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A prospective comparative analysis of the national Smart Specialization Strategies in Central Europe

Expert assessment of synergies and areas of potential cooperation related to Smart Specialization Strategies in Central Europe

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Extended Summary

The main objectives of this assignment are: a) to identify whether there will be sufficient common areas of potential cooperation in the area of R&D and innovation between the concerned Central European (CE) countries and regions; b) to provide recommendations for the set-up of governance models as a framework for a more efficient and enhanced cooperation platform, and c) to make recommendations for follow-up activities.

The report explains the methodology used for selecting common areas of collaboration, which resulted in seven areas in which there is a highly varied potential for intra-regional central European cooperation.

In **step 1**, we group priorities from CE S3 strategies into 18 relatively coherent technology priority areas (TPA clusters), see a table below.

Initial list of 18 common S3 technology priority areas of the CE countries/regions

1	*ENERGY & ENVIRONMENT*
2	ICT & ELECTRONICS
3	PUBLIC HEALTH & MEDICINE
4	AGRO-BIO-ECONOMY
5	TRANSPORT & MOBILITY
6	ELECTROTECHNICAL AND MECHANICAL INDUSTRIES
7	ADVANCED MANUFACTURING SYSTEMS
8	NEW MATERIALS
9	LIFE SCIENCES
10	SECURITY
11	TOURISM
12	BIOTECHNOLOGY
13	SMART CITIES AND COMMUNITIES
14	CONSULTANCY
15	NANOTECHNOLOGY
16	WOOD TECHNOLOGIES
17	CHEMICAL TECHNOLOGIES
18	PHOTONICS
19	OTHER

Through the process that we explain below the final list of priorities has been reduced to seven TPAs (see below).

A final list of 7 common S3 technology priority areas of the CE countries/regions

1	*ENERGY AND ENVIRONMENT*
2	PUBLIC HEALTH, MEDICINE AND LIFE SCIENCES
3	AGRO- AND BIO-ECONOMY
4	ADVANCED MATERIALS AND NANOTECHNOLOGY
5	TRANSPORT AND MOBILITY
6	ADVANCED MANUFACTURING SYSTEMS
7	ICT AND ELECTRONICS

In **step 2**, we group R&D and innovation capacities into TPA clusters from Step 1 based on the stage of innovation chain (upstream, midstream and downstream). This step forms the basis for identifying regional/national strengths in different areas of innovation value chain. For upstream part of innovation value chain, we use data on FP7 and H2020 on joint R&D projects in which Central European (CE) regions are partners grouped by TPAs. On midstream part of innovation value chain, we use data on star clusters grouped by TPAs. We also identify regional/national strengths by using data on KET patents from RegPat database. On the downstream part of innovation value chain, we use data on industry and business stakeholders. We also use data on trade in value added which gives an idea of the link between TPA of S3 and sectors in which CE regions are integrated through value chains. This verification step is quite important in the context of the CE, which is a region in the EU that is the most dependent on GVCs. In that context, it is quite important that the prioritisation of TPAs correspond to some extent to sectors that are potential users of new technologies and knowledge to be developed within the S3 related programs. This is one of the possible ways to ensure matching between upgrading through value chains with the countries/regions own technology efforts.

In **step 3** we identify overlaps among upstream, midstream and downstream areas that are linked up to TPAs. These should be the fields with the greatest potential for complementarities and inter-regional cooperation.

In the **final step**, we provide summaries of selected thematic areas and collect data on key stakeholders in the respective TPA (firms, R&D organisations, universities). The final selected areas with potential for inter-regional cooperation are 1) Energy and environment, 2) Public health, medicine and life sciences, 3) Agro- and bio-economy, 4) Advanced materials and nanotechnology, 5) Transport and mobility, 6) Advanced manufacturing systems, and 7) ICT and electronics.

Energy and environment

Priorities in energy and environment area are quite broadly defined and each country/region put emphasis on different aspects of the area: on energy, on environment industries or broadly defined transformation into a circular or sustainable economy.

The area of energy and environment is diverse and differs regarding its innovation, knowledge and market features. For this study, it is useful to distinguish between three areas: fossil fuels producers (oil, coal, gas), renewable producers (photovoltaic, the wind, biomass, hydropower), and environmental industries and services. Each of these areas operates in different modes of innovation, have somewhat different knowledge bases and market structures.

In traditional energy sectors (hydropower, coal and gas), there are developed RDI capacities in all CE regions but technological opportunities for cooperation are not obvious, or they seem to be difficult to realise due to divergent interests of established large players. Also, given that the S3 is about the

promotion of structural change and realisation of new technological opportunities the scope for intra-regional CE cooperation in this area does not seem to be great.

Based on the available data and evidence it is hard without further in-depth analysis to foresee opportunities for cooperation in environmental industries and services. This is quite a broad area with diverse technologies, which is quite poorly present in the S3 documents. We presume that there should be much greater opportunities for intra-regional CE cooperation than we have been able to detect based on the available evidence. As part of preparations for meeting in Zagreb it would be worth explore whether regions/countries consider environmental industries and services as a particularly promising area for intra-CE cooperation.

Eastern Central European economies are lagging behind in renewable energy sectors regarding both RDI and application. The evidence suggests that Bavaria is both the regional technology and market leader followed in segments by Saxony. There seem to be ample potential opportunities for cooperation in the area of renewable energy despite technology and market gaps between CE leader and follower regions. In fact, these opportunities may be substantial due to differences in RDI gaps between German, Austrian and Eastern CE countries. These opportunities may be particularly strong in the area of application of new knowledge. The current inter-regional cooperation in this area seems to be weak as there are only four H2020 projects where up to four CE countries participate.

In RDI area, the potential main organiser of the inter-regional cooperation could be Fraunhofer Gesellschaft institutes in the field of energy and environment. We are not in a position to pinpoint to a specific sub-area within the renewable energy are which would be the focus of the CE cooperation. This could be discussed at the meeting in Zagreb, which hopefully could clarify if there are overlapping interests in the area of renewable energy among CE countries/regions. The analysis of S3 documents points that this is indeed very strong priority area in many CE regions/countries, but the evidence is too flimsy to give us further detailed ideas of the specific common sub-areas. In report we list selected scientific research institutions and some private companies active in renewable energy and environmental services which could play an important role in defining the directions of possible topics of cooperation in the future.

Public health, medicine and life sciences

In public health, medicine and life sciences the opportunities for inter-regional cooperation differ sharply between pharma, biotechnology and medical devices. In all three areas, Bavaria is a very strong leader, and other regions have competencies specific niches of each of these areas. A much of cooperation in pharma is taking place within the European Innovative Medicines Initiative (IMI). Presumably, these could be niches for such cooperation within the Central Europe, but these would need to be 'discovered' within dedicated working parties for IMI. Also, the actors in this area are established pharma companies many of which are not in national ownership and thus opportunities for inter-regional cooperation may be difficult to shape. Therefore, we consider that the possibilities for intra-regional CE cooperation in pharma would be better realized within the existing EU initiatives. However, this would need to be verified by experts in this area.

The opportunities for CE focused inter-regional cooperation seem to be present in different areas of biotechnology. Two areas seem to be particular candidates: medical biotechnology in which many regions have developed competencies and industrial biotechnology, which is a new and dynamic area. The CE cooperation could give necessary push to various existing and emerging local initiatives in the Eastern CE regions. In medical biotechnology, the initiative could try to create synergies between different activities of universities and their spinoffs. Industrial biotechnology is quite a new area where public sector organisations and their spinoffs are much less present compared to medical biotechnology. However, given the potential of industrial biotechnology to integrate product improvements with pollution prevention, this seems to be an area where latecomers like East CE regions/countries could embark in international cooperation as a way to acquire knowledge in this emerging area.

Another area with potential for intra-regional cooperation could be medical devices. This area is already developed in segments in Hungary and niches in other CE regions while Bavaria is again the leader in

the area. Possibly, CE cooperation could enlarge and support the emerging initiatives in this area where Bavaria could play a role of the coordinator.

Agro- and bio-economy

The area of agro- and bio-economy has limited opportunities for inter-regional cooperation for several reasons which we list in the main text (modest R&D, priority in only four countries and of very different scope; etc). However, despite these limitations it seems that in the food area functional foods could be one promising route for the CE collaboration (see below)

Another quite specific East Central European specificity is specialisation in the wood sector and forestry in regions/countries where this sector plays important role (Poland, Czech R, Slovenia, and Croatia). This cooperation should focus on the issue of technology and industry upgrading as these countries share similarities regarding technological levels and competitiveness.

A last but not least promising route is initiating cooperation in different areas of bioeconomy/circular economy which calls for exploring new approaches that can affect couple sustainability with competitiveness. These are issues that all Eastern CE share and where there seems to be limited awareness of these issues. The form that this cooperation could take would be initially confined on joint workshops and exchange of good practices and would involve both applied RDI and policy issues.

Advanced materials (nanotechnology)

The potential for cooperation in the area of advanced materials (nanotechnology**)** is the highest between Germany and Poland. The thematic area of advanced materials (nanotechnology) is intertwined with other sectoral activities, and it is closely related to the automotive and aerospace sector. This actually means that the potential impact of cooperation will be greater than the potential gains to be achieved by the group of companies driving the development of these technologies. Our analysis confirms that there is a strong potential for cooperation in this area. Increasing awareness of the opportunities and potentials of these new technologies requires the involvement of the business sector, in addition to the key scientific research institutions. It is also important to note that the thematic expertise does not represent a source of competitiveness unless it is used creatively for developing new innovative products.

Based on the existing evidence, it is hard to pinpoint the exact sub-areas and topics of potential cooperation between the partner organisations from CE. This will require the organisation of a series of targeted matchmaking events with the involvement of relevant stakeholders interested in exploring opportunities to develop new industrial applications within this thematic area with a clearly defined focus.

Transport and mobility

The potential and scope of cooperation among the CE countries and regions which identified the transport and mobility among their RIS3 priorities are high. While Bavaria has not identified the transport and mobility as one of its RIS3 priority, the existing evidence confirms that it plays a leading position in this area. Therefore, exploring the opportunities of cooperation with Bavaria is recommendable and worth pursuing it in the nearest future. Enhancing technological and commercial exploitation requires the involvement of the business sector, in addition to the key scientific research institutions. The overall potential of cooperation among the stakeholders from CE is the strongest in the automotive sector. There is a significant concentration of companies in this sector; however, it is a highly globalised industry with strong competition. The focus of future cooperation will need to be determined following a bottom-up approach with the involvement of relevant stakeholders.

The opportunities for cooperation also lie in the two other core areas (i.e. aerospace and rail systems). Taking into account interdisciplinary character of these industries and recent developments (i.e. lightweight design, e-propulsion, use of latest electronics, and Industry 4.0) there is a clear link to other TPAs covered by the present report, namely Advanced materials and nanotechnology, Advanced manufacturing systems, ICT and electronics.

Advanced manufacturing systems

In advanced manufacturing systems, the review of policy priorities suggests a possible cooperation between Burgenland, the two German Länders, Czech Republic, Poland and Slovenia. Only Bavaria is characterized by a significant concentration of companies driving the development of these technologies. Although there are some networks established in the other CE countries and regions the overall level of concentration of economic activities in this area is low. On the other hand, there is a relatively high concentration of mechanical engineering industries in the CEECs. Overall, there is a strong potential for cooperation in the sub-area of factory and process automation (e.g. smart machines and equipment, actuators and smart sensors) because of the actual potential and the added value for mechanical and systems engineering, manufacturing industry and process manufacturing, automation technology, the ICT and electronics industry. Comparatively, the opportunity of cooperation in the area of cyber-physical systems remains largely limited.

ICT and electronics

Croatia, Slovenia and Styria do not list ICT and electronics as their RIS3 priorities. However, there are some similarities with the area of advanced manufacturing systems that shows overlaps. The performance measured by patenting activities in the area of micro-, nano-electronics and photonics are relatively low in Central Europe except for Bavaria, Saxony and to some extent in Styria in relation to micro- nanoelectronics. Another trend is the increase of patenting in the area of ICT in Hungary, Poland and Slovenia. Overall, Bavaria has a concentration of companies specialised in this area, whereas in the majority of cases the concentration can be assessed as moderate and in the case of Burgenland as relatively low.

Digital technologies find applications in different business areas and not only in manufacturing and processing industry. For example, the development of innovative solutions to control power consumption, generation and distribution (smart grids) offers a strong basis for cooperation in CE. Other fields of collaboration, which could become the focus areas of cooperation in the future include intelligent transport systems, in addition to ICT security solutions. Our analysis also found that the potential of cooperation in the field of micro and nanoelectronics is limited. The development of advanced software and seamless software architectures are headline topics of possible collaboration with the involvement of partner organisations from CE.

Analysis of trade value chains

The analysis across TPAs has been conducted based on upstream (R&D) and midstream (patents, clusters) and as much as possible across downstream areas i.e. focused on companies engaged in these areas. We have complemented this by the analysis of the integration of Central Europe through trade value chains, which also capture downstream parts of innovation value chain. The potential for inter-regional integration should be higher in sectors, which are strongly integrated into global value chains (GVC). Also, sectors that are important regarding employment and technology and rely heavily on GVCs should also be the ones that countries should prioritise as important for their RDI efforts.

As the basis for establishing links between SS priorities and user sectors, we have used the initial list of 18 common S3 technology priority areas of the CE countries/regions. This has made it easier to allocate specific TPAs to specific sectors. Out of 18 common TPAs, eleven areas could be matched to sectors ranked regarding their global integration (Table 59).

We identify eight GVC intensive sectors in CE: Textiles, textile products, leather and footwear; Chemicals and non-metallic mineral products; Basic metals and fabricated metal products; Machinery and equipment, nec; Electrical and optical equipment; Transport equipment; Manufacturing nec; recycling, and Electricity, gas and water supply. We match these sectors with TPA for which these sectors should be considered as users i.e. areas of application of technological knowledge. Individual sectors can be a locus of application of several TPAs. On that basis, we identify eleven TPAs as defined by the CE S3 strategies to be the most relevant for the GVC intensive sectors: New materials; Chemical technologies; Electro technical and mechanical industries; ICT & Electronics; Advanced manufacturing systems; Transport and mobility; Photonics, Nanotechnology; Smart cities and communities; Energy and Environment, and Biotechnology.

The Table 59 suggests that from the perspective of international GVC integration and opportunities for technology upgrading ICT electronics, Advanced manufacturing systems and Advanced material and nanotechnology represent the most important priorities for technology upgrading through GVC in CE. So, based on the criterion of 'sustainable GVC integration' these three TPA should be considered as having higher priority when deciding in the selection of common S3 priority areas for cooperation. We should bear in mind that this criterion might not be the only one to be used in the selection. However, given very high GVC integration of the CE and obvious need to make this integration sustainable would require intensive technology upgrading exactly in these sectors technology users in which CE is already highly integrated into the global economy.

Based on this criterion agro- and bio-economy, public health, medicine and life sciences and partly energy and environment would be less of a priority. However, we should bear in mind that based on other criteria like sustainable development, employment, climate change and other grand challenges these areas have obvious advantages.

Overview of potential priority sub-areas

Based on received comments on the draft version of this report we have further disaggregated seven TPAs into sub-areas which in overall has given us 19 potential priority sub-areas from which experts and proposed verification workshop should be able to choose several areas with greatest potential and viability or modify this list.

Overview of potential for CE cooperation within the (sub-) thematic priority areas

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
Energy and Environment	• Traditional (fossil) energy technologies incl. power engineering	• Not a priority	• Large established players. The capacity to 'kick start' cooperation is beyond the capacities of the CE S3 stakeholders.
	• Renewable energy (wind, PVC, biomass)	• Strong priority	• Strong and rising demand coupled with the need for diversification into new energy areas. Also, the opportunity to establish CE supply chains linked to technology upgrading.
	• Environmental services	• Moderate priority	• Strong and rising demand but very different levels of development among countries/regions represent an excellent opportunity for knowledge exchange. Working groups should explore whether it should be macro or specific innovation focused cooperation.
Public Health, Medicine and Life Science	• Biotechnology (medical and industrial)	• Very high priority	• Very promising technology area where CE needs to invest more. Developed R&D capacities in health and unrealized opportunities in medical biotech.

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
			Industrial biotechnology as new and emerging area which has not been given enough attention in national S3 strategies
	• Medical devices	• Moderate priority	• Uneven development across CE but opportunities for establishing a regional supply chain. The outcome is highly dependent on coordinating a large number of poorly coordinated players.
Agro-and Bio-Economy	• Functional food	• Strong priority	• A strong opportunity but also necessity given the economic importance of food industry in CE. It would enhance so far poor cooperation between industry and R&D sector in CE.
	• Wood/forest sector	• Moderate priority	• The Large potential in parts of CE coupled with high trade interdependence. Cooperation should focus on improvements in the supply chain management with the aim to promote a shift from 'forest sector' to 'forest-based bioeconomy'. The main obstacle: a variety of national players with limited international cooperation experiences
	• Circular economy/bio-economy	• Strong priority	• Potential regarding biomass and need to develop regional approach along the lines of EU Bioeconomy strategy. A large range of stakeholders that would be possible to organise provided that the cooperation be initially confined on dissemination of good practice and mutual learning.
Advanced Materials and Nanotechnology	• A wide range of specific technologies	• Strong priority	• Potential impact on industries beyond the sectors is driving the development of these technologies. Creative combination of technologies into new products.

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
Transport and Mobility	• Automotive	• Strong priority	• A significant concentration of companies in automotive sector but a highly globalised industry with strong competition. The focus of cooperation to be determined based on actual needs of relevant stakeholders.
	• Aerospace and Rail	• Moderate priority	
Advanced Manufacturing Systems	• Factory and process automation	• Strong priority	• Potential and added value for manufacturing and process manufacturing.
	• Industry 4.0 related solutions (cyber-physical systems)	• Not a priority	• Strong competition and still at early stage of development.
	• Data analytics, complex simulation, and modelling	• Moderate priority	• Availability of competencies in software systems engineering, communication.
ICT & Electronics	• Intelligent transport systems • Smart grids and energy networks • New safety and security solutions	• Strong priority	• Considered a priority and relevant activities are undertaken in this field. • The demand for programming and modelling methods, platforms and software and available competencies in these areas. • Activities undertaken by platforms at the national level. Area of activity important for optimisation of manufacturing and processing industry. • Strong global competition in the semiconductor industry.
	• Photonics sensing technologies	• Moderate priority	
	• Micro and Nanoelectronics	• Not a priority	

In the area of *Renewable energy* (wind, PVC, biomass) the gap RDI and technology gap between German regions and Eastern CE is large and is compounded by different sizes and levels of investments in renewable in Germany and the rest of Central Europe. Still, there are pockets of excellence in technology applications in Central Europe either in individual firms or public research organisations. Given the leading role of Germany in this area, it would seem desirable that one of Fraunhofer institutes in this areas coordinates this cooperation, which should be pitched at intermediate level i.e. between R&D and implementation. This cooperation could explore the applicability of new technological solutions in selected areas of renewables with the aim that in the next stage consortium attracts more private companies.

Environmental services are developed to very different degrees in Central Europe, and this unevenness represents an excellent opportunity for knowledge exchange and dissemination of the best practice. This cooperation could focus on either macro issues like how to optimise the management of complex major urban services or treatment of the most difficult forms of pollution or exploring specific technology solutions in reducing pollution or environmental sustainability. In the case of macro orientation, cooperation would involve largely public bodies and public research organisations. In the case of specific innovation projects, it should involve interested firms in the consortium led by PRO.

Medical and industrial biotechnology are two different areas but which also share common knowledge base. Industrial biotechnology is about the development, manufacture and selling of products and services that use or contain biological material as catalysts or feedstock to make industrial products while medical biotechnology is about discovering or developing new therapeutics that action in or on the body by pharmacological, immunological or metabolic means. In CE, Germany leads the way but also there are pockets of RD excellence in the rest of CE. The importance of these areas for the CE cooperation may not be justified only by the existing strengths but more by technological opportunities that it offers. Industrial biotechnology is a new promising area which may become the largest sector in comparison to agricultural and medical biotechnologies or sectors. It is comparatively less developed in Eastern Central Europe than medical biotechnology. Given the nature of this area, any cooperation would need to involve stakeholders from both public and private sector. The focus could be identified only after analyses of the competencies of interested stakeholders.

Medical devices represent quite a heterogeneous area with applications of the very different technological level. The overall picture is of Bavaria as the leader, clustering of medical devices producers in Hungary and niche producers in other CE economies. Given this technological diversity and the fact that health R&D is relatively developed in eastern CE it would be worthwhile exploring how cooperation within the CE could assist internationalisation and technical cooperation of different companies. The main stakeholders in this effort should be national associations of medical devices producers and individual companies interested in further internationalisation. The aim is to facilitate the development of supply chain in the CE akin to supply chains in sectors like automotive.

Food industry is one of the current strengths of Central Europe as witnessed by the healthy competition of domestic and foreign companies on these markets. The number of clusters in the food sector in Central Europe is relatively high but equally links with the R&D organisations are not at desired level. However, given the economic importance of this sector and a variety of players in the sector as well as rising demand for healthy food there is scope for CE collaboration, which would be around building g knowledge basis in specific niches of food technologies. The example of this niche is a functional food. There is now a growing realisation of the market potential for functional foods, based on the principle of added value linked to health benefit[1]. So, cooperation in this area would be not only desirable but given shift from traditional to functional food should also be seen as one of the necessities in technology upgrading of the CE food industry. As stated in the Consensus document of the EU experts in this area: 'The food industry has unique opportunities to develop products that are not only nutritional in the traditional sense, but which have additional activity that can lead to an improved state of health and well-being and/or reduction in risk of disease (functional foods)'. The aim of the cooperation would be to enhance the knowledge exchange in functional food science from which should be expected further specific projects and developments. Also, given the diversity of stakeholders in this are the cooperation should be coordinated by the public research organisation with the experiences of in the area of functional product development.

Wood (Forest) sector in Central Europe has high potential especially given the potential in Eastern CE and the fact that Germany and Austria are the largest roundwood importers after China. Also, European forest-based sector is in a period of profound structural change as markets for existing import of the

[1] See *British Journal of Nutrition* (1999), 81, Sl-S27, Scientific Concepts of Functional Foods in Europe

Consensus Document. Available at http://www.ufrgs.br/alimentus/disciplinas/tecnologia-de-alimentos-especiais/alimentos-funcionais/funcionais_consenso_europeu.pdf

wood products is in decline and new forest products that did not exist in the 20th century are emerging[2]. Therefore, given this high interdependence within CE, it would seem promising to explore opportunities for technology upgrading in this sector which would be in the interest of both importers and exporters. This cooperation may explore possibilities for improvements in the supply chain management, for the efficiency of forest management and improvements in the cascading use of wood. The overall aim of cooperation would be improving resource efficiency in the use of this important resource and to promote a shift from 'forest sector' to 'forest-based bioeconomy'.[3]

Circular economy/bio-economy is one of the priority areas either as part of the S3 or as part of growth strategies of several CE countries. CE countries have potential regarding biomass availability and bio-economy also represents an opportunity for economic growth and job creation. At the same time, to enhance this potential, effective regional cooperation is needed, able to address various stakeholders such as researchers, economic operators, policy makers and citizens, i.e. the final beneficiaries of bio-based products. This cooperation would effectively develop regional approach along the lines of the EU Bioeconomy Strategy and action plan which focuses on three key aspects:

- developing new technologies and processes for the bioeconomy;
- developing markets and competitiveness in bioeconomy sectors; and
- pushing policymakers and stakeholders to work more closely together.

This cooperation should involve a large range of stakeholders and would be in initial stages confined on dissemination of good practice and mutual learning. Given the nature of this, it should be coordinated by public organisations.

The key message emerging from the analysis of the area of *Advanced materials and nanotechnology* is that there is a strong potential for cooperation in CE. The report puts a spotlight on positive spillovers beyond the industries driving the development of these technologies and the need to creatively combining current competencies into new competitive products.

In the area of *Transport and mobility*, it is found that the potential of cooperation among the stakeholders from CE is the strongest in the automotive sector. There is a significant concentration of companies; however, it is a highly globalised industry with strong competition. The focus of future cooperation will need to be determined following a bottom-up approach with the involvement of relevant stakeholders.

Within the area of *Advanced manufacturing systems*, there is a strong potential for cooperation in factory and process automation (e.g. smart machines and equipment, actuators and smart sensors) because of the potential that exist in this field among the partner organisations from CE and the added value for mechanical and systems engineering, manufacturing industry and process manufacturing, automation technology, the ICT and electronics industry.

Solutions for remote monitoring of autonomous production systems are being developed for various applications including manufacturing. As a result of Industry 4.0, in the future machines, systems, and sensors worldwide will communicate with each other and share information. This will not only enable companies to make production significantly more efficient; it will give them greater flexibility when it comes to tailoring production to meet market requirements. Bavaria traditionally has a high level of competence in the development of complex system solutions and has extensive research knowledge in embedded systems. The overall potential of cooperation in the sub-area of cyber-physical systems remains largely limited.

Taking into account competencies in software systems engineering, communication, data and information management, applied computer science, and software engineering in CE, there is still a

[2] Schwarzbauer, P et al (2015) The Future of the Forest-based Sector in Central Europe – Structural Changes Towards Bioeconomy, Presented at the

[3] Lauri Hetemaki (ed) *Future of the European Forestry based sector: Structural Changes towards bio-economy* http://www.efi.int/files/attachments/publications/efi_wsctu_6_2014.pdf

potential for cooperation concerning programming and modelling methods, and software for industrial applications.

Digital technologies (ICT & Electronics) find applications in different business areas and not only in manufacturing and processing industry. For example, the development of innovative solutions to control power consumption, generation and distribution (smart grids) offers a solid foundation for cooperation in CE. Other fields of cooperation, which could become the focus areas of collaboration in the future, include intelligent transport systems, in addition to new safety and security solutions.

Our analysis also found that the potential of cooperation in the field of micro and nanoelectronics is limited. As far as photonics sensing technologies are concerned, they can be used in various application areas, including for example the optimisation and automatization of production processes.

Governance aspects and implementation

Another question to consider is governance issues or how to organise the process of inter-regional cooperation in common S3 TPAs. We offer several avenues on how this can be pursued. First, by strengthening the participation and involvement of S3 Central Europe stakeholders from the respective thematic areas within the already existing structures at the EU level. Second, to establish and launch new S3 Central Europe Cooperation Networks in areas with a clearly defined thematic focus. These can be some of the seven proposed common TPAs or better specific sub-areas within these still broadly defined areas. Third, to support strategic partnerships within the individual CEECs with the aim to enhance the involvement of regional/national partnerships into the existing EU networks or organisational structures of the new S3 Central Europe networks. One of our key messages is that connecting the thematic networks from the different levels of governance (EU, national and regional) is the key.

We have outlined the possible governance of S3 cooperation networks drawn by a typical organisational structure used by other thematic networks and initiatives. We outline the most advanced form of collaboration with the full commitment of financial and human resources and give brief descriptions of responsibilities for each function. Accordingly, any other lighter version of cooperation network should be appropriately 'descaled'.

We briefly outline four funding models, which can be applied to S3 Central European networks and point to differences in their complexities. The first funding model is based on the EU investment instruments, such as the European Structural and Investment (ESI) Funds, COSME, Horizon2020 and the European Fund for Strategic Investments (EFSI). Second, projects could be financed by respective national authorities by the national laws, rules, regulations & procedures in effect. Third, projects can be funded via 15% of ERDF, CF and EMFF priority axis, which may be spent in EU outside programme area (Article 70(2) CPR). Finally, projects can be funded by co-investment for joint-demonstration opportunities (combination of different sources of funding).

As further follow-up actions, we suggest that the meeting where this report will be discussed should result in forming several working parties to be led by led organisations - one from each of the regions/countries for one of each of seven or more TPAs or sub-areas. The lead organisations should receive assistance from DG Regio in defining to greater details the scope of the networking project, its aims and focus as well as appropriate governance model with the suggestions on potential modes of funding. We also propose a few critical guidelines how to prepare the workshop as a way to kick-start the process.

Introduction

This report was prepared by Prof. Slavo Radosevic from the University College London, School of Slavonic and East European Studies and Jacek Walendowski from Technopolis Group Belgium, in the framework of the Directorate-General Regional and Urban Policy request for the provision of external expertise related to the expert assessment of synergies and areas of potential cooperation related to Smart Specialisation Strategies in Member States located in Central Europe, i.e. the Czech Republic, the Slovak Republic, Hungary, Poland, Slovenia, Croatia, Burgenland, Styria, Bavaria, and Saxony (Contracts No. 2016CE160AT024 and 2016CE160AT005).

The main objectives of this assignment can be summarised as follows:

- To identify whether there will be sufficient common areas of potential cooperation in the field of R&D and innovation between the concerned Central European countries and regions on the basis of a desk research of the existing RIS3 strategies, in addition to the databases and mapping tools, such as the Eye@RIS3 database of smart specialisation priorities and Cluster Mapping tool.
- To provide indications and recommendations for the set-up of governance models as a framework for a more efficient and enhanced cooperation platform.
- To give recommendations whether a more in-depth analysis or other specific actions for cooperation (e.g. pilot actions, workshops, common research projects, etc.) may be justified and if yes, provide some guiding principle for such follow-up activities.

This report is organised as follows:

- **Chapter 1** Methodology for selecting common areas of cooperation in CE
- **Chapter 2** Energy and environment
- **Chapter 3** Public health, medicine and life sciences
- **Chapter 4** Agro- and bio-economy
- **Chapter 5** Advanced materials and nanotechnology
- **Chapter 6** Transport and mobility
- **Chapter 7** Advanced manufacturing systems
- **Chapter 8** ICT and electronics
- **Chapter 9** Correspondence between S3 and Global value chains involvement
- **Chapter 10** Implementation and governance models
- **Chapter 11:** Conclusions
- **Annexes**

Following the extended summary, we briefly explain the methodology for selecting the common areas of cooperation. Each of seven selected areas is divided into three sub-areas, which cover specific parts of innovation value chain: upstream (R&D), midstream (clusters, patents, industry) and downstream areas (industry, trade in value added). Chapters 2-8 summarise the main features of policy priorities in CE regions/countries that have declared the respective areas as their priority and they list major players in the CE in the respective areas. Chapter 9 explores the correspondence between S3 technology priority areas and their links to sectors based on their orientation towards global value chains. Chapter 10 proposes governance model for inter-regional cooperation and briefly outline possible further activities. Chapter 11 presents the main findings of analysis.

1 Methodology for selecting areas of cooperation in Central Europe

The primary task of this research was to identify common areas of potential collaboration in the area of R&D and innovation (RDI) between the concerned Central European countries and regions. Therefore, the aim was to get a list of relatively coherent cluster areas which can represent the basis for inter-regional cooperation. The initial foundation for the list of technology priority areas (TPA) is given by the EYE@RIS3 database. We have approached this issue through the following analytical steps.

Step 1: We grouped priorities from CE S3 strategies into initial **relatively coherent technology priority areas (TPA clusters) based on revealed similarity of areas (see Annex 12).**

The challenge is that the regional/national priorities were established using different methodological approaches, i.e. they have different focuses regarding upstream/midstream/downstream parts of innovation chain. Some are focused more upstream (RD focused) while others are more downstream oriented (areas of application) or even product focused. Also, priorities differ regarding scope. For example, some TPAs are very broadly defined while others are very detailed.

Given these differences, it is not possible to come up with straightforward and consistent criteria for grouping S3 thematic priority areas into homogenous groups. Instead, we had to opt for more pedestrian and iterative approach to produce the final list of common priorities.

The EYE@RIS3 database is used as the initial starting point for finding common areas of cooperation. The list of TPAs was crosschecked with the priority areas as described in regional/national S3 documents. In the majority of cases, there was 100% correspondence between S3 document and EYE@RIS3 database except in two cases (Saxony and Czech R). In both cases, for consistency reasons we have opted for priorities from EUE@RIS3 database.

The table below is for Saxony and priorities are taken from S3 document and RIS3 database. We have difficulties to explain these differences which may be due to different timings between database entry and S3 document. For consistency reasons, we have opted for priorities as defined in RIS3 database.

Based on S3 document	***Based on EYE@RIS3 database***
Environment and Resources	Advanced production technologies
Energy	Biotechnology
Raw materials (new materials)	Nanotechnology New materials Photonics
Mobility	Microelectronics including organic and polymer electronics (semiconductors)
Health and nutrition	n.a.
Digital communication	ICT & digital communication

Czech R is a specific case as its S3 document *de facto* does not contain priorities regarding S3 areas as the whole approach is very much horizontally focused. Priorities in RIS3 database come from this one para in S3 document.

'Overall, based on the above combination of available empirical data on the one hand (data on export intensity, intensity of R&D expenditure, trends in turnover in time), and based on the on-going process of entrepreneurial discovery that was launched in 2013 at the regional level on the other hand, it is possible to identify the areas of the economic specialisation in which the Czech Republic shows above-

average growth potential. *These include the manufacture of transport means, mechanical engineering, electronics and electrical engineering, IT services and software, electricity production and distribution, drugs and medical products'.*

On that basis, RIS3 database lists the following priority areas:

- Transport means (automotive, aerospace, including connected ecosystem of supplying and supporting industries).
- Engineering industries and electrotechnics.
- ICT, automatisation and electronics.
- Healthcare and medical technology and devices.

In this first step, the list of 18 TPAs (see Annex 12) has been generated and represent the starting and the longest list of common TPAs. This list of TPAs (see Table 1) has been reduced into seven TPAs based on the additional analysis and the steps 2-4. There is not the special reason why we could not stop at 18 priority areas except that the bigger number of priority areas would not resolve any of the major weaknesses of selection, i.e., different focus (upstream/midstream/downstream) and scope (level of disaggregation within the same focus area). So, given that the bigger number of common TPAs would not by itself be an advantage we were aiming for the number of TPAs which would be manageable when it comes to implementation of further joint activities. Also, a bigger number of TPAs would further complicate the assessment of RDI capacities which are envisaged in the next step of our analysis. First, a bigger number of areas would require detailed information on the available RDI capacities and strengths in specific CE countries/regions which are not always available. Second, given blurring boundaries among some of the TPAs and vagueness of many of the SS strategies the longer list of priorities would raise its problems regarding overlaps among TPAs.

