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SMART SPECIALIZATION AND SUSTAINABILITY IN CENTRAL AND EASTERN EUROPE: AN INQUIRY INTO THE LOGIC OF INTERVENTION

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Biographical Note

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Abstract

The purpose of this study is to offer an in-depth analysis of the selected priorities for smart specialization under the "sustainable innovation" priority area in Central and Eastern Europe (CEE). We apply text-mining techniques to classify the smart specialization priorities encoded by the CEE countries in the Smart Specialization Platform created by the European Commission. Our findings reveal the strong emphasis placed on "resource efficiency", "sustainable energy and renewables"

and “bio-economy and sustainable agriculture” at the CEE level. We conclude that the logic of intervention is backed by the need to increase the resource productivity at the CEE level, but also by the opportunity to exploit the strong comparative advantages in the bio-economy and sustainable manufacturing sectors and to capitalize on the large allocations for environmental investments from the European Structural and Investments Funds 2014 – 2020. Fostering the environmental industries and enhancing the regional innovation systems at the CEE level are some of the most important policy interventions at the CEE level, which can turn the proposed visions into sustainable growth.
Keywords: smart specialization, sustainability, logic of intervention, Central and Eastern Europe
JEL Classification: R5

1. Introduction

Smart specialization is an innovation policy concept that aims to boost regional innovation, while enabling all European regions to develop their competitive advantages and strengths. Smart specialization is closely related to the European Cohesion Policy 2014 – 2020, whose purpose is to reduce differences between regions and to ensure growth across Europe. Consequently, all Member States had to develop national and/ or regional “smart specialization strategies” (RIS3), to meet the ex-ante conditionality associated to the thematic objective 1: “Strengthening research, technological development and innovation” and thematic objective 2: “Enhancing access to and use of quality of ICT”. Such a strategy is expected to develop and match the research and innovation strengths to the business needs, “in order to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts” (EU Regulation No. 1303/ 2013). What is new to this new concept is the fact that it emphasizes the principle of prioritization in a vertical logic and defines a method to identify the desirable areas for policy interventions (Foray and Goenaga, 2013).

Central and Eastern European countries (CEE)[1] are deemed a special attention in the processes of smart specialization. In their transition to market-based economies, these countries embarked on strong and sustainable growth paths (Aghion et al., 2011), but they did not grow based on research-driven innovation; instead, they relied on the interaction of domestic R&D with more advanced technology from imported equipment and inputs (Radosevic and Stancova, 2015); in addition, CEE economies have currently an unfavourable sectoral structure – i.e. high share of agriculture, moderately high share of manufacturing industry, low share of services, especially

[1] The Central and Eastern European (CEE) countries considered in this paper are those countries belonging to the Communist Bloc before 1990 and are now members of the European Union, i.e. Bulgaria, Croatia, the Czech Republic, Estonia, Lithuania, Latvia, Hungary, Poland, Romania, Slovenia and Slovakia.

advanced services (Brown et al., 2017). Despite a strong potential advantage in many pure and applied science fields (Camagni and Capello, 2014), there is a substantial gap in demand for research and technological development and many deficiencies in the policy frameworks and institutional capacities are observed at the CEE level (Bachtler et al., 2014).

For various reasons, the elements of a green and sustainable economy are being introduced slowly at the CEE level (Gorzelak, 2015). During the transition to the market economy, these countries were concerned with the creation of the legal and institutional framework for environmental preservation, in line with the EU accession requirements (Serbanica and Constantin, 2017). However, new threats have appeared with the increase of consumption, which resulted in more transportation, constant urbanization and inefficient waste management in particular (Gorzelak, 2015).). Today, CEE countries are ranked among the first 50 out of 180 countries in the Environmental Performance Index 2018, i.e. Slovakia (28th), Lithuania (29th), Bulgaria (30th), Czech Republic (33rd), Slovenia (34th), Latvia (37th), Croatia (41st), Hungary (43rd), Romania (45th), Estonia (48th) and Poland (50th). With a view to the future, the CEE countries are called to "green the economy", while looking for acceptable trade-offs between economic growth and environmental quality; under these conditions, the smart specialization strategies should be providential. Within this context, the purpose of our paper is to offer an in-depth analysis of the selected priorities for smart specialization in the "sustainable innovation" priority at the CEE level and to examine the logic of intervention that backs the potential of growth in this area.

