	# of PhD students enrolled annually	

Strategic objective Strengthen innovation ecosystem	until 2027	Finance PostDoc and 'researcher' positions at universities and PROs	# of new researcher positions
		Regulatory changes to support academic promotions based on enhanced academic portfolio (e.g., number of projects, number of published papers etc.)	# of promoted staff with enhanced academic portfolio according to novel rules
	2.3. Upgrade the scientific infrastructure for research and development	Establish/upgrade university laboratories for scientific research in the areas selected by S3	# of labs updated # of novel labs established
		Labs provide services to private sector	# of services developed # of companies served Private sector revenues raised
		Develop a financing model for universities and PROs to offer services to private sector	# of faculties with developed financing model for services
	2.4. Support researchers in international activities	Local grants for researchers that apply for international funding and meet the evaluation threshold, but are not selected for funding	Value of grants and/or number of projects financed
		Establish central offices with dedicated personnel at universities for international projects management	# of operational offices established
		Enhance eligibility of Macedonian researchers (from academia, PROs and companies) within the EU and other international donors' programs	# of new calls where MK and its institutions are eligible to apply
	3.1. Establish the necessary institutional infrastructure for innovations, knowledge and technology transfer in the next 5 years	Operational Centers of Excellence (CoEs) by 2024 responsible for sharing knowledge and best practices to companies in S3 domains and/or interdisciplinary topics like green and digital transformation	Location identified and adapted Staffing hired & trained Budget provided Operational procedures developed # of CoEs opened within academia, chambers or other key stakeholders # of services offered (e.g., trainings, best practices, business development support, research) # of users/companies
		Operational national technology transfer office by 2024 responsible for commercialization of academic research	Location identified and adapted Staffing hired & trained Budget provided Operational procedures developed # of services offered (e.g., industry partnerships, IP/patents, incubation of startups/university spinoffs etc.) # of users/companies
Operational science and technology park(s) by 2027, which will offer space, shared resources and access to R&D for high-tech SMEs		Location(s) identified and adapted Staffing hired & trained Budget provided Operational procedures developed # of services offered (e.g., access to space, access to R&D facilities, access to tech and business experts etc.)	

			# of high-tech tenants
		Necessary IPR framework to stimulate knowledge and technology transfer by 2023	# of universities and PROs with IPR policies
		Changes of regulation (e.g., Law for Innovation Activity to support academia/business collaboration and implementation of S3 findings)	Adoption of necessary changes
3.2. Increase the level of institutional cooperation between academia and industry by 5 times in the next 5 years		Competitive grants for applied research (funding schemes for academia and industry collaboration)	# of projects implemented # of academia-business collaboration partnerships formed
		Introduce industrial PhD positions	# of industrial PhDs focusing on S3 domains # of students pursuing industrial PhDs # of companies exploiting industrial PhDs
		Adapt / expand innovation vouchers	# of companies using innovation vouchers # of universities and PROs offering innovation services # of products/practices developed/improved
		Tax incentives for companies cooperating with academia	#/value of privately funded cooperation of companies with academia
3.3. Support start-ups and spinoffs that develop custom solutions exploiting the open data concept or the cross-sectorial potentials		Technical assistance for custom product development, access to finance, access to markets and IPR	# of start-ups with improved investment readiness and business performance
		Acceleration programs for start-ups and spinoffs working in S3 domains and selected verticals	# of accelerators supported # of users receiving TA # of start-ups receiving investment Average revenue growth of start-ups 2 years after the participation in the acceleration program
		Provide incentives (financial/non-financial) for public companies that open their data for innovative product development	# of public institutions offering data for public use # of developed solutions using open data from public institutions
		Regulatory changes for open data (compulsory) by public institutions	Adoption of necessary changes
		Support fintech entrepreneurs	# of companies developing fintech products/solutions
		Promote establishment and provide co-financing for of business angel clubs, crowdfunding platforms, PE/VC funds	# of funds established # of active business angels # of investees Value of raised financing
Strategic objective 4. Improve the competitiveness level of local industries through digitalization	4.1. Support SMEs to adopt digital operation	Introduction of digitalization voucher schemes for technical assistance enabling digital transformation of SMEs	Database of digitalization consultants that meet requirements/criteria (e.g., training, certification etc.) created #/value of digitalization vouchers # of SMEs digitalizing their processes