Table 1 Initial list of 18 common S3 technology priority areas of the CE countries/regions

1	*ENERGY & ENVIRONMENT*
2	ICT & ELECTRONICS
3	PUBLIC HEALTH & MEDICINE
4	AGRO-BIO-ECONOMY
5	TRANSPORT & MOBILITY
6	ELECTROTECHNICAL AND MECHANICAL INDUSTRIES
7	ADVANCED MANUFACTURING SYSTEMS
8	NEW MATERIALS
9	LIFE SCIENCES
10	SECURITY
11	TOURISM
12	BIOTECHNOLOGY
13	SMART CITIES AND COMMUNITIES
14	CONSULTANCY
15	NANOTECHNOLOGY

16	WOOD TECHNOLOGIES
17	CHEMICAL TECHNOLOGIES
18	PHOTONICS
19	OTHER

So, the final list of priorities has eliminated only four of the 18 (+1) TPAs, and it has merged those areas where boundaries based on S3 evidence are blurred. Two areas (energy & environment, and ICT & Electronics) have been unchanged regarding scope. Eight TPAs have been merged: public health and medicine has been merged with life sciences, new materials and photonics have been merged into advanced materials and nanotechnology, electro technical and mechanical industries have been merged into advanced manufacturing systems, biotechnology has been merged into agro and bio-economy, smart cities and communities have been merged into transport and mobility, and chemical technologies and wood technologies have been merged into agro and bio-economy. The only of 18 sectors that have been dropped out are security, tourism, consultancy and other (see Annex 12). The final list in Table 2 was confirmed only after further checks and logical steps 2-4.

Table 2 A final list of 7 common S3 technology priority areas of the CE countries/regions

1	*ENERGY AND ENVIRONMENT*
2	PUBLIC HEALTH, MEDICINE AND LIFE SCIENCES
3	AGRO- AND BIO-ECONOMY
4	ADVANCED MATERIALS AND NANOTECHNOLOGY
5	TRANSPORT AND MOBILITY
6	ADVANCED MANUFACTURING SYSTEMS
7	ICT AND ELECTRONICS

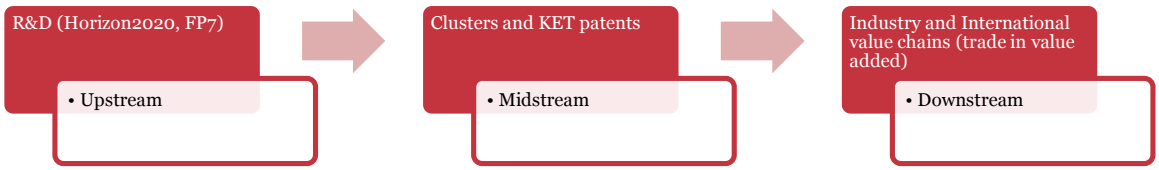
Step 2: **Group data on R&D and innovation capacities into TPA clusters from Step 1 based on stage of innovation chain (upstream, midstream and downstream).**

The next step in the analysis is getting a picture of areas of strength of individual regions/countries based on the variety of available indicators which ideally should cover all stages of innovation value chain. This is even more important as S3 is not only about detecting common areas for R&D cooperation as these can be identified through H2020 data or only about areas for commercial cooperation through trade. So, given data availability, we opted for detecting capacities for cooperation by dividing them into upstream, midstream and downstream areas or dimensions.

For the *upstream* part of innovation value chain, we use data on FP7 and H2020 on joint R&D projects in which Central European (CE) regions are partners grouped by TPAs. For *midstream* part of innovation value chain, we use data on star clusters grouped by TPAs. We also identify regional/national strengths by using data on KET patents from RegPat database. For the d*ownstream* part of innovation value chain, we use documentary evidence on industry and main stakeholders in the respective TPAs as well as data on trade in value added. This latter analysis enabled us to establish the link between TPAs of S3 and sectors in which CE regions/countries are integrated into global value chains and presumably into regional value chains. Unfortunately, data on trade in value added are not available among individual CE countries but only with the world. For example, we still do not have data on trade in value added between let's say Czech R and Hungary but only for the trade of each of these economies with the world. Still, we think that this data source represents valuable check of strengths of linkages of the CE countries with the world in their respective sectors which are potential users of RDI in joint TPAs.

A figure below summarises this conceptual and statistical approach.

Figure 1 Identifying regional/national strengths in different areas of innovation value chain



The analysis of three parts of innovation value chain enables assessment of strengths and RDI capacities in each of three activities (upstream, midstream, downstream). It allows us to assess whether in the respective TPAs CE countries/regions have strengths in R&D or upstream areas, whether their applied technology activities as detected through clusters and KET patents are of equal strengths and whether they are engaged in global value chains in sectors which are potential users of TPAs generated knowledge. In summary, the available data enables us to assess the involvement of the CE countries/regions in respective TPAs in H2020 and FP7, in clusters and patenting and in potential areas of application or use of TPA knowledge.

The underlying idea is that those TPA where we can identify areas of overlapping strengths in all three parts of innovation value chain should be considered as priority areas for inter-regional cooperation. For example, regions and countries may have strengths only in some parts of the innovation value chain i,e upstream but not downstream or vice versa or midstream but not downstream). As reader will see shortly the picture that emerges is that the developed CE regions (Bavaria, Saxony) usually have strengths in all three parts of the innovation value chain while less developed CE regions usually have developed only segments of the innovation value chain, be it only upstream, only downstream or only midstream parts but rarely all three segments. Still, strengths in one of the segments represent the important 'entry point' for inter-regional cooperation, especially if there are strengths in corresponding parts of the innovation value chain. For example, eastern regions of CE often have strengths in manufacturing capacities which can be linked up to R&D capacities in other regions.

As a final step in this verification process, we have matched S3 priorities with sectors based on their degree of dependence on global value chains, which are considered as the main users of new technologies, and knowledge, which should be created within the S3 TPAs. This additional step has been conducted due to high involvement of Central Europe global value chains as demonstrated by high shares of foreign value added in their gross exports. The rationale is the following: countries/regions that rely heavily on technology transfer from abroad should match their technology efforts through S3 TPAs with those sectors in which they are the most intensively engaged in global production networks. The TPAs, which are potential knowledge suppliers for GVC dependent sectors, should be considered as priority areas based on this important criterion. However, this cannot be the only criterion but in the context of the CE, it is also a criterion, which cannot be bypassed.

The first analytical basis for step this has been correspondence tables between S3TPAs, clusters, patents, FP7/H2030 R&D areas and sectors with CE value chains[4]. These tables contain indicators on each of three areas (upstream, midstream and downstream) of TPAs.

[4] These tables are long excel sheets which are available upon request

Step 3: **Based on steps 1-2 agree on the list of TPAs which have the greatest potential for inter-regional linkages.**

In this stage, we derived reduced list of seven priorities. This final list has emerged either by eliminating some of the initial 18 TPAs (Annex 12) or by merging them into broader categories as presented in Tables 1 and 2 above.

Step 4: **Based on the list of agreed TPAs with the greatest potential for inter-regional cooperation write up summaries of selected thematic areas and collect data on key stakeholders in the respective TPA (firms, R&D organisations, universities).**

The real process of work on the study could not evolve in this linear fashion but much more iterative manner. Namely, the available indicators are not sufficient to get a reliable picture of strengths and RDI capacities of individual countries/regions. Also, information from S3 documents on specific TPAs is often very poor or non-existent. Hence, we had to rely on other sources of information to get a somewhat more reliable picture of the individual TPAs. However, this picture is still with many gaps as it is based only on publicly available information. It is important to complement it further by experts insights which we hope can be involved in the stage of discussion on this study and in the implementation of the proposed cooperation activities.

2 Energy and environment

2.1 Policy priorities

2.1.1 Brief overview of the priority area

Table 3 Overview of Central European countries and regions with energy and environment as RIS3 priority

Countries	No. of regions	Regions	Descriptions
Austria	national	National level	Energy & Environment
Austria	1	Steiermark	Eco-Tech
Austria	1	Burgenland	Renewable energy, smart grids, new building materials, energy efficiency in buildings and transport)
Germany	1	Bavaria	Clean-tech
Poland	national	National level	Smart and energy efficient construction
Poland	national	National level	High efficiency, low-emission and integrated circuits manufacturing, storage, transmission and distribution of energy
Poland	national	National level	Innovative technologies and processing water recovery and reducing its consumption
Poland	national	National level	Minimising waste, including unfit for processing and use of materials and energy waste (recycling and other recovery methods)
Poland	national	National level	Sensors (including biosensors) and smart sensor networks
Poland	national	National level	Biotechnological processes and products speciality chemicals and environmental engineering
Croatia	national	National level	Energy and sustainable environment
Hungary	national	National level	Clean and renewable energies
Hungary	national	National level	Sustainable environment
Slovenia	national	National level	Smart Cities and Communities
Slovenia	national	National level	Smart buildings and homes
Slovenia	national	National level	Smart use of resources

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

2.1.2 Thematic focus and the main EU networks

2.1.2.1 Focus areas and technologies

In **Bavaria,** Cleantech is a very important priority as evidenced by the Bavarian State Government decision to expand the share of renewables to 50% of electricity production by 2020. Specifically, State's S3 is focusing on technologies for renewable energy supply (inter alia photovoltaic, wind, geothermal, biogas / biogenic raw materials), efficient use of energy (including energy efficiency in buildings, industrial process engineering, electric mobility), storage technology (among other things electrical, electrochemical and chemical storage) as well as new technologies for power grids (for example, Smart grids, super grids). These are accompanied by numerous initiatives and funding instruments in this area[5].

Saxony. Energy and environment are also priority in Saxony S3 document though it is not presented in S3 database (see Table 3). For the promotion of this priority Saxony has established CLEANTECH East Germany initiative[6]. For example, in 2011 the share of environmental engineering industry in the Saxony gross domestic product was 6% with 20,000 people employed.

Austria: The number of enterprises producing environmental technologies was estimated to 390 companies (2011). The turnover amounted to € 8.2 billion of which € 6 billion were due to exports. Environmental technology suppliers employ around 28,600 persons. A sector is stable and growing[7]. Within that context, one of **Steiermark's** S3 priority is eco-tech while **Burgenland** focuses on sustainable energy (topics such as renewable energy, new materials, energy efficiency in buildings).

In the area of energy, **Poland** has prioritised sustainable energy and natural resources and waste management. Within energy area, focus is on storage, transmission and distribution of energy, smart and energy efficient construction and within resources on modern technology sourcing, processing and use of natural resources and the production of substitutes, on minimizing waste, including unfit for processing and use of materials and energy waste (recycling and other recovery methods), and on innovative technologies and processing water recovery and reducing its consumption. Restructuring of supply of primary energy in Poland is of utmost importance as hard coal and lignite, cover 56% of the demand with 88% of electricity coming from coal[8]. The share of renewables in electricity supply reached 10% in 2013[9].

In the energy area, **Slovenia** is focusing on Smart housing units and Smart environment using intelligent building management systems. The implementation of smart grids is currently in a phase of pilot projects or demonstration projects[10].

Hungary's first S3 priority in this area is green energy – renewables and bioenergy, nuclear energy, and energy efficiency. More specifically, these are: bioenergy, biomass, solar energy, water energy, wind energy, geothermal energy, utilisation of thermal water, clean coal technology, energy-efficient and self-sustaining systems, energy distribution systems, energy storage, nuclear energy (innovative fuels, decommissioning technologies), water treatment technologies (sewage treatment), waste management and utilisation, and environmental biotechnology. Government renewable energy supply target for 2020 is 13% from 8% achieved in 2010[11]. **Hungary's** second priority in this area is a sustainable environment which is focused on natural resource management, and advanced environmental technologies.

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[5] See for example page 32 of Background analysis of strategy, part II

[6] http://www.cleantech-ost.de/

[7] https://www.wko.at/Content.Node/Interessenvertretung/Umwelt-und-Energie/Studie_Oesterreichischische-Umwelttechnikindustrie_WIFO-2013.pdf

[8] PAIZ (2015) Energy Sector in Poland, Warsaw

[9] Honorata Nyga-Łukaszewska, Selected Issues in Innovation in the Energy Industry. The Case of Poland, International Journal of Management and Economics, No. 50, April–June 2016, pp. 100–112.

[10] Agencija za Energijo (2015) Report on the Eenergy Sector in Slovenia 2014, Ljubljana

[11] HITA (2014) Energy Sector and Renewable Energy, Hungarian Investent and Trade Agency

Croatia has chosen four sub-priorities within the energy and environment area: energy technologies and equipment; environment technologies and equipment; green construction and, smart grid and energy systems.

Czech R does not list energy as its priority area in RIS3 database. However, its S3 strategy document points out that country ranks among top world exporters of electricity, and it has significantly strengthened this position in the last decade. S3 document also lists Sustainable and safe production and distribution of electricity as one of the major application sectors and themes at the national level including 10 of its 14 regions. Analysis points to the following sub-areas as priorities: Production and conversion of energy, devices for energy generation and distribution; Transmission and management of production and transmission of electricity, smart energy networks; Performance electronics, heavy-current electrical engineering; Nuclear power engineering; Mining and use of coal; Renewable energy sources, use of waste for energy recovery; Energy materials; Low-carbon technologies and energy savings, and Energy optimisation of activities for transport and transport security. Also, National innovation platforms were convened for the area of Engineering, electricity production and distribution, electrical engineering.

Slovakia also does not list energy and environment as its priority in RIS3 database. Its S3 document reports three basic groups of the thematic priorities: Research and Development Priorities, Technological priorities, and Social priorities. One of its technological priorities is Sustainable Energy which focuses on the effective usable energy sources (reduction of the energy intensity, emission reduction program ALEGRO, smart grid technology, the safety of nuclear power plants, etc.).

2.1.2.2 Cooperation with the EU-level networks

There are quite some EU-level networks in the area of energy and environment to which any potential CE joint initiative could draw upon or link-up:

- European Technology Platform for the Electricity Networks of the Future (smart grids) is European Forum for Policy and R & D in the area of smart grids. www.smartgrids.eu
- The European Technology and Innovation Platform on Wind Energy (ETIPWind) connect Europe's wind energy community. Key stakeholders in the platform involve the wind energy industry, political stakeholders and research institutions. https://etipwind.eu
- European Biofuels Technology Platform (Biofuels) aims to contribute to the development of competitive, world-class value chains for biofuels, to create a healthy biofuels industry and to the acceleration of the sustainable supply of biofuels in the EU. http://biofuelstp.eu/
- European Photovoltaic Technology Platform - The platform has the task to develop a strategy and the corresponding conversion plan for education, research and development, innovation and market introduction of photovoltaics. www.eupvplatform.org
- European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP) - a coalition of stakeholders who see the CO2 capture and storage (CCS) as a key technology for combating climate change. ZEP is a consultant to the European Commission regarding the necessary research, demonstration and deployment of CCS. www.zeroemissionsplatform.eu
- European Technology Platform on Renewable Heating and Cooling (RHC) - The platform brings together operators in the fields of biomass, geothermal and solar. The aim is to define a common strategy to increase the use of renewable energy technologies for heating and cooling. www.rhc-platform.org
- Hydrogen Europe (formerly known as NEW-IG) is the leading European industry association representing almost 100 companies in the fuel cells and hydrogen industry http://hydrogeneurope.eu/

- The European Innovation Partnership on Water - EIP Water in short - is an initiative within the EU 2020 Innovation Union. The EIP Water facilitates the development of innovative solutions to address major European and global water challenges. http://www.eip-water.eu/
- ACQUEAU is one of the 7 clusters of the EUREKA network with 100 companies across Europe and beyond whose goal is to promote transnational collaboration for developing innovative projects in water technologies. www.acqueau.eu
- Water Supply and Sanitation Technology Platform (WssTP) concerns the coordination and cooperation of research and development in the water industry. www.wsstp.eu

In addition to EU-level networks, there are macro-regional and inter-country initiatives of relevance to this initiative (based on S3 documents).

Danube regional strategy (DRS) has one of its objectives the "Promotion of the use of sustainable energy", which is also a priority of all CE economies (except Czech R). The DRS countries have begun the development of a common energy sustainability strategy and formed a joint working group for that purpose.

Slovenia is engaged in the initiative to establish a leading regional institution in the field of renewable materials and healthy living environment, including the Fraunhofer-Institut für Holzforschung Wilhelm- Klaudit-Institut.

Hungary and Slovenia have exchanged information in the areas of energy sources for sustainable development and industrial technologies. Hungary has with Austria RDI cooperation in energy efficient solutions and the establishment of energy storage sites, primarily to increase energy production.

2.2 Upstream dimension of the innovation value chains (Research and technology capabilities)

2.2.1 Analysis of FP7, H2020 projects

Table 4 Participation in FP7 projects in the area of energy and environment

Countries/Regions	***Number of participants***
Bavaria	136
Poland	123
Czech Republic	68
Saxony	33
Slovenia	54
Hungary	70
Slovak Republic	27
Styria	22
Burgerland	2
Croatia	28

Annex 1 contains a full list of projects and beneficiaries of H2020 projects in the area of energy and environment. There are five projects in which four or more Central European organisations are partners.

Bavaria and Poland are extensively involved in the EU R&D networks with 136 and 123 participations respectively. On the other hand, Austrian regions (Styria and Burgenland) seem to be relatively under-represented. Slovakia and Croatia have the smallest number of participations among central European countries. Slovakian S3 document notes that the least funding from OP R&D has been received in the area of sustainable energy and energy (€ 75.29 million).

A broadly similar ordering of intensity of R&D activity in this area is present regarding received funding from FP7 programme (Table 5).

Table 5 Funding of FP7 projects in the area of energy and environment

Countries/Regions	***Energy and environment***
Bavaria	55195755
Poland	18878210
Saxony	14272404
Czech Republic	8441090
Slovenia	8569566
Hungary	13694955
Styria	6830784
Burgerland	210150
Slovak Republic	3272502
Croatia	3911823

The strength of Bavaria in the area of energy R&D is recognised through project coordination with 9 out of 12 coordinations among which Fraunhofer institutes have five coordinations.

Table 6 Coordinators of FP7 projects in the area of energy and environment

Organisations	***Regions/Countries***	***Number of projects coordinated***
HELMHOLTZ-ZENTRUM FUER UMWELTFORSCHUNG GMBH - UFZ	Saxony	2
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	5
LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Bavaria	2
UNIVERZA V LJUBLJANI	Slovenia	1
WIRTSCHAFT UND INFRASTRUKTUR GMBH & CO PLANUNGS KG	Bavaria	1
UNIVERSITAET BAYREUTH	Bavaria	1

Source: Own based on the E-CORDA database.

Bavaria is extensively involved in R&D in energy and environment with its seven universities, ten universities of applied sciences, eight Helmholtz Institutes, two institutes of the Fraunhofer-Gesellschaft and the Competence Center for Renewable Resources, the ATZ Development Center (since 1 July 2012 Part of the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT), the Environment Institute, the Center for Applied Energy Research ZAE Bayern and the Environment Institute Neumarkt in Environmental Research.

Energy research in **Saxony** is conducted at the Technical Universities in Chemnitz, Dresden and Freiberg, and at the technical colleges in Mittweida, Zittau / Görlitz and Zwickau. Also, nine institutes of Fraunhofer-Gesellschaft have energy-technologic facilities. Also, three institutes of the Leibniz Association, the Helmholtz-Zentrum Dresden-Rossendorf, and the Kurt-Schwabe Institute for Measuring and Sensor Technology work in the R&D on energy technologies. Saxony also has developed R & D infrastructure in the area of bioenergy. In addition to German Biomass Research Centre, there are numerous University Research Institutes and innovative companies[12].

Slovenia is the only central European country whose R&D organisation (University Ljubljana) is the project coordinator in the energy area.

Croatia has a few public research institutions with established position in this field: Faculty of Electrical Engineering and Computing, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Faculty of Electrical Engineering Mechanical Engineering and Naval Architecture, University of Split and Energy Institute Hrvoje Požar from Zagreb. In environmental R&D, Rudjer Boskovic Institute (RBI) is by far the largest organisation in Croatia covering the greatest diversity of the major research disciplines (environmental chemistry, biology, informatics, modelling, oceanography, geology, physics and radiology). Only marine and environmental science include over 150 researchers. In overall, there are more than 400 researchers in Croatia working in the field of environmental research and protection, comprising the development of environment-friendly technologies and equipment.

Slovakia has experience with construction, operation and decommissioning of nuclear power plants and related research and training capacities. There are 350 researchers in the field. Its S3 document highlights research in nuclear energy with a focus on safety, storage of spent fuel; research of Generation IV reactors and problems of the nuclear fusion. It underlines the need for Slovakia to participate in global projects, and in the development of new systems of energy transfer (power cables free of stray electric and magnetic fields).

[12] Background analysis of Strategy, Part III

2.3 Midstream dimension of the innovation value chains (patents, clusters)

2.3.1 Geographic distribution of patents

Four major areas of patenting in energy and environment are climate change and energy, environmental management, greenhouse gases and water adaptation. R&D in water adaptation and greenhouse gases is by far the most developed in Bavaria which is the absolute leader in all areas of energy R&D followed by Saxony, Steiermark and Poland.

Table 7 Patent applications in energy and environment (selected environmental technologies) during the period 2011-2012

	Climate Change & Energy		***Environmental management***		***Greenhouse gasses***		***Water Adaptation***		***Total***	
Country/Time	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Bavaria	279	174	184.9	160	5.9	6.7	12.4	12.9	482.2	353.6
Saxony	45.0	34.4	15.0	15.8	0.1	0.9	2.8	0.8	62.9	51.9
Czech Republic	7.7	7.2	6.5	25.0	0.0	0.0	0.0	0.0	14.2	32.2
Steiermark	18.0	8.8	11.6	15.0	0.5	0.0	2.0	0.0	32.1	23.8
Poland	14.2	11.0	8.2	6.4	1.0	1.3	0.0	1.0	23.4	19.7
Hungary	6.0	8.0	8.0	4.2	0.0	0.0	1.0	0.0	15.0	12.2
Slovenia	3.0	2.3	8.5	7.0	0.0	0.0	1.0	0.0	12.5	9.3
Slovak Republic	1.5	3.0	3.0	4.0	0.0	0.0	0.0	0.0	4.5	7.0
Burgenland	2.5	2.0	1.0	1.8	0.0	1.1	0.0	0.0	3.5	4.9

Source: OECD REGPAT Database.

There are interesting differences between research and technology (patents) rankings regarding the position of Styria which has more patents in this area than Poland while its FP7 budget is much below Polish. This probably reflects the different orientation of their R&D systems and the role of private sector.

2.3.2 The clusters in energy and environment area

The major areas in which there are clusters in energy and environment in Central Europe are electric power generation and transmission, environmental industries, environmental services, oil and gas production and transportation and coal mining. The biggest number of clusters is in environmental services (10). However, it is surprising that the classification of the EU Cluster Observatory does not account for dedicated clusters in renewables although they do exist in CE. For example, Poland has five major clusters in the energy area of which two are in renewables (Lublin Eco-Energy Cluster, Mazovian Energy Alliance, Małopolskie and Podkarpackie Clean Energy Cluster, Podkarpackie Renewable Energy Cluster and Dolnośląskie Renewable Energy Cluster (Lower Silesian Renewable Energy Cluster[13]). The number of 3-star clusters is restricted to Bavaria (1), Saxony (1) and Czech R which has 4 clusters ranked

[13] PAED (2014) Cluster Benchmarking in Poland – Edition 2014 General Report, Mnistry of Economy, Warsaw

at 3-star level which are all in traditional energy areas (electric power generation and transmission and oil and gas production and transportation).

Table 8 Central European clusters in the area of energy and environment

Electric Power Generation and Transmission

Region/Country	Number of clusters	Ranking of clusters
Hungary	2	2
Czech R	4+1	(3)(2)
Poland	1	2

Environmental Industries

Region/Country	Number of clusters	Ranking of clusters
Bavaria	1	3
Saxony	1	3
Steiermark	1	2
Hungary	2	2
Czech R	1	2
Poland	1	2
Slovakia	1+1	(2)(3)

Environmental Services

Region/Country	Number of clusters	Ranking of clusters
Czech R	2+2	(2)(3)
Hungary	1+1	2
Poland	2+2	2
Croatia	1+1	2

Oil and Gas Production and Transportation

Czech R	1	3
Hungary	2	2
Poland	3	2
Croatia	1	2

Coal Mining

Czech R	2	2
Poland	2	2

Source: EU Cluster Observatory.

2.4 Downstream dimension of the innovation value chains (Industry)

2.4.1 Major economic operators in the area of energy and environment

Table 9 List of economic agents in the area of energy and environment

Clusters/Firms	***Countries/Regions***
Large global operators (Siemens, GE, Bosch, Schott Solar, Wacker, Süd-Chemie / Clariant) with dynamic renewables sector	Bavaria
Developed photovoltaic, wind and biomass sectors	Saxony
Large electricity producers	Poland
Developed environmental technology industry	Austria
Developed competencies in energy conservation construction	Slovenia
Developed competencies in design, production and maintenance of equipment for efficient heating/cooling in buildings and industrial facilities	Croatia

Bavaria has quite developed the business sector in the area of energy and environment. For example, in 2008 there were 683 companies with 55,000 employees and a turnover of € 11.6 billion[14]. Some of these companies include big players like Siemens, GE, Bosch, Schott Solar, Wacker, Süd-Chemie / Clariant. An example of the top company in renewables is Aschoff Solar which offers complete solar system solutions for industrial customers on the international market. In 2012, Aschoff Solar GmbH received the export award in the service category by the Bavarian Minister of Economic Affairs[15].

Saxony has developed photovoltaics industry with 5,300 workers and the revenue of € 2.5 billion. The value of electricity supplied by the photovoltaics has increased significantly from 111 million kWh (2008) to 646 million kWh (2011). The expansion was not only in the production of photovoltaic systems but also in the equipment of photovoltaic factories and special services. A particular strength of Saxon photovoltaic industry is that it covers the entire value chain of the base materials (silicon) wafers, cells to module manufacturing. This includes planning company, a manufacturer of panels, key components of thermal power plants (eg., Memory, heat exchangers, control equipment) and the installation of complete plants. However, it is the wind energy that forms by far the most significant current source of renewable energies in Saxony. The Wind generated in 1335.7 GWh electricity in 2010 and 1653.3 GWh in 2011 and employed 1.602 people in 2011.

Saxony is also strong in biomass which covers all sectors of energy use of biomass from solid biomass to vegetable oil, biogas, and bio-fuels. In total, there are about 100 companies that operate in the bioenergy sector. These companies are predominantly small and medium sized businesses in the plant engineering, and in biomass production. EC Cluster Observatory lists one cluster in energy and environment in Saxony. However, background analysis for S3 strategy shows that there are also four networks in this area. An example of the top company in this area is EnviTec Biogas AG, founded in 2002 and headquartered in Lohne, Lower Saxony, which is one of the leading companies in the segment

[14] Background analysis for Strategy, Teil III

[15] Energy supply with renewables – Made in Germany. Information on technologies, suppliers, products and services 2016 edition, http://www.renewables-made-in-germany.com/

of turnkey biogas plant construction which has already installed worldwide over 370 MW and 600 modules, including agricultural biogas plants and waste-to-energy plants[16].

The **Austrian** environmental technology industry is highly research and innovation-intensive with 66% of the enterprises indicated that their innovation was a novelty on an international scale[17].

Polish electricity supply is highly concentrated with the three biggest producers having more than half of installed capacities and produced nearly 2/3 of Poland's electricity. At present, the largest companies in the energy sector include Grupa Kapitałowa (GK) PGE, GK Tauron, GK Enea, EDF, ZE PAK and GK Energa. In Poland, the leading position among renewables is held by wind energy. The current share of wind energy in all sources of electricity of renewable origin is 57.6%. The Polish energy sector will require significant investments due to emission requirements and ageing plants. Almost 40% of power blocks are over 40 years old, and 15% of them are over 50 years old and qualify for immediate retirement. Power plant owners cannot afford to finance such extensive investments from own equity, so it will be necessary to find financing from external sources. Foreign direct investments in 201 were USD 678.8 million mainly by French, German and Swedish companies[18].

Slovenian enterprises in the field of building construction have mastered a wide range of technologies and knowledge covering almost all of the fundamental aspects of modern and sustainable construction regarding tradition and cultural heritage. Slovenian companies, backed by the experience of research and educational institutions, manage to construct buildings and implement competitive projects which combine various areas of modern engineering such as energy autonomy of buildings, multifunctional building envelope, smart systems in buildings, advanced building materials and computer-integrated life cycle of buildings, which is complemented by activities in the field of smart built environment.

In **Croatia,** there are active companies in design, production and maintenance of equipment for efficient heating/cooling in buildings and industrial facilities. KONČAR - Electrical Engineering Institute Inc. is a leading private research organisation for industrial research and experimental development in the area of energy and transport. KONČAR - Electrical Industry Inc. is the regional producer of Smart Grid and Smart Metering solutions, intensively working on Digital transformer stations and producing research results on an international level regarding emerging communication protocols and standards. Croatian industry has capacities to operate and develop certain solutions in PVC area, for example, the wind turbine of 1 MW and 2,5 MW. However, Croatian companies largely aim at upgrading of existing technologies soon to be outdated, i.e. improvement of existing technologies for conversion, generators and related equipment, transformers, solutions for control and energy storage and micro networks. In Wind technologies – mentioned KONČAR group with numerous sub-contractors - offers solutions in developing and producing almost every component of wind energy plants (except wind blades) and a wind turbine as a whole. The development of the wind turbine system was accompanied by intensive cooperation with Faculty of Electrical Engineering and Computing and Faculty of Mechanical Engineering and Naval Architecture at the University of Zagreb in last 15 years.

The manufacturing sector in the field of biomass energy mainly consists of recently formed small and medium companies, together with Lesaffre - a major European producer of yeast biomass. Croatian producers of complete projects in the area of renewable energy sources, such as Đuro Đaković d.o.o. (one of the largest industrial groups in Croatia and the region) have the capacity for production integrated bio-production facilities which together with KONČAR generators and control systems, can establish unique manufacturing and create the potential for a large number of RDI investments.

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[17] https://www.wko.at/Content.Node/Interessenvertretung/Umwelt-und-Energie/Studie_Oesterreichischische-Umwelttechnikindustrie_WIFO-2013.pdf

[18] PAIZ (2015) Energy Sector in Poland, Warsaw

Croatian Center of Renewable energy sources (CCRES) formed in 1988, is an association of companies with the main intention to excel in applied research and development by focusing on the optimal use of the nation's energy resources. Cluster "Inteligentna Energija", a business network gathers 32 export-oriented SMEs investing in RDI (11 patents) in the framework of this TPA. The cluster is focused on energy technologies in areas of energy efficiency, energy management, HVAC and energy systems, smart grids, hydro-energy (small hydropower plants), solar energy (PV and thermal systems) and biomass. Some of leading SMEs, investing in RDI in this field are Printegris, Veski, Helb, EnergoControl Zagreb, Solvis and RITEH. Some of EU projects, in which cluster participates are: Building European energy community Mediterranean Energy Clusters, Transferring European VET Structures to cover skill needs in Energy Efficiency Sector, Transferring European VET Structures to cover biomass skill requirements. The company Brodarski Institut d.o.o. is one of the relevant and competent companies in the area and performs activities in the area of smart grids, hydro energy and biomass.

Table 10 Concentration of economic activities in the area of energy and environment

Regions/Country	***Indication about the concentration of economic activities***	***Overall assessment***
Czech R	Highly developed electricity production Technology user in renewables Developed segments of RDI in energy and environment (patents)	Insufficiently developed renewables sector
Austria	Developed environmental technologies industry	Developed renewable sector
Bavaria	Highly developed renewables sector	Leader in renewable technologies
Saxony	Highly developed renewables sector	Leader in renewable technologies
Poland	Highly concentrated in the electricity market. Fragmented in renewables. Technology user in renewables	Insufficiently developed renewables sector; Traditional energy sector in need of technological modernisation
Slovenia	Developed competencies in energy saving construction Technology user in renewables	Insufficiently developed renewables sector
Croatia	Developed competencies in segments of energy engineering. Technology user in renewables	Insufficiently developed renewables sector

Source: Own assessment based on the European Cluster Observatory, Eurostat (sbs_r_nuts06_r2) and documentary review.

2.5 Summary assessment

Differences in levels of energy and environment RDI between Germany/Austrian and new member states from Central Europe are reflected in broader indicators like Eco-Innovation Scoreboard. The Eco-Innovation Scoreboard (Eco-IS) illustrates eco-innovation performance across the EU Member States. The scoreboard aims at capturing the different aspects of eco-innovation by applying 16 indicators grouped into five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes. The Eco-IS thereby shows how well individual Member States perform in different dimensions of eco-innovation compared to the EU average and presents their strengths and weaknesses[19]. If we take the EU average as 100 on this composite indicator than Germany (129) and Austria (108) are above the EU average, Czech R,(99), and Slovenia, (96) are close to EU average while other CE countries are well below average (Hungary 81, Slovakia 72, Croatia 67 and Poland 59). These differences in eco-innovation are fairly well reflected in developments in RDI in energy and environment TPAs in different CE countries/regions, especially regarding renewable energy.

[19] http://ec.europa.eu/environment/ecoap/scoreboard_en

Priorities in energy and environment area are quite broadly defined and each country/region put emphasis on different aspects of the area: on energy, on environment industries or broadly defined transformation into a circular or sustainable economy. These differences in scope or focus make it difficult in this stage to confidently pinpoint to one area which has the potential for realisation of synergies or mutual complementarities. However, given these caveats, we suggest that the renewable energy area may be the one where opportunities for intra-regional CE cooperation should be explored.

The area of energy and environment is diverse and differs regarding its innovation, knowledge and market features. For this study, it is useful to distinguish between three areas: fossil fuels producers (oil, coal, gas), renewable producers (photovoltaics, the wind, biomass, hydropower), and environmental industries and services. Each of these areas operates in different modes of innovation, have somewhat different knowledge bases and market structures.

In traditional energy sectors (hydropower, coal and gas) there are developed RDI capacities in all CE regions but technological opportunities for cooperation are not obvious, or they seem to be difficult to realise due to divergent interests of established large players. Also, given that the S3 is about the promotion of structural change and realisation of new technological opportunities the scope for intra-regional CE cooperation in this area does not seem to be great.

Based on the available data and evidence it is hard without further in-depth analysis to foresee opportunities for cooperation in environmental industries and services. This is quite a broad area with diverse technologies which is quite poorly present in the S3 documents. We presume that there should be much greater opportunities for intra-regional CE cooperation than we have been able to detect based on the available evidence. As part of preparations for meeting in Zagreb, it would be worth explore whether regions/countries consider environmental industries and services as a particularly promising area for intra-CE cooperation.

Eastern Central European economies are lagging behind in renewable energy sectors both regarding RDI and application. The evidence suggests that Bavaria is both the regional technology and market leader followed in segments by Saxony. There seem to be ample potential opportunities for cooperation in the area of renewable energy despite technology and market gaps between CE leader and follower regions. In fact, these opportunities may be substantial due to differences in RDI gaps between German, Austrian and Eastern CE countries. These opportunities may be particularly strong in the area of application of new knowledge. The current inter-regional cooperation in this area seems to be weak as there are only four H2020 projects where up to 4 CE countries participate.