2. Smart specialization and sustainability objectives

The smart specialization principles and goals are meant to provide strategies and roles for any county or regions, irrespective of their scientific profile or innovation performance; it follows the "place-based" approach to economic development and takes into account the geographical characteristics - to help generate growth in all regions, not only in those advanced in knowledge production. However, for the lagging behind, peripheral areas – that are still far from the technology frontier and lack critical mass for innovation, the supporters of smart specialization concept advocate for keeping the focus on existing industrial strengths instead of building up novel high-tech industry (Foray et al. 2011; Tiits et al. 2015). In these areas, science, technology & innovation policies are expected to promote knowledge – intensive activities in all sectors, including low- and medium-technology industry and services (Havas et al., 2015).

Smart specialization strategies are expected to be relevant to all three priorities of Europe 2020 i.e. smart, sustainable and inclusive growth. With respect to the latter, smart specialization-related investments should help shift towards a resource-efficient and low carbon economy

(European Commission, 2012a). There is a clear need to connect innovation and sustainability agenda to achieve first a de-coupling of economic growth from environmental degradation and resource consumption, but also to respond to the global demand for eco-innovative and environmental technologies, eco-friendly products and services and green and sustainable design ideas (European Commission, 2012b). Different policy objectives could connect smart specialization to sustainable growth and sustainability issues, as presented below:

- ***Resource – efficiency***: Europe 2020 Strategy stresses the need for transition to a green, low-carbon and resource-efficient economy, where all resources (e.g. raw materials, energy, water, air and soil) are sustainably managed. Innovation is seen as an essential factor to succeed in decoupling growth from natural capital utilization (European Commission, 2012b) and new innovations in resource-efficient production methods and "circular economy" are expected – so that to increase resource productivity (the relationship between what an economy produces and the materials it uses based on its domestic material consumption).
- ***Sustainable energy & transport:*** To achieve the EUs' 20-20-20 objectives on greenhouse gas emissions, energy and renewables, investments in innovation are further required. As such, the potential actions that can be pursued are related to innovative ideas in building, mobility, design and energy management (European Commission, 2012a) or to energy efficiency in industry, buildings and urban planning, production of sustainable bio-fuel and biomass, creation of smart grids and other ICT based solutions, developing fuel cell and hydrogen technology. In the same direction, promoting sustainable transport solutions is one of the most effective methods to support energy-efficiency targets (European Commission, 2012b).
- ***Bio-economy:*** In line with the provisions of the "Bio-economy Strategy for Europe 2020", new advancements are needed to reinforce the agro-food sector, fisheries and aquaculture, wood, forestry, paper and pulp industries, bio-based, bio-chemicals and plastics products, biofuels or bio-pharm industries (European Commission, 2012c). Innovation is therefore needed to complement or transform the activities of traditional sectors into added-value production (European Commission, 2012b).
- ***Eco-innovation:*** Defined as "any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving a more efficient and responsible use of natural resources" (European Commission, 2011).

Eco-innovations should therefore help reduce resource inputs (materials, water, land, energy etc.) and control the impacts of outputs (emissions, waste etc.).

Capturing economic differentiation patterns is one of the central principles of smart specialization and the European countries and their regions are strongly recommended to focus on a limited number of innovation priorities, to exploit related variety and to avoid imitating other regions. Smart Specialisation should set in motion regional change and generate unique assets and capabilities based on the region's distinctive industry structures and knowledge bases (European Commsission, 2012). The selection of priorities for smart specialization should therefore be based both on the analysis of the strengths and potential of national/ regional economies and on a process of entrepreneurial discovery, in a broad stakeholder involvement process (McCann and Ortega-Argiles, 2015).