Strategic objective 5. Increase the human potential in the ICT domain		Establishment of knowledge sharing hubs/platforms (e.g., Digital Innovation Hubs – DIHs)	# of SMEs using services from DIHs # of SMEs aware of relevant digital opportunities and best practices
		Incentives for necessary equipment procurement of local SMEs	# of SMEs upgrading equipment
		Regulatory requirements that will stimulate complete digital operation of businesses	Adoption of necessary changes
	4.2. Support development of specific ICT solutions aimed at digitalization of industry, agribusiness and construction, as well as other sectors (SWOT)	Networking between different sectors for ideas exchange on development needs that can be overcome by digitalization (e.g., quarterly round tables)	# of networking/knowledge sharing events (e.g., digital transformation awards) # of participants in networking events # of interdisciplinary teams formed to explore business development needs
		Operational National Center for Digital Transformation	Location identified and adapted Staffing hired & trained Budget provided Operational procedures developed # of services offered # of users/companies
	5.1. Increase the number of enrolled and graduated students on ICT-related study programs on universities	Specialized/interdisciplinary programs at different levels to tackle the need of the market (e.g. Masters Degree on Data Science, ICT in Agriculture, Energy or other fields)	# of established interdisciplinary programs # of interdisciplinary programs accredited # of students enrolled at interdisciplinary programs
		Incentives for companies providing scholarships for undergraduate students in the S3 domains	# of enrolled students receiving scholarships
		Collaboration among ICT companies and technical faculties	# of joint projects (including student theses based on company needs)
		Stimulate students to work on R&D	# of students working on R&D (both industrial and academic positions)
		Promote informal ICT education for non-ICT professionals through digital skills vouchers	# of employed people improving digital skills # of unemployed people retrained in digital skills
5.2. Increase the digital skillset of the population		Offer attractive e-services vs. classical ones (lower price, more options, efficiency)	# of new e-services introduced and used
		Provide continuous needs analysis of future skills and design adequate training programs	# of training programs developed
	Organize conferences and knowledge transfer events for latest technology developments in ICT and digitalization	# of organized events # of people attending the events # of established novel collaboration efforts based on these networking events	

	5.3. Stimulate brain-gain by attracting international experts that contribute to the domestic economy	Regulation changes/adaptations for attracting digital nomads (e.g., enable longer stay in MK)	Legislation changed/adapted for stay in the country Tax changes to support digital nomads working in the country for domestic companies (addressing the dual taxation aspect)
		Sandboxes for digital nomads	# of sandboxes opened on a national level Value of funds allocated to support sandboxes in terms of location, infrastructure etc.
		Establish a platform that will match ICT professionals originating from MK willing to share knowledge, networks and experiences with domestic companies	Network established # of people joining the network/platform # of companies benefiting from these international experts
Strategic objective 6. Digitalization of the public sector	6.1. All key public services for business and citizens fully online by 2030	Regulatory changes that will eliminate paper-based operation of public services for businesses and citizens	Adoption of necessary changes
		Policy implementation / law enforcement in the area of digitalization (digital identity, digital signature)	Adoption of necessary changes Policies in place # of people using digital identity based services
		Centralization and simplification of administrative procedures	Citizens' satisfaction of level of digitalization and simplification of public services
		Interoperability among public institutions	# of formalized digital partnerships between public institutions
		Strengthen the ICT capacity of public institutions with domestic ICT support	Value of novel ICT infrastructure in public institutions # of people in working in public institutions with increased digital skills # of local ICT companies cooperating/supporting public institutions with custom ICT solutions
		Establish a government body/dedicated team to digitalization	Body/team established and operational
		Public procurement stimulate digital innovation	% of public tenders that stimulate digital innovation (less prescribed TORs, selection criteria based on economic value and not lowest price)
		Promote open data of public institutions to support innovative product development	# of public institutions opening their data Quality of opened data for innovative product development
		Support staff mobility within public institutions to support knowledge exchange	# of specialists performing mobility
		6.2. Increased awareness of benefits of ICT solutions in the cross-sectoral areas selected in the SWOT	Cross-sectoral conferences supported by the government at least once a year
Develop project funding calls (e.g. FITD) for digitalization of public services	# of calls dedicated to digitalization of public services		