In RDI area the potential main organiser of the inter-regional cooperation could be Fraunhofer Gesellschaft institutes in the field of energy and environment. For a list of national/regional stakeholders in this area see above sections 3.4.1 and 3.2.1. We are not in a position to pinpoint to a specific sub-area within the renewable energy are which would be the focus of the CE cooperation. This could be discussed at the meeting in Zagreb which hopefully could clarify if there are overlapping interests in the area of renewable energy among CE countries/regions. The analysis of S3 documents points that this is indeed very strong priority area in many CE regions/countries, but the evidence is too flimsy to give us further detailed ideas of the specific common sub-areas. The selected scientific research institutions and some private companies active in renewable energy and environmental services in this thematic area are listed below. They could play a major role in defining the directions of possible topics of cooperation in the future.

Germany (Bavaria and Saxony)

- Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT
- Technical University Munich
- Ludwig-Maximilians-University Munich
- Fraunhofer Institute for Wind Energy and Energy System Technology
- The Fraunhofer Institute for Solar Energy Systems
- Max Planck Society

- University Bayreuth
- Technical Universities in Chemnitz, Dresden and Freiberg,
- The technical colleges in Mittweida, Zittau / Görlitz and Zwickau
- The Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- The Kurt-Schwabe Institute for Measuring and Sensor Technology
- Siemens
- A large number of SMEs working in renewable energy and environmental services areas (for example, EnviTec Biogas AG, WIP-Renewable Energies)

Austria (Steiermark and Burgenland)

- Joanneum Research Forschungsgesellschaft
- Graz University
- Biomass - Kraftwerk Guessing gmbh und co. Kg
- Bios Bioenergiesysteme GmbH

Poland

- Warsaw University
- Lodz Polytehnics
- Polish Academy of Sciences
- Lublin Eco-Energy Cluster
- Mazovian Energy Alliance
- Małopolskie and Podkarpackie Clean Energy Cluster
- Podkarpackie Renewable Energy Cluster
- Dolnośląskie Renewable Energy Cluster (Lower Silesian Renewable Energy Cluster

Czech R

- Charles University Prague
- Faculty of Environmental Technology, Universitry of Chmeistry and Technology, Prague
- Czech Technical University in Praguequatest AS *(environmental services)*
- Kybertec s.r.o. *Renewable energy (wind)*

Hungary

- Alcufer (environmental services)
- GEONARDO Environmental Technologies Ltd
- SEMILAB (Photovoltaics)

Slovakia

- Slovak Innovation and Energy Agency (SIEA)
- Environmental Institute, s.r.o. (EI), Kos (*environmental services*)

Slovenia

- University Ljubljana
- Institut Jozef Stefan

Croatia

- University of Zagreb, Faculty of Electrical Engineering and Computing and Faculty of Mechanical Engineering and Naval Architecture
- KONČAR - Electrical Engineering Institute Inc.
- KONČAR - Electrical Industry Inc.
- Brodarski Institut d.o.o
- Đuro Đaković d.o.o. (renewable energy)
- Croatian Center of Renewable energy sources (CCRES)
- Cluster “Inteligentna Energija”,
- Prointegris, Veski, Helb, EnergoControl Zagreb, Solvis and RITEH (*SMEs investing in RDI in renewable energy and efficiency*)

3 Public health, medicine and life sciences

3.1 Policy priorities

According to report developed under the project "Effective use of European Structural and Investment (ESI) Funds for health investments" [20] investments in health are funded almost exclusively by national sources and ESIF represent 'only a minor source of health investment supporting mostly only individual projects' in the areas of R&D (biomedicine, pharmaceuticals, technology innovation) and other areas like occupational health, elderly care, active and healthy ageing, health workplace and improving employability. RDI activities support the development of new and the improvement of existing solutions and treatments for medical conditions. The main areas of focus are biotechnology and nanomedicine[21].

3.1.1 Brief overview of the priority area

Table 11 Overview of Central European countries and regions with public health, medicine and life sciences identified as RIS3 priority

Countries	No. of regions	Regions	Descriptions
Germany	1	Bavaria	Life sciences (esp. biotechnology and systems biology)
Germany	*1*	*Saxony*	*Biotechnology*
Czech Republic	national	National level	Healthcare and medical technology and devices.
Poland	national	National level	Medical diagnosis and treatment of lifestyle diseases and personalised medicine
Poland	national	National level	Medical engineering technologies, including biotechnologies
Poland	national	National level	Production of medicinal products
Croatia	national	National level	Health and quality of life
Hungary	national	National level	Healthy society and wellbeing
Slovenia	national	National level	Health/Medicine - relates to two sets, medical and quality of life. They include new substances and technologies in biomedicine combined with smart healthcare, high-quality food and clean environment.
Austria	1	Steiermark	Health Tech
Austria	national	National level	Life sciences
Austria	1	Burgenland	Life Science: Pharmaceutical and Medizintechnik

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

The focus of CE countries/regions in this area is diverse and ranges from medicine and medicinal products (Poland and Czech R) to broadly defined health and well-being (Hungary, Croatia) and to focus on life sciences (Austria and Bavaria) and biotechnology (Saxony). Slovakia does not list this area as a priority though its list of technological priorities in S3 document refers to this area (see below).

[20] http://www.esifforhealth.eu/pdf/Mapping_Report_Final.pdf

[21] ibid

3.1.2 Thematic focus and the main EU networks

3.1.2.1 Focus areas and technologies

Based on RIS3 Database **Saxony** is the only Central European region with biotechnology as a priority though this does not seem to be a priority in the original document. Data show (see below) that medically oriented or red biotechnology is the most developed in Saxony[22].

Bavaria also has biotechnology as its priority but as part of life sciences.

Austria has chosen life sciences as one of S3 priorities with Steiermark and Burgenland also prioritising segments of it.

Within the broad area of healthy society, **Poland** is focused on Medical engineering technologies, including biotechnologies, medical diagnosis and treatment of lifestyle diseases and personalised medicine, and on Production of medicinal products.

A focus of **Slovenia** in this area is on Biopharmaceuticals; Translational Medicine: Diagnostics and Therapeutics; Cancer treatment – diagnosis and therapy; Resistant bacteria, and on Natural medicines and cosmetics.

Hungary's priority Healthy society and wellbeing are focused on understanding diseases, early diagnosis, advanced medical and instrumental therapies, clinical methods, pharmaceutical research and development, innovative health industry and health tourism solutions.

Sub-priorities within this area in **Croatia** are (1) pharmaceuticals and medical equipment and devices; (2) health services and methods for preventive and personalised medicine and diagnostics, and (3) nutrition. In pharma area, the focus is on strengthening Croatia's position as a hub for health product manufacturing, through integrating existing enterprise and research strengths to drive development and manufacture of next generation of drugs and OTC products, medical equipment and devices. In health services, the focus is on E-solutions for health and remote delivery of healthcare and assisted living, moving the emphasis of care to the patient in their home. In nutrition, the focus is on building capacity to develop and produce high nutrition health foods or ingredients in relation to maintenance, growth, reproduction, health and disease of an organism.

Czech R S3 document considers Drugs and medical products and methods for healthy ageing as one of the major application sectors and themes at the national level as well as 8 of its 14 regions. Within this area S3 list as sub-priorities Medical equipment and aids, Implants and medical replacements, biologically active materials, Diagnostic Devices, Drugs, pharmacochemistry and Health services and care (spa and balneology, clinical studies, biostatistics, etc.). National innovation platform has been convened for Pharmaceuticals and medical technology area.

RIS3 database entry for **Slovakia** does not list health, medicine and life sciences in its S3 priorities. However, its S3 document reports three basic groups of the thematic priorities: Research and Development Priorities, Technological priorities, and Social priorities. One of the technological priorities is Biomedicine and Biotechnology. The focus is on new diagnostic and therapeutic approaches for cancer, heart disease, blood vessels and brain, endocrine and metabolic disorders, infectious diseases and allergies. In the field of biotechnology, there is a focus on pharmacological and industrial biotechnologies.

[22] Blue BT is about the marine and aquatic applications of biotechnology, but its use is relatively rare. Green biotechnology is biotechnology applied to agricultural processes. Red biotechnology is applied to medical processes. The Industrial Biotechnology ("white biotechnology") is one of the key technologies of the 21st century and as an "innovation engine" of chemical industry. It uses the tools of modern biotechnology for the development of new biotechnological production processes and products Source: https://en.wikipedia.org/wiki/Biotechnology

3.1.2.2 Cooperation with the EU-level networks

Some of the major EU networks in this area are:

- **The Innovative Medicines Initiative (IMI)** is Europe's largest public-private initiative aiming to speed up the development of better and safer medicines for patients. IMI was launched in 2008 and currently has over 50 projects, with more in the pipeline. Some focus on specific health issues such as neurological conditions (Alzheimer's disease, schizophrenia, depression, chronic pain, and autism), diabetes, lung disease, oncology, inflammation & infection, tuberculosis, and obesity. Others focus on broader challenges in drug development like drug and vaccine safety, knowledge management, the sustainability of chemical drug production, the use of stem cells for drug discovery, drug behaviour in the body, the creation of a European platform to discover novel medicines, and antimicrobial resistance. In addition to research projects, IMI supports education and training projects. IMI facilitate collaboration between the key players involved in healthcare research, including universities, the pharmaceutical and other industries, small and medium-sized enterprises (SMEs), patient organisations, and medicines regulators. It is the world's biggest public-private partnership (PPP) in the life sciences. Through the IMI 2 programme, it has a €3.3 billion budget for the period 2014-2024. https://www.imi.europa.eu
- **EFPIA (European Federation of Pharmaceutical Industries and Associations**) brings together 33 European national pharmaceutical industry associations as well as 41 leading companies undertaking research, development and the manufacture in Europe of medicinal products for human use. EFPIA is tightly involved in the IMI activities. http://www.efpia.eu/
- **EUFEPS European Federation for Pharmaceutical Sciences** represent the interests of scientists in industry, academia, government and other institutions engaged in drug research, development, regulation and policymaking through Europe. Founded in 1991, its aim is to serve and advance excellence in the pharmaceutical sciences and innovative drug research. Currently, EUFEPS links 18 Member Societies in 18 countries. In addition, there are Individual Members of EUFEPS. http://www.eufeps.org/
- **ESTRO The European Society for Therapeutic Radiology and Oncology** is a non-profit and scientific organisation that fosters the role of Radiation Oncology in order to improve patients' care in the multimodality treatment of cancer. It has over 6500 members in and outside Europe; ESTRO supports all the Radiation Oncology professionals in their daily practice: Radiation Oncologists, Medical Physicists, Radiobiologists and RTTs (Radiation Therapists) and the wider oncology community. ESTRO's mission is to promote innovation, research, and dissemination of science through its congresses, ad hoc meetings, educational courses and publications. http://www.estro.org/
- **International Probiotics Association** (IPA) is an international organisation with members equally divided between industry and academia, and its goal is to provide a forum for the exchange of research and the latest breakthroughs in probiotic technology and new product development. IPA holds NGO status before Codex Alimentarius and is the global voice of probiotics as the majority of the world's industrial producers are members. It works with government bodies and industry to assist in establishing scientific standards for probiotic supplements, probiotic pharmaceutical products and functional foods. http://internationalprobiotics.org/

Slovenian S3 document point that some Slovenian partners have already established links and developed joint projects in this area in the framework of territorial cooperation with Croatia, Austria (Styria, Carinthia and Vienna) and Italy (Friuli).

3.2 Upstream dimension of the innovation value chains (Research and technology capabilities)

3.2.1 Analysis of FP7, H2020 projects

Table 12 Participation in FP7 projects in the area of public health, medicine and life sciences

Countries/Regions	***Number of participants***
Bavaria	214
Poland	84
Hungary	70
Czech Republic	49
Saxony	31
Slovenia	34
Styria	12
Slovak Republic	13
Croatia	9
Burgerland	0

Based on FP7 data Bavaria is the CE leader with the large margin with its 214 participants in FP7 projects. Also, given their sizes, Slovenia and Hungary have quite developed R&D sectors in this area. Burgerland is the only region/country which has not received the EU funding in this area although Graz University has coordinated two FP7 projects. The lead of Bavaria is even bigger regarding received FP 7 funding as it has received 131Mn euros when compared to the next biggest spender Poland and Saxony which received 16mnEur each.

Table 13 Funding of FP7 projects in the area of public health, medicine and life sciences

Countries/Regions	***EC contribution***
Bavaria	131022156.6
Poland	16334728.82
Saxony	16704996.16
Czech Republic	10478891.53
Slovenia	5079841.94
Hungary	13043028.04
Styria	6397748.4
Burgerland	0
Slovak Republic	2650980.55
Croatia	1185610

The strength of Bavarian R&D in medicine and health is confirmed through 24 project coordinations in FP7 which by far outweighs all other regions/countries.

Table 14 Coordinators of FP7 projects in the area of public health, medicine and life sciences

Organizations	Regions/Countries	Number of projects coordinated
MEDIZINISCHE UNIVERSITAT GRAZ	Burgenland	2
UNIVERZITA KARLOVA V PRAZE	Czech R	1
HELMHOLTZ ZENTRUM MUENCHEN DEUTSCHES FORSCHUNGSZENTRUM FUER GESUNDHEIT UND UMWELT GMBH	Bavaria	3
VERUM- STIFTUNG FUER VERHALTEN UND UMWELT	Bavaria	1
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	5
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	Bavaria	2
TECHNISCHE UNIVERSITAET DRESDEN	Saxony	3
JULIUS-MAXIMILIANS UNIVERSITAET WUERZBURG	Bavaria	1
KLINIKUM DER UNIVERSITAET REGENSBURG	Bavaria	2
UNIVERSITAET LEIPZIG	Saxony	2
LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Bavaria	2
KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN	Bavaria	1
TILL I.D. GMBH	Bavaria	1
DEUTSCHES HERZZENTRUM MUNCHEN	Bavaria	1
KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN	Bavaria	1
KLINIKUM DER UNIVERSITAT MUNCHEN	Bavaria	1
GENOID MOLEKULARBIOLOGIAI KUTATO, GYARTO ES EGESZSEGUGYI SZOLGALATO KFT	Hungary	1
BIOTALENTUM TUDASFEJLESZTO KFT	Hungary	1
UNIVERSYTET MEDYCZNY W LODZI.	Poland	1
WARSZAWSKI UNIWERSYTET MEDYCZNY	Poland	1
INSTITUT JOZEF STEFAN	Slovenia	1

Source: Own based on the E-CORDA database.

In H2020 there are six projects and two networks in which there are 4 or more CE countries participating. Annex 2 provides List of projects and beneficiaries of H2020 projects in the area of public health, medicine and life sciences.

Bavaria's R&D in life sciences is located in universities of Munich (Ludwig-Maximilians University (LMU), Technische Universität München (TUM)) with their hospitals, as well as the biosciences University Institute in Regensburg, Würzburg, Erlangen- Nuremberg and Bayreuth. Life sciences R&D is also carried in the research institutes of the Max Planck Society (Max Planck Institute of Biochemistry and Neurobiology, both in Martinsried near Munich, Max Planck Institute of Psychiatry in Munich), the Helmholtz Zentrum München for Environment and Health, the Rudolf Virchow Center in Würzburg (DFG Research Center for Experimental Biomedicine), Regensburger Center for Interventional Immunology (RCI) as well as the working groups and institutes of the Fraunhofer-Gesellschaft (as in Würzburg, Regensburg and Straubing).

Saxony is host to two of the four German excellence institutions in the field of regenerative medicine /therapy located which are located in Dresden (Centre for Regenerative Therapies) and Leipzig (Translational Centre for Regenerative Medicine). In Saxony, more than 1500 scientists work in biotechnology in more than 200 research groups at universities, institutes and facilities of the Fraunhofer and Max Planck Society and other publicly funded agencies. Also, based on background analysis 85% of all "core biotech companies" in Saxony are at least nationally networked.

Styria is focused on health tech and applied research and technology development. Its main R&D organisation is Joanneum Research which is applied R&D organisation.

Poland. R&D health and medicine in Poland is undertaken as elsewhere at clinics and universities. Also, there is Biocentrum Ochota a consortium of six academic institutions of the Polish Academy of Sciences. The consortium conducts among others research within the following fields: molecular biology of molecular chaperones, biosensors and microsystems for multiparameter biochemical analysis, mitochondrial protein biogenesis, etc.

Croatia has several strong public research institutions in this area: research groups at the Faculty of Medicine and Veterinary Faculty, University of Zagreb, Croatian Institute for Brain Research, RBI, Mediterranean Institute for Life Sciences in Split, Institute for Medical Research and Occupational Health and Veterinary Institute in Zagreb, Medial Schools at universities of Rijeka, Split and Osijek. Together with the private sector, all of these institutions account for more than 1000 researchers involved in R&D. Outputs of three out of four Croatian ERC grants have application in this area.

RBI is Croatia's leading life science institution, and it is, among other topics, strong in physics and medicine. To further develop the medical diagnostics field, RBI established a PET/CT Centre for preclinical research, the only one of its kind in the South East Europe.

In **Slovakia,** almost 2 000 researchers work in the area of biotechnology and biomedicine, and they publish more than a fourth of all Slovak publications in international scientific journals. In this area, three centres operate Biotechnology Centre of the Slovak Republic (BITCET, Laboratory of Nuclear Magnetic Resonance (NMR) and the Laboratory of Electromagnetic Compatibility (EMC).

Czech pharmaceutical research is concentrated at the Research Centre of Structure and Mechanisms of Action of Potential Drugs, which includes laboratories at the Pharmaceutical Faculty of Charles University in Hradec Králové and two enterprises: Zentiva and Generi Biotech[23]. However, there seems to be significant stagnation in sectoral dynamics after 2008[24].

Technical University Prague has established a new faculty of Biomedical Engineering that concentrates fully on research and teaching in the field of biomedical and clinical technology. The Faculty closely

[23] Jiří Vaněček,, PHARMACEUTICALS AND BIOTECHNOLOGY IN THE CZECH REPUBLIC, Technology Centre of the Academy of Sciences CR, mimeo

[24] ibid

cooperates with medical faculties of Charles University Prague through joint laboratories in medical engineering. Czech R also has competencies in nanomedicine, in particular in nanofibres which are used in tissue engineering, burn treatments and various surgical operations. These developments are realised through the cooperation of company Elmarco and Technical University Liberec[25].

In the area of biotechnology, Czech R has recently founded the Centre for Integrated Genomics which consists of selected laboratories of the Institute of Molecular Genetics and Institute of Physiology AS CR, Charles University and the College of Chemical Technology in Praha. The Centre is sequencing and mapping the genome, and studying gene expression and function, regulation of the cell cycle and cell differentiation. Other institutions in this area are Institute of Molecular Genetics, the Biophysical Institute AS CR and in the Science Faculty of Charles University and others. Fundamentals of modern biotechnology are being assessed at the Centre for Molecular and Gene Biotechnology, which includes laboratories at the Institute of Microbiology, Institute of Molecular Biology, Institute of Chemical Technology and five biotech and pharmaceutical enterprises: Biopharm, Envisan-Gem, Galena, Immunotech and Vidia. The Institute of Macromolecular Chemistry AS CR and the Institute of Chemical Technology Praha are developing and studying biodegradable polymers and polymers for medical applications. The focus is on the development of skin replacements and synthesis of macromolecular carriers for targeted applications and controlled release of active substances.

In the pharmaceutical industry, a significant share of R&D is done in the private sector (Table 15). WE do not have data for German lander, but we presume that Bavaria would be again leader by quite a significant margin. Among other CE economies, Slovenian pharma industry is a very significant investor, especially given the size of the country while Czech R private sector invests comparatively much less.

Table 15 Pharmaceutical industry research and development in Central Europe, in million Euros in 2012

Germany	*5767*
Austria	453
Poland	227
Slovenia	164
Hungary	158
Czech Republic	49
Croatia	40
Slovakia n.a.	n.a.

Source: EFPIA, The Pharmaceutical Industry in Figures, Key Data, 2014, European Federation of Pharmaceuticals Industries and Associations

Note: The figures relate to the R&D carried out in each country. Austria, Croatia, Finland, France, Greece, Ireland, Netherlands, Portugal, Slovenia: 2011; Czech Republic: 2009

3.3 Midstream dimension of the innovation value chains (Patents and Clusters)

3.3.1 Geographic distribution of patents

Distribution of patents in pharma does not fully reflect the absolute size of R&D budgets of the private sector which may warrant further exploration (Table 16). For example, patenting of Czech organisations is quite high given low R&D budget of private sector. Presumably, patenting in Czech R is done largely by public R&D organisations while the private sector is more oriented towards generics. Two other area of knowledge – biotechnology and medical technology – show a huge lead of Bavaria again.

[25] CzechInvest (2015) Medical Devices in the Czech R. Investment Opportunities.

Table 16 Overview of patenting activities in the area of biotechnology, medical technology and pharma in 2011-2013 period

	Biotechnology	***Medical technology***	***Pharmaceuticals***	***Total***
Bavaria	386	678	260	1324
POL: Poland	81	52	98	231
HUN: Hungary	42	42	85	170
Saxony	69	47	39	155
CZE: Czech Republic	26	58	66	150
SVN: Slovenia	21	25	43	90
Styria	31	37	13	81
HRV: Croatia	10	7	15	32
SVK: Slovak Republic	6	5	7	18
Burgenland	3	1	0	4
Total	676	954	626	2256

Source: OECD REGPAT Database.

Industrial biotechnology is so called third wave in biotechnology. It is an approach to pollution prevention, resource conservation, and cost reduction which has the potential to integrate product improvements with pollution prevention[26]. Patenting within the CE is highly uneven which reflects large differences in RD capacities in this area. It is developed in Bavaria with Saxony-Poland, and Hungary and also partly Slovenia and Styria being the second tier countries/regions. Industrial biotechnology does not seem to be developed in Czech R, Slovak and Croatia (Table 17) This is clearly reflected in support to SMEs in industrial biotechnology which is established in 4 places in Germany, two in Poland and one in Slovenia (Figure 2).

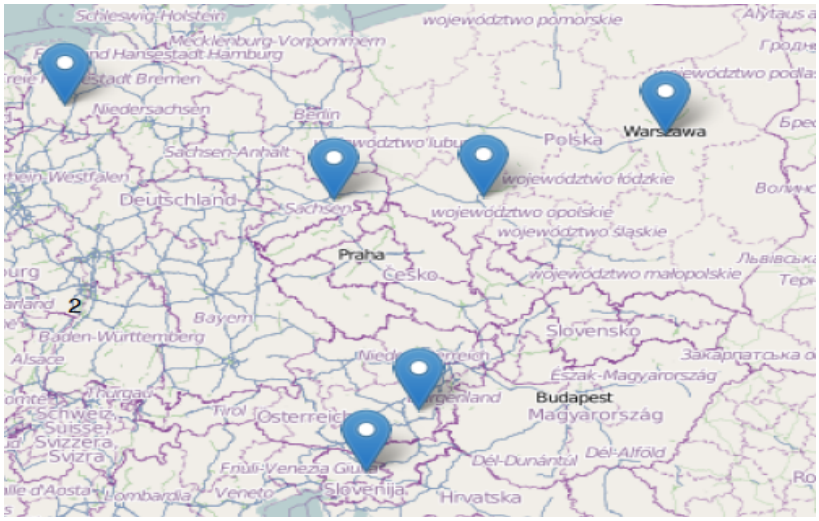
Table 17 Patent applications in KET industrial biotechnology area in 2011

Bavaria	*67*
Saxony	17
Poland	14
Hungary	12
Slovenia	9
Styria	9
Burgenland	0
Czech Republic	3
Slovakia	2
Croatia	2

Source: KETs Observatory

[26] https://www.bio.org/articles/what-industrial-biotechnology

Figure 2 SMEs' access to Key Enabling Technologies – Industrial Biotechnology



Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 3 contains a full list of organisations.

3.3.2 Clusters in pharma, biotechnology and medical devices

There are 9 clusters in biopharma in CE, but only one (Bavarian) is ranked as 3-star cluster. A number of clusters in medical devices is much bigger (30) of which more than half (16) are located in Bavaria where 3 clusters are ranked as 4-star clusters. Among other CE countries/regions Hungary has developed several clusters of medical devices of which one is ranked as 3-star cluster.

Table 18 Clusters in Central Europe in area of pharmaceuticals and medical devices

Biopharmaceuticals

Region/Country	Number of clusters	Ranking of clusters
Czech R	2	3
Bavaria	2	2/3
Saxony	1	2
Hungary	2	2
Slovenia	2	2

Medical Devices

Region/Country	Number of clusters	Ranking of clusters
Bavaria	9+4+3	2/3/4
Saxony	1	3
Hungary	3+1	2/3
Czech R	5	2
Steiermark	1	2
Poland	1	2
Slovakia	1	2
Slovenia	1	2

Source: EU Cluster Observatory

Bavaria is the leading region in CE in the life sciences but also the leading Lander within Germany. This is underlined by the fact that in Edge Cluster Competition of the Federal Ministry of Education and Research (BMBF) (2015) two Bavarian clusters in the life sciences received funding: The Munich Biotech Cluster and the Medical Valley with the "Center of Excellence for Medical Technology". The grant awarded by the BMBF funding of € 40 million is coupled by equal self-financing of the participating industrial partners. The funding is aimed towards more effective and safer drugs against cancer, cardiovascular and autoimmune diseases. Bavaria supports the expansion of the cluster management with 2 million € and provides further € 8.5 million for pre-seed funding for personalised medicine available. The Medical Valley cluster catchment area inhabits around 180 dedicated medical technology companies (including global leaders such Siemens Healthcare, Peter Brehm, WaveLight) with more than 16,000 people employed.

Saxony: The cluster Biotechnology - Life Sciences Central Germany is an innovation network that involves companies and research institutions from Thuringia, Saxony and Saxony-Anhalt together. The network aims to strengthen cooperation between companies and research institutions in the biotechnology and life sciences to encourage science industry and interfaces to other industries such as chemical, information technology and the plant biology.

Hungary. The MediCluster of Hungarian Medical Manufacturers and Service Providers[27] was established by members of the Association of Hungarian Medical Device Manufacturers in 2006. The organisations participating in the cluster include key players in the Hungarian medical technology sector. These companies are Hungarian-owned and involved in the development, production, distribution and promotion of medical technology to provide high-quality medical solutions. Dominant areas of the MediCluster's work include the development, manufacture and distribution of home diagnosis and treatment products and hospital equipment. In 2008, the MediCluster earned the title "Accredited Innovation Cluster" of the nine accredited clusters[28]

In **Croatia,** there is a cluster for Health Industry which has gathered 14 companies, 13 R&D organisations, and three supporting organisations which are currently involved in two projects. There is significant potential in clinical research, due to a strong research base with certified clinical researchers and good hospital infrastructure which has drawn many global pharmaceutical companies to conduct clinical research projects in Croatia. Main companies active in this field are Clinres Farmacija, Optimapharm, Altiora CRO, Quintiles Croatia, Parexel International, PPD and inVentive.

The first biotechnology cluster in the **Czech Republic** is being built in South Moravian Innovative Centre in Brno. The Centre was founded in 2002 by four corporate bodies: South Moravian Region, Technical University Brno, the Masaryk- University, and the statutory town Brno. In 2005 two new members were accepted: the University of Veterinary and Pharmaceutical Sciences Brno, and Mendel University of Agriculture and Forestry Brno. The cluster focuses mainly on biotech companies engaged in environmental protection, decontamination of waste water and soil, etc.[29].

Smaller biotechnology parks are starting, in Olomouc on the campus of the Institute of Experimental Botanic AS CR, and in Nové Hrady at the campus of the University of South Bohemia. However, there seems to be meagre interest from pharmaceutical companies in introducing these research results into their program. Also, the motivation of the researchers to move their compounds to a stage where they are commercially interesting is not at required level[30].

[27] http://www.mediklaszter.eu/

[28] HITA (2015) Medical Technology in Hungary. Incubation, innovation and manufacturing precision

[29] Jiří Vaněček,, PHARMACEUTICALS AND BIOTECHNOLOGY IN THE CZECH REPUBLIC, Technology Centre of the Academy of Sciences CR, mimeo

[30] Jiří Vaněček,, PHARMACEUTICALS AND BIOTECHNOLOGY IN THE CZECH REPUBLIC, Technology Centre of the Academy of Sciences CR, mimeo

Poland has some clusters in biotech, biomedicine which are not on the list of EU Cluster Observatory. In Poland, about 89% of a total number of biotech companies is located in six core regions with major metropolitan areas. Six life science clusters that house biotech firms operate in Poland[31]. Two most prominent are LifeScience Cluster Kraków and Nutribiomed Cluster.

Krakow cluster was created at the initiative of the Jagiellonian University in October 2006. Its primary aim is to „support initiatives and innovations in the life science field and create conditions for effective commercialization of the results of research and development work". Administered by the Jagiellonian Centre of Innovation Sp. z o.o., the cluster embraces 32 institutions, including biotech companies and healthcare companies.

The primary task of Nutribiomed Cluster is to develop new dietary supplements, nutraceuticals and biomedical preparations based on native natural resources and its know-how. Members are University of Wrocław, Wrocław Technology Park S.A., Wrocław Medical Science and Technology Park, Wrocław University of Environmental and Life Sciences, Poznań University of Life Sciences and several biomedical companies (Chem In, GALENA FSP, Algae Labs, Finepharm S.A., Biochefa FZNP and BIOXEN Sp. z o.o.)

Polish Technology Platform for Innovative Medicine (PPTIM) embraces companies conducting and funding research to develop new drugs, medical technologies, medical equipment modernization and the development of innovations in medicine. Its primary aim is to develop innovative pharmacy and increase the competitiveness of the Polish pharmaceutical industry. Platforms gather more than 20 companies.

The BioTechMed is a consortium of companies and scientific institutions from the region of Łódź, constituting the Advanced Technology Center together conducting research and development in the field of healthcare and protection of the natural environment, using the achievements of biotechnology, technology and medical sciences. Members are Molecular and Macromolecular Research Center of the Polish Academy of Sciences, Institute for Medical Biology of the Polish Academy of Sciences, Nofer Institute of Occupational Medicine, Technical University of Łódź, University of Łódz, Medical University of Łódź and several companies and organisations.

InnoBioBiz Cluster Łódź was created by Łódź biotechnology companies and business support institutions in December 2011. The Medical University of Łódź and the University of Łódź are among the members of the cluster as well. The main goal of this cluster is to create conditions for the development and promotion of innovative biobusiness in the region, based mainly on the innovative biotech companies. The cluster gathers nine companies[32].

[31] Micek G., (2014), Biotech industry in Poland, Technical Report financed by International Visegrad Countries – V4 Small Grant Biotechnology in the Visegrad Countries, Commissioned by ICEG European Center.

[32] Source: Biotech Consulting (2012) Report on Polish Biotech & Pharma, Report for the Polish Ministry of Economy "The Promotion of Polish Economy in International Markets", Sub-measure 6.5.1 of the Operational Programme Innovative Economy (OPIE).

3.4 Downstream dimension of the innovation value chains (Industry)

3.4.1 Major economic operators in the area of pharma, biotechnology and medical devices

The market, technology and industry structure of this area are quite different between pharma and biotechnology. Biotech is characterised by smaller firms and niche products while pharma is dominated by big business with significant R&D budget and focus either on costs (generics) or marketing (new drugs). The share of generics in sales reflects the broad orientation of country's pharma industry. Given its size, Slovenia is significant exporter while Poland and Czech R are principal importers of drugs.

Table 19 Production, employment and trade flows in pharmaceutical industry in 2012

Country	Production in mn euros 2012	Employment 2012	Export	Import	Trade balance	Share of generics in sales (in % Estimates)
Germany	27683	110006	56012	35970	20042	32.0
Austria	2753	11195	7302	6404	898	33.0
Hungary	2629	22600	3774	2824	950	38.2
Poland	2574	28500	1918	4219	-2301	54.5
Slovenia	1761	9050	2100	834	1266	24.4
Croatia	455	5900	426	641	-215	43.5
Slovakia	na	3000	297	1408	-1111	na
Czech Republic n.a.	n.a.	2300	1324	2992	-1668	na

Note: All data based on SITC 54, veterinary products excluded. For employment, Austria, Estonia, Ireland, Slovakia: 2011 data; Czech Republic: 2009

Note: 'generic' means a medicine based on an active substance that is out of patent and which is marketed under a different name from that of the original branded medicine (generics data do not include those generics marketed by the originator).

Source: EFPIA, The Pharmaceutical Industry in Figures, Key Data, 2014, European Federation of Pharmaceutical Industries and Associations

The **Polish** pharmaceutical market is dominated by generic drugs with share amounting to 66 percent (the biggest share regarding products sold in Europe). The Polish pharmaceutical market is mature, with 450 enterprises operating there at present. The pharmaceutical sector is virtually in private hands (mostly foreign investors). Additionally, about 70 enterprises in Poland operate in the biotechnological sector. The biggest pharma firms by market share are Sanofi-Grupa (including Zentiva) Rzeszów, Chociw (8.5%), Novartis (including Sandoz) Stryków (8.2%), GSK Poznań 6.1%, Polpharma Starogard Gdański, Duchnice, Sieradz 5.2% and Roche Warszawa 4.6%.

Poland is becoming more and more attractive investment location for R&D and clinical trials, thanks to a large population of patients and relatively low operational costs. From 17,000 new trials registered worldwide in 2009, 469 trials, (2.5 per cent) were registered in Poland. Poland is ranked 10th worldwide regarding the number of centres carrying out clinical trials and 1st among the so-called emerging markets (1.176 centres, 1.6 percent of all centres conducting clinical trials worldwide). There are about 50 centres in Poland, which accept contracts for performance of clinical trials. Some companies such as AstraZeneca have decided to open their clinical trial centres. Most clinical trials are carried out in oncology and cardiology, but also diabetology and pulmonology[33].

[33] PAIZ (2015) Pharmaceutical and Biotechnological Sector in Poland,

Pharma is a quite developed sector in **Slovenia** which spends 25% of total national gross expenditures for R&D and is one of the top areas regarding the intensity of cooperation between public research organisations and the economy. In addition to a pharmacy, which is an extremely concentrated economic activity, Slovenia possesses comparative advantages also in the field of "Manufacture of medical and dental instruments and supplies" which is dominated by small and medium-sized enterprises. During the entrepreneurial discovery process 24 initiatives, about the area of Health – Medicine, were prepared with an estimated investment value of over EUR 500 million. Over 170 stakeholders participated in the preparation of these initiatives of which the majority are representatives of the economy.