3. Research method

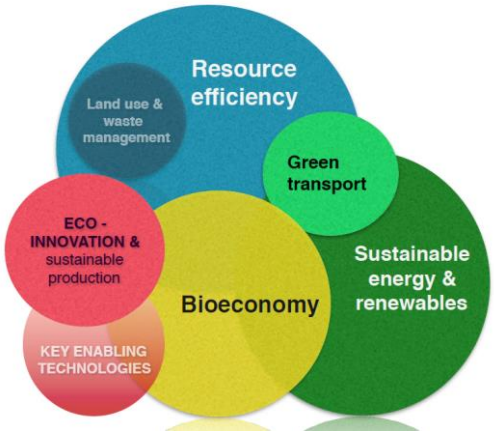
This paper applies text-mining techniques to the RIS3 priorities encoded by the Central and Eastern European countries in the (RIS3) Smart Specialization Platform created by the European Commission. Our purpose is to identify those smart specialization priorities that match the "sustainability" policy objective and fall under the "sustainable innovation" category. It should be noted here the fact that each priority area may target simultaneously more than one domains. Our purpose is to identify the areas of focus and advantage in tacking sustainability issues and to observe the similarities that exist between the countries. 11 Central and Eastern European countries – namely Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovakia – were subjected to our analysis.

Overall, out of 63 smart specialization priorities encoded by these countries, more than a third (23) fall under the category of "sustainable innovation" (Appendix 1); of these, "resource efficiency" is the headline area of focus, which is strongly intertwined with "sustainable land & water use and waste management", "sustainable energy and renewables", "smart green and integrated transport systems", "bio-economy and sustainable agriculture" and "eco-innovation".

Figure 1 presents the main smart specialization priorities for sustainable innovation in Central and Eastern Europe, while highlighting the similarities in approaches (the biggest the bubble, the more priorities falling under that category), but also the links between the priorities. At the same time, Figure 2 maps the main sectors envisaged by these priorities, following the same rationale (the biggest the bubble, the more priorities targeting that sector). By far, the manufacturing sector (NACE code: C) and the energy, gas, steam and air conditioning supply sector (NACE code:

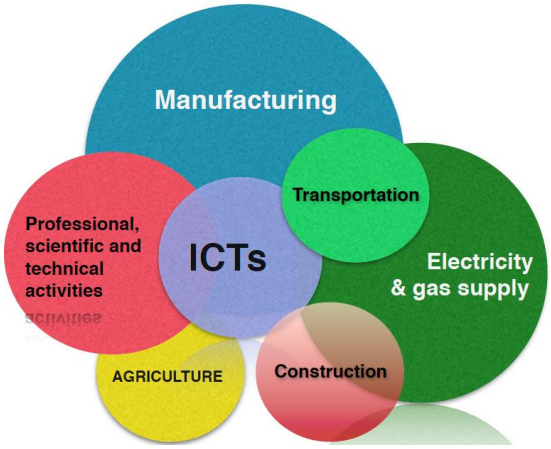
E) are in focus, while the information and communication services sector/ ICTs (NACE code: J) has a pivotal role in connecting all the other sectors.

Figure 1. Smart specialization priorities for sustainable innovation in CEE countries



Source: own elaboration based on the data encoded in the RIS3 Platform.

Figure 2. Smart specialization sectors for sustainable innovation in CEE countries



Source: own elaboration based on the data encoded in the RIS3 Platform.

4. Results and discussion

For Central and Eastern European Countries, sustainable innovation is a key priority in the 2014 – 2020 framework, which is prompted by various explanations.

4.1. The selection of smart specialization priorities for "sustainable innovation" at the CEE level is motivated by genuine needs to improve sustainability performances

Table 1 introduces a number of relevant indicators to depict the current sustainable innovation performance at the CEE level. By far, *resource productivity* – which is measured as gross domestic

product in purchasing power standards (PPS) over domestic material consumption - is one the main drawbacks at the CEE level, i.e. the values of resource productivity range from 0,7 to 1,9 PPS per Kg, which is much below the EU level (2,2 PPS per kg). At the same time, the recycling rate of municipal waste is less than 33% of the total municipal waste, with Romania recording the lowest rate (13,1%), more than three times less than the EU average (45,8%). Enhancing the management of natural resources, increasing the value of raw material base, depolluting and reusing waste are thus important priorities for the CEE countries in their path to sustainable economies.