	Promote creation of multidisciplinary teams to create new product for specific industries	# of created multidisciplinary teams
	Technical assistance from foreign experts/consultants	# of engaged experts # of companies/institutions using their services

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POLICY MIX INPUT: SUSTAINABLE MATERIALS AND SMART BUILDINGS

Strategic objectives	Specific goals	Policy measures	Indicators
Strategic objective 1. Building strong partnerships to strengthen the innovative ecosystem	SO 1.1: Raising public awareness for innovation based on the concept of circular economy, eco-innovative materials and smart buildings	Conferences/workshops/exhibition's for dissemination the results and raise the awareness for aims of domain (greening, digitalization, energy efficiency, renewables, secondary raw materials, circular economy...)	No. of organized conferences/workshops/exhibitions No. of participants from Q-Helix No. of establish networks No. of broadcasting events via media
	SO 1.2: Improving the cooperation (network) for the domain aims: (i). in the frame of academia (A); (ii). between business sector (B) and the academia; (iii). among policy makers (government sector - C), business and academia; (iv). among municipalities (M), A, B and C; (v). among A, B, C, M and non-government sector	Establishment a Center to enhance the cooperation among A, B, C and M in the frame of S3 domain Workshops academia-academia to straighten the partnership for the aims of domain (ex. IoT in buildings) Support creation interactive database facing the challenges of economy of domain Encourage cooperation among centers for development on business level Support academy-business fairs for boosting cooperation Support the employment in municipality that deal with EE, secondary raw materials and recycling	Center established by 2024 No. of workshops /participants No. of interactive participants No. of business companies No. of fairs organized No. of employed persons in municipalities
	SO 1.3: Fostering cooperation between Q Helix partners to benefit from EU programs (Horizon Europe, Erasmus Plus, etc.)	Establishment Horizon Europe center at MoE for support, information and implementation of projects in the frame of program Straightening the support for other EU programs	Nacionalcenter for Horizon Europe up to 2023 No. of employers in the center No. of organized events National platform for Horizon Europa - interactive No. of applied and realized projects
	SO 1.4: Support cooperation (A,B,C,O) towards improved environmental protection (soil, water, air, solid waste) and treatment of waste (industrial, construction, textile, agricultural,	Trainings/seminars for the aims of SO1.4 Promotion activities based on: Save the nature trough the utilization of the concept of circular economy	No. of organized events No. of participants No. of applied mutual projects

	electronic, glass, etc.) as a secondary raw material		
Strategic objective 2: Modernization the education system to support innovation (greening and digitalization) and entrepreneurship	SO 2.1: Upgrading the actual University curricula's on the Green Deal and Sustainable Development Goals	Up-grades of actual Low for high education emphasizing Green Deal (GD) and Sustainable Developing Goals (SDGs) to be integrated in curricula for the next accreditation	No. of graduated, master and PhD programs up-graded with GD and SDGs
		Up-grading the actual low for VET emphasizing Green Deal and Sustainable Developing Goals to be integrated in curricula for the next accreditation	No. of VET curricula
		Call for support mobility between academia and business and vice versa	No. of mobility's No. of calls
		Joint development of university curricula between academia and business sector	No. of developed university programs in cooperation with business sector
		Creation interactive platform sharing the needs of industry (business), experts and needs for problem solving	No. of active participants
	SO 2.2: Promoting lifelong learning (LLL) relating to the objectives of domain goals to improve human resource capacity	Straightening the national finance support for establishing LLL (tailor made training program) for boosting innovation in business sector trough R&D	No. of companies attending LLL No. of accredited LLL with defined ECTS
		Creation of mandatory training program for municipality staff for the aims of domain	No. of training programs No. trained people
		Straightening cooperation of companies with VET center	No. of VET centers No. of trainings
	SO 2.3: Promoting knowledge transfer from business to academia to enhance practical access to education and skills	Tax relief of companies continuously supporting transfer of knowledge from business to academia	No. of companies supporting knowledge transfer
		Enhance the clinical education from company experts in academia	No. of experts involved in high education No. of experts involved in VET
Strategic objective 3: Strengthening scientific excellence	SO 3.1: Support to national investments / research and development institutions related to human resources, research	Increase national research found up to 3.5% from BDP up to 2023	Up-grades of legal framework
		Establishment Ministry for research, technological development and innovation	Up to 2024
		Simulative IPR legislation for knowledge and technology transfer up to 2023	No. of universities with IPR policies