The leading **Hungarian** companies in pharma industry are: Gedeon Richter (largest independent drugmaker in Central and Eastern Europe, operates the largest pharmaceutical R&D centre in CEE), Sanofi (The company has complex activities in Hungary from manufacturing through R&D to distribution of pharmaceuticals), Teva Hungary (the production of active pharmaceutical ingredients), Egis (active in the pharmaceutical value chain from manufacturing through R&D to marketing)[34].

Several **Hungarian** companies have achieved international recognition in the area of medical technology with cutting edge products and technologies. The three most significant companies are: Coloplast (manufacturing of ostomy, wound care and incontinence products with turnover €217 million), BD (prefillable syringes are manufactured up to 500 million/ year with turnover of €41,7 million), and GE Healthcare R&D Centre which employs around 200 highly qualified, innovative engineers who work together to shape the future of medical imaging with turnover of €11,1 million. Medical devices industry has more than 150 manufacturers which export annually more than €300 million of which 56% of goods are exported to Germany. Some of the major Hungarian companies in medical equipment are part of the Medicor Group, are almost entirely Hungarian-owned and serve as the headquarters for Hungarian production of medical instruments and related services. These companies include Medicor ElektronikaZrt., Medicor Kéziműszer Zrt., Medicor Szerviz Zrt., Dispomedicor Zrt. and Medicor Meditű Kft., and Innomed Zrt[35].

In **Croatia,** health and pharma industry is moderately concentrated. It is characterised by a relatively small group of large companies that represent a significant share of the annual Croatian turnover and export. Large companies (PLIVA, Belupo, JGL, Genera) hold a dominant position in the market and are the leading generic and OTC companies in Central and Eastern Europe. Currently, the pharmaceutical sub-sector employs around 4,500 people in 37 companies, but when also taking into account the wider supply chain, this number increases to about 10,000 people with overall annual revenue of over €700 million. Production of medical equipment and devices is much smaller, but emerging sector which also shows a good performance. This sub-sector employs around 1400 workers in about 200 companies and generates revenue of around €100 million annually.

There are about ten large and 15 smaller pharmaceutical enterprises in the **Czech Republic**. Among the biggest pharmaceutical producers are Farmak, Ivax Pharmaceuticals (formerly Galena), Zentiva and Spofa, which mostly produce active pharmaceutical ingredients (API) and generics. Some of the generics are a version of in-house drugs with expired patent protection[36].

[34] the hungarian healthcare sector, February 2015, Prepared by Killian Hanssens, Edit Sziráki Economic & Commercial Counsellor, Hungary

[35] HITA (2015) Medical Technology in Hungary. Incubation, innovation and manufacturing precision

[36] Jiří Vaněček,, PHARMACEUTICALS AND BIOTECHNOLOGY IN THE CZECH REPUBLIC, Technology Centre of the Academy of Sciences CR, mimeo

Table 20 List of economic operators in the area of pharma, biotechnology and medical devices

Clusters/Firms	***Countries/Regions***
A high concentration of biotech firms (107) and many major global companies in pharma industry	Bavaria
Firms in medical application of biotechnology, ten pharma companies and 100 specialised service suppliers	Saxony
Developed pharma industry. 85 biotech companies and concentration in four university towns. Developed sector of medical devices	Hungary
Around 130 biotech firms largely in medical biotechnology	Poland
Well developed pharma industry, highly concentrated	Slovenia
Developed pharma industry of moderate concentration; The emerging industry of medical devices	Croatia
Moderately developed pharma sector - 25 companies of different sizes). The emerging biotech sector	Czech R

Source: Own based on the documentary review.

The biotech industry in **Bavaria** involves 107 dedicated biotech companies with 3620 employees (2012) which ranks it as second Lander in Germany[37]. Based on broader definition identified by BioM GmbH for the Biotechnology Cluster there were 205 biotech companies (including 178 SMEs) with 10,886 employees (including 4,336 in SMEs). In the pharmaceutical sector major companies are: Roche Diagnostics (Penzberg, about 5,000 employees in research and production); Merck, Sharp & Dohme (over 1,500 employees); AMGEN (with branches in Regensburg and Munich); Life Technologies / GeneArt (Regensburg); Novartis (with several thousand employees at Novartis Pharma in Nuremberg as well as the headquarters of the Generics division Sandoz in Holzkirchen near Munich); Daichii Sankyo (with German and European headquarters in Munich, a large manufacturing plant - and the Research Unit of Oncology.

Saxony biotechnology companies are mainly active in the fields of genomics, proteomics, tissue engineering, diagnostics, drug development, environmental biotechnology and biomedicine. Together with the research institutes, the focus is on the medical applications of biotechnology: regenerative medicine and molecular bioengineering.

The focus in Saxony on the red or medical biotechnology. The biopharmaceutical field is the most important field of work surveyed biotech companies (53%) while about a quarter (28%) of all Saxon Core Biotech belongs to white and grey or in industrial biotechnology. Green biotechnology/plant biotechnology firms amount to 17% of all companies by focusing on areas such as the enzyme development and enzyme optimisation or the generation of biomaterials. Another ten pharmaceutical companies and over 100 specialised service providers and suppliers complete the Saxon biotechnology industry.

In **Hungary**, there are 85 biotech companies (2011) which employ 1816 employees, export €26 million annually and conduct R&D of €18 million[38]. Around 47 red biotech (medicine) and bioinformatics companies are clustered in the major university towns of Budapest, Pecs, Debrecen and Szeged. The majority of core biotech companies are very young and established in 2005-2007.

In **Poland**, there are 129 biotech firms– 39 of them employ at least 50 people, including nine classical biotech companies, while others are small firms. There are about 40 dedicated biotechnology

[37] Background analysis

[38] CONVINCIVE Consulting and Hungarian Biotechnology Assoication (2012) BT in Hungary. 2011 Statistics

companies. The employment in the biotech sector is estimated at over 2,700 people, including almost 500 R&D employees. The majority of companies operate in the field of red biotechnology (medicine) [39].

The most common items produced by **Czech** biotech companies are monoclonal antibodies and antibody-based diagnostic kits. The biggest producer of immunoanalytical tools is Immunotech (Praha). Several biotechnology companies in the Czech Republic offer services in environmental protection. Biotechnology has longer business cycles and is higher risk compared with traditional areas of the healthcare industry, and therefore these companies suffer from insufficient capitalization.

Table 21 Concentration of economic activities in the field of pharma, biotechnology and medical devices

Regions/Country	***Indication about the concentration of economic activities***	***Overall assessment***
Bavaria	A very high concentration of companies in all three segments: in pharma, in biotechnology and medical devices. Also, competencies developed in the entire innovation value chain (from R&D to application)	Bavaria is European leader in these areas including industrial biotechnology
Saxony	Strong R&D in regenerative medicine	Very strong in medical biotechnology
Styria	NA	Developed competencies in health tech and applications including industrial biotechnology
Poland	Pharma is dominated by generics companies. Developed and growing biotech sector.	Biotech sector as the promising area for inter-regional cooperation. The emerging global location for clinical trials
Hungary	Developed pharma industry. The emerging biotech sector. Developed sector of medical devices	Medical devices sector as the promising area for inter-regional cooperation
Czech R	The emerging biotech sector. Moderate concentration in pharma	Developed competencies in biotech, including biotech related to waste treatment
Slovenia	A highly concentrated pharma industry	Pharma industry as the promising area for inter-regional cooperation
Croatia	Moderately concentrated health and pharma industry. The emerging sector of medical devices	Opportunities for inter-regional cooperation in segments of pharma and medical devices

Source: Own assessment based on the documentary review.

[39] Micek G., (2014), Biotech industry in Poland, Technical Report financed by International Visegrad Countries – V4 Small Grant Biotechnology in the Visegrad Countries, Commissioned by ICEG European Center.

3.5 Summary assessment

In this TPA the opportunities for inter-regional cooperation differ sharply between pharma, biotechnology and medical devices. In all three areas, Bavaria is a very strong leader, and other regions have competencies specific niches of each of these areas. A much of cooperation in pharma is taking place within the European Innovative Medicines Initiative (IMI). Presumably, these could be niches for such cooperation within the Central Europe, but these would need to be 'discovered' within dedicated working parties for IMI. Also, the actors in this area are established pharma companies many of which are not in national ownership and thus opportunities for inter-regional cooperation may be difficult to shape. So, we consider that the opportunities for intra-regional CE cooperation in pharma would be better realised within the existing EU initiatives. However, this would need to be verified by experts in this area.
The opportunities for CE focused inter-regional cooperation seem to be much more present in different areas of biotechnology. Two areas seem to be particular candidates: medical biotechnology in which many regions have developed competencies and industrial biotechnology which is a new and dynamic area. The CE cooperation could give necessary push to various existing and emerging local initiatives in the Eastern CE regionsMedical biotechnology would initiative could try to create synergies among various activities of universities and their spinoffs in this area. Industrial biotechnology is quite a new area where public sector organisations and their spinoffs are less present compared to medical biotechnology. However, given the potential of industrial biotechnology to integrate product improvements with pollution prevention, this seems to be an area where latecomers like East CE regions/countries could embark in international cooperation as a way to acquire knowledge in this emerging area.

Another area with potential for intra-regional cooperation could be medical devices. This area is already developed in segments in Hungary and niches in other CE regions while Bavaria is again the leader in the area. Possibly, CE cooperation could enlarge and support the emerging initiatives in this area where Bavaria could play a role of the coordinator. A list below represent selection of potential stakeholders in this area which are mainly involved in medicine and biotechnology:

Germany

- Ludwig-Maximilians University (LMU)
- Technische Universität München (TUM)
- Technical University Dresden
- University Leipzig
- Max Planck Institutes of Biochemistry and Neurobiology (Martinsried near Munich)
- The Helmholtz Zentrum München for Environment and Health
- The Rudolf Virchow Center in Würzburg (DFG Research Center for Experimental Biomedicine)
- Regensburger Center for Interventional Immunology (RCI)
- Dresden (Center for Regenerative Therapies)
- Leipzig (Translational Centre for Regenerative Medicine).
- The Munich Biotech Cluster and the Medical Valley with the "Center of Excellence for Medical Technology".
- The cluster Biotechnology - Life Sciences Central Germany
- Big Pharma
- Roche Diagnostics; Merck, Sharp & Dohme; AMGEN; Life Technologies / GeneArt (Regensburg); Novartis (Nuremberg); Sandoz (Holzkirchen near Munich); Daichii Sankyo (Munich).
- A large number of potential stakeholders from new technology biotech firms.

Austria

- Graz University
- Medical University Graz

Czech R

- Pharmaceutical Faculty of Charles University
- Biomedical Engineering Faculty of Technical University Prague
- Technical University Liberec
- Biotechnology Institute of Czech Academy of Sciences
- The Centre for Integrated Genomics
- Institute of Molecular Genetics,
- The Biophysical Institute AS CR
- The Centre for Molecular and Gene Biotechnology
- Institute of Clinical and Experimental Medicine (IKME)
- South Moravian Innovative Centre in Brno
- Biotech/pharma NTBFs: Biopharm, Envisan-Gem, Galena, Immunotech and Vidia, Exbio Praha, Generi Biotech

Poland

- Warsaw Medical University
- Biocentrum Ochota
- LifeScience Cluster Kraków
- Nutribiomed Cluster, Wroclaw.
- Polish Technology Platform for Innovative Medicine (PPTIM)
- InnoBioBiz Cluster Łódź
- Institute of Experimental Biology of Polish Academy of Sciences (Nencki Institute)

Hungary

- Semmelweis University
- University of Szeged
- University of Pecs, Medical School
- Research Centre for Natural Sciences, Hungarian Academy of Sciences
- The MediCluster of Hungarian Medical Manufacturers and Service Providers
- Bay Zoltán Nonprofit Ltd.
- Institute of Experimental Medicine - Hungarian Academy of Sciences

Slovakia

- Biotechnology Centre of the Slovak Republic (BITCET
- Laboratory of Nuclear Magnetic Resonance (NMR)
- the Laboratory of Electromagnetic Compatibility (EMC)

Slovenia

- Ljubljana University
- Institut Joze Stefan
- University Clinical Centre Ljubljana
- Institute fir Microbiology and Immunology

Croatia

- Faculty of Medicine and Veterinary Faculty, University of Zagreb
- Croatian Institute for Brain Research, School of Medicine
- Institute Rudje r Boskovic
- Mediterranean Institute for Life Sciences in Split

4 Agro- and bio-economy

4.1 Policy priorities

4.1.1 Brief overview of the priority area

Table 22 Overview of Central European countries and regions with agro- and bio-economy identified as RIS3 priority

Countries	No. of regions	Regions	Descriptions
Croatia	national	National level	Bio-economy
Slovenia	national	National level	Networks for the transition to the circular economy: sustainable biomass transformation and new bio-based materials, technologies for the use of secondary and raw-materials and reuse of waste; and production of energy based on alternative sources.
Austria	1	Burgenland	Life Science (Health and Wellness, pharmaceutical, Medizintechnik, beverages and food services in accommodation)
Croatia	national	National level	Agro-food
Hungary	national	National level	Healthy local food
Slovenia	national	National level	Sustainable food production: high-quality food in relation to a business model that will integrate knowledge institutions with manufacturers and economic entities along the entire value chain, including the development of new marketing models; establish an innovative and short supply chains for locally and organically produced foods with a guaranteed and recognised traceability from the field to the table; ensure long-term sustainable conditions for the development of the varieties and farming practices adapted to Slovenian territory and to climate change.
Hungary	national	National level	Agricultural innovation
Poland	national	National level	Healthy food (high quality and performance of production)
Poland	national	National level	Innovative technologies, processes and products of the agri-food and forestry-wood

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

Bio-economy uses biomass or renewable biological material from agriculture, forestry and seas. It is a broad term, which encompasses any activity associated with the use of biotechnology, bioprocesses and bio-based products, aimed at the production of goods and services[40]. In a narrow meaning, bio-economy is the use of biotechnology in the industry, environmental protection and in challenges posed by climate change Knowledge-based bioeconomy is innovation driven activity where traditional industries (e.g.,. agriculture, construction) connect with KETs (e.g.,. biotechnology, ICT) and create innovative solutions for the major societal challenges (food, climate change, energy supply). Except for Germany, Austria and partly Poland the broad concept of bioeconomy has not yet been adopted as a policy concern in Central European region though some countries, like Croatia and Slovenia, have selected bioeconomy as one of their S3 priorities. While Croatia has done it explicitly, Slovenia has implicitly opted for bioeconomy but it approached it through the notion of circular economy. Other countries (Hungary, Poland) and regions have selected food through agricultural innovation as an S3 priority. Austria has prioritised beverages and food services but through the broader notion of life sciences which also includes health and wellness. It is interesting that none of two German regions has explicitly chosen bioeconomy as their S3 priority though this approach is adopted as a policy concern in Germany. Also, S3 Database entries for Czech R and Slovakia do not list agro or bio-economy as the priority but their S3 document points to this area as important in RDI of the country (see below).

[40] Wicki Ludwik and Aleksandra Wicka (2016) BIO-ECONOMY SECTOR IN POLAND AND ITS IMPORTANCE IN THE ECONOMY, Proceedings of the 2016 International Conference "ECONOMIC SCIENCE FOR RURAL DEVELOPMENT" No 41 Jelgava, LLU ESAF, 21-22 April 2016, pp. 219-219

4.1.2 Thematic focus and the main EU networks

4.1.2.1 Focus areas and technologies

In bioeconomy and environment area **Poland** is focused on Innovative technologies, processes and products of the agri-food and forestry-wood, Healthy food (high quality and performance of production), and Biotechnological processes and products in speciality chemicals and environmental engineering.

Hungary's priority in this area is healthy local food and agricultural innovation. Healthy local food includes food processing, locally produced and processed food of high added value. It covers the RDI of the entire food chain and is designed to promote the development of only short food chains, both in space and time, which preserve the biological value, helping the development of a local "brands" and, thus, establish not only the possibility of the local sales, but also the opportunity to export (especially in the case of the Hungarian specialities). The innovation in the agricultural sector, which is traditionally present in Hungary, is about sectoral renewal from the agricultural knowledge centres through innovative R&D solutions in crop production and protection technologies, in addition to animal production and veterinary medicine. It also includes R&D in the fisheries management and forest and wildlife management, innovative vegetables and fruit growing, viticulture and wine-making and the development of innovative irrigation systems.

Food and Bio-economy priority in **Croatia** is focused on two sub-priorities: (1) Sustainable Food production and processing, and (2) Sustainable wood production and processing. Sustainable food production and processing are focused on sustainable, competitive and efficient agro-food, fishery and aquaculture production and processing. Food production and processing including the manufacture of safe, value-added and innovative foods with the aim to covers the RDI of the entire food chain. Sustainable wood production and processing are focused on sustainable, competitive and efficient wood production including the manufacture of value added and innovative wood products.

Slovenia is prioritising technologies for sustainable biomass transformation and new bio-based materials; technologies for the use of secondary and raw-materials and reuse of waste, and production of energy based on alternative sources. Within food sector, the focus is on Sustainable production and processing of food products into functional foods, and on Technologies for sustainable agricultural production (livestock and plants). Slovenia has relatively well-preserved natural resources which led to the decision to aim for the circular economy by eliminating the waste and provide conditions for an extended circulation period of products in use, their cascading use and the provision of clean and unpolluted materials which can be reused.

S3 Database entry for **Czech R** does not list agro or bio-economy as its priority, but its S3 document points to Natural resources, sustainable agriculture and food safety and sufficiency as seventh application theme. Analysis indicates that this is an area 'in which the Czech Republic currently has no immediate comparative advantage on an international scale, but the area is considered as critical with respect to maintaining long-term competitiveness and preventing risks (sustainability of development, resource security and sufficiency) that may jeopardise prosperity of the economy and society in the long-term'. Within this theme, narrower application areas have been identified: Natural resources, agriculture and food; Separation and remediation technologies for the environment and the food industry; Technologies for water and soil processing, purification and treatment and for waste processing; The food industry and food security; Agricultural and food technology (biotechnology, microbiological procedures etc.); Production of alcoholic beverages (including brewing) and related supply chains, and Freshwater aquaculture and fish processing.

S3 RIS database does not list bioeconomy or agrifood as a priority area for **Slovakia.** However, S3 document reports three basic groups of the thematic priorities: Research and Development Priorities, Technological priorities, and Social priorities. One of the technological priorities is Environment and Agriculture.

4.1.2.2 Cooperation with the EU-level networks

In the area of food industry, there are several EU level networking and partnerships organisations which are of relevance for the Central European cooperation networks in the area of bioeconomy.

- **European Innovation Partnership "Agricultural Production and Sustainability"** aims to find solutions to the two fundamental challenges for European agriculture: increasing production and productivity to respond to the significant increase in global demand for food, and increased sustainability and resource efficiency. The EIP-AGRI brings together innovation actors (farmers, advisers, researchers, businesses, NGOs and others) at EU level and within the rural development programmes (RDPs). Together they form an EU-wide EIP network. EIP Operational Groups can be funded under the RDPs, are project-based and tackle a certain (practical) problem or opportunity which may lead to innovation. http://ec.europa.eu/eip/agriculture/
- **The Farm Animal Breeding and Reproduction Technology Platform (FABRE TP)** promotes research and innovation for sustainable animal breeding and reproduction in Europe. FABRE TP is the main contact point for farm animal breeding and reproduction organisations in Europe, aiming to mobilise the research efforts, technological development and innovation efforts in Europe. FABRE TP started as an initiative of pro-active partners in breeding in 2005, then continued as an EC funded project in 2006, and is since 2009 an official European Technology Platform. www.fabretp.info
- **The European Technology Platform (ETP) 'Plants for the Future'** is a stakeholder forum for the plant sector with members from industry, academia and the farming community. It serves as a platform for all stakeholders concerned with plants to provide their views and represent their interests in an open discussion process. The future role of plants is expressed in the vision of a Knowledge-Based Bio-Economy (KBBE), in which plants are the main pillar. www.plantetp.org
- **European Technology Platform for Global Animal Health** is the focusing and prioritisation of research for new or improved vaccines and diagnostic tests. http://www.ifaheurope.org
- **European Technology Platform "Food for Life"** focuses on innovation in the agri-food industry. http://etp.fooddrinkeurope.eu

4.2 Upstream dimension of the value chains (Research and technology capabilities)

4.2.1 Analysis of FP7, H2020 projects

Participation in FP7 projects in this area shows entirely different structure by countries /regions when compared to new technology areas like biomedicine or new materials. The presence of the Central European countries (NMS) is relatively much bigger when compared to Bavaria and Saxony. The country with the largest number of FP7 participation in this area is Hungary, and then Poland followed by Czech R and Bavaria. A presence of two Austria regions is also much smaller when compared to other regions/countries.

Table 23 Participation in FP7 projects in the area of agro- and bio-economy

Countries/Regions	***Number of participants***
Bavaria	44
Poland	52
Czech Republic	45

Countries/Regions	*Number of participants*
Saxony	14
Slovenia	32
Hungary	60
Slovak Republic	18
Burgenland	0
Styria	8
Croatia	15

Source: Own based on the E-CORDA database.

However, the structure of funding shows that numerous participation of the new member states from CE countries is largely supported by smaller funding amounts (Table 24). For example, 60 Hungarian participations in FP7 in this area are covered by EUR7.4mn of the EU funding. In overall, the amounts of the financing in this area seems to be relatively modest irrespective of the country or region.

Table 24 Funding of FP7 projects in the area of agro- and bio-economy

Countries/Regions	*Agro- and bio-economy*
Bavaria	13463032
Poland	7133205
Saxony	2915689
Czech Republic	7913745
Slovenia	3067463
Hungary	7405113
Styria	4789839
Burgerland	0
Slovak Republic	1756509
Croatia	1329287

Source: Own based on the E-CORDA database.

This is further supported by the number of coordinations of FP7 projects in the area of agro- and bio-economy which are only 7 of which three by Bavarian organisations. Again, Burgenland and Graz University are presented as coordinators but are not present in data on funding.

Table 25 Coordinators of FP7 projects in the area of agro- and bio-economy

Organizations	***Regions/Countries***	***Number of projects coordinated***
DEBRECENI EGYETEM	Hungary	1
LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Bavaria	1
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	1
TECHNISCHE UNIVERSITAET GRAZ	Burgenland	1
WIRTSCHAFT UND INFRASTRUKTUR GMBH & CO PLANUNGS KG	Bavaria	1
VYZKUMNY USTAV ZIVOCISNE VYROBY V.V.I. UHRINEVES	Czech R	1
INSTYTUT MEDYCYNY PRACY NOFERA	Poland	1

Source: Own based on the E-CORDA database.

In H2020 there are 44 projects in which there are participants from CE (see Annex 4 which contains a full list of organisations). In six of these projects, there are at least four participants from this region. It is interesting that in Platform of bioeconomy ERA-NET Actions there are only 3 CE regions/countries (Germany, Slovenia, Austria) which further confirms a low degree of awareness of the bioeconomy as the emerging TPA.

4.3 Midstream dimension of innovation value chains (patents and clusters)

4.3.1 Geographic distribution of patents

Patents in agriculture and bio-economy are not considered as KETs, and thus neither KET Observatory nor OECD RegPat database have patents for this area. Aloes, there are not data on SMEs' access to technological knowledge in this area.

4.3.2 Clustering in agro- and bio-economy

There are 49 clusters in six main areas of agro and bio-economy: agricultural inputs and services, blue growth or maritime industries, fishing and fisheries products, food processing and manufacturing, livestock processing and forestry. The large majority of these are ranked as 2 star clusters except one in Czech R and Poland in Agricultural inputs and services, and seven forestry clusters in Czech R. Given the prominent role of Hungary in RD in agro and bio-economy it is surprising that this has not been followed by more intensive midstream activities like clustering.

Table 26 Clusters in Central Europe in area of agro- and bio-economy

Region/Country	Number of clusters	Ranking of clusters
Agricultural Inputs and Services		
Czech R	1+1	(2)(3)
Poland	1+1	(2)(3)
Slovakia	1+1	2
Blue Growth (Maritime) Industries		
Czech R	1	2
Bavaria	1	2
Saxony	1	2
Hungary	1	2
Poland	3	2
Croatia	1	2
Fishing and Fishing Products		
Czech R	1	2
Bavaria	1	2
Poland	2	2
Food Processing and Manufacturing		
Czech R	1	2
Bavaria	2	2
Poland	2	2
Hungary	1	2
Livestock Processing		
Poland	7	2
Hungary	3	2
Czech R	1	2
Forestry		
Czech R	7	3
Poland	6	2
Slovenia	1	2

Source: EU Cluster Observatory

Saxony. Based on data of the EC Cluster Observatory Saxony has only one cluster in maritime industries. However, background analysis of the S3 for Saxony indicates that there is a top cluster in BioEconomy (probably classified in biotechnology) which links relevant research and industrial sectors in Central Germany (esp. Saxony and Saxony-Anhalt). The core competence of this cluster is the development, scaling and application of innovative technical processes for the sustainable material use of bio-based, renewable raw materials from non-food industries (in particular wood) and for the production of valuable products for various industries, connected to the energy use of waste materials along the entire value chain. Among the partners of the cluster are big business as well as over 40 innovative SMEs. The cluster is one of the winners in the third round of top cluster competition of the BMBF. In addition to cluster, there is the network, founded in 2009 which connects over 60 Saxon actors

in the field of biotechnology as well as the adjacent areas of the engineering sciences on materials science to medical technology.

In Bavaria and Saxony, there are members of the "German Food Clusters" which represent the complete value chain in food processing. The aim is to link economy, science and research to accelerate the transfer of knowledge.[41]

Clusters play an important role in the growing competitiveness of the **Polish food sector**. Food clusters are the third most numerous group of clusters in Poland (20 out of a total of 212), surpassed only by ICT and tourism sector clusters. These clusters are located in 12 voivodeships, including three in each of the Lubelskie, Lódzkie, Podlaskie and Warmiosko-Mazurskie voivodeships. The most developed clusters are located in Lubelskie Voivodeship - Cluster Valley of Bio Food and Food Cluster of Southern Wielkopolska.[42] The other main clusters in food industry are the following:

- "FOOD 4 GOOD" food for health (www.food4good.com.pl)
- Agro Cluster 'Kujawy' - Association for Innovation and Development (www.agroklaster.pl)
- Centre of innovation and technology of packaging food products- European Competence Agreement www.ribs.org.pl
- Grajewo Industrial Cluster (www.cpir.org.pl/category/klastry/grajewski-klaster-przemyslowy)
- Leszno Flavours (www.leszczynskiesmaki.pl)
- Eastern Food-Industrial District (www.klasterspozywczy.pl)
- Beef Cluster (www.klaster-wolowiny.pl)

Furthermore, some smaller food sub-clusters are operating within largest regional clusters, for example (bakery cluster and regional food cluster in Podlasie, Eastern Poland).

Croatia has recently established three clusters in agro- and bio-economy: for Wood processing sector, Maritime Industry and Food processing sector (see below).

Table 27 Croatian Competitiveness Clusters in agro- and bio-economy

Croatian Competitiveness Clusters	***Private sector***	***Local and regional authorities***	***Support institutions (RDA, Croatian Chamber of Commerce)***	***Science and Research organisations***	***Number of planned projects in Project pipelines***
CCC for Wood Processing Sector	53	9	13	4	7
CCC for Maritime Industry	15	3	5	6	3
CCC for Food Processing Sector	21	11	15	12	10

Source: Croatian 3S strategy document

[41] See: http://www.germanfoodclusters.org/about-us-1

[42] See: http://www.klaster.kalisz.pl/

4.4 Downstream dimension of the value chains (Industry)

4.4.1 Major economic operators in the area of agro- and bio-economy

Hungary. A total of 4,971 companies is active in the food and beverage sector in Hungary the majority of which are (52%) are controlled by domestic entrepreneurs, while the share of foreign capital is 48%. The vegetable oil processing, confectionery and snacks segments are dominated by multinational companies, while the meat and poultry, vegetable and fruit processing, as well as the baking industry, are mostly controlled by domestic capital. Regarding company size, approximately 70% of the sector's output comes from large enterprises. The remaining production is highly dispersed, as 96% of the players in the industry are micro-companies with less than ten employees.

Clustering in Hungarian food industry seems to be below expected level. One of the actions towards increased networking is the Hungaricum Club initiative launched in 1999 by four local companies: Herend Porcelain Manufactory, Pick Szeged Co., Tokaj Trading House and Zwack Unicum, with the purpose to promote the production and consumption of Hungarian products in the internal market. The Hungaricum brand is awarded to handicraft, industrial, food and beverage products that are part of the material cultural heritage of Hungary. At present, there are 115 products included in the Hungaricum Club. Among these, 71 belong to the agricultural and the food and beverage sectors[43].

Poland. The factor considerably accelerating the growth of the Polish food industry was an accession to the European Union in 2004. This entailed a broad stream of subsidies, both before and after the accession, allowing for the adaptation of manufacturing plants to EU standards. The opening of European markets prompted an over three-fold (from € 5 billion in 1994 to € 17.5 billion in 2012) growth of the export of agricultural and food products[44]. From 2004 to 2013, Polish firms invested around EUR 1 billion on average every year. In 2014, Poland ranked the 4th largest net exporter of food products in the EU, after Netherlands, France and Spain.

On the list of the largest companies, three groups of enterprises are most prominent. These are manufacturers of alcohol (lead by Kompania Piwowarska), manufacturers of meat and meat products and representatives of the dairy sector. Neither of these groups can boast a significant advantage over the others, and neither is a definitive leader of the Polish food sector[45]. The sector is populated by some companies of limited size which reduce their profitability and ability to internationalise. Thus, consolidation of food production in Poland seems to be inevitable as well as substantial new investments in modernisation. So far, technological modernisation has been confined most often on the largest players. However, Poland has improved tremendously in quality control as firms are increasingly involved in the EU food quality schemes and implemented other safety and hygiene standards. As at the end of 2013, safety and hygiene systems have been implemented in more than 75% of Polish agri-food producers[46].However, R&D and innovation activity in the industry are quite low with only around one-quarter of innovating firms[47].

The food sector of **Slovenia** is not ranked high regarding comparative advantages. However, certain segments demonstrate a positive trend which shows that there is potential in this area. During the entrepreneurial discovery process 30 initiatives, in the field of Sustainable food production, were prepared with an estimated investment value of over € 500 million. Over 200 stakeholders participated in the preparation of these initiatives of which over a half are representatives of the economy. Regarding natural resources, Slovenia has great potential in the field of bovine meat production based on the model of sustainable extensification. This is also a result of the fact that the percentage of grasslands stands at around two-thirds of the agricultural land, which represent the ideal primary production resources while

[43] EMIS Insight (2015) Food & Beverage Sector Hungary, April 2015, Euromoney

[44] PAIZ (2013) Food Sector in Poland: Sector profile

[45] PAIZ (2013) Food Sector in Poland: Sector profile

[46] ibid

[47] ibid

ensuring sustainable management of natural habitats with dominant grassland in less-favoured cultivation areas.

With forests covering 58.4% of the country, Slovenia is one of the most forested countries in Europe and wood is its natural asset. Slovenia is an active exporter of wood but is currently exporting mainly various forms of raw timber. Slovenia has competitive export prices of builders' joinery or various building materials made of wood with the Slovenian manufacturers of prefabricated buildings offering competitive prices in comparison to Europe's leading companies. The current annual export amounts to around € 150 million.

Croatian food processing companies mainly rely on domestic plant and animal and fishery production and are relatively competitive. Apart from half a dozen large corporations (Agrokor Group, Podravka, Atlantic Group, Kraš, Cromaris and others), there are many developed and growing SMEs and private farms that are creating a network of successful food producers within the Croatian food sector. Croatia has a very active private sector in the fields of food and nutrition. Most of the companies in Croatia engaged in nutraceutical R&D are for the local context large entities with R&D departments comprising between 15-50 researchers and exporting to international markets. However, Croatian food industry has generally outdated technologies (low efficiency, high energy consumption, low quality products, high final product price), low level of investments in research and development (new product development, production of trendy products e.g. functional food), weak connection between primary producers (of raw materials) and food industry.

RDI capacity in the business sector is mainly concentrated in the largest companies such as Agrokor Group, Podravka, Atlantic Group and Heineken. Investment of € 3.870.434 (9,6% of total investment by BICRO and HIT).

The wood processing sector in Croatia numbers more than 1,300 companies that employ over 21,000 workers, generating total revenues of approximately € 1 billion. Export figures show that the wood-processing sector represents almost 7% of Croatian manufacturing exports. Nevertheless, this sector is lagging behind regarding technological capabilities and usage of innovative and value added solutions in production. This is especially related to the finalisation process. The majority of Croatian furniture manufacturers do not invest in design and innovation. In the wood processing industry, RDI capacity is mainly concentrated in larger companies whose departments are mostly concerned with finding innovative solutions for the modernisation of production (mostly through application of robotic devices and new ICT solutions, i.e. 3D printers), automation of the production processes, application of new materials for surface treatment (coating, oil, etc.) and sustainable wood production. The key scientific institution in this sector in Croatia is the Faculty of Forestry of the University of Zagreb.

Table 28 Concentration of economic activities in the area of advanced materials and nanotechnology

Regions/Country	***Indication about the concentration of economic activities***	***Overall assessment***
Hungary	Mixed domestic and foreign-owned companies of different sizes	Comparatively more developed upstream (R&D) than midstream (clusters) and downstream activities
Poland	A large number of domestic firms but of limited size. Fourth size exporter in the EU	A sector with good export potential in need of expanded modernization beyond large players. Also, need to compete on innovation will require more RD investments
Slovenia	Domestically oriented food industry. Wood sector in need of upgrading.	Possible new opportunities from application of circular economy approach
Croatia	Half a dozen large firms regionally oriented with the growing layer of SMEs in niche products. RDI activity	A strong need for further technological modernisation in the sector

Regions/Country	*Indication about the concentration of economic activities*	*Overall assessment*
	concentrated in the largest companies Wood sector in need of upgrading.	

Source: Own assessment based on the documentary review.