In terms of sustainable energy and renewables, almost all CEE countries have smart specialization priorities related to the production of clean and renewable energy, increasing energy-efficiency of building structures and residential infrastructure and development of smart systems/ devices for energy production, diagnostic, storage, transmission and distribution of energy. For the moment, the energy productivity at the CEE level is of only 7,5 PPS per kg of oil equivalent, which is again much below the EU average (9,1 PPS per kg of oil equivalent). As for greening the transport systems, Central and Eastern European countries mainly aim to develop their strong automotive industry (Czech Republic, Romania, Poland, Slovenia) and to develop environmentally friendly transport solutions. These ambitions are rooted in both profitability and sustainability motivations, as the transport sector is increasingly causing pollution and generates CO2 emissions, which are much higher than the EU average (124 g CO2 per km at the EU level vs. 118 g per km at the EU level).

4.2. The sectoral composition of the CEE economies favours the interventions in the bio-economy sector and in the high- and medium-high technology manufacturing

Given the fact that traditional sectors still have a high share in the sectoral composition of Central and Eastern European economies – with higher shares for agriculture and industry and lower shares for service sectors, bio-economy is a priority for most countries in the region.

Table 1. Sustainable innovation performance in the CEE countries

S3 Priority	Indicator	Unit/ Source	CEE	Max CEE		Min CEE		EU
RESOURCE EFFICIENY & WASTE MANAGE-MENT	**Resource productivity**	Euro PPS/ kg, 2016; Eurostat code: t2020_rl100	1,2	SI	1,9	BG, RO	0,7	2,2
	Recycling rate of municipal waste	% of recycled waste in the total municipal waste generation; 2016: Eurostat code: t2020_rt120	32,7	SI	57,7	RO	13,1	45,8

SUSTAINABLE TRANSPORT & ENERGY	**Average CO2 emissions per km from new passenger cars**	g CO2 per km, 2016; Eurostat code: sdg_12_30	124	HR	111,5	EE	133,9	118
	Energy productivity	PPS per kg of oil equivalent, 2016; Eurostat code: t2020_rd310	7,5	RO	10,3	EE	4,6	9,1
BIO-ECONOMY & SUSTAINABLE AGRICULTURE	**Location quotient in the Bio-economy**	% of employment in the bioeconomy divided by the EU employment share in the bioeconomy, 2015; Bioeconomy Knowledge Centre	1,6	RO	3,71	CZ, SK	0,91	1
	Residue production from the main crop groups	Mt of dry matter per year / biomass potential; (Camia et al., 2018)	13,8 (avg)	PL	45,5	EE	1,7	15,7 (avg)
ECO-INNOVATION	**Eco-innovation index by country**	EU28 =100, 2016; Eurostat code: t2020_rt200	73	SI	117	BG	38	100
	Employment in high- and medium-high technology manufacturing	% of total employment, 2016; Eurostat code: tsc00011	6,2	CZ	11,5	LV	1,8	5,8

*Notes: *BG = Bulgaria, CZ = Czech Republic, HR = Croatia, EE = Estonia, LV = Latvia, LT = Lithuania; HU = Hungary; PL = Poland; RO = Romania; SK = Slovakia; SI = Slovenia*

Source: Own processing based on the above sources

The focus in the bio-economy sector at the CEE level stays on biomass processing, but attention is also given to innovative technologies for plant and animal breeding, food safety, development of niche products from unconventional raw materials etc. Currently, the location quotient in the Bio-economy sector at the CEE level is of 1,6, with Romania having a very strong potential for sustainable agriculture; similarly, Poland has one of the strongest performances for biomass production at the EU, which also furthers its prospects for smart specialization in the bio-economy sector. These priories go hand in hand with those falling under the "eco-innovation" category and relating to high- and medium-high technology manufacturing, where mechatronics, mechanical engineering, and digital solutions are on focus. CEE countries are not among the leaders in the eco-innovation scoreboards at the EU level, but they have above-the-average performances for medium and medium-high technology manufacturing, which prompts their potential for fostering sustainable

manufacturing. For the moment, Slovenia, the sole "innovation leader" in the region, goes further to "Industry 4.0" solutions, automation, smart sensors, virtual technological production systems etc.