	infrastructure and national projects	National grants for scientific projects at universities	No. of annually financed projects No. of annually published papers No. of conferences
		Center of excellence for research and technological development in the frame of the S3 domain	Determination of location, engaged staff, budget and offered services
		National grants for projects supporting business-academia	No. of national projects No. of industrial PhD
		Supportive grants for projects evaluated but not received EU financial support (to have priority in national funding)	No. of financed projects
		Private grants supporting academia-business	No. of projects financed from business sector
		Vouchers/Challenging grants supporting acceleration and technological extension	No. of accelerating products
		MSc and PhD grants for domestic and international students Post Doc grants Introducing Career researcher at Universities	No. of MSc students enrolled annually No. of PhD students enrolled annually No. of employed researchers at universities
		Involving Industrial PhD and post doc. position	Up-grades of actual Low for high education
		Platform for national research infrastructure	No. of stakeholders involved
		Grants (national and private) for upgrade laboratory equipment at university/research centers selected by S3	No. of lab. Equipment per year No. of laboratories per year
		Grants for accredited laboratories/methods	No. of accredited labs./methods
		Subsidies for companies employing research staff	No. of employed research staff
SO 3.2: Providing incentives (subsidies, grants or tax exemptions) for the business community investing in R&D&I (working together with academia)	Grants for establishing/straightening R&D&I laboratories at business sector working in collaboration with academia Subsidies/tax exemption for companies investing in business-academia projects Grants for business R&D support for the aims of industry Co-financed grants for commercialization of innovations	No. of laboratories in business sector No. of companies supporting collaborative grants No. of companies supporting industrial research No. of commercialized products	
SO3.3: Provide support for fulfilling administrative procedures for the use of EU programs (Horizon	Support centers for international programs at institutional level (faculties, business, NGO) dealing with international project management Activate new EU programs: EUREKA, LIFE, EuroAtom	No. of applications No. of projects No of new EU programs	

	Europe)	Facilitation of tender procedures for procurement of laboratory and research equipment in higher education institutions	No. of tender procedures
Strategic objective 4 : Competitive companies through environmentally sustainable business models	SO 4.1: Support innovations and patents for <u>reducing CO₂ footprint</u>	Support products lowering actual CO ₂ footprint	No. of low CO ₂ footprint products
		Vouchers for patenting products/materials	No. of patents
		Introducing labeling – CO ₂ footprint	No. of companies
	SO 4.2: Reducing <u>energy consumption</u> (by ICT solutions, sustainable materials, renewables, smart buildings)	Incentive measures for digitalization, EE, renewable energy sources, recycling	No. of digitalized companies up to 2027
		Certification of staff for a specific area of the domain	No. of applied renewables
		Subsidies / grants to improve insulation, use of renewable energy sources, IoT and chargers for electric vehicles in collective, residential buildings	No. of EE companies up to 2025 No. of companies supporting recycling
		Introducing energy labeling of buildings	No. of certified staff for the aims of domain No. of smart buildings No. of energy-labeled buildings
	SO 4.3: Increase the <u>productivity</u> of companies by modernization (automatization/digitalization)	Subsidies / grants for new equipment supporting automatization and digitalization	No. of modern companies
		Develop of software for support of more efficient and sustainable way of projecting and building	No. of stakeholders
	SO 4.4: Support of companies that use <u>secondary raw materials</u> in line to the concept of <u>circular economy</u>	Subsidies / grants for utilization secondary raw materials instead of primary raw materials	No. of used secondary raw materials
		Support interactive digital platform for secondary raw materials (waste producers-waste users)	No. of stakeholders supporting the platform
		Public procurement to stimulate new innovative solutions	No. of innovations
		State support with subventions and stimulation for production of recycled ecological products	No. of products
		VAT reduction for utilization of ecological/recycled materials/products and EE technologies	No. of companies
	Stimulation of utilization of sustainable materials and smart building solutions in cultural heritage (CH)	No. of CH objects	
	Introducing eco-labeling (eco-hotels...)	No. of eco-objects	
SO 4.5: Support to the local	Grants for opening/supporting start-ups and spin offs	No. of new products No. of start-ups, spin-offs,	