4.5 Summary assessment

The area of agro- and bio-economy has moderate opportunities for inter-regional cooperation for several reasons. First, investments in R&D in this area are modest (see Table 22). Second, this area is a priority only for Hungary, Poland, Croatia, and Slovenia and in each of these, the approach is different. It ranges from a focus on bioeconomy (Croatia) to agri-innovation (Hungary), food industry (Poland) and circular economy (Slovenia). Third, there seems to be a paucity of links between R&D activities and links with the food producers which can make establishing of cooperation in the S3 area which should be of applied nature quite challenging. Fourth, the clustering is quite uneven, and they seem to be largely downstream (market) oriented with weak links to RD. In the absence of well-organized stakeholders, it may be difficult to initiate the intra-CEE cooperation. Fifth, food sector gathers companies of different sizes and RDI activities are confined to the large players. Except for Poland which has become a fourth exporter in EU, other three countries have largely domestic market-oriented food sectors. The opportunity to engage these players in international cooperation may be quite daunting task, and it may be quite difficult to identify potential 'product champions' or network organisers. Also, 'despite the strong position of Poland on the European food markets, no Polish sector can be considered the development engine of the sector in Europe or the region'[48]. The alternative would be to initiate cooperation which is largely based on SMEs. However, this cooperation would need to be quite focused on one niche area and would need to enhance much more coupling between RDI and market application orientation than is the case today in this sector. Our analytical work has not been able to identify which would be these niches, and this can be done only by involving 'insiders' in this are in different countries. On that basis, it would be possible to identify and organise cooperation among SMEs which are knowledge intensive and link them up with the public R&D organisations. Another quite specific East Central European specificity is specialisation in the wood sector and forestry in regions/countries where these sectors play a major role (Poland, Czech R, Slovenia, Croatia). This cooperation should focus on the issue of technology and industry upgrading as these countries share similarities regarding technological levels and competitiveness.

A last but not least promising route is initiating cooperation in different areas of bioeconomy/circular economy which calls for exploring new approaches that can affect couple sustainability with competitiveness. These are issues that all Eastern CE shares and where there seems to be limited awareness of these issues. The form that this cooperation could take would be initially confined on joint workshops and exchange of good practices and would involve both applied RDI and policy issues.

The list below represents selected stakeholders in the broadly defined area of agro and bio-economy:

Germany

- Technical University Munich
- Ludwig-Maximilians-Universitaet Muenchen
- Fraunhofer Gesellschaft
- Helmholtz Centre for Environmental Research - UFZ

[48] PAIZ (2013) Food Sector in Poland: Sector profile

Austria

- Technical University Graz

Poland

- Research Institute of Horticulture in Skierniewice
- The National Food and Nutrition Institute
- Institute of Soil Science and Plant Cultivation (IUNG)
- Some of 20 food clusters in Poland

Czech R

- Mendel University Brno
- The Institute of Microbiology of the Czech Academy of Sciences
- Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences

Hungary

- Biological Research Centre, Szeged, Hungarian Academy of Sciences
- National Agricultural Research and Innovation Center (NARI)
- Centre for Agricultural Research, Hungarian Academy of Sciences
- University of Szeged
- Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics
- Campden BRI Magyarország Nonprofit Kft.
- Research Institutes of the Centre for Agricultural and Applied Economic Sciences of University of Debrecen

Slovakia

- Slovak Academy of Sciences
- Slovak University of Agriculture Nitra
- National Agriculture and Food Centre

Slovenia

- University of Ljubljana

Croatia

- Faculty of Forestry of the University of Zagreb
- Agrokor

5 Advanced materials and nanotechnology

5.1 Policy priorities

5.1.1 Brief overview of the priority area

The Table 29 below clearly indicates that both German Länders covered by the present assignment identified advanced materials (nanotechnology) as one their RIS3 priorities. In Austria, this thematic area is also designated as a priority both at the national and regional level (i.e. Burgenland). From the group of CEECs, only Poland identified advanced materials (nanotechnology) as its priority area. At the level of policy priorities, it is found that the potential of cooperation in Central Europe exists primarily between regions from Germany, Austria, Poland, and the Slovak Republic (in the case of the latter especially in the area of metals).

Table 29 Overview of Central European countries and regions with advanced materials and nanotechnology identified as RIS3 priority

Countries	No. of regions	Regions	Descriptions
Austria	national	National level	Materials & production
Austria	1	Burgenland	Materials (plastic, wood, metal) and their intelligent application
Germany	2	Saxony, Bavaria	New materials; Nanotechnology; New and intelligent materials, nano- and micro-technology
Poland	national	National level	Electronic conducting polymers
Poland	national	National level	Multifunctional materials and composites with advanced properties, including nano-processes and nano-products
Poland	national	National level	Modern technology sourcing, processing and use of natural resources and the production of substitutes
The Slovak Republic	national	National level	Production and processing of iron and steel[49]

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

5.1.2 Thematic focus and the main EU networks

5.1.2.1 Focus areas and technologies

In **Austria,** one of the priorities set out by the National Research Promotion Agency (FFG) is related to the thematic area of materials and production. A total of around twelve percent of FFG funding is spent on manufacturing or production related projects and eleven percent on materials science. It should be noted that many projects in other areas also include aspects relevant to materials science and manufacturing.

In **Burgenland,** the Research, Technology, and Innovation strategy (known also as 'RTI Strategy Burgenland 2025')[50] is oriented at the RIS3 process of the European Commission and aims at further

[49] Also, mentioned within the thematic area of 'Electrotechnical and mechanical industries'

[50] See: http://www.fti-burgenland.at/fileadmin/user_upload/FTI_Strategie_2025.pdf

developing Burgenland's competencies in research, technology and innovation and has a focus on sustainable energy, sustainable quality of life and smart processes, technologies and products.

As in other Austrian regions, advanced manufacturing is strongly addressed under the topic of "Industry 4.0" which is one theme of Burgenland's 2025 vision, as developed in the regional research, technology and innovation strategy. In addition to exchange and cooperation activities in materials and their smart implementation, and Industry 4.0 or 'Production of the Future' are addressed under the heading of intelligent processes, technologies and products.[51]

The **Styria's** strategy "Research in Styria: The Strategy of the Province of Styria for the Promotion of Science and Research" is based on the "Forschungsstrategie Steiermark 2005+" (Research Strategy Styria 2005+). With regards to thematic focus of the scientific institutions, it defines themes related to societal challenges and market trends, including advanced materials.[52] According to the 2005+ Strategy, the advance materials are traditionally well-developed strengths both on the side of the regional offer of research services as well a strong industrial demand.[53]

According to the **Bavaria's** RIS-3 Strategy, the development and use of new materials are the keys to product and process innovations in various industries, including the automotive industry, the aerospace industry, mechanical engineering and medical technology.

In **Saxony,** the importance of intelligent materials has been recognised as a priority area in its RIS3 strategy. A concrete example is a metal (Neodym) specifically for high-performance magnets in electric motors and generators in wind turbines and electrically powered vehicles. Another focus is on the production of technical textiles. In this case, the entire value chain from textile research, yarn and surface production, textile finishing and clothing and rope making, tape production is covered. Other key applications exist in the fields of lightweight construction, CFRP for wind power and mobility.

The **Poland's** RIS-3 strategy identified the following three priorities which are related to advanced materials and nanotechnology: Electronic conducting polymers; multifunctional materials and composites with advanced properties; and modern technology sourcing, processing and use of natural resources and the production of substitutes. For example, specific technologies that are mentioned in these technological areas range from photovoltaics and other alternative sources of energy; personal electronics and intelligent textiles; multi-composite materials and nanostructured ultra-light and ultra-resistant materials; advanced materials and nanotechnology for products with high value-added as well as for process industries to the re-use of core materials for chemical industries, cement, construction and road, etc.

In the **Slovak Republic**, the focus of activities within this area is on new materials (especially lightweight structural materials and composites, organic materials, steel and special materials), surface treatment and diagnosis system for applications in the field of the Slovak economic specialisation, especially in the automotive industry, mechanical engineering, engineering, electronics, metallurgy, energy.

[51] See: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/burgenland

[52] See: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/styria

[53] See: http://www.forschungsrat.steiermark.at/cms/dokumente/11107742_33997004/7791817f/forschungsstrategie.pdf

5.1.2.2 Cooperation with the EU-level networks

Concrete examples of the existing networks in this specific thematic area at the EU level are outlined below:

- European Materials Research Society – E-MRS;
- European Steel Technology Platform – ESTEP;
- European Technology Platform for Advanced Engineering Materials and Technologies – EuMaT;
- European Technology Platform initiative NANOfutures;
- European Technology Platform Textile;
- Federation of European Materials Societies – FEMS;
- Metallurgy Europe;
- NANO Regions Alliance (NANORA); and
- The RegioTex initiative.

5.2 Upstream dimension of the value chains (Research and technology capabilities)

5.2.1 Analysis of FP7, H2020 projects

The analysis of FP7 projects funded under the Priority area 'Nanosciences, Nanotechnologies, Materials and new Production Technologies'[54] confirms that the higher number of participants is found in countries and regions where advanced materials (nanotechnology) was identified as a priority (see Table 28). This specifically applies to Bavaria, Saxony and Poland. One of the unexpected findings is a relatively low level of participation in case of Austrian regions in the light of priorities identified in the section above. Also, the number of organisations from the Czech Republic is comparable to that of Poland even though this thematic area was not specifically designated as a priority in the former. Overall, these findings are in line with the results emerging from the analysis of EC contributions (see Table 31).

Table 30 Participation in FP7 projects in the area of advanced materials and nanotechnology

Countries/Regions	***Number of participants***
Bavaria	237
Poland	89
Czech Republic	81
Saxony	54
Slovenia	44
Hungary	38
Slovak Republic	23
Styria	17
Croatia	6

[54] Calls related to the Factories of the Future (FoF) are not included in the calculations.

Table 31 Funding of FP7 projects in the area of advanced materials and nanotechnology

Countries/Regions	***EC contributions***
Bavaria	104.623.944
Poland	19.371.529
Saxony	15.524.166
Czech Republic	15.445.691
Slovenia	9.499.400
Hungary	6.845.278
Styria	6.398.954
Slovak Republic	3.758.141
Croatia	830.343

Source: Own based on the E-CORDA database.

The Table 32 below shows that Bavaria is on the leading position regarding the number of coordinated projects funded under the FP7. The organisation which most frequently played a role of coordinator was Fraunhofer. The overall capacity of coordinating projects in this specific area by actors from the remaining Central European countries and regions is to a large extent limited.

Table 32 Coordinators of FP7 projects in the area of advanced materials and nanotechnology

Organisations	***Regions/Countries***	***Number of projects coordinated***
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	26
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	Bavaria	6
TILL I.D. GMBH	Bavaria	1
AIRBUS DEFENCE AND SPACE GMBH	Bavaria	1
DEUTSCHES MUSEUM VON MEISTERWERKEN DER NATURWISSENSCHAFT UND TECHNIK	Bavaria	1
KLINIKUM RECHTS DER ISAR DER TECHNISCHEN UNIVERSITAT MUNCHEN	Bavaria	1
OSRAM OPTO SEMICONDUCTORS GMBH	Bavaria	1
MOSTOSTAL WARSZAWA SA	Poland	2
INSTYTUT TECHNOLOGII MATERIALOW ELEKTRONICZNYCH	Poland	1
CENTRALNY INSTYTUT OCHRONY PRACY - PANSTWOWY INSTYTUT BADAWCZY	Poland	1
AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE	Poland	1
INSTYTUT OBROBKI PLASTYCZNEJ	Poland	1
UNIVERSITAET GRAZ	Styria	1
IBZ-SALZCHEMIE GMBH & CO KG	Saxony	1
TECHNOLOGICKE CENTRUM AKADEMIE VED CESKE REPUBLIKY	Czech Republic	1

Organisations	*Regions/Countries*	*Number of projects coordinated*
RESEARCH CENTRE FOR NATURAL SCIENCES, HUNGARIAN ACADEMY OF SCIENCES	Hungary	1
USTAV MATERIALOV A MECHANIKY STROJOV SLOVENSKEJ AKADEMIE	Slovak Republic	1

Source: Own based on the E-CORDA database.

According to the latest publicly available H2020 data (see Annex 5), projects funded under the Priority areas 'Industrial Leadership – Leadership in enabling and industrial technologies – Advanced materials & Nanotechnologies' have so far involved in most of the cases two or one countries from Central Europe. In four cases, it was found that three countries were involved and only in one case the partner organisations from five countries joined the forces together as documented below.

5.3 Midstream dimension of the innovation value chains (patents)

5.3.1 Geographic distribution of patents

The table below confirms Bavaria as a leader regarding the number of patents in the area of advanced materials (nanotechnology). Comparatively, the Saxony Länder accounts for a higher number of patents which are related to advanced materials than nanotechnology. Among the Austrian regions, only Styria recorded significant patenting activity in the area of advanced materials which is comparable with that of Poland as the entire country. However, Styria has not specifically identified the area of advanced materials (nanotechnology) among its RIS3 priorities. Overall, the patenting activities in the area of advanced materials are limited except in Poland and Slovenia. It is also important to note that the RIS3 of the latter does not make a direct reference to this thematic area.

As far as the nanotechnology is concerned hardly any patents could be found in the CEECs. As presented in Table 33, the patenting activities have been concentrated in Slovenia and the Czech Republic. The recent trends indicate to the increased activities in the area of nanotechnology in Poland.

Table 33 Overview of patenting activities in the area of advanced materials and nanotechnology in 2011

Regions/Countries	*KET area*	*Number of Patents*
Bavaria	Advanced materials	221
Saxony	Advanced materials	31
Bavaria	Nanotechnology	19
Styria	Advanced materials	19
Poland	Advanced materials	18
Slovenia	Advanced materials	13
Czech Republic	Advanced materials	6
Slovak Republic	Advanced materials	5
Hungary	Advanced materials	5
Saxony	Nanotechnology	4
Czech Republic	Nanotechnology	4
Slovenia	Nanotechnology	2
Poland	Nanotechnology	2
Styria	Nanotechnology	1

Regions/Countries	*KET area*	*Number of Patents*
Hungary	Nanotechnology	1
Burgenland	Nanotechnology	0
Burgenland	Advanced materials	0
Slovak Republic	Nanotechnology	0
Croatia	Nanotechnology	0
Croatia	Advanced materials	0

Source: KETs Observatory.

Table 34 Patent applications in nanotechnology during the period 2011-2012

Countries/Regions	*Year*	*Patents*	*Year*	*Patents*
Bavaria	2011	19,5	2012	20,9
Saxony	2011	7,4	2012	6,3
Slovenia	2011	4,9	2012	0,7
Czech Republic	2011	4,0	2012	0,5
Hungary	2011	2,0	2012	1,0
Poland	2011	1,2	2012	8,1
Slovak Republic	2011	0,0	2012	1,0
Croatia	2011	0,0	2012	0,0
Burgenland	2011	0,0	2012	0,0
Styria	2011	0,0	2012	0,0

Source: OECD REGPAT Database.

5.4 Midstream and downstream dimension of the innovation value chains (Clusters and Industry)

5.4.1 Key economic operators in the area of advanced materials and nanotechnology

Table 35 List of economic operators in the field of advanced materials and nanotechnology

Clusters/Firms	*Countries/Regions*
Plastics Cluster Burgenland A list of all member companies of the Plastics Cluster Burgenland is available under the following link: http://www.kunststoff-burgenland.at/pages/en/partner-companies.php The Unger Steel Group	Burgenland
A2LT – Austrian Advanced Lightweight Technology Platform AMAG Austria Metall AG, BöllhoffGmbH, EK Design, ENGEL AUSTRIA GmbH, Engineering Center Steyr GmbH, FACC AG, FH OÖ (F&E GmbH), FILL GmbH, FroniusGmbH, Gabler Band, KVT Fastening, LKR Ranshofen/ AIT, MAGNA, MARK Hydraulik GmbH, Montanuniversität Leoben, PanklRacing Systems, Peak Technology GmbH, POLYTEC Group, RübigGmbH, Siemens IndustrySoftware GmbH, TeufelbergerGmbH, TCKT - Transfercenter für Kunststofftechnik, TripanLeichtbauteile Wimmer GmbH, voestalpine AG.	Styria

Clusters/Firms	*Countries/Regions*
The organisation profiles for each member are available under the following link. http://www.a2lt.at/files/Kompetenzlandkarte_A2LT_021015.pdf	
The Cluster New Materials; MAI Carbon	Bavaria
Cluster of Excellence MERGE; MaliTec – Solutions for Technical Textiles; TeMaK	Saxony
Synaptise SA; CoMIn Sp. z o. o. (Coordination and Management in Innovations) /Polskie Centrum Fotoniki i Światłowodów; Dekor Plastics Sp. z o.o.; InfoSCAN S.A.; Saule Technologies; Qwerty; 3D-nano; ZM „ Mesko" S.A; Boryszew Automotive Plastics; WSK „PZL-Rzeszów" S.A.; WIELTON S.A.; Sanitec KOLO; Fundacja Wspierania Nanonauk i Nanotechnologii NANONET; ABB, Korporacyjne Centrum Badawcze; Dolnośląski Klaster Nanotechnologii; EDC GE Aviation Systems; Grupa LOTOS; Agencją Rozwoju Regionalnego Agroreg S.A; BORYSZEW SA; PKN Orlen; ZM SILESIA SA; BIPROMET S.A.; Centrum Badań i Rozwoju Technologii dla Przemysłu S.A.; IMPEXMETAL SA, HUTA ALUMINIUM KONIN The full list is available under the following links: http://www.smart.gov.pl/pl/specjalizacje/kis16 http://www.smart.gov.pl/pl/specjalizacje/kis13 http://www.smart.gov.pl/pl/specjalizacje/kis10	Poland
Aluminium producer ZSNP; Fagor Ederlan Slovakia; a.s.; Sapa Profily, a.s., or Thermosolar, s.r.o.; US Steel Košice	Slovak Republic

Source: Own based on the documentary review.

5.4.1.1 Austria

5.4.1.1.1 Burgenland

Members of the Plastics Cluster Burgenland (Kunststoff-Cluster) offer jobs to approx. 2,000 employees.[55]

MARETO Kunststoffverarbeitung GmbH is a young company of the TUPACK Verpackungen group which is one of the world largest producers of plastic tubes for the cosmetic and the pharmaceutical industry. It carries our research and development of new plastic materials, printing techniques, new packaging solutions and quality assurance procedures.[56]

The Unger Steel Group is one of the leading manufacturing companies specialised in steel construction.[57]

5.4.1.1.2 Styria

A2LT – Austrian Advanced Lightweight Technology Platform.[58] It is a cooperative initiative of Automotive-, Mechatronics-, Plastics-Cluster, the industry division of the Economic Chamber of Upper Austria and the Automotive Cluster Styria. Materials cluster Styria GmbH is another concrete example of cooperation of between science and industry in the field of material science.[59]

[55] See: http://www.kunststoff-burgenland.at/pages/en/plastics-cluster.php

[56] See: http://www.mareto.at/index_e.html

[57] See: http://www.ungersteel.com/en

[58] See: http://www.a2lt.at

[59] See: http://www.materialscluster.at/

5.4.1.2 Germany

5.4.1.2.1 Bavaria

The Cluster New Materials (Cluster Neue Werkstoffe)[60] brings together some 360 companies.

The Leading-Edge Cluster initiative MAI Carbon[61], which was founded at the suggestion of Carbon Composites e.V. (CCeV) aims to make the substance carbon fit for serial production and to turn the Munich-Augsburg-Ingolstadt region into a European competence centre for CFRP lightweight construction.

According to the BMBF Competence atlas, "Nanotechnology in Germany" of Bavaria is ranked on the second position following NRW. Altogether there 169 companies (of which 118 SMEs) undertaking activities related to nanotechnology.

5.4.1.2.2 Saxony

Industrial applications primarily in the textile and clothing industry, the mechanical and plant engineering, semiconductor and microsystems technology, the automotive and automotive industry, the aerospace engineering, steel and wood construction and biomaterials and medical engineering.

A cluster of Excellence MERGE is the Germany's first and only Federal Cluster of Excellence in the field of lightweight structures.[62]

The Saxony's networks relevant in the field of advanced materials include MaliTec and TeMaK.

MaliTec – Solutions for Technical Textiles (2005-2008).[63]

TeMaK is a corporate alliance for the processing of lightweight materials based on magnesium alloys. The partner organisations are listed under the following link.[64]

Dresden has established itself as a venue for international exhibitions and conferences. These include the SEMICON Europa / Plastic Electronics as well as the Congress Nanofair with strong materials and energy focus.

5.4.1.3 Poland

See the table above.

Table 36 summarises the information the concentration of activities in the area of advanced materials and nanotechnology.

5.4.1.4 Slovak Republic

In the region of the Central Slovakia – the Banská Bystrica self-government region (Žiar nad Hronom) an aluminium processing cluster is developing. Aluminium producer ZSNP in Žiar nad Hronom. Banská Bystrica Region there is the second significant cluster operating in the area of production and processing of metals.

[60] See: http://www.bayern-innovativ.de/f5a07e2d-c9b1-7413-3e41-c62c7c7da7f2?Edition=en

[61] See: http://carbon-composites.eu/en

[62] See: https://www.tu-chemnitz.de/MERGE/index.php

[63] See: http://www.unternehmen-region.de/de/1034.php

[64] See: http://www.temak-plus.de/index.php/das-netzwerk

Table 36 Concentration of economic activities in the area of advanced materials and nanotechnology

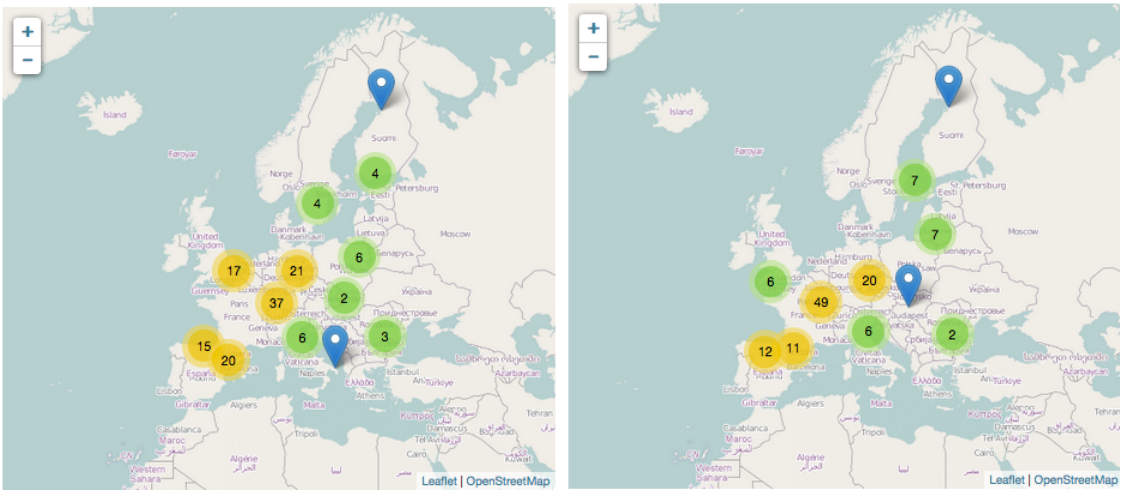
Regions/Country	***Indication of the concentration of economic activities***	***Overall assessment***
Styria	Leading companies involved in the activities of the A2LT Platform from the Automotive Cluster Styria	The moderate concentration of companies driving the development of these technologies.
Burgenland	Members of the Plastics Cluster Burgenland offer jobs to approx. 2,000 employees.	Low concentration of companies driving the development of these technologies.
Bavaria	Altogether some 360 companies involved in the activities of the Cluster New Materials.	A significant concentration of companies driving the development of these technologies.
Saxony	Some 35 Industrial Board Members of the Cluster of Excellence MERGE	The moderate concentration of companies driving the development of these technologies.
Poland	Information not available. The average size of advanced materials (nano) clusters is max. 15 companies.	Low concentration of companies driving the development of these technologies.
Slovak Republic	Developing aluminium processing cluster, in addition to cluster in the area of production and processing of metals.	Low concentration of companies driving the development of these technologies.

Source: Own assessment based on the documentary review.

The Figure 3 below shows the SMEs services providers in the area of advanced materials and nanotechnology. This does not provide a complete picture but confirms the general situation regarding existing capacity and potential of cooperation in these key enabling technologies.

Figure 3 SMEs' access to Key Enabling Technologies – Advanced materials and nanotechnology

Advanced Materials **Nanotechnology**



Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 6 contains a full list of organisations.

5.5 Summary assessment

This TPA is an interdisciplinary area, spanning the physics, engineering applications, and manufacturing processes. It also encompasses nanotechnologies which involve designing and producing objects or structures on the level of 100 nanometers or less. By the existing evidence, it is hard to pinpoint the exact sub-areas and topics of potential cooperation between the partner organisations from CE. This will require the organisation of a series of targeted match-making events with the involvement of relevant stakeholders interested in exploring opportunities to develop new industrial applications within this thematic area with a clearly defined focus.

Based on the available data, it can be confirmed that the potential of cooperation in the area of advanced materials (nanotechnology) is the highest between Germany and Poland. This relatively better performance is recorded in all three dimensions of the innovation value chains, i.e. research and technology capabilities, patenting activity and presence of clusters and economic operators.

Primarily, the topics of interest for stakeholders from Bavaria include a number of specific technologies related to lightweight construction, characteristics and processing of polymers, fiber-reinforced composites, materials for printed electronics, technical ceramics and glasses, functionalized surfaces, technical textiles, carbon fibre reinforced polymer, in addition to activities related to nanotechnology.

The interests of Germany's first and only Federal Cluster of Excellence in the field of lightweight structures, namely MERGE Cluster of Excellence are around topics such as thermoplastics and technologies related to multifunctional lightweight structures. Recently, MERGE Cluster in cooperation with partner organisations from other EU countries has submitted a proposal in response to a call under H2020 – INNOSUP to establish and develop European Lightweight Cluster Alliance (ELCA) which brings together partners from France, German, France, Italy, Spain, Sweden and the UK.

In Poland, specific technologies that are mentioned within the three priorities in the area of advanced materials and nanotechnology range from photovoltaics and other alternative sources of energy; personal electronics and intelligent textiles; multi-composite materials and nanostructured ultra-light and ultra-resistant materials; advanced materials and nanotechnology for products with high value-added as well as for process industries to the re-use of core materials for chemical industries, cement, construction and road, etc. Specifically, concerning nanotechnology industrial applications, it is important to note the activities undertaken by members of the Silesian NANO Cluster. Among its core areas of interests are carbon materials in which some cluster members are quite strong, functional composites and lightweight material, antibacterial nanomaterials and applications, metal, polymer, ceramic coating, functional materials, nanomaterials, and processing, etc.

Metallic materials and metallurgical manufacturing constitute an important area of activities. Established in 2014, Metallurgy Europe is a seven-year EUREKA Cluster Programme with the ambition of developing and industrialising the next-generation of this type of materials. The Metallurgy Europe partners focus on the following R&D topics:

- Light alloys and metal-matrix composites;
- High-temperature extreme alloys and composites;
- New and improved steels;
- Advanced superconductors;
- High-ZT thermoelectric alloys;
- Biocompatible metallurgy;
- Metal-based 3D micro-parts & embedded sensors;
- Automated additive manufacturing;
- Combinatorial alloy development;
- Coatings & Surface protection;

- Powder metallurgy techniques;
- Predictive modelling and advanced characterisation; and
- Recycling, refinement, re-use and waste elimination.

The relevant actors from the Czech Republic, Slovenia and Styria, could also be mobilised to explore the possibilities of establishing cooperation in this thematic area, even though advanced materials (nanotechnology) is not specifically identified as one their RIS3 priorities. This can be substantiated by the existing evidence which points to the involvement of the stakeholders from the Czech Republic in the FP7 projects, the extent of patenting activities in Slovenia and the developing network of relevant economic operators in Styria.

As noted in the RIS3 Strategy of the Czech Republic, the country has mainly been historically successful in thematic priorities ICT, Nanosciences, nanotechnologies, materials and new production technologies (NMP), and within these priorities, the Czech Republic reports the significant involvement of companies. For example, the Technical University of Liberec – Institute for Nanomaterials, Advanced Technologies and Innovation have become well-known due to its international patent for the industrial manufacture of nanofibers and patented industrial technology for nanofibre production, which has been successfully commercialised by the company Elmarco under the name Nanospider™ technology.[65] The Institute carries out research related to the environmental application of nanomaterials and demonstrates capacity in other domains including the development of advanced engineering constructions and technologies, in particular, mechatronic systems, propulsion units and other components of machines and vehicles as well as progressive methods for the processing of new materials.

In Slovenia, the two main focus areas and technologies are a) Sustainable production technologies in metallurgy and b) multi-component smart materials and coatings. According to the RIS3 strategy, certain initiatives and international connections have already been established in the field of development and use of nanomaterials in cooperation with partners from the Netherlands, Belgium, Israel and Sweden. Also, some 25 initiatives in the area of materials have been identified during the entrepreneurial discovery process, and the total value of the investment is estimated at €850 million.

In the framework of the A2LT -Austrian Advanced Lightweight Technology[66], which is a cooperative initiative of Automotive-, Mechatronics-, Plastics-Cluster, the industry division of the Economic Chamber of Upper Austria and the Automotive Cluster Styria, the following co-operation themes were developed by partners for funding joint solutions and thus could constitute examples of possible cooperation topics with other CE countries/regions:

- Corrosion at hybrid solutions;
- mechanical processing of fibre-reinforced composites and hybrid solutions;
- the production process of thermoplastics composites;
- fastening process for metal and composites;
- material characterisation at the glueing process;
- detection of composites fatigue failures;
- lightweight solutions with wires;
- a hydraulic cylinder as a lightweight solution;
- improvement of the CFK-filament wounding; and
- alternative filament systems (ceramic/metal filaments).

[65] See: http://www.elmarco.com/electrospinning/electrospinning-technology

[66] See: http://www.a2lt.at

In conclusion, the direct impact of enhanced cooperation on the employment is not expected to be significant. Nevertheless, the thematic area of advanced materials (nanotechnology) is intertwined with other sectoral activities (e.g. monitoring oil/water quality through the application of nanomaterials and MEMS technology), and it is closely related to the automotive and aerospace sector which are part of the analysis in the following section. This means that the potential impact of cooperation will be in fact greater than the potential gains to be achieved by the group of companies driving the development of these technologies. Although the supply of advanced materials looks promising a challenge lying ahead is to lower the production costs which will require efforts of international cooperation. It is also important to note that the thematic knowledge and experience does not represent a source of competitiveness unless it is used creatively for developing specific industrial applications defined by the private sector needs. The public procurement ought to be also considered as it offers new opportunities and the public sector can play a role of the launching customer.

Increasing awareness of the opportunities and potentials of these new technologies requires the involvement of the business sector, in addition to the key scientific research institutions as presented below.

Styria

- MCL - Materials Centre Leoben
- PCCL - Polymer Competence Centre Leoben
- Erich Schmid Institute of Materials Science

Bavaria

- Fraunhofer Institut für Silicatforschung
- Neue Materialien Bayreuth GmbH
- Neue Materialen Fürth GmbH
- SKZ - German Plastics Centre, including Universität Bayreuth, Universität Erlangen-Nürnberg, der Georg-Simon-Ohm Hochschule Nürnberg, and den Hochschulen für angewandte Wissenschaften München und Rosenheim

Saxony

- CeWOTec Chemnitzer Werkstoff- und Oberflächentechnik
- Sächsisches Textilforschungsinstitut
- Cetex Institut für Textil- und Verarbeitungsmaschinen gemeinnützige GmbH
- Technische Universität Dresden, Institut für Leichtbau und Kunststofftechnik (ILK)
- „Materialforschungsverbund Dresden“(MFD)
- Leibniz-Institut für Festkörper und Werkstoffforschung (IFW)
- Leibniz-Institut für Polymerforschung (IPF)
- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Fraunhofer-Institut für Keramische Technologien und Systeme (IKTS)
- Fraunhofer-Institut für Werkstoff- und Strahltechnik (IWS)
- Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (IZFP)
- Fraunhofer Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM)
- Max-Planck-Institut für chemische Physik fester Stoffe (CPfS)
- Leibniz-Institut für Festkörper und Werkstoffforschung

- IMA – Materialforschung und Anwendungstechnik GmbH
- Helmholtz-Institut Freiberg für Ressourcentechnologie (HIF)
- Technologiezentrum Halbleitermaterialien (THM)
- FNE Forschungsinstitut für Nichteisen-Metalle
- FILK Forschungsinstitut für Leder und Kunststoff
- Leibniz-Institut für Oberflächenmodifizierung
- Kunststoffzentrum Leipzig
- Fraunhofer-Institut für Elektronische Nanosysteme ENAS
- Kompetenznetzwerk für Nanosystemintegration, Chemnitz (Gemeinschaftsprojekt der Technischen Universität Chemnitz mit drei Fraunhofer-Instituten, drei Institute der Leibniz-Gemeinschaft sowie einem Institut der Helmholtz-Gemeinschaft)
- Fraunhofer-Center Nanoelektronische Technologien IPMS-CNT
- Nanoelectronics Materials Lab (NaMLab)
- Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW)

It is also important to mention research networks, such as Dresdner Fraunhofer-Cluster Nanoanalytik[67] and the ECEMP - European Centre for Emerging Materials and Processes Dresden.[68]

Poland

- Silesian University of Technology (Faculty of Materials Engineering and Metallurgy)
- The University of Silesia (Faculty of Computer Science and Materials Science)
- The Centre of Polymer and Carbon Materials (CMPW) of the Polish Academy of Sciences (PAN)
- Institute of Non-Ferrous Metals – IMN (Centre of Metals Processing and Metallic Composites)
- Institute of Chemical Engineering of the Polish Academy of Sciences (PAN)
- Stanislaw Staszic Institute for Ferrous Metallurgy
- Polish Welding Centre of Excellence (Accredited Research Laboratory of Welding)
- Various scientific research institutions from Warsaw, Cracow, Wroclaw, and Lodz

Slovak Republic

- Slovak Academy of Sciences R&D Centre INOVAL

[67] See: http://www.nanoanalytik.fraunhofer.de/en.html

[68] See: https://tu-dresden.de/die_tu_dresden/fakultaeten/fakultaet_maschinenwesen/ilk/forschung/forschung/grossprojekte/ecemp/das_ecemp/index_html

6 Transport and mobility

6.1 Policy priorities

6.1.1 Brief overview of the priority area

The transport and mobility area has been on the agenda of the majority of Central European countries and recognised as such as the RIS3 priority. There is only no indication that this specific thematic area is identified as a priority in the RIS3 strategies of the two German Länders (i.e. Bavaria and Saxony) and Burgenland. At the level of policy priorities, it is found that there is a considerable potential for cooperation within this specific area in Central Europe.

Table 37 Overview of Central European countries and regions with transport and mobility identified as RIS3 priority

Countries	No. of regions	Regions	Descriptions
Austria	national	National level	Mobility
Austria	1	Styria	Mobility
Croatia	national	National level	Transport and mobility
Czech Republic	national	National level	Transport means (automotive, aerospace, including connected ecosystem of supplying and supporting industries).
Hungary	national	National level	Advanced technologies in the vehicle and other machine industries
Poland	national	National level	Environmentally friendly transport solutions
Slovak Republic	national	National level	Automotive & Mechanical Engineering industries
Slovenia	national	National level	Mobility - developing demanding and complex energy-efficient products with higher value added, consistent with the new EU standards in the field of transport emission reductions (EURO 6c, EURO 7) and in the field of security (EURO NCAP) - incl. niche components and systems for internal combustion engines, E-mobility and energy storage systems, systems and components for security and comfort (interior and exterior), and materials for the automotive industry.