4.3. Supporting sustainable innovation is a core objective of the European Structural and Investment Funds 2014 - 2020, whose main recipients are the CEE countries.

CEE countries are the most important beneficiaries of Cohesion Policy, which devotes high shares of funds from Cohesion Fund and European Regional Development Fund to the environmental issues. Table 2 presents the shares of allocations for sustainable growth at the CEE level, where more than 46% of the European Structural and Investment Funds 2014 – 2020 are targeted to the low-carbon economy, climate change adaptation, environment & resource efficiency, transport and energy infrastructure. The selection of smart specialization priorities in these areas is thus motivated by the need to couple environmental investments to the state-of-the-art technologies and innovations and to use the dedicated funds to respond to the environmental challenges.

Table 2. European Structural and Investment Funds 2014 - 2020. Allocations by theme

	ESIF ALLOCATIONS FOR SUSTAINABLE GROWTH (% of total allocations by country)				
Countries	**Low-carbon economy**	**Climate change adaptation**	**Environment &Resource efficiency**	**Transport & Energy Infrastructure**	**TOTAL**
BG	12,6	4,3	21,7	14,4	53
HR	6,9	4,8	21,7	11,7	45,1
CZ	12,1	5,6	12	25,6	55,3
EE	11,5	4,4	9,4	10,6	35,9
LT	12,7	3,9	12,3	14,1	43
LV	9,3	4,8	13,9	20,6	48,6
HU	11,4	5,5	11,8	13,3	42
PL	10,8	1,5	9,9	**27,7**	49,9
RO	10,9	6,6	15,9	19,4	52,8
SI	7,3	**7,6**	16,6	8,4	39,9
SK	6,9	6,6	12,2	22,8	48,5
CEE	**10,2**	**5,1**	**14,3**	**17,1**	**46,7**
EU	**9,5**	**6**	**13,6**	**12,6**	**41,7**