	ecosystem for start-ups and technology transfer (start-ups, spin-offs, accelerators, technology transfer centers)	<p>Accelerating the products to the market</p> <p>Support the opening institutional infrastructure for boosting innovation based on the aims of S3 domain (Fablabs, Makerspace, hubs, CoE, Innovation clusters, Technology Park, Technology Transfer Center)</p> <p>Support start-ups and spin off for regional and international promotion of domestic products</p>	<p>...Fablabs...</p> <p>No. of companies promoting domestic products at regional and international markets</p>
		Subvention credit for SMART Buildings, isolation, EE solutions	No. of companies
<p>Strategic objective 5 :</p> <p>The business environment imposes recycling, energy efficiency and the use of renewable energy sources</p>	<p>SO 5.1:</p> <p>Supporting legislation towards:</p> <p>(i) waste disposal in accordance with the concept of circular economy and recycling;</p> <p>(ii) energy efficiency and renewable energy sources;</p> <p>(iii) smart buildings.</p>	Interventions in low for intellectual properties to up-grade the actual gap for patenting (especially for universities)	No. of patents
		Up-grades of actual low for solid waste management	No. of companies utilized solid waste
		Up-grades of actuals law for energy efficiency and renewables	No. of EE solutions
		Supportive legislation for smart buildings	No. of smart buildings
		Activate legal provisions for the application of digital tools in the procurement process	No. of companies applied digital tools in the procurement process
		Legal measure for increasing the prices of packaging, and refunding the funds of the citizens after returning the packaging (as in Germany for example).	The amount of budget increase
		Introduce a law on the obligation to use materials tested in accredited laboratories	No. of tested materials
		Introduction of stricter legal provisions and their implementation to limit harmful emissions and adverse environmental impacts from changing non-environmental resources and processes	No. of specific legal measures
		Support the quality criteria and technical solutions for public procurement tenders for infrastructure projects, instead of the lowest price	<p>Amendment of the public procurement law.</p> <p>Preparation of a rulebook and guide for public procurement and training of public procurement staff</p>
		Grants for modernization of all rulebooks related to the construction process and materials, their modernization, i.e. adjustment to the EU regulation for the domain aims	No. of modernized rulebooks
Harmonization of the national regulations at the Institute for Standardization with the EU regulations	No. of harmonized national regulations with EU regulations		

		Supporting the development of new business models	No. of new business models
	SO 5.2:	Center for construction and demolition waste collection	Location, staff, aims...
	The public waste collection system encourages the separation of household waste and industrial waste	Support (taxis) waste separation	
		Opening resource collection center	No. of collected types of waste (resources)
		Reorganization of system for waste collection, selection and recycling in municipalities	No. of municipalities where waste selection is fully regulated and enabled
Strategic objective 6 : Opening new markets and internationalization	SO 6.1: Promotion of domestic products on the regional and global market	Campaign for building awareness of the uniqueness and specificity of certain national products in order to increase their recognition in the international market	No. of awareness raising events
		Establish center/sector for promotion domestic products	No. of participants
		Straightening cooperation between academia and business for export promotion based on market research and scientific facts	No. of export products
		Trainings and support for the access at international markets	No. of events No. of participants
		Informative interactive database for regional and international promotion of domestic products (including list of fairs)	No. of users
		Support the quality of domestic products from accredited laboratories	No. of products
		Support the consortia of domestic companies to open offices in third markets	No. of offices in third markets No. of participants in consortia
		Financial support of national associations for membership in relevant international associations	No. of participations in international associations
	SO 6.2: Networking with International Associations, Chambers, Businesses and Academies	Trainings for construction contracts published by international federations and associations	No. of trainings No. of trained persons
		Stimulating a new forms of organization within the chambers (associations, associations, groups ...) whose business model will be based on reducing the number of components and materials, simplifying the design of the required components and using the same component or system for various functions as well as optimizing the whole construction.	No. of cost effective organizational models