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

6.1.2 Thematic focus and the main EU networks

6.1.2.1 Focus areas and technologies

In **Austria,** one of the priorities set out by the National Research Promotion Agency (FFG) is related to the thematic area of mobility. The Mobility of the Future is a mission-oriented research and development programme to help Austria create a transport system designed to meet future mobility and

social challenges. The programme duration is from 2012 until 2020, and the annual budget is estimated at some €15 million.[69] Considered as the "Green Heart" of Austria, **Styria** is viewed to be the ideal location for corporate and public activities regarding future concepts for a cleaner and sustainable mobility.

In **Croatia**, one of the five key thematic priority areas identified in its S3 strategy concerns transport and mobility. Within this priority area, the following four sub-thematic areas are defined: (1) green transport with main RDI topics: green boats and vehicles, alternative drive technologies, low emission vehicle power train; (2) advanced vehicle structures with main RDI topics: complex and custom-made manufacturing, specialized boats and special purpose ships, advance production of parts for automotive industry; (3) smart, safe and intelligent transport system with main RDI topics: technology-assisted drive ("drive by wire"), surveying graphics systems with wide range of applications, smart management systems for security processes, integrated electric transport systems and infrastructure, smart and secure mobility and logistics, sustainable mobility plan and (4) innovative transport and logistics services.

In the **Czech Republic,** one of the established innovation platforms is dealing with manufacturing of transport equipment. The use of latest electronics and many electrical engineering components in the automotive sector reflecting the global trends is mentioned in the RIS3 strategy.

In **Hungary,** advanced technologies in the vehicle and other machine industries is a priority area that covers several segments of the machine industry RDI. The main objective (but not exclusively) is to develop the vehicle industry from the development of vehicle components to the different branches of machine production (including, but not limited to, agricultural, food processing, precision and household machinery).

In **Poland**, within the priority area of environmentally friendly transport solutions the focus has been placed on the following sub-areas, such as innovative means of transport; eco-friendly construction solutions and components in the modes of transport; transport management systems; innovative materials in the modes of transport; and innovative production technologies in the modes of transport and their components.[70]

In the **Slovak Republic**, the "Automotive and mechanical engineering industries" (vehicle and machine industries) is identified as one of the strategic priorities. It is expected that by 2020, sub-supplier companies operating in the automotive industry and other sectors will be reflecting the global trends, and there will be higher involvement in cooperation with MNC. By developing a new strategic segmentation, it will be possible to rebuild of own value chains, exploiting new market opportunities (niche markets) and opening new markets, according to the RIS3 strategy.

In **Slovenia**, the following focus areas and technologies are identified within the priority area of mobility, including niche components and systems for internal combustion engines; E-mobility and energy storage systems; systems and components for security and comfort (interior and exterior); in addition to materials for the automotive industry.

The RIS3 strategy also points to the interdisciplinary character of the auto industry. It is directly intertwined with the metal processing industry, electrical engineering industry, tool industry and mechanical engineering industry. To this end, a wide range of cooperation with public research and educational sectors has been established. It is also important to note the recently launched so-called "Strategic Partnerships at the level of the individual specialisation domains.

[69] See: http://www.bmvit.gv.at/bmvit/en/service/publications/downloads/mobility_of_the_future.pdf

[70] See: http://www.smart.gov.pl/pl/specjalizacje/kis9

6.1.2.2 Cooperation with the EU-level networks

Concrete examples of the existing networks in this specific thematic area at the EU level are outlined below:

- Advisory Council for Aviation Research and Innovation in Europe - ACARE;
- Alliance for Logistics Innovation through Collaboration in Europe - ALICE;
- Clean Sky 2 (CS2);
- European Green Vehicles Initiative PPP;
- European Rail Research Advisory Council – ERRAC.
- European Road Transport Research Advisory Council;
- European RTD-Cluster on Lightweight Design – SEAM;
- European Technology Platform – WATERBONE;
- Shift2Rail; and
- Single European Sky ATM Research (SESAR) 2020.

6.2 Upstream dimension of the value chains (Research and technology capabilities)

6.2.1 Analysis of FP7, H2020 projects

The intensity of participation of countries and regions (measured by the number of participants in FP7 projects funded under Priority area 'Transport including Aeronautics') which identified the transport and mobility to be among their RIS3 priorities reached a comparable level (see Table 38 The only exception is Bavaria that is clearing taking a lead in comparison with other countries and regions of Central Europe, however, it has not explicitly identified the transport and mobility to be among its RIS3 priority areas.

This finding is confirmed by the results of analysis of EC contributions presented in Table 39 below. The only notable difference is that Styria accounts for the considerable amount of co-financing, and it is placed in the second position, following Bavaria. It means that the funding per participant is on average higher among the Central European countries and regions.

Table 38 Participation in FP7 projects in the area of transport and mobility

Countries/Regions	***Number of participants***
Bavaria	180
Poland	107
Czech Republic	58
Hungary	49
Styria	38
Slovenia	35
Saxony	22
Croatia	20
Slovak Republic	18
Burgenland	1

Table 39 Funding of FP7 projects in the area of transport and mobility

Countries/Regions	***EC contributions***
Bavaria	62.994.336
Styria	13.413.261
Poland	13.106.046
Czech Republic	9.722.151
Slovenia	6.783.664
Saxony	6.551.603
Hungary	6.023.511
Croatia	4.470.387
Slovak Republic	1.748.893
Burgenland	382.658

Source: Own based on the E-CORDA database.

The table below clearly shows that the overall capacity to coordinate FP7 projects in the area of transport by stakeholders from the CEECs is limited. In the case of Styria, the two organisations that most frequently played a role of coordinator were namely: TeleConsult Austria GmbH (specialised in the field of precise positioning and reliable navigation, particularly the areas of development and combination of navigation, telecommunication, and information technologies, and services for applications in the context of transport and mobility); and AVL LIST (specialised in the development of powertrain systems with internal combustion engines as well as instrumentation and test systems).

Table 40 Coordinators of FP7 projects in the area of transport and mobility

Organisations	***Regions/Countries***	***Number of projects coordinated***
AIRBUS DEFENCE AND SPACE GMBH	Bavaria	5
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	9
ANWENDUNGSZENTRUM GMBH OBERPFAFFENHOFEN	Bavaria	1
IFEN GESELLSCHAFT FUR SATELLITENNAVIGATION MBH	Bavaria	1
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	Bavaria	1
SIEMENS AKTIENGESELLSCHAFT	Bavaria	1
UNIVERSITAET DER BUNDESWEHR MUENCHEN	Bavaria	1
ULEME E.E.I.G	Bavaria	1
MAN DIESEL & TURBO SE	Bavaria	1
TeleConsult Austria GmbH	Styria	2
AVL LIST GMBH	Styria	2
TECHNISCHE UNIVERSITAET GRAZ	Styria	1
SLOT CONSULTING LTD	Hungary	3
REGIONAL ENVIRONMENTAL CENTER FOR CENTRAL AND EASTERN EUROPE -REC	Hungary	1

Organisations	*Regions/Countries*	*Number of projects coordinated*
INSTYTUT LOTNICTWA	Poland	1
INSTYTUT LOGISTYKI I MAGAZYNOWANIA	Poland	2
INSTYTUT MASZYN PRZEPLYWOWYCH IM ROBERTA SZEWALSKIEGO POLSKIEJ AKADEMII NAUK - IMP PAN	Poland	1
ZAVOD ZA GRADBENISTVO SLOVENIJE	Slovenia	1
MUNICIPALITY OF LJUBLJANA	Slovenia	1
ZILINSKA UNIVERZITA V ZILINE	Slovak Republic	1

Source: Own based on the E-CORDA database.

According to the latest available data (see Annex 7), the majority of H2020 projects funded under the Priority area 'Societal Challenges - Smart, Green and Integrated Transport' involved one or two countries from Central Europe. The results show that three Central European Countries were involved in the total number of 11 projects and in the case of six projects the participation reached to four countries from Central Europe.

6.3 Midstream and downstream dimension of the value chains (Industry)

6.3.1 Key economic operators in the area of transport and mobility

Table 41 List of economic operators in the area of transport and mobility

Clusters/Firms	*Countries/Regions*
ACstyria Autocluster	Styria
Končar Electric Vehicles Inc.; Gredelj Rolling Stock Factory; Đuro Đaković Transport; AVL ltd.; ALTPRO ltd; HSTEC; Rimac Automobili, DOK-ING; Maritime competitiveness cluster; Pro Rail Alliance; Telegra d.o.o.; TEB Automatika; PLC; HMI; SCADA systems; LED Elektronika; TEB Informatika; ZG Projekt d.o.o.; Promel d.o.o.; Ericsson Nikola Tesla; and ORYX	Croatia
Škoda Auto; Hyundai Motor Manufacturing Czech; Toyota Peugeot Citroën Automobile; SOR Libchavy; Iveco Czech Republic; ŠKODA ELECTRIC; TATRA TRUCKS a.s., etc. The full list is available at the following link: http://www.czechinvest.org/en/1automotive-industry	Czech Republic
AGC Glass, Alpine; Apollo Tyres; Audi; Autolive; AIPA Regional Industry Development Cluster, etc. The full list is available at the following link: http://hipa.hu/media/12871/hipa_automotive_in_hungary.pdf	Hungary
Boryszew S.A.; Inteco S.A.; Tenneco Automotive Polska Sp. z o.o.; Centrum Techniki Okrętowej S.A.; Faurecia Grójec R&D Center S.A.; Sanden Manufacturing Poland Sp. z o.o.; Melex Sp. z o.o.; Klaster Logistyczno –Transportowy „Północ Południe"; Staropolska Izba Przemysłowo-Handlowa w Kielcach / PKS w Ostrowcu Św. S.A.; Kapsch Telematic Services Sp. z o.o.; Solaris; Jelcz; Pesa; Silesia Automotive Cluster; Jhonson Controls / KEIPER Polska Sp. z o.o.; Kamex Spółka z o.o.; FAMAD Sp. z o.o. Fabryka Maszyn i Urządzeń Przemysłowych; Euro-Track-Nysa; HP Polska; Johnson Controls Sp. z o.o.; Ficomirrors Polska; GST AUTOMOTIVE SAFETY POLAND, etc. The full list is available under the following links: http://www.paiz.gov.pl/files/?id_plik=26196 http://coi.opolskie.pl/wp-content/uploads/2015/11/Automotive-in-Opolskie-Region-suppliers-list.xlsx	Poland

Clusters/Firms	*Countries/Regions*
Volkswagen Slovakia, PSA Peugeot Citroën Slovakia, Kia Motors Slovakia, the Automobile Cluster – Western Slovakia; 1st Slovak Engineering Cluster, etc. The full list is available at the following link: http://www.sario.sk/sites/default/files/content/files/automotive_industry_0.pdf	Slovak Republic
Adria Mobil; Agis zavore; Akrapovic; Boxmark Leather / Unicut; Carthago / Carthago Reisemobilbau; CECOMP / CECOMP; Cimos; Domel; Ebm-papst Slovenija / EBM Papst; Filc; GKN Driveline Slovenija / G.K.N. Industries; etc. The full list is available at the following link: http://www.investslovenia.org/industries/automotive	Slovenia

Source: Own based on the documentary review.

6.3.1.1 Austria

6.3.1.1.1 Styria

The Network of Styria's automotive industry is the ACstyria Autocluster with some 220 highly innovative partners in the field of clean mobility focus on ECO powertrains, ECO materials and ECO design as well as smart production.[71]

6.3.1.2 Croatia

On the Croatian market are companies that have successfully integrated into the system of supplying spare parts for the world's top automobile manufacturers (PSA, GM, Fiat, BMW, Audi, Ford, Renault, Toyota, Volvo, etc.). Croatia also boasts the production of electric cars XD (DOK-ING and Concept One – Rimac Automobili).[72]

6.3.1.3 Czech Republic

With passenger car production at 107.5 vehicles per 1,000 persons, the Czech Republic has maintained its supreme position among world automotive leaders regarding per-capita output. It is also among the fifteen largest global passenger car producers by volume. The Czech automotive industry employs more than 150,000 people and accounts for more than 20% of both Czech manufacturing output and Czech exports.[73]

The Innovation Platform on Manufacturing of Transport Equipment mentioned in the RIS3 strategy is a possible source of further information.

6.3.1.4 Hungary

The automotive sector is one of Hungary's leading industries, accounting for 20% of total exports. The number of TIER1 and TIER2 equipment manufacturers is continually rising: since the early 1990s several OEMs, such as Suzuki, Audi, General Motors and Daimler as well as 43 of the top 100 global OEM parts suppliers are present in Hungary.[74]

6.3.1.5 Poland

The cluster Silesia Automotive & Advanced Manufacturing was established in 2011 and covers three regions in the Southern part of Poland: Sląskie, Małopolskie and Opolskie. More than 230 companies

[71] See: http://www.acstyria.com/de/index.php

[72] See: http://www.aik-invest.hr/en/sectors/automotive-industry

[73] See: http://www.czechinvest.org/en/1automotive-industry

[74] See: http://hipa.hu/en/key-sectors/automotive-industry

are active in the automotive sector in this area, of which 45 are official cluster members of Silesia Automotive.[75]

6.3.1.6 Slovak Republic

Among the important activities of modern automotive industry, development can be listed not only the construction of the latest automotive plants with the latest technologies but also the first initiatives in the development of e-Mobility in Slovakia.[76]

6.3.1.7 Slovenia

The most recent industry trend favours large system suppliers capable of developing and manufacturing entire vehicle assemblies, sub-assemblies of whole vehicles. It accounts for 16,000 direct automotive employment in some 250 companies.[77] A strategic partnership has already been established in the area of Mobility which will have to be further strengthened – it is a possible source of further information. The table below presents the information about the concentration of activities in the area of transport and mobility.

Table 42 Concentration of economic activities in the area of transport and mobility

Regions/Countries	***Star clusters***	***Indication of the concentration of economic activities***	***Overall assessment***
Styria	Automotive (2) Mobility technologies (2)	Share of employment in NACE 29 - manufacturing of motor vehicles (8.7%) and in NACE 30 – manufacturing of other transport equipment (0.2%) Some 220 companies and research organisations involved in the activities of the ACstyria Autocluster.	A significant concentration of companies specialised in this area of activities.
Croatia	Transportation and logistics (2) Water transportation (2)	Share of employment in NACE 29 - manufacturing of motor vehicles (0.8%) and in NACE 30 – manufacturing of other transport equipment (4.9%) The automotive industry is almost entirely composed of the parts suppliers. As for the Croatian industry of rail vehicles, significant production potential exists in several firmly established companies which, together, employ approximately 1100 employees. Croatian automotive industry employs 2,103 people.	Low concentration of companies specialised in this area of activities.
Czech Republic	Automotive (3-2) Mobility technologies (2)	Share of employment in NACE 29 - manufacturing	A significant concentration of

[75] See: http://www.silesia-automotive.pl

[76] See: http://www.sario.sk/en/invest/sectorial-analyses/automotive-industry

[77] See: http://www.investslovenia.org/industries/automotive

Regions/Countries	*Star clusters*	*Indication of the concentration of economic activities*	*Overall assessment*
	Aerospace vehicles (3-2)	of motor vehicles (11.8%) and in NACE 30 – manufacturing of other transport equipment (1.7%) The Czech automotive industry employs more than 150,000 people and accounts for more than 20% of both Czech manufacturing output and Czech exports.	companies specialised in this area of activities.
Hungary	Automotive (3-2) Mobility technologies (2) Transportation and logistics (2)	Share of employment in NACE 29 - manufacturing of motor vehicles (11.3%) and in NACE 30 – manufacturing of other transport equipment (0.7%) Around 700 companies, employing approximately over 140,000 people.	A significant concentration of companies specialised in this area of activities.
Poland	Automotive (3-2) Mobility technologies (3) Aerospace vehicles (2) Transportation and logistics (3-2) Water transportation (3-2)	Share of employment in NACE 29 - manufacturing of motor vehicles (6.7%) and in NACE 30 – manufacturing of other transport equipment (1.8%) More than 230 companies are active in the automotive sector in Southern Poland.	A significant concentration of companies specialised in this area of activities.
Slovak Republic	Automotive (3-2) Mobility technologies (2) Transportation and logistics (3)	Share of employment in NACE 29 - manufacturing of motor vehicles (13.9%) and in NACE 30 – manufacturing of other transport equipment (1%)	A significant concentration of companies specialised in this area of activities.
Slovenia	Information not available	Share of employment in NACE 29 - manufacturing of motor vehicles (6.5%) and in NACE 30 – manufacturing of other transport equipment (0.3%) The supply chain includes over 100 Tier 1 and Tier 2 suppliers and more than 600 lower-level sub-suppliers. Slovenia accounts for 16,000 direct employment in the automotive sector in some 250 companies.	A significant concentration of companies specialised in this area of activities.

Source: Own assessment based on the European Cluster Observatory, Eurostat (sbs_r_nuts06_r2) and documentary review.

6.4 Summary assessment

Based on the available data, it is found that the potential and scope of cooperation among the CE countries and regions which identified the transport and mobility among their RIS3 priorities is high. Overall the participation in FP7 project reached a comparable level, even though Bavaria and Styria were relatively more successful in obtaining the co- funding. While Bavaria has not identified the transport and mobility as one of its RIS3 priority; the existing evidence confirms that it plays a leading position in this area. Therefore, exploring the opportunities of cooperation with Bavaria is recommendable and worth pursuing it in the nearest future.

The potential impact of increased collaboration in the area of transport and mobility on the employment is considerable in the majority of countries mentioned above and regions and due to a lower concentration of activities in Croatia and Slovenia, less influence on the employment is expected in these countries. On the other hand, the automotive sector is characterised by strong competition in highly globalised industry and subsequently Tier 2 suppliers face high pricing pressure and are dependent on satisfying the needs of the automotive manufacturers. This situation is likely to have an impact on the potential cooperation and subsequently on the socio-economic performance in this area.

One of the major trends concerning the transition to smart and sustainable mobility is related to technological developments and innovations. According to the Clingendael Report (2016) new technologies imply electrification, particularly with hybrids, short distance (passenger) and urban transport; battery-electric vehicles will be cost competitive with conventional internal combustion engines by 2020-2030 (given the right incentives), and potential for radical technological shifts, such as the deployment of driverless vehicles in limited (infrastructure) contexts. It is also noted that many new technological innovations are already available. Thus the availability of innovative technology is not the issue. The problem is mainly due to the slow speed by which they are implemented in the marketplace.

During the preparation of the present report, we also came across the information about a number of relevant the forthcoming events:

- AUTOCONTACT conference on Future Automotive Supply Chain – Managing Complexity and Innovation organised by ACstyria Auto cluster took place on 15-16 September 2016 in Bad Radkersburg.[78] The automotive industry is one of the most complex but also the most innovative industries worldwide. Current trends such as lightweight design, digitisation, autonomous driving and Industry 4.0 pose major challenges which can only be accomplished by an appropriate cooperation along the entire supply chain. The event will bring together OEMs and automotive component suppliers who will share their know-how and experience about how to successfully compete in the market in the face of these new developments.
- Central & Eastern European Automotive Forum which will take place on 11 - 12 October 2016 in Prague. It is a high-level and networking-focused event which is targeted at auto executives, suppliers, purchasing directors, analysts and officials.[79]

In this regard, it is relevant to mention here a launch of the first call under the sectoral programme INNOMOTO in Poland. Established in 2015 by multiple stakeholders including the Automotive Industry Institute (PIMOT), Polish Chamber of Automotive Industry (PIM), the Polish Automotive Industry Association (PZPM), the Association of Distributors and the Automotive Parts Manufacturers (SDCM), the Employers' Association of Automotive and Industrial Products (ZPMiAP) and the Association of Automotive Industry Employers (ZPM), the main objective of the programme is to increase competitiveness and innovativeness of Polish automotive sector.

The focus of the INNOMOTO sectoral programme will be on the following three thematic research areas:

[78] See: http://www.autocontact.at/2016

[79] See: http://www.ceeautomotive.com

- Innovative production technologies, regeneration, recovery and recycling;
- Innovative vehicles and propulsion; and
- Innovative parts, components and systems to be used in vehicles.

The total financial allocation earmarked for projects to be funded under the first call of the programme is estimated at PLN 250m which is equivalent to about €57.5 million according to the current exchange rate.[80]

In conclusion, it is found that opportunities for cooperation lie in the three core areas (i.e. automotive, aerospace and rail systems) but mainly in the former. Primarily, the focus of cooperation should be determined by actual needs of relevant stakeholders following a bottom-up approach. Taking into account interdisciplinary character of these industries and recent developments (i.e. lightweight design, e-propulsion, use of latest electronics, and Industry 4.0) there is a clear link to other TPAs covered by the present report, namely Advanced materials and nanotechnology, Advanced manufacturing systems, ICT and electronics.

Enhancing technological and commercial exploitation requires the involvement of the business sector, in addition to the key scientific research institutions as presented below.

Styria

- FH Joanneum GmbH
- Graz University of Technology

Croatia

- Faculty of Mechanical Engineering and Naval Architecture, at University of Zagreb
- Faculty of transport and traffic Sciences, University of Zagreb
- Končar Electrical Engineering Institute
- Faculty of Engineering – University of Rijeka
- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture – University of Split
- Brodarski Institute
- Centre of Competence for internal combustion engines and motor vehicles

Czech Republic

- Technical University in Prague
- Technical University of Liberec
- University of West Bohemia, Pilsen
- Brno University of Technology
- VŠB – Technical University of Ostrava

Hungary

- Bay Zoltán Nonprofit Ltd. For Applied Research
- Budapest University of Technology and Economics
- Hungarian Academy of Sciences – Institute for Computer Science and Control

[80] Exchange rate as of September 2016: 1 EUR is equivalent to 4.3436 PLN, http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/index_en.cfm

- Jedlik Ányos Cluster
- Óbuda University
- Széchenyi István University
- University of Miskolc
- University of Pannonia

Poland

- AGH University of Science and Technology
- Instytut Lotnictwa, Engineering Design Centre
- Przemysłowy Instytut Motoryzacji
- Warsaw University of Technology
- Wroclaw University of Technology
- Rzeszow University of Technology

Slovak Republic

- The Slovak the University of Technology in Bratislava
- The Technical University in Košice, Faculty of Engineering
- University of Žilina
- University of Alexander Dubček of Trenčín

Slovenia

- University of Ljubljana, Faculty of Electrical Engineering
- University of Ljubljana, Faculty of Mechanical Engineering
- University of Maribor, Faculty of Electrical Engineering and Computer Science
- University of Maribor, Faculty of Mechanical Engineering

7 Advanced manufacturing systems

7.1 Policy priorities

7.1.1 Brief overview of the priority area

Within the area of advanced manufacturing systems, the possibilities of cooperation as documented in the table below exist between Burgenland, the two German Länders, the Czech Republic, Poland and Slovenia. As for the remaining CEECs and Saxony, it was not possible to assign the priorities presented in the EYE@RIS database to this specific thematic area.

Table 43 Overview of Central European countries and regions with advanced manufacturing systems identified as RIS3 priority

Countries	*No. of regions*	*Regions*	*Descriptions*
Austria	1	Burgenland	Industry 4.0: automation and IT networking production and logistics, digital production and 3D printing, product and process safety, control and regulating technique
Czech Republic	national	National level	Engineering industries and electrotechnical[81]
Germany	2	Bavaria Saxony	Efficient production technologies, mechatronics, automatisation & robotics Advanced production technologies
Poland	national	National level	Automation and Robotics processes
Slovenia	national	National level	SI_industry 4.0 - Smart Factories/ integrated solutions enabling companies to build competent value-chains incl. production optimisation: (distributed) production management and control, quality assurance, regulation and data processing, intra-logistics, automation; 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.

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

[81] Also mentioned within the thematic area of 'Electrotechnical and mechanical industries'

7.1.2 Thematic focus and the main EU networks

7.1.2.1 Focus areas and technologies

Bavaria is characterised by an outstanding R&D expertise in the area of production technologies, robotics, automation and automotive engineering. For example, the two concrete examples of the relevant initiatives are the Fraunhofer Project Group on Process Innovation[82] and the Fraunhofer IWU's Project Group on Resource Efficient Mechatronic Processing Machines (RMV).[83]

In **Saxony**, there are three successful projects' consortia within the Zwan - zig20 initiative, including FAST – fast actuators sensors and transceivers[84], Smart³ – materials solution growth[85], and Agent3D.[86] At the Fraunhofer Institute for Machine Tools and Forming Technology IWU, a new concept is being developed, known as "E³ Production". It is planned that the demonstrators and pilot applications will be formulated by 2016 at four sites in Germany. The "E³-Forschungsfabrik Resource-Efficient Production" was unveiled as one of these demonstrators at Fraunhofer IWU in spring of 2014. New centres of technology, production techniques and factory planning strategies are being researched for energy- and resource-efficient production in the three competence areas of "Powertrain", "Car Body Manufacturing" and "Data and Energy Management 2.0".

In **Burgenland**, advanced manufacturing is strongly addressed under the topic of "Industry 4.0" which is one theme of Burgenland's 2025 vision, as developed in the regional research, technology and innovation strategy.[87]

In the **Czech Republic**, the main focus is placed on industrial automation, communication, identification, control equipment; robotics, artificial intelligence; switching technology, circuit breakers, switches, distributors; microelectronics; analytical, metering and scientific devices; electric motors and electric rotary machines and devices; in addition to optics, optoelectronics, lasers and their applications.

In **Slovenia**, the two most important focus areas include production optimisation: (distributed) production management and control, quality assurance, regulation and data processing, intralogistics, automation; and optimisation and automation of production processes: smart machines and equipment, mechatronic systems, actuators and smart sensors. It is also important to note that one of the objectives set out by the RIS3 strategy is to increase export of automated industrial systems and equipment by at least 25% by 2023, in particular in tool industry, robotics and smart industrial mechatronic systems.

Comparatively, in **Poland,** the focus has been placed on the following sub-areas, including architecture and optimisation of processes, automation technologies and robotisation of processes, control systems, in addition to machinery and equipment for automatization and robotisation of processes.

7.1.2.2 Cooperation with the EU-level networks

Concrete examples of the existing networks in this specific thematic area at the EU level are outlined below:

- Enterprise Europe Network – sector expertise;
- euRobotics;
- European Association of the Machine Tool Industries – CECIMO;
- European Factories of the Future Research Association - EFFRA;

[82] See: http://www.lup.uni-bayreuth.de/en/fhg/index.html

[83] See: http://www.iwb.tum.de/en/Projektgruppe+RMV.html

[84] See: http://de.fast-zwanzig20.de

[85] See: http://www.unternehmen-region.de/de/7653.php

[86] See: http://www.agent3d.de/

[87] See: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/burgenland

- European Technology Platform Manu*future;* and
- The I4MS initiative (ICT Innovation for Manufacturing SMEs) with the network of Competence Centres

7.2 Upstream dimension of the value chains (Research and technology capabilities)

7.2.1 Analysis of FP7, H2020 projects

The analysis of FP projects funded under the Priority area 'Information and Communication Technologies & Nanosciences, Nanotechnologies, Materials and New Production Technologies related to Factories of the Future (FoF)' confirms the strong position of the German Länders (see Table 44 and Table 45). Due to the overall low number of FoF projects, it is not possible to appraise the potential of cooperation as indicated in the section above when discussing the policy priorities.

Table 44 Participation in FP7 projects in the area of advanced manufacturing systems

Countries/Regions	***Number of participants***
Bavaria	27
Saxony	6
Hungary	4
Czech Republic	1
Poland	1

Table 45 Funding of FP7 projects in the area of advanced manufacturing systems

Countries/Regions	***EC contributions***
Bavaria	9.981.494
Saxony	1.906.154
Hungary	807.007
Czech Republic	139.042
Poland	78.288

Source: Own based on the E-CORDA database.

The overall capacity in Central Europe of coordinating the projects in the area of advanced manufacturing systems is limited except Bavaria. Among the organisations that most frequently coordinated FP7 projects in this area was Fraunhofer (see Table 46).

Table 46 Coordinators of FP7 projects in the area of advanced manufacturing systems

Organisations	***Regions/Countries***	***Number of projects coordinated***
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	3
KUKA Laboratories GmbH	Bavaria	1
TECHNISCHE UNIVERSITAET MUENCHEN	Bavaria	1
DMG ELECTRONICS GMBH	Bavaria	1

Source: Own based on the E-CORDA database.

Annex 8 contains more detailed information about projects and beneficiaries of H2020 projects in the area of advanced manufacturing systems under the Priority area 'Industrial Leadership - Leadership in enabling and industrial technologies - Advanced manufacturing and processing'. In the majority of cases, one or two Central European countries are involved in this type of project. In comparison, there are just a few projects in which three or four countries would be involved. This indicates that the cooperation in this area takes place with the involvement of other European countries and is not specifically limited to Central Europe.

7.2.2 Geographic distribution of patents

The table below clearly shows that the two German Länders are taking a lead on patenting activities in the area of advanced manufacturing systems. Styria occupies the third place in the ranking with the number of patents that is comparable to that of Saxony. The overall patenting activity in other CEECs and Burgenland is limited, even though they have identified advanced manufacturing as their RIS3 priority areas.

Table 47 Overview of patenting activities in the area of advanced manufacturing systems in 2011

Regions/Countries	***KET area***	***Number of Patents***
Bavaria	Advanced manufacturing technologies	447
Saxony	Advanced manufacturing technologies	33
Styria	Advanced manufacturing technologies	29
Poland	Advanced manufacturing technologies	19
Czech Republic	Advanced manufacturing technologies	16
Hungary	Advanced manufacturing technologies	8
Slovenia	Advanced manufacturing technologies	7
Slovakia	Advanced manufacturing technologies	4
Burgenland	Advanced manufacturing technologies	0
Croatia	Advanced manufacturing technologies	0

Source: KETs Observatory.

7.3 Midstream and downstream dimension of the value chains (Industry)

7.3.1 Key economic operators in the area of advanced manufacturing systems

Table 48 List of economic operators in the area of advanced manufacturing systems

Clusters/Firms	***Countries/Regions***
Technology Centres (Eisenstadt, Mittelburgenland, and Jennersdorf)	Burgenland
Siemens; Kuka, Reis Robotik, Krones, König und Bauer Cluster Mechatronik & Automation; Strategische Partnerschaft Sensorik e. V. (SPS)	Bavaria
The Saxony Automotive Supplier Network (AMZ); the Mechanical Engineering Network Saxony VEMAS*innovativ*	Saxony
TOS; Kovosvit MAS; TAJMAC-ZPS; ŽĎAS; Škoda Machine Tool and Šmeral Brno; the Association of Engineering Technology, etc. The full list is available at the following link: http://www.czechinvest.org/data/files/engineering-web-1963-en.zip	Czech Republic
Polskie Zakłady Lotnicze Sp. z o.o.; SPM Poland Sp. z o.o.; BlueSoft STC Sp. z o.o; Faurecia Grójec R&D Center S.A.; ArcelorMittal Poland S.A.; WABCO Polska Sp. z o.o; 3M Poland Sp. z o.o.; 3M Wrocław Industrial Adhesive and Tapes Division, etc. The full list is available at the following link under the WG 'ROBO': http://www.smart.gov.pl/files/upload/164/skład osobowy GR lipiec 2015.pdf	Poland
Information not available.	Slovenia

Source: Own based on the documentary review.

7.3.1.1 Austria

7.3.1.1.1 Burgenland

The network of relevant Technology Centres in Eisenstadt, Mittelburgenland, and Jennersdorf.[88]

The preparation of initiative 'Austrian Centre for Digital Production' in cooperation between the Vienna University of Technology and the University of Applied Science FH Burgenland.

7.3.1.2 Germany

7.3.1.2.1 Bavaria

Cluster Mechatronik & Automation supports and accompanies F&E projects in every technology sector which are relevant for mechatronics such as industry or service robotics, semiconductor industry, automation, engineering, automotive, environmental and medical engineering as well as drive technology and electromobility.[89]

[88] See: http://195.230.172.174/www_technologiezentren/cms/front_content.php

[89] See: http://www.cluster-ma.de/en

Strategische Partnerschaft Sensorik e. V. (SPS) officially manages the Bavarian cluster for the competence field of sensor technology since 2006. This means that we bundle the interests of enterprises, universities, and other research institutes on behalf of the Free State of Bavaria. It is a widely recognised network in the sensor technology sector.[90]

The relevant initiative implemented in the past Network initiative 'Maschinen- und Automobilbau Initiative Next Economy (MAINE)'.

7.3.1.2.2 Saxony

The Saxony Automotive Supplier Network (AMZ) integrates the representatives of the business and scientific communities, regional institutions and facilities as well as governmental agencies. This permits the consolidation of resources and potentials available throughout Saxony in various committees.[91]

The Mechanical Engineering Network Saxony VEMAS*innovativ*. Established in 2004, it serves as a technology- and product-open platform for technology transfer, for the exchange of knowledge and experience, for market development as well as for exploitation of synergies aiming at the further development of products along the value chain.[92]

7.3.1.3 Czech Republic

See the table above.

7.3.1.4 Poland

See the table above.

7.3.1.5 Slovenia

During the entrepreneurial discovery process 16 initiatives, about the area of Factories of the Future, were prepared with an estimated investment value of €950 million.

Table 49 Concentration of economic activities in the area of advanced manufacturing systems

Regions/Country	***Indication about the concentration of economic activities***	***Overall assessment***
Burgenland	The network of Technology Centres in Eisenstadt, Mittelburgenland, and Jennersdorf	Low concentration of companies driving the development of these technologies.
Bavaria	Cluster Mechatronik & Automation. Members of the Cluster include some 120 enterprises, scientific or public institutions. Strategische Partnerschaft Sensorik e. V. (SPS). It is a cluster with roughly 70 members (companies and institutes) from industry and science, and additional 150 associated partners.	A significant concentration of companies driving the development of these technologies.
Saxony	The Saxony Automotive Supplier Network (AMZ) The Mechanical Engineering Network Saxony VEMAS*innovativ*	Low concentration of companies driving the development of these technologies.

[90] See: http://www.sensorik-bayern.de/en

[91] See: http://www.amz-sachsen.de/en/home

[92] See: http://www.vemas-sachsen.de

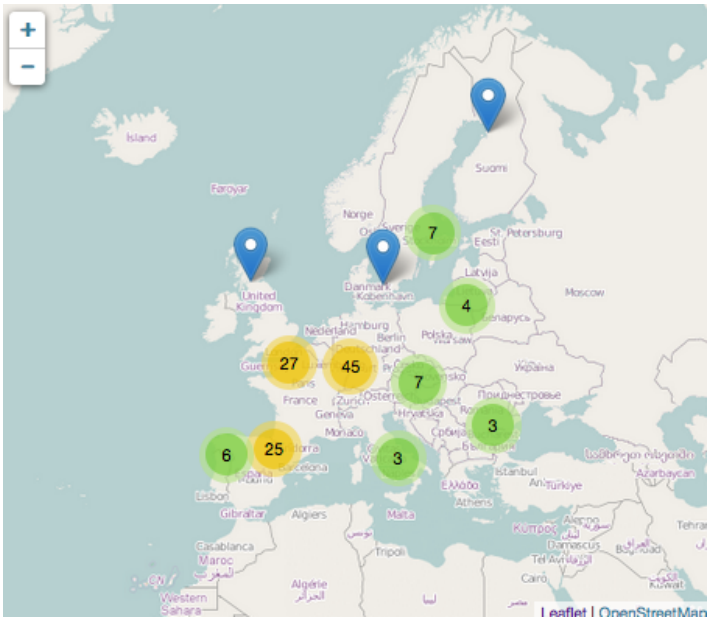
Regions/Country	*Indication about the concentration of economic activities*	*Overall assessment*
Czech Republic	Czech Machinery Cluster	Low concentration of companies driving the development of these technologies.
Poland	A network of relevant individual companies.	Low concentration of companies driving the development of these technologies.
Slovenia	Over 200 stakeholders participated in the preparation of the Factories of the Future related initiatives of which over 150 were representatives of the economy.	Low concentration of companies driving the development of these technologies.

Source: Own assessment based on the documentary review.

The figure below shows the SMEs services providers in the area of advanced manufacturing systems. This does not provide a complete picture but confirms the general situation regarding existing capacity and potential of cooperation in these key enabling technologies.

Figure 4 SMEs' access to Key Enabling Technologies – Advanced manufacturing technologies

Advanced manufacturing technologies



Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 9 contains a full list of organisations.

7.4 Summary assessment

In conclusion, the review of policy priorities suggests a possible cooperation between Burgenland, the two German Länders, Czech Republic, Poland and Slovenia. The two German Länders are leading regarding participation in the FP7 projects funded under the Priority area 'Information and Communication Technologies & Nanosciences, Nanotechnologies, Materials and New Production Technologies related to Factories of the Future (FoF)' and they also account for the highest number of patents. Comparatively, the number of patents in the remaining Central European countries and regions except Styria is lower. By existing evidence, it is found that only Bavaria is characterised by significant concentration of companies driving the development of these technologies and even though there are some networks established in the other Central European countries and regions the overall level of concentration of economic activities in this area is low. On the other hand, there is a relatively high concentration of mechanical engineering industries in the CEECs.

One of the emerging results from the analysis carried out in the framework of this assignment is that providing solutions for factory and process automation is one of the possible sub-areas of cooperation with the involvement of partner organisations from CE. Overall there is a strong competition in specific automation technologies, and recent developments show attempts to replace technology leaders in global export markets. A concrete example is a German robotics company Kuka which entered into an investment agreement with Chinese consumer appliance company Midea Group in June 2016.

Since the manufacturing sector may not always have an interest in testing novel sensors and system solutions that are intelligently networked embracing the Industry 4.0/Smart factories concept, there are other opportunities for applications in other areas. According to a recent report (McKinsey, 2015) the main areas in which Industry 4.0 will create additional value include: autonomous vehicles, logistics and navigation, home controllers and security systems, energy management and security in office buildings, operations and equipment optimisation in factories, optimisation in retail, worksites, human health and fitness, in addition to various applications in cities.

During the preparation of this report, we came across some events which confirms interest in adopting the Smart Factory/Industry 4.0 concept among the stakeholders from the recent EU Members States. This is presented only for illustrative purpose and by no means should be considered as an exhaustive list of relevant events. For example, the Polish-German Chamber of Industry and Commerce is organising a conference "Automation and production technologies in agro-food, cosmetics, pharmaceuticals and chemical industries – Industry 4.0 Polish and German markets" which took place on 20 September 2016 in Warsaw. The aim of the conference is to compare the latest trends and developments in the area of automation and process technology on the Polish and German markets.[93] Another event "Future Factory – on the way to Industry 4.0" which is organised by four leading companies in the field of new production technologies under the patronage of the Mayor of Wroclaw and Wroclaw University of Technology will take place on 12-13 October 2016 in Wroclaw. The aim of the conference is to present the latest trends and developments in the area of Industry 4.0.[94]

It is also important to note that digitisation is applied through a more intensive use of data analytics, complex simulation and modelling. Taking into account competencies in software systems engineering, communication, data and information management, applied computer science, and software engineering in CE, there is still a potential for cooperation concerning programming and modelling methods, and software for industrial applications. More detailed information about ICT and electronics is presented in Section 9.

The scientific research institutions active in this thematic area are outlined below and can play an important role in defining the directions of possible topics of cooperation in the future.

[93] See: http://ahk.pl/pl/wydarzenia/singel-view-events/events/konferencja-automatyzacja-i-technika-procesowa-w-przemysle-spozywczym-kosmetycznym-farmaceutycznym-i-chemicznym-przemysl-40-rynek-polski-i-ni/?no_cache=1&cHash=6e4aa0bb171b1e70d7c0e47fe53193b3

[94] See: http://przemysl40.pl/en

Burgenland

- Technology Centres in Eisenstadt, Mittelburgenland, and Jennersdorf.

Bavaria

- Robotik und Mechatronikzentrum des DLR
- Fraunhofer-Institute für Integrierte Schaltungen
- Fraunhofer-Institute für Integrierte Systeme und Bauelemente
- Technischen Universität München
- Universitäten Augsburg, Bayreuth and Erlangen-Nürnberg
- Universities of Applied Sciences in Augsburg, Amberg-Weiden, Aschaffenburg, Kempten, München und Würzburg-Schweinfurt

Saxony

- TU Chemnitz – Professur Strukturleichtbau und Kunststoffverarbeitung
- TU Chemnitz – Institut für Fördertechnik und Kunststoffe (IFK)
- Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik (IWU)
- Sächsisches Textilforschungsinstitut e.V. – STFI Chemnitz
- TU Dresden – Institut für Leichtbau und Kunststofftechnik (ILK)
- TU Dresden – Institut für Textilmaschinen und Textile Hochleistungswerkstofftechnik
- TU Dresden – Institut für Werkstoffwissenschaften, Professur für Pulvermetallurgie, Sinter- und Verbund-werkstoffe
- Leichtbau-Zentrum Sachsen (LZS)
- Fraunhofer-Institut für Werkstoff- und Strahltechnik (IWS)
- Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (IZPF) – Institutsteil Dresden
- Leibniz-Institut für Festkörper- und Werkstoffforschung (IFW)
- Leibniz-Institut für Polymerforschung (IPF)
- Universitäres Zentrum für Luft- und Raumfahrt UZLR
- TU Freiberg – Fakultät für Werkstoffwissenschaft und Werkstofftechnologie
- Kunststoff-Zentrum Leipzig

Czech Republic

- NETME – New Technologies for Mechanical Engineering
- Brno University of Technology (UT)
- Technical University of Ostrava (TUO)
- University of West Bohemia, Plzeň (UWB)
- Research Centre of Manufacturing Technology

Poland

- AGH University of Science and Technology in Cracow (Faculty of Mechanical Engineering and Robotics, the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering, and the Faculty of Computer Science, Electronics and Telecommunication)
- University of Technology in Cracow (Faculty of Mechanical Engineering)
- Institute of Advanced Manufacturing Technology

- Politechnika Łódzka, Instytut Automatyki
- Politechnika Śląska, Wydział Mechaniczny Technologiczny /
- Park Naukowo-Technologiczny „TECHNOPARK GLIWICE”

Slovenia

The planned Strategic partnerships to be established for each specialisation domain can be possible sources for further information.

8 ICT and electronics

8.1 Policy priorities

8.1.1 Overview of the priority area

The table below shows that only in the case of Croatia, Slovenia and Styria it was not possible to assign priorities identified in the EYE@RIS3 database to the area of ICT and electronics. The detailed review of priorities also indicates that there are some similarities with the area of advanced manufacturing systems as discussed above as in the RIS3 of the Czech Republic there is a reference made to topics such as automation, thus the both areas are closely related and should be treated as a functional area to the extent possible.

Table 50 Overview of Central European countries and regions with ICT and electronics identified as RIS3 priority

Countries	***No. of regions***	***Regions***	***Descriptions***
Austria	national	National level	ICT (embedded systems; micro-electronics; visual computing; semantic systems; quantum informatics; optoelectronics).
Austria	1	Burgenland	Innovative (IT-based) services and creative industries (Opto) electronics, mechatronics[95]
Czech Republic	national	National level	ICT, automatisation and electronics.
Germany	2	Bavaria	Innovative technology-based services ICT (cyber-security; big data; cloud computing; industry 4.0; e-commerce; craftsmanship 4.0; robotics for automation in production, logistics & healthcare; connected mobility; e-health, digital care, precision medicine & tele-medicine; smart energy; digital media e.g. in film and gaming; e-tourism; e-finance; smart construction; digital agriculture for resource efficiency & transparency; e-environment & environmental protection).
		Saxony	ICT & digital communication (IT infrastructures, e-commerce, e-business, e-government, software development, IT services, mobile embedded elements for communication among daily objects and towards their environment (embedded systems & internet of things), self-learning systems for the creation and storage of knowledge and learning, time & resource-efficient computing systems for simulation & visualisation,applications for IT security with legal implications (identity management, authentification, linking information), cyber-physical

[95] Also mentioned within the thematic area of 'Electrotechnical and mechanical industries'

Countries	*No. of regions*	*Regions*	*Descriptions*
			systems); Microelectronics including organic and polymer electronics (semiconductors); and Photonics.
Hungary	national	National level	ICT and information services.
Poland	national	National level	Smart networks and geo-information technologies. Optoelectronic systems and materials[96]
Slovak Republic	national	National level	ICT and Services; Consumer electronics and electrical equipment.

Source: Own based on the EYE@RIS3 (exported on 13 June 2016).

8.1.2 Thematic focus and the main EU networks

8.1.2.1 Focus areas and technologies

As mentioned above, the topic of "Industry 4.0" is recognised as one of the priority areas in **Burgenland**. However, more detailed information about the thematic focus is not available.

Established in 2014, one of the **Czech Republic's** innovations platforms is active in the field of IT services and software, electronics, electrical engineering. According to the RIS3 strategy, the platforms are tasked with proposing priorities and formulating recommendations concerning the planned interventions. Within the area of electronics and electrical engineering, the reference is made to a specific group of technologies, namely: industrial automation; communication, identification, control equipment; robotics; artificial intelligence, etc. As far as the specialisation domain of IT services and software is concerned a number of specific topics are mentioned, e.g. network technologies and network security, antivirus SW; database, information and expert systems, enterprise SW; creative IT services, digital media (engineering and architectural services, computer games, audio-visual and promotional services), etc.

Bavaria is transforming itself into a digital economy and has its own Strategy "Digital Bavaria". The overall vision of this strategy is to make Bavaria first-class digital business location until 2020. It is expected that digital technologies will have a positive influence on the competitiveness of Bavarian companies.

With the aim of improving the connection between **Saxony's** scientific research institutions and industry in this thematic area, a series of projects have been carried out with the involvement of Chair of Information Systems at the Technical University of Dresden and the different relevant organisations.[97]

In **Hungary**, it is recognised that ICTs encompass and support the sectoral priorities, such as bioinformatics or diagnostic imaging in the health industry, or the intelligent transport systems in the vehicle industry, or "smart city" in the energy domain. It is also noted in the RIS3 strategy that a number of ICT solutions cannot be linked to sectoral priorities in an unambiguous way or may be related to more sectors (e.g. smart business, company, home; smart city; information security, security technology; gamification, simulation and optimisation technology; e-learning systems; big data; "Internet of things", etc.).

[96] As above

[97] See: https://tu-dresden.de/die_tu_dresden/fakultaeten/fakultaet_wirtschaftswissenschaften/wi/isih/isih_forschung/abgeschl_forschungsprojekte

In **Poland**, the sub-priority areas include: technologies of Internet of the Future, Internet of things, integrated systems; intelligent networks in the infrastructure (smart cities, smart homes, smart factories, etc.); architecture, systems and applications in intelligent networks; management of information in intelligent networks; human-machine and machine-machine interfaces; standardisation, security and modelling of intelligent networks, etc.[98]

In the **Slovak Republic**, automation, robotics and digital technology are one the identified prospective areas. For example, the topics such as smart production system; smart and industrial transport; and smart technologies for the intelligent management of smart products consumption, are mentioned in the RIS3 strategy.

8.1.2.2 Cooperation with the EU-level networks

Concrete examples of the existing networks in this specific thematic area at the EU level are outlined below:

- Aeneas;
- ARTEMIS Industry Association;
- ECSEL – Joint Undertaking Electronic components and systems;
- Enterprise Europe Network – sector expertise;
- European Technology Platform for communications networks and services - NetWorld2020; and
- European Technology Platform in the area of High-Performance Computing (HPC);
- European Technology Platform on Smart Systems Integration – EpoSS;
- European Technology Platform Photonics21;
- European Technology Platform, New European Media Initiative; and
- European Technology Platform, the Networked European Software and Services Initiative – NESSI.

8.2 Upstream dimension of the value chains (Research and technology capabilities)

8.2.1 Analysis of FP7, H2020 projects

The analysis of FP projects funded under the Priority area 'Information and Communication Technologies & JTIs ARTEMIS-ECSEL'[99] shows that Bavaria in the leading position, followed by Poland, Hungary and the Czech Republic (see Table 49) which is in line with the finding concerning the policy priorities. The performance in countries and regions for which no indication of priority in the area of ICT and electronics could be established looks relatively good in Slovenia and Styria. It is also important to note that Slovenia identified advanced manufacturing systems as its one the RIS3 priorities which are closely related to the area under review. The analysis of EC contributions (see Table 51) shows that Styria and Saxony are placed in the higher position in the ranking which means that they accounted on average for higher levels of funding.

Table 51 Participation in FP7 projects in the area of ICT and electronics

Countries/Regions	***Number of participants***
Bavaria	612
Poland	167
Hungary	124

[98] See: http://www.smart.gov.pl/pl/specjalizacje/kis15

[99] Calls related to Factories of the Future (FoF) were subject of analysis in Section on Advanced manufacturing systems and not taken into account in the calculations.

Countries/Regions	*Number of participants*
Czech Republic	108
Styria	102
Saxony	83
Slovenia	69
Slovak Republic	38
Croatia	13

Table 52 Funding of FP7 projects in the area of ICT and electronics

Countries/Regions	*EC contributions*
Bavaria	257.920.391
Styria	43.558.243
Saxony	31.135.858
Poland	30.465.249
Hungary	23.577.144
Czech Republic	21.670.977
Slovenia	17.129.811
Slovak Republic	6.322.211
Croatia	1.541.130

Source: Own based on the E-CORDA database.

The table below clearly shows that Bavaria plays a major role in coordinating related FP7 projects, whereas the overall capability to lead such projects in the remaining Central European countries are regions is low. The organisation which played most often a role of the coordinator is Fraunhofer as we observed in the various thematic areas covered in the scope of this assignment.

Table 53 Coordinators of FP7 projects in the area of ICT and electronics

Organisations	*Regions/Countries*	*Number of projects coordinated*
FRAUNHOFER-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Bavaria	32
INFINEON TECHNOLOGIES AG	Bavaria	6
SIEMENS AKTIENGESELLSCHAFT	Bavaria	2
TECHNISCHE UNIVERSITAET MUENCHEN	Bavaria	2
KUKA Laboratories GmbH	Bavaria	2
AIRBUS DEFENCE AND SPACE GMBH	Bavaria	1
LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	Bavaria	1

Organisations	*Regions/Countries*	*Number of projects coordinated*
MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.	Bavaria	1
OSRAM GMBH	Bavaria	1
PARMENIDES STIFTUNG	Bavaria	1
SUSS MICROTEC AG	Bavaria	1
OSRAM OPTO SEMICONDUCTORS GMBH	Bavaria	1
UNIVERSITAET REGENSBURG	Bavaria	1
INTEDIS GMBH & CO KG	Bavaria	1
JULIUS-MAXIMILIANS UNIVERSITAET WUERZBURG	Bavaria	1
NANOPLUS NANOSYSTEMS AND TECHNOLOGIES GMBH	Bavaria	1
SCHNEIDER ELECTRIC AUTOMATION GMBH	Bavaria	1
UNIVERSITAT AUGSBURG	Bavaria	1
TECHNISCHE UNIVERSITAET GRAZ	Styria	5
JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH	Styria	2
AMS AG	Styria	1
AT & S AUSTRIA TECHNOLOGIE & SYSTEMTECHNIK AKTIENGESELLSCHAFT	Styria	1
AVL LIST GMBH	Styria	1
UNIVERSITAET GRAZ	Styria	1
TECHNISCHE UNIVERSITAET DRESDEN	Saxony	3
DRESDEN ELEKTRONIK INGENIEURTECHNIK GMBH	Saxony	1
GWT-TUD GMBH	Saxony	1
UNIVERSITAET LEIPZIG	Saxony	1
MOSTOSTAL WARSZAWA SA	Poland	1
POLITECHNIKA WARSZAWSKA	Poland	1
UNIWERSYTET WARSZAWSKI	Poland	1
COMARCH S.A.	Poland	1
UNIWERSYTET MIKOLAJA KOPERNIKA W TORUNIU	Poland	1
HONEYWELL INTERNATIONAL SRO	Czech Republic	1
MAGYAR TUDOMANYOS AKADEMIA SZAMITASTECHNIKAI ES AUTOMATIZALASI KUTATOINTEZET	Hungary	1
FYZIKALNY USTAV SLOVENSKEJ AKADEMIE VIED	Slovak Republic	1

Source: Own based on the E-CORDA database.The available data of H2020 projects funded under the Priority area 'Industrial Leadership - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)' indicates that the majority of projects involved the participation of one or two Central European countries. Comparatively, there are few projects so far in which more than three countries from Central Europe and this is similar to a finding emerging from the analysis of other thematic areas.

8.3 Midstream dimension of the value chains (patents)

8.3.1 Geographic distribution of patents

Overall, the performance measured by patenting activities in the area of micro-, nano-electronics and photonics is relatively low in Central Europe except for Bavaria, Saxony and to some extent in Styria in relation to micro- nanoelectronics (see Table 54). The patenting applications in the area of ICT during the period 2011-2013 shows increased activity in countries like Hungary, Poland and Slovenia.

Table 54 Overview of patenting activities in the area of micro-, nano-electronics and photonics in 2011

Regions/Countries	***KET area***	***Number of Patents***
Bavaria	Micro- nanoelectronics	346
Bavaria	Photonics	251
Saxony	Micro- nanoelectronics	55
Styria	Micro- nanoelectronics	40
Saxony	Photonics	25
Hungary	Photonics	15
Styria	Photonics	13
Poland	Photonics	8
Poland	Micro- nanoelectronics	7
Czech Republic	Photonics	5
Slovenia	Photonics	5
Czech Republic	Micro- nanoelectronics	4
Burgenland	Photonics	3
Burgenland	Micro- nanoelectronics	3
Slovak Republic	Photonics	3
Hungary	Micro- nanoelectronics	3
Slovak Republic	Micro- nanoelectronics	2
Slovenia	Micro- nanoelectronics	2
Croatia	Photonics	1
Croatia	Micro- nanoelectronics	0

Source: KETs Observatory.

Table 55 Patent applications in ICT during the period 2011-2013

Countries/Regions	Year	Patents	Year	Patents	Year	Patents
Bavaria	2011	1462,6	2012	1502,8	2013	1555,0
Saxony	2011	97,5	2012	111,3	2013	92,4
Hungary	2011	85,5	2012	87,3	2013	89,9
Styria	2011	73,6	2012	81,6	2013	77,6
Poland	2011	72,1	2012	59,9	2013	74,9
Slovenia	2011	22,8	2012	45,4	2013	45,3
Czech Republic	2011	21,5	2012	26,0	2013	27,8
Croatia	2011	8,8	2012	8,5	2013	15,6
Slovak Republic	2011	7,8	2012	6,5	2013	10,3
Burgenland	2011	3,5	2012	4,6	2013	2,9

Source: OECD REGPAT Database.

8.4 Midstream and downstream dimension of the value chains (Clusters, Industry)

8.4.1 Key economic operators in the area of ICT and electronics

Table 56 List of economic operators in the area of ICT and electronics

Clusters/Firms	Countries/Regions
For more detailed information see the Section 8.5 Advanced manufacturing systems.	Burgenland
Safety & Security Technology Cluster; Czech Cloud Cluster; Czech IT Cluster; Hradec IT Cluster; ON Semiconductor; STMicroelectronics; ASICentrum, etc. The full lists are available at the following links: http://www.czechinvest.org/data/files/elektro-web-5234-en.zip http://www.czechinvest.org/data/files/ict-web-98-en.zip	Czech Republic
The Bavarian Information and Communication Technology Cluster (BICCnet) Cluster Mechatronik & Automation e.V. (see also Section 8.5 Advanced manufacturing systems) The full lists are available at the following links: http://www.bayern-innovativ.de/4512beea-a2e1-51df-8031-efd125b9432d?C=00112234-0000-0000-0000-00000090B01 http://www.bayern-innovativ.de/4512beea-a2e1-51df-8031-efd125b9432d?C=00112234-0000-0000-0000-00000091237	Bavaria
Silicon Saxony e. V., Organic Electronics Saxony e.V	Saxony
Sárvár FLEXTRONICS: KomáromFOXCONN; Cegléd INFINEON; InfomatiX; MobileEngine Cellum; IND Group/Misys; NNG, etc. The full lists are available at the following links: https://hipa.hu/downloadmanager/download/nohtml/1/id/5 https://hipa.hu/downloadmanager/download/nohtml/1/id/3	Hungary
Philips Lighting Poland SA; LG Electronics Mława sp. z o.o.; Polska Grupa Zbrojeniowa SA; Indesit Company Polska; Flextronics International Poland sp. z o.o.; Amica Wronki SA GK, Wronki OPEGIEKA Sp. z o.o.; ITTI Sp. z o.o; Asseco Poland s.a., etc. The full lists are available at the following links: http://www.paiz.gov.pl/files/?id_plik=26197 http://www.smart.gov.pl/files/upload/164/skład osobowy GR lipiec 2015.pdf (under the WG 'GEO')	Poland
Košice IT Valley; ZAICT; Asseco Central Europe a.s.; T-systems Slovakia, s.r.o.; Soitron, a.s.	Slovak Republic

Clusters/Firms	*Countries/Regions*
The full list is available at the following link: http://www.sario.sk/sites/default/files/content/files/information_and_communication_technology_0.pdf	

Source: Own based on the documentary review.

8.4.1.1 Austria

8.4.1.1.1 Burgenland

For more detailed information see the Section 8.5 Advanced manufacturing systems in Burgenland.

8.4.1.2 Germany

8.4.1.2.1 Bavaria

The Bavarian Information and Communication Technology Cluster (BICCnet).[100] The employment accounts for over 300,000 people operating in information and communications technology in Bavaria, BICCnet represents one of the most important ICT locations in the world.

For more detailed information concerning the Cluster Mechatronik & Automation e.V. see the Section 8.5 Advanced manufacturing systems.

The BAIKEM network founded in 2001 opens up and provides stimulus for innovation at all stages of value creation. Topics include, for instance, printed circuit technology, a microsystems technology (MEMS), embedded systems, polymer electronics and energy-efficient electronics. The fields of application are varied, from the automotive industry to energy management and medical engineering.

The network provides direct access to experts and potential partners through innovation congresses and cooperation fora. The BAIKEM network today comprises more than 5,000 companies in 400 institutes from 32 countries.[101]

8.4.1.2.2 Saxony

Silicon Saxony e. V. is a trade association for the micro- and nanoelectronic, smart system, application and energy system industries, connecting some 300 manufacturers, suppliers, research institutes, universities and public institutions in a network.[102]

Established in 2008 by seven companies and three research institutes the Organic Electronics Saxony e.V is a network which aims at strengthening the organic centre in Saxony and globally.[103]

8.4.1.3 Czech Republic

The Czech Republic is one of Europe's top locations for ICT investments. Repeatedly recognised by various researchers, this fact is confirmed by the strong inflow of high-value-added projects of the world's top ICT companies and is fuelled by the country's tradition of excellence in technical fields. The list of successful investors in the country involves Microsoft, Skype, DHL, Tieto, Red Hat, SolarWinds and IBM. The Czech Republic is recognised for its long industrial tradition, and it is absolutely no surprise that new technologies naturally grow in the established environment of recognised universities, institutions and research centres. Two of the world's few antivirus software providers, AVAST and AVG, grew out of this environment. Of all the countries where the Latin alphabet is used, the Czech Republic

[100] See: http://bicc-net.de

[101] See: http://www.bayern-innovativ.de/3e1fbfcd-c05d-f64a-0efd-f31bd33a6512?Edition=en

[102] See: http://www.silicon-saxony.de/en/the-network

[103] See: http://www.oes-net.de/en

is the only one whose domestic web search provider, Seznam.cz, is challenging Google in the local market.[104]

More than anything else, the Czech electronics and electrical engineering sector are based on its long tradition and the extensive skills of its employees. The entire industry accounts for more than 14% of Czech manufacturing output, which makes it the second-largest sector in the economy. Over 17,000 companies employ more than 180,000 workers in the sector here. Most of the sector's output is exported, mainly to markets within the European Union.[105]

8.4.1.4 Hungary

Between 2009 and 2014, it increased by more than 24% reaching €2.21 billion in 2014. Hardware accounted for 51.7% of the total market, while the software segment gained a 21.4% share, and services made up the remaining 26.9%. The Hungarian IT market is expected to expand at a compound annual growth rate (CAGR) of 3.8% between 2015 and 2019, with an accelerating growth trend toward the end of the forecast period. The share of electronics in the total of Hungarian exports accounted for 27.8, and the total number of employees in the industry is estimated at 160,000.[106]

8.4.1.5 Poland

Poland is the larger producer of electronic equipment in Europe – the output value in 2014 amounted to €13.8 billion. The electronics sector will be one of the fastest growing segments of the Polish economy. According to forecast, the sector will grow by 3.1% per annum until 2019.

8.4.1.6 Slovak Republic

The gross value added of the Slovak ICT sector was €3 billion in 2012, and it creates 4.5% of Slovak economy's GDP. In the same year, the employment accounted for almost 46 thous.[107]

Table 57 Concentration of economic activities in the area of ICT and electronics

Regions/Countries	***Star clusters***	***Indication of the concentration of economic activities***	***Overall assessment***
Burgenland	Information not available.	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (0.9%) Number of persons employed on NACE J61 – Telecommunications (243); J62 – Computer programming (681); J63 – Information service (251).	Low concentration of companies specialised in this area of activities.
Czech Republic	Communications equipment and services (3-2) Information technology and analytical instruments (3-2)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (3.5%) Number of persons employed on NACE J61 – Telecommunications (18.191); J62 – Computer programming (64.042); J63 – Information service (11.923).	The moderate concentration of companies specialised in this area of activities.

[104] See: http://www.czechinvest.org/en/ict

[105] See: http://www.czechinvest.org/en/electronics-electrical-engineering

[106] See: https://hipa.hu

[107] See: http://www.sario.sk

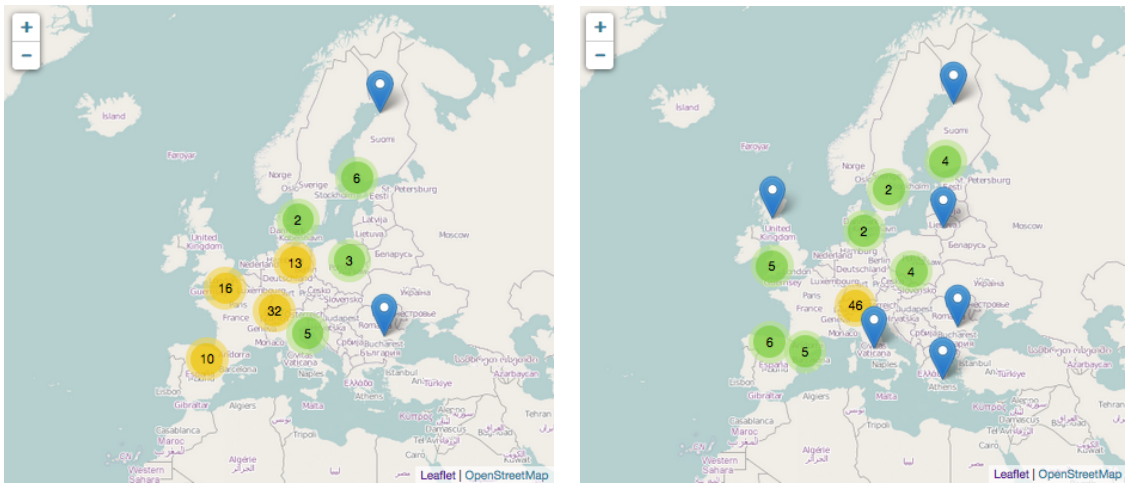
Regions/Countries	*Star clusters*	*Indication of the concentration of economic activities*	*Overall assessment*
Bavaria	Communications equipment and services (2) Digital industries (4-3-2) Distribution and electronic commerce (2) Information technology and analytical instruments (4-3-2)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (6.4%) Number of persons employed on NACE J61 – Telecommunications (12.866); J62 – Computer programming (125.025); J63 – Information service (15.320).	A significant concentration of companies specialised in this area of activities.
Saxony	Digital industries (2) Information technology and analytical instruments (2)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (6.6%) Number of persons employed on NACE J61 – Telecommunications (1.070); J62 – Computer programming (16.560); J63 – Information service (3.915).	The moderate concentration of companies specialised in this area of activities.
Hungary	Communications equipment and services (3-2) Digital industries (3-2) Distribution and electronic commerce (3) Information technology and analytical instruments (2)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (7.5%) Number of persons employed on NACE J61 – Telecommunications (18.656); J62 – Computer programming (55.562); J63 – Information service (12.201).	The moderate concentration of companies specialised in this area of activities.
Poland	Communications equipment and services (3-2) Digital industries (2) Distribution and electronic commerce (2) Information technology and analytical instruments (3-2)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (2.6%) Number of persons employed on NACE J61 – Telecommunications (54.585); J62 – Computer programming (129.565); J63 – Information service (34.221).	The moderate concentration of companies specialised in this area of activities.
Slovak Republic	Communications equipment and services (3) Digital industries (2) Information technology and analytical instruments (3)	Share of employment in NACE 26 - manufacturing of computer, electronic and optical products (3.6%) Number of persons employed on NACE J61 – Telecommunications (10.703); J62 – Computer programming (23.446); J63 – Information service (9.245).	The moderate concentration of companies specialised in this area of activities.

Source: Own assessment based on the European Cluster Observatory, Eurostat (sbs_r_nuts06_r2) and documentary review.

The figure below shows the SMEs services providers in the area of micro-, nano-electronics and photonics. This does not provide a complete picture but confirms the general situation regarding existing capacity and potential of cooperation in these key enabling technologies.

Figure 5 SMEs' access to Key Enabling Technologies – Micro-, nano-electronics, and photonics

Micro-, nano-electronics **Photonics**



Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 10 contains a full list of organisations.

8.5 Summary assessment

In conclusion, in Croatia, Slovenia and Styria RIS3 priorities there is no direct reference to the thematic area of ICT and electronics. However, there are some similarities with the area of advanced manufacturing systems that needs to be taken into account. For example, the analysis of relevant FP7 projects showed a relatively good performance of Slovenia where advanced manufacturing systems are identified as one of its RIS3 priorities. Comparatively, Bavaria ranked on the first position, followed by Poland, Hungary and the Czech Republic regarding the number of FP7 projects funded under the Priority area 'Information and Communication Technologies & JTIs ARTEMIS-ECSEL'.

Digital technologies can find applications various business areas. For example, there is much interest among the stakeholders from CE in smart grids and energy networks that can automatically monitor energy flows. It will also be relevant to explore new opportunities for cooperation in the field of intelligent transport systems (i.e. integration of telecommunications, electronics and information technologies with transport engineering) seeking new solutions appropriate for the urban context in CE. ICT security could be another possible focus areas of cooperation in the future.

The performance measured by patenting activities in the area of micro-, nano-electronics and photonics is relatively low in Central Europe except for Bavaria, Saxony and to some extent in Styria in relation to micro- nanoelectronics. The potential of cooperation within the sub-area of micro- nanoelectronics clearly remains limited. There are already many international working groups established which focus on addressing the challenge of implementing 450 mm technology into the chip production process.

Manufacturing and production remain one of the application areas of photonic sensing technologies. Overall the European photonics industry is facing fierce global market competition and has to cope with a very high speed of technological developments in the field. Photonic sensing technologies can play an important role in the development of the overall concept of the smart factory which offers new opportunities for companies from CE to optimise their production processes and develop new products with high added value.

One of the recently launched transnational calls for proposals concerns photo sensing technologies. Funding bodies from nine countries together with the European Commission (DG CONNECT), who is co-financing the competition, grant up to €18 million for projects on photonics-based sensing technologies. Project consortia should be made up of companies and research institutions from at least two of the participating countries and regions: Austria, Flanders Region (Belgium), Germany, Israel, Poland, Portugal, Turkey, Tuscany Region (Italy) and the United Kingdom.[108] The scope of the call includes different application areas, such as safety, civil security, manufacturing/production, environmental monitoring, medical applications. Also, cross-sectoral approaches may be proposed (e.g. between medical and security, food and water safety or environmental applications).

Another noticeable trend is the increase of patenting activities in the area of ICT in Hungary, Poland and Slovenia. Overall, Bavaria is characterised by significant concentration of companies specialised in this area of activities, whereas in the majority of cases the concentration can be assessed as moderate and in the case of Burgenland as relatively low. The ICT recent advances in Cloud, Internet of Things, and Big Data increase the need for programming and modelling methods, platforms and software that facilitate the development of more interconnected, flexible, reliable, secure and efficient software. The development of advanced software and seamless software architectures are headline topics of possible cooperation with the involvement of partner organisations from CE.

Czech Republic

- Department of Microelectronics, Czech Technical University in Prague
- The Institute of Scientific Instruments, Academy of Sciences of the Czech Republic
- Department of Cybernetics, Czech Technical University in Prague
- Charles University, Prague
- University of Economics, Prague
- Masaryk University, Brno
- Brno University of Technology
- Technical University of Ostrava
- University of Hradec Králové

Bavaria

- Exzellenzuniversitäten LMU und TUM
- Fraunhofer-Institut für Eingebettete Systeme und Kommunikationstechnik ESK
- Fraunhofer Einrichtung für Angewandte und Integrierte Sicherheit AISEC
- Friedrich-Alexander Universität Nürnberg-Erlangen
- Fraunhofer-Institute für Integrierte Schaltungen
- Fraunhofer-Institute für Integrierte Systeme und Bauelemente
- Universities of Applied Sciences in Augsburg, Kempten, Regensburg, Würzburg, Bamberg, Bayreuth
- Coburg, Passau, Landshut and Deggendorf

Saxony

- Institut für Print- und Medientechnik der Technischen Universität Chemnitz (mit Schwerpunkt auf Druck-technik)

[108] See: https://photonicsensing.eu/call-2016

- ResUbic-Lab der Technischen Universität Dresden (erforscht die Anwendung und Steuerung eingebetteter Systeme in und von der Cloud [cyber-physikalische Systeme])
- SAP Research Center Dresden (mit Future Factory)
- Fraunhofer-Institut für Elektronische Nanosysteme ENAS
- Fraunhofer-Institut für integrierte Schaltungen IIS, Außenstelle Entwurfsautomatisierung (EAS)
- Fraunhofer-Institut für Photonische Mikrosysteme IPMS einschl. Center Nanoelektronische Technologien CNT
- Fraunhofer-Institut für Elektronenstrahl und Plasmatechnik FEP einschließlich der Fraunhofer-Einrichtung für Organik, Materialien und Elektronische Bauelemente COMEDD
- Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration IZM, All Silicon System Integration Dresden

Hungary

- Eötvös Loránd University
- Budapest Technical University
- Budapest Business School
- Óbuda University
- Corvinus University of Budapest
- Gábor Dénes College
- Pannon University
- University of Pécs
- University of Szeged
- Széchenyi István University

Poland

- Centre of Computer Science – AGH University of Science and Technology
- Institute of Innovative Technologies
- Politechnika Gdańska, Wydział Elektroniki, Telekomunikacji i Informatyki
- Politechnika Wrocławska, Wydział Elektroniki
- Science and Technology Park in Gliwice
- Szczeciński Park Naukowo-Technologiczny

Slovak Republic

- Faculty of Mathematics, Physics and Informatics of the Comenius University in Bratislava
- Faculty of Electrical Engineering and Information Technology and Faculty of Informatics and Information Technologies of the Slovak University of Technology in Bratislava
- Faculty of Electrical Engineering and Informatics of the Technical University of Košice
- Faculty of Management Science and Informatics of the University of Žilina

9 Trade in value added (global value chains)

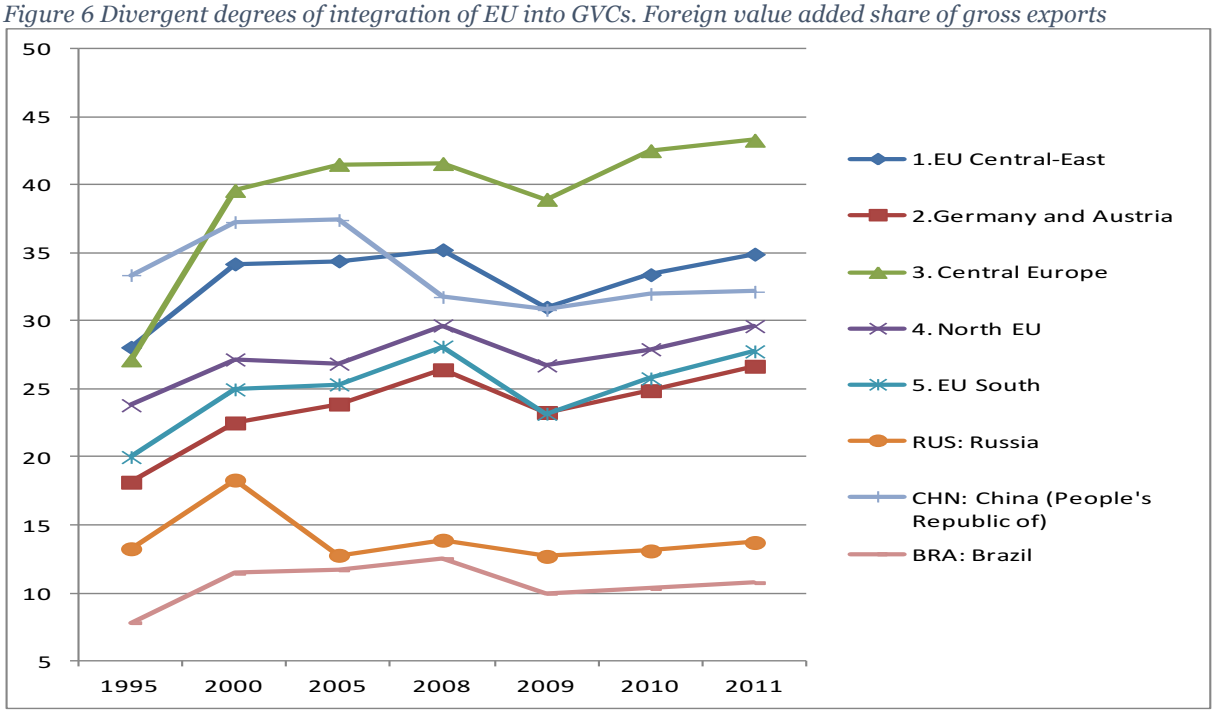
Earlier chapters have explored upstream, midstream and partly downstream dimensions of innovation value chain from the perspective of the opportunities for intra-Central European cooperation. Intra-regional cooperation cannot be confined to upstream parts of innovation value chain, i.e.,. on R&D but should also include downstream activities or sectors in which R&D is applied. This is particularly relevant in the context of CE which is the example of the EU macro-region that is the most integrated through trade linkages. Also, East CE region has become strongly incorporated into the EU RDI networks through H2020 and other EU programs. The issue is whether there are linkages between areas of RD cooperation (upstream) and areas of trade integration (downstream cooperation). This issue is quite important in the context of Smart specialisation which is focused on application areas and not just on R&D dimension of innovation value chain. So, it is important to establish whether S3 priorities are in those areas in which CE regions also integrated into the global economy. If S3 priorities are also in areas, which are potential users of new knowledge and technologies to be developed within S3 related activities this will ensure better links between upstream and downstream parts of innovation value chain. We should be aware that new technologies have broad areas of application which are not only in tradable sectors but are also in services, many of which are usually not tradable. Fortunately, new data on trade in value added enable us to trace these links through inputs output linkages and link up trade data with the sectors in which value added been created which can also include services sectors

The areas of application of technologies are ultimately visible in economic data through deployment of new technologies or of acquired foreign knowledge. The most direct (though still very imperfect) representation of the use of technologies can be detected through trade data. Trade data are based on flows of products which contain diverse levels of embodied technological knowledge. When we group trade data on different products into sectors, we can get a rough picture of the technological levels at which countries import or export. So, trade sectors are a good proxy for inter-regional/country flows of embodied knowledge.

However, data based on gross export and import do not proxy well these knowledge flows as they do not show sources of value added in a trade. The dispersal of the various parts and components to different foreign locations has given rise to increased trade with the use of imported intermediate goods. A high share of sophisticated imported intermediates gives the wrong impression that the country export is also sophisticated, i.e., high regarding own knowledge content. The availability of trade data based on the origin of value added helps to solve this weakness of gross trade data.

East Central Europe (New member states) is quite strongly integrated into global value chains. Figure 6 below shows that regarding foreign value added share of gross exports almost 45% of the CE gross exports contains foreign value added i.e. parts and components imported for the purpose of export.

Figure 6 Divergent degrees of integration of EU into GVCs. Foreign value added share of gross exports



Source: OECD/WTO Trade in Value-Added Database

The very successful example of value chain driven growth in the EU is the German-Central European Supply Chain (IMF, 2013). This supply chain benefits to both parties. First, among vertical investment driven by differences in factor prices, affiliate jobs in CEE appear not to compete with jobs in Austria and Germany (Marin, 2010). Lower costs of CEE affiliates help firms to lower overall productions costs and to stay competitive. On the other hand, integration in global value chains (GVC) enables productivity growth and employment in CEE as well as opens prospects for further industry upgrading. This is the example of bottom up VC driven clustering that led to 'Win – Win' outcome.

Further industry upgrading of CE requires not only deepening of German/Austrian/CE cooperation but also deepening of intra-CEE cooperation through value chains. S3 offers an opportunity in this respect to promote both upstream but also midstream and downstream cooperation in innovation value chains. The sectors which are strongly integrated through value chains should also offer opportunities for technology upgrading. These sectors should be recognised as potential areas of technology applications developed through S3 activities.

Hence, in this section, we link up analysis of GVC trade of CE with the S3 priority areas of the CE. The sectors which are heavily integrated through GVC offer greater opportunities for inter-regional cooperation in upstream and midstream activities supported through S3 than sectors which are inward oriented. For example, an automotive industry which is the core of the German-Central European Supply Chain is a heavy user of new developments in ICT & Electronics as well as new developments in advanced manufacturing systems including new materials. Also, new developments in the direction of smart cities and communities directly affect automotive industry but also automotive industry shapes development in this area. So, if CE is to continue to grow based on automotive industry, it would be quite important that its S3 priorities are also related to TPA which generate technology and knowledge which can be used by the automotive industry. In a nutshell, we want to check whether there is a correspondence between sectors in which CE countries are trading and sector in which they have prioritised their RDI investments through S3 related programs. If not, there is a mismatch between areas of their RDI specialisation and areas of their trade specialisation.

This is especially important for those trade sectors in which CE countries are dependent on GVC or on sectors which have a high share of imported parts and components. A large share of foreign value added in the gross export of a country suggests that this country is highly dependent on foreign import of parts and components. If these components and parts are technologically sophisticated a high share of foreign value added shows that the country is dependent on import of foreign knowledge. For example, Table 56 shows that almost 49% of Hungarian exports contains foreign value added i.e.,. parts and components that are embodied in products which are exported from Hungary. Alternatively, 62% of Czech R export of electrical and optical equipment contains foreign value added. The three most GVC dependent economies are Czech R, Hungary and Slovakia with the share of foreign value added in gross exports of 45, 48 and 46 percent respectively. Slovenia, Poland and Croatia are significantly less involved in global value chains as their share of foreign value added in gross exports is 36, 32 and 20% respectively.

We consider as GVC dependent those sectors in which share of foreign value added in gross exports exceeds 40% which is the average share for at least three CE countries. Based on this arbitrary criterion which is nevertheless grounded in our data we identify 8 GVC intensive sectors in CE. These are Textiles, textile products, leather and footwear; Chemicals and non-metallic mineral products; Basic metals and fabricated metal products; Machinery and equipment, nec; Electrical and optical equipment; Transport equipment; Manufacturing nec; recycling and Electricity, gas and water supply. The food industry is less GVC dependent as well as wood and paper-related industries. As would be expected services are much less GVC dependent. Among countries, GVC dependence varies in between Hungary (which is the most GVC dependent) and Croatia which is the least dependent. This reflects the fact that Croatia has not been part of the CE supply chain and it is only recently that this country has become more integrated into European supply chains.

Table 58 Foreign value added share of gross exports 2011 (in %)

	Foreign value added share of gross exports 2011 (in %)											
	Austria	Germany	Czech R.	Hungary	Slovak R.	Poland	Slovenia	Croatia				
CTOTAL: TOTAL	27,82	25,54	45,28	48,68	46,84	32,39	36,18	20,17	35,3625		CTOTAL: TOTAL	35
C01T05: Agriculture, hunting, forestry and fishing	22,35	22,6	34,26	27,8	24,37	20,15	24,54	15,43	23,9375		C34T35: Transport equipment	49
C10T14: Mining and quarrying	23,12	23,52	28,66	27,81	23,52	16,97	26,07	18,99	23,5825		C30T33: Electrical and optical equipment	45
C15T37: Total Manufactures	36,13	30,26	52,34	57,85	54,76	40,08	43,55	31,25	43,2775		C23T26: Chemicals and non-metallic mineral products	44
C15T16: Food products, beverages and tobacco	28,25	27,51	39,68	37,08	34	24,23	34,5	18,3	30,44375		C27T28: Basic metals and fabricated metal products	44
C17T19: Textiles, textile products, leather and footwear	33,04	30,75	50	54,97	37,1	33,76	49,47	23,17	39,0325		C15T37: Total Manufactures	43
C20T22: Wood, paper, paper products, printing and publishing	27,72	20,99	38,68	40,96	32,01	29,01	36,73	21,06	30,895		C17T19: Textiles, textile products, leather and footwea	39
C20: Wood and products of wood and cork	26,94	24,31	38,21	41,89	23,53	25,81	35,57	17,6	29,2325		C29: Machinery and equipment, nec	38
C21T22: Pulp, paper, paper products, printing and publishing	28,27	20,22	38,87	40,65	35,57	30,75	37,55	27,15	32,37875		C36T37: Manufacturing nec; recycling	37
C23T26: Chemicals and non-metallic mineral products	36,91	32,39	48,85	52,31	60,19	40,41	38,14	44,39	44,19875		C40T41: Electricity, gas and water supply	36
C27T28: Basic metals and fabricated metal products	40,64	38,17	50	52,39	54,2	41,91	43,93	31,36	44,075		C21T22: Pulp, paper, paper products, printing and pu	32
C29: Machinery and equipment, nec	33,18	26,68	46,45	46,21	45,82	36,9	44,65	25,94	38,22875		C20T22: Wood, paper, paper products, printing and pu	31
C30T33: Electrical and optical equipment	31,2	25,1	62,21	71,75	56,55	48,04	43,31	23,11	45,15875		C15T16: Food products, beverages and tobacco	30
C34T35: Transport equipment	47,07	32,08	53,09	60,59	60,44	47,2	56,46	32,09	48,6275		C20: Wood and products of wood and cork	29
C36T37: Manufacturing nec; recycling	36,18	26,28	43,03	43,93	40,32	36,45	39,84	28,59	36,8275		C45: Construction	27
C40T41: Electricity, gas and water supply	44,03	24,11	34,65	44,34	49,68	25	31,57	36,19	36,19625		C01T05: Agriculture, hunting, forestry and fishing	24
C45: Construction	22,34	18,31	26,7	35,79	24,72	25,48	30,84	28,07	26,53125		C10T14: Mining and quarrying	24
C50T74: Total Business Sector Services	13,74	12,52	21,7	23,57	20,04	15,36	21,08	14,78	17,84875		C60T63: Transport and storage	23
C50T55: Wholesale and retail trade; Hotels and restaurants	12,84	11,77	22,89	24,09	20,58	13,03	19,47	12,84	17,18875		C60T64: Transport and storage, post and telecommuni	22
C50T52: Wholesale and retail trade; repairs	12,28	11,63	21,97	23,3	20,51	13,1	18,42	13,08	16,78625		C55: Hotels and restaurants	19
C55: Hotels and restaurants	13,86	13,63	26,97	28,22	21,14	12,33	22,55	12,69	18,92375		C50T74: Total Business Sector Services	18
C60T64: Transport and storage, post and telecommunication	18,82	19,09	21,19	29,73	22,61	20,92	25,98	19,29	22,20375		C50T55: Wholesale and retail trade; Hotels and restau	17
C60T63: Transport and storage	19,2	19,4	21,66	31,15	23,45	21,09	26,95	20,47	22,92125		C50T52: Wholesale and retail trade; repairs	17
C64: Post and telecommunications	16,97	16,07	13,64	16,14	11,8	17,61	18,55	7,52	14,7875		C73T74: R&D and other business activities	16
C65T67: Financial intermediation	10,3	10,23	11,23	13,6	11,08	11,57	10,27	5,56	10,48		C85: Health and social work	16
C70T74: Real estate, renting and business activities	12,59	8,81	21,31	17,31	14,84	14,44	16,28	9,91	14,43625		C90T93: Other community, social and personal service	15
C70: Real estate activities	7,29	3,25	21,47	11,7	9,58	11,98	7,48	3,65	9,55		C72: Computer and related activities	15
C71: Renting of machinery and equipment	8,82	4,6	22,48	14,47	19,3	13,22	19,58	7,09	13,695		C75T95: Community, social and personal services	15
C72: Computer and related activities	14,97	10,39	18,79	18,47	11,11	16,52	16,76	13,87	15,11		C64: Post and telecommunications	15
C73T74: R&D and other business activities	13,46	9	22,14	18,2	16,33	14,33	17,93	15,78	15,89625		C70T74: Real estate, renting and business activities	14
C75T95: Community, social and personal services	11,58	8,66	21,96	17,31	13,34	14,08	19,52	13,9	15,04375		C71: Renting of machinery and equipment	14
C75: Public administration and defence; compulsory social security	8,52	8,92	9,29	9,22	10,99	8,61	9,44	14,05	9,88		C65T67: Financial intermediation	10
C80: Education	4,81	4,35	8,29	9,52	9,73	4,96	8,61	5,5	6,97125		C75: Public administration and defence; compulsory sc	10
C85: Health and social work	12,8	8,25	20,7	22,03	19,24	13,48	17	12,88	15,7975		C70: Real estate activities	10
C90T93: Other community, social and personal services	11,96	8,79	23,57	17,63	13,19	14,31	20,42	14,1	15,49625		C80: Education	7
Note: Cut off point for highlighted areas is 40%												

Source: authors based on TIVA Database

On the positive side, high GVC dependence enables countries to engage in international industrial, technology, subcontracting, and trade networks. Countries have opportunities to benefit from the quick acquisition of world standards of productivity, quality and to benefit from continuous improvements of production capabilities as lead firms are introducing improvements and new products. Equally, they face the challenge of technology upgrading through GVCs. Technological upgrading for these countries is about increasing domestic value added in gross export.

From innovation policy perspective GVC dependent sectors are those in which CE economies are the most intensively engaged in the process of technology transfer. Also, these are sectors in which they have competitive advantages and have become an integral part of the European industrial fabric. Accordingly, these are sectors to which CE economies should pay particular attention in building their technological capabilities and in which they should aim to increase the share of domestic value added in export. However, the share of foreign value added in gross export in Eastern Central Europe continues to rise, which may suggest potential weakness in technology upgrading in these sectors (Figure 6). In that respect, these sectors should be given attention in the process of SS. They are critical users of knowledge and technologies that will hopefully be generated through SS related RDI programs.

If we take criterion of GVC integration as important in prioritising SS activities and programs, then it is important to explore whether the CE SS priorities are relevant for the sectors which are highly integrated into the GVCs. In other words, we are interested in whether SS TPAs are of relevance for GVC integrated sectors? If they are not, this may suggest that innovation policy is heading in different directions when compared to FDI, trade and industrial policy. In the context of this study, we are interested whether common CE SS priorities correlate to sectors which in these countries are the most integrated into the global economy. As already pointed out, it is in these sectors that CE economies have the most intensive technology transfers, and it is these sectors in which they are in the highest need of technology upgrading as the best way to main their place in continually changing dynamics of global production networks.

There is not a simple and straightforward method to identify which sectors are potential users of new technologies. Also, resources within this study do not allow for an ambitious attempt to try to find the appropriate method. On the other hand, the multi-sectoral nature of many modern technologies (the best example is ICT) makes it unrealistic to link up specific TPAs to specific sectors. However, based on our understanding of technological spectrum and given a high level of aggregation of economic sectors we have allocated individual TPAs to specific sectors as dominant users. Also, given multi-sectoral nature of new technologies, we have allocated several TPAs to specific sectors. We consider this very rough first approximation useful for establishing if there is a mismatch between SSS priorities and globally integrated dominant sectors users of this knowledge.

As the basis for establishing links between SS priorities and user sectors, we have used the initial list of 18 common S3 technology priority areas of the CE countries/regions. This more detailed list should make it easier to allocate specific TPAs to specific sectors. Out of 18 common TPAs eleven areas could be matched to sectors ranked regarding their global integration (Table 59).

We identify the following eleven TPAs as defined by the CE S3 strategies to be the most relevant for the sectors of their use: New materials; Chemical technologies; Electrotechnical and mechanical industries; ICT & Electronics; Advanced manufacturing systems; Transport and mobility: Photonics, Nanotechnology; Smart cities and communities; Energy and Environment, and Biotechnology). This is a very important additional criterion for overly upstream or only R&D orientation for the selection of TPA for intra-regional CE cooperation.

The Table 59 suggest that from the perspective of international GVC integration and opportunities for technology upgrading ICT Electronics, Advanced manufacturing systems and Advanced material and nanotechnology represent the most important priorities for technology upgrading through GVC in CE. So, based on the criterion of 'sustainable GVC integration' these three TPA should be considered as having higher priority when deciding in the selection of joint S3 priority areas for cooperation. We should bear in mind that this criterion may not be the only one to be used in the selection. However,

given very high GVC integration of the CE and obvious need to make this integration sustainable would require intensive technology upgrading exactly in these sectors technology users in which CE is already highly integrated into the global economy.

Based on this criterion agro- and bio-economy, public health, medicine and life sciences and partly energy and environment would be less of a priority. However, we should bear in mind that based on other criteria like sustainable development, employment, climate change and other grand challenges these areas may have advantages.

Table 59 Technology priority areas of the Central European smart specialisation[109] strategies and sectors technology users ranked by GVC dependence

Sectors technology users	GVC dependence	Central Europe S3 common priorities			
C34T35: Transport equipment	49	**ICT & Electronics**	**Transport & Mobility**	**New Materials**	**Smart Cities and Communities**
C30T33: Electrical and optical equipment	45	**ICT & Electronics**	**Advanced Matufacturing Systems**	**Photonics**	
C23T26: Chemicals and non-metallic mineral products	44	**Chemical Technologies**	**New Materials**	**Biotechnology**	
C27T28: Basic metals and fabricated metal products	44	**Electrotechnical and Mechanical Industries**	**New Materials**	**Nanotechnology**	
C17T19: Textiles, textile products, leather and footwear	39	**New Materials**			
C29: Machinery and equipment, nec	38	**Electrotechnical and Mechanical Industries**	**Advanced Matufacturing Systems**	**Photonics**	
C36T37: Manufacturing nec; recycling	37	**Energy & Environment**	**Advanced Matufacturing Systems**		**Nanotechnology**
C40T41: Electricity, gas and water supply	36	**Energy & Environment**			
C21T22: Pulp, paper, paper products, printing and publishing	32	Energy & Environment	Wood Technologies		
C20T22: Wood, paper, paper products, printing and publishing	31	Energy & Environment	Wood Technologies		
C15T16: Food products, beverages and tobacco	30	Agro-Bio-Economy	Biotechnology	Life Sciences	
C20: Wood and products of wood and cork	29	Energy & Environment	Wood Technologies		
C45: Construction	27	ICT & Electronics	Smart Cities and Communities		
C01T05: Agriculture, hunting, forestry and fishing	24	Agro-Bio-Economy	Biotechnology	Wood Technologies	
C10T14: Mining and quarrying	24	Energy & Environment			
C60T63: Transport and storage	23	ICT & Electronics	Transport & Mobility	Electrotechnical and Mechanical Industries	
C60T64: Transport and storage, post and telecommunication	22	ICT & Electronics	Transport & Mobility	Electrotechnical and Mechanical Industries	
C55: Hotels and restaurants	19	ICT & Electronics	Agro-Bio-Economy	Tourism	
C50T74: Total Business Sector Services	18				
C50T55: Wholesale and retail trade; Hotels and restaurants	17	Energy & Environment	ICT & Electronics	Tourism	Smart Cities and Communities
C50T52: Wholesale and retail trade; repairs	17	ICT & Electronics	Tourism	Smart Cities and Communities	
C73T74: R&D and other business activities	16	Smart Cities and Communities	Consultancy		
C85: Health and social work	16	ICT & Electronics	Public Health & Medicine	Life Sciences	
C90T93: Other community, social and personal services	15	ICT & Electronics	Public Health & Medicine	Smart Cities and Communities	
C72: Computer and related activities	15	ICT & Electronics	Smart Cities and Communities	Consultancy	
C75T95: Community, social and personal services	15	ICT & Electronics	Smart Cities and Communities	Other	
C64: Post and telecommunications	15	ICT & Electronics	Smart Cities and Communities		
C70T74: Real estate, renting and business activities	14	Tourism	Smart Cities and Communities	Consultancy	
C71: Renting of machinery and equipment	14	ICT & Electronics	Smart Cities and Communities		
C65T67: Financial intermediation	10	ICT & Electronics	Photonics		
C75: Public administration and defence; compulsory social security	10	ICT & Electronics	ICT & Electronics		
C70: Real estate activities	10	Tourism	Tourism	Smart Cities and Communities	
C80: Education	7	ICT & Electronics			

[109] We use here initial classification on 18 technology priority areas (see table 1 and Annex table 13)

This additional criterion of GVC integration correspondence to S3 priorities has broadly confirmed the importance of three priority areas as being of great significance for enhancing CE cooperation. This would ensure that the CE cooperation is not only strong in downstream activities (production through supply chains and trade) but equally that this macro-region creates potential or knowledge base for intra-regional technology upgrading. This issue is of particular importance in many sectors for Hungary and transport equipment and electrical and optical equipment where CE countries are very strongly integrated into global value chains. Also, generic nature of ICT and electronics calls for much stronger prioritisation of this TPA in all CE economies.

Also, generic nature of ICT and electronics is present also in non-GV dependent sectors.

Table 60 Central European smart specialization priorities and user sectors the most dependent on global value chains

	Sectors the most dependent on GVC (based on % of of foreign VA in gross export)											
	Austria	Germany	Czech R.	Hungary	Slovak R.	Poland	Slovenia	Croatia	Central Europe S3 common priorities			
C34T35: Transport equipment	**47.07**	32.08	**53.09**	**60.59**	**60.44**	**47.2**	**56.46**	32.09	**ICT & Electronics**	**Transport & Mobility**	**New Materials**	**Smart Cities and Communities**
C30T33: Electrical and optical equipment	31.2	25.1	**62.21**	**71.75**	**56.55**	**48.04**	**43.31**	23.11	**ICT & Electronics**	**Advanced Matufacturing Systems**	**Photonics**	
C23T26: Chemicals and non-metallic mineral products	36.91	32.39	**48.85**	**52.31**	**60.19**	**40.41**	38.14	**44.39**	**Chemical Technologies**	**New Materials**	**Biotechnology**	
C27T28: Basic metals and fabricated metal products	**40.64**	38.17	**50**	**52.39**	**54.2**	**41.91**	**43.93**	31.36	**Electrotechnical and Mechanical Industries**	**New Materials**	**Nanotechnology**	
C17T19: Textiles, textile products, leather and footwear	33.04	30.75	**50**	**54.97**	37.1	33.76	**49.47**	23.17	**New Materials**			
C29: Machinery and equipment, nec	33.18	26.68	**46.45**	**46.21**	**45.82**	36.9	**44.65**	25.94	**Electrotechnical and Mechanical Industries**	**Advanced Matufacturing Systems**	**Photonics**	
C36T37: Manufacturing nec; recycling	36.18	26.28	**43.03**	**43.93**	**40.32**	36.45	39.84	28.59	**Energy & Environment**	**Advanced Matufacturing Systems**		**Nanotechnology**
C40T41: Electricity, gas and water supply	**44.03**	24.11	34.65	**44.34**	**49.68**	25	31.57	36.19	**Energy & Environment**			
C21T22: Pulp, paper, paper products, printing and publishing	28.27	20.22	38.87	**40.65**	35.57	30.75	37.55	27.15	Energy & Environment	Wood Technologies		
C20T22: Wood, paper, paper products, printing and publishing	27.72	20.99	38.68	**40.96**	32.01	29.01	36.73	21.06	Energy & Environment	Wood Technologies		
C15T16: Food products, beverages and tobacco	28.25	27.51	39.68	37.08	34	24.23	34.5	18.3	Agro-Bio-Economy	Biotechnology	Life Sciences	
C20: Wood and products of wood and cork	26.94	24.31	38.21	**41.89**	23.53	25.81	35.57	17.6	Energy & Environment	Wood Technologies		

10 Implementation and governance models

10.1 S3 Central Europe in the context of the existing networks in the EU

Our analysis confirms the existence of various networks at the EU level within each thematic area covered by the present report. We also identified various initiatives, which promote synergies and complementarities by encouraging 'soft/light' cooperation, on the basis of the voluntary principle (e.g. Smart Specialisation Platform for Industrial Modernisation, including the Regional cooperation networks for industrial modernization, known also as the 'Reconfirm initiative'; I4MS Digital Innovation Hubs; the forthcoming KIC on added-value manufacturing; and the European Cluster Collaboration Platform.

On the other hand, the co-investment projects by the national authorities are realised only in the framework of the EUREKA initiative, in addition to cross-border projects funded within the European Territorial Cooperation (ETC), better known as Interreg, and the EU macro-regional strategies.

In this context, one of the options would be **to strengthen the participation and involvement of S3 Central Europe stakeholders from the respective thematic areas within the already existing structures at the EU level.** For example, enhancing the cooperation could be considered (non-exclusive list) exclusively with the following initiatives and networks, including The Regional Digital Innovation Hubs/EFFRA, ECSEL, European RTD-Cluster on Lightweight Design – SEAM, etc.

The second option would be **to establish and launch new S3 Central Europe Cooperation Networks in areas with a clearly defined thematic focus**.

Another finding emerging from the documentary review is the establishment of the strategic partnerships in the different S3 specialisation domains, especially in the CEECs**.** Since the key stakeholders from these partnerships possess the right thematic knowledge and industrial expertise, they will be good candidates for experts to be involved in the existing EU networks or organisational structures of the new S3 Central Europe networks.

Connecting the thematic networks from the different levels of governance (EU, national and regional) is the key. The national and regional networks in their specific thematic areas are already playing an active role by organising various events. For example, the events like Central & Eastern European Automotive Forum[110] or International MERGE Technologies Conference for Lightweight Structures took place with some specific purpose.[111] To maximise the potential success of the future initiatives, it will be required to reach out and take an active part in such strategic meeting places.

With regards to the rules and procedures, the adopted practice by the leading initiatives, such as RWTH Aachen Cluster Digital Photonic Production (Joint research under one roof) is to make a distinction between research in joint groups (only non-exclusive utilisation/licensing, fundamentally oriented research topics), and complementary research by partners, i.e. single or bilateral (exclusive utilisation/licensing, application-oriented research themes and possible product development – not eligible for funding).[112] This clearly defines rules concerning the commercialisation IP rights which is required in this type of initiatives 'under one roof' involving the cooperation between the industrial partners and scientific institutions.

[110] See: http://www.ceeautomotive.com

[111] See: https://www.tu-chemnitz.de/IMTC

[112] See: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/sites/default/files/report/Aachen%20Centre%20for%203D%20Printing.pdf

One of the key lessons learned within the Vanguard Initiative is that setting up the appropriate legal structure and IPR framework is critical. It is recommended that IP aspects need to be considered at an early stage of development, notably at the moment of mobilising and involving the industrial partners.

Also, the mKETs-Pilot lines project pointed to the challenge that most companies (SMEs) have no capacity to monitor and pursue infringements of IPRs at the worldwide level Consequently, the need for secrecy on the underlying technology has a negative effect on the diffusion pace of new applications.[113]

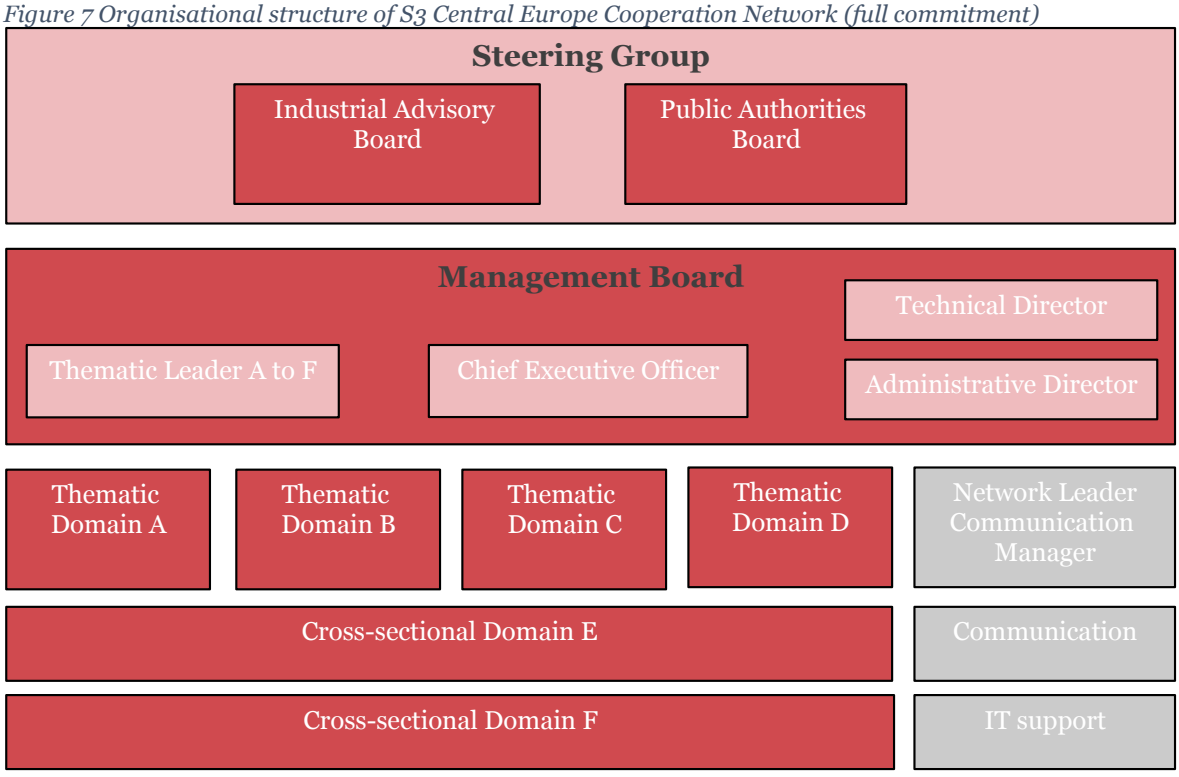
In this context, it is important to note that the European IPR Helpdesk offers free of charge, first-line support on IP and IPR matters to beneficiaries of EU funded research projects and EU SMEs involved in transnational partnership agreements, especially within the Enterprise Europe Network (EEN).[114] **The European IPR Helpdesk could be used as the knowledge base for obtaining IPR support