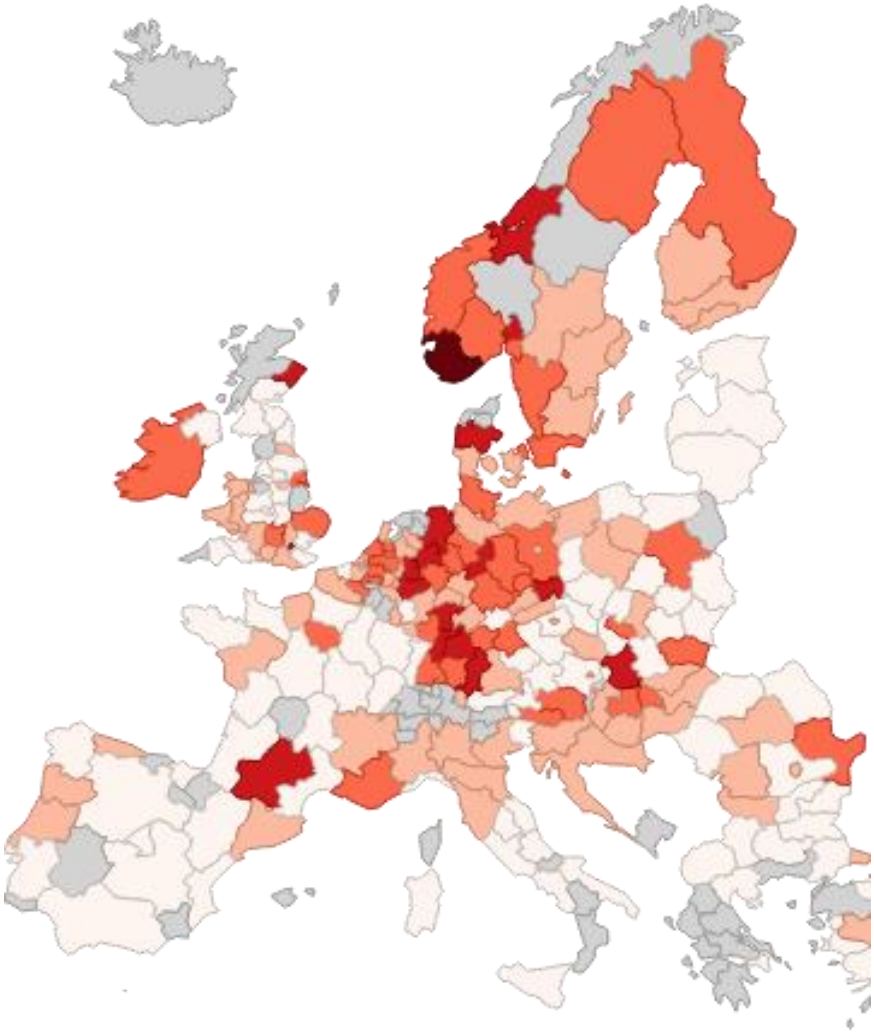
Source: EU Cohesion Data

4.4. Few CEE regions have comparative advantages in environmental industries

Environmental industries are one of the 10 emerging industries in the European Union, with more than 71000 establishments all over Europe and a share of about 3,5% in the overall economy; they are the most crosscutting emerging industries identified by the European Cluster Observatory, as they include a very large range of products, services, technologies and processes serving many

different sectors. Currently, the top eight regions are located in Germany (European Commission, 2016), while the CEE countries host 22 clusters in environmental industries, of which a single one has three stars (SK 02 – Zapadne Slovenko) and six clusters have each two stars[2] (Figure 3).

Figure 3. Regional hotspots in environmental industries



Source: European Cluster Observatory - Cluster mapping tool: Environmental industries.

The potential for smart specialization in environmental industries is thus unequal between the CEE countries and between the regions of the same countries. At the one end of the spectrum, the Baltic countries do not have agglomeration advantages in environmental industries and for them the focus is on energy production and biomass exploitation. Croatia, Bulgaria and Slovenia have each a single one-star cluster in environmental industries, but their location quotients are not very high. Romania,

[2] In the European Cluster Observatory, a cluster gets 1 star for being in top 20% in Europe along each of the four dimensions: size, specialization, productivity and growth.

Hungary and Poland have each one two-stars cluster (RO22 – South East; HU21 – Central Transdanubia, PL12 - Mazowieckie) and few other one-star clusters and they all have the potential to largely increase resource efficiency, energy productivity and biomass exploitation. At the other end of the spectrum, the Czech Republic and Slovakia have each a region with a high location quotient in environmental industries (+1,6) and host two and three-stars clusters (CZ 08 – Moravian Silesian Region, SK 02 – Zapadne Slovensko and SK 04 – Vychodne Slovensko); for these regions, the potential for smart specialization in sustainable innovation is already proven and should be further enhanced and explored.

To these one should add the fact that - except for the CZ 01 region (Prague), which is a strong innovator, all the other CEE regions hosting clusters in environmental industries are modest or moderate innovators, according to the European Regional Innovation Scoreboard (European Commission, 2017). Such regions are highly recommended to adopt the broader view of innovation, which goes beyond R&D-based innovations to issues that address the role of entrepreneurship, human resources and other policies in fostering structural change (Clar et al., 2015), while prioritizing the transformation of the socio-economic fabric (Rodriguez-Pose, 2015).

5. Concluding remarks

This paper has investigated different lines of arguments that back the selection of smart specialization priorities for sustainable innovation in Central and Eastern European Countries. Our findings reveal the genuine needs to increase resource productivity, energy efficiency and eco-innovation potential at the CEE level; at the same time, out results emphasize the large growth potential for the bio-economy and sustainable manufacturing sectors in the region, while capitalizing on the large amounts of the European and Structural Funds that are allocated to sustainable growth in these countries. With a view to the future, it will be of a paramount importance for the CEE countries to foster the environmental industries sector – which is now concentrated in few regional hotpots - and to overcome the barriers to regional innovation, to keep up the pace with Europe’s innovation leaders.

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DISCLAIMER

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Appendix 1

Table A1. Smart specialization priorities for sustainable innovation in Central and Eastern Europe

Smart specialization priority	Objectives by country
Resource efficiency, land use & waste management	Management of natural resources, agriculture and food (CZ); enhancement of resources (EE); sustainable and productive forest growing in changing climatic conditions (LV); waste and waste treatment, storage and disposal (LT); processing and use of natural resources and the production of substitutes/ environmental engineering/ processing and use of materials and energy waste/ innovative technologies and processing water recovery and reducing its consumption (PL); innovative technologies, equipment and technical systems for the generation of bio-resources / depolluting and waste reuse technologies/ optimizing the use of conventional and non-conventional water resources (RO); sustainability of buildings with re-use of used construction materials and of waste as well as renewable and eco-friendly and healthy materials/ networks for the transition to circular economy (SI); increasing the value of domestic raw material base (SK).
Sustainable energy and renewables	Devices for energy production and distribution, nuclear energy, mining/ renewables (CZ); energy-efficiency related to knowledge-based construction (EE); energy technologies, systems and equipment (HR); clean and renewable energies (HU); development of smart grids, demand-supply systems / increasing energy efficiency of building structures and residential infrastructure elements/ development of next-generation technologies for energy from renewable energy sources (LV); smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and customers/ solar energy equipment and technologies for its use for the production of electricity, heat and cooling/ technology for the development and use of smart low-energy buildings (LT); high efficiency, low-emission and integrated circuits manufacturing, storage, transmission and distribution of energy / smart and energy efficient construction (PL); intelligent cities (RO); energy refurbishment of buildings, smart appliances for energy efficiency and self-sufficiency of buildings/

	interfaces between smart buildings and smart grids, integrated management systems for buildings, homes and the working environment of the future (SI) etc.
Smart green & integrated transport systems	Transport means: automotive, aircraft, aerospace, rail, including connected ecosystem of supplying and supporting industries (CZ); added value manufacturing of road and rail vehicles parts and systems/ intelligent transport systems and logistics (HR); environment friendly transport solutions (HR, PL); new-generation vehicles and ecological and energy-efficient technologies (RO); developing high value-added, demanding, complex, energy-efficient products consistent with the new EU transport emission standards (EURO 6c, EURO 7) and security standards (EURO NCAP) (SI) etc.
Bio-economy & sustainable agriculture	Food industry, agricultural and food technology (CZ); biomass (primarily timber and food) and oil shale (EE); sustainable wood & food production and processing (HR); full use of wood biomass for chemical processing and energy / development of innovative high value-added niche products from wood, traditional and unconventional agricultural plant and animal raw materials / technological solutions for the use of plant and animal breeding and processing by-products / food safety (LV); energy and fuel production using biomass (LT); agricultural innovation (HU), healthy food (high quality and performance of production) / innovative technologies, processes and products of the agri-food and forestry-wood (PL); integration of wood-chain in the design of homes and working environments of the future / sustainable biomass transformation and production of new bio-based materials, technologies for use of secondary and raw-materials and reuse of waste (SI) etc.
Eco-innovation & sustainable production	Mechatronic and clean technologies (BG); mechanical engineering: machines, engineering, manufacturing equipment (CZ); digital construction (LT); new-generation vehicles/ substitution of critical materials and functional covering (RO); production and processing of plastics; automotive and mechanical engineering industries, consumer electronics and electrical equipment (SK); Industry 4.0 - Smart Factories: integrated solutions enabling companies to build competent value-chains; optimisation and automation of production processes: smart machines and equipment, mechatronic systems, actuators and smart sensors, virtual technological production systems, remote monitoring and management, modularity of products and solutions, intelligent materials, etc. (SI)

*Notes: *BG = Bulgaria, CZ = Czech Republic, HR = Croatia, EE = Estonia, LV = Latvia, LT = Lithuania; HU = Hungary; PL = Poland; RO = Romania; SK = Slovakia; SI = Slovenia*

Source: Smart Specialization Platform – EyeRIS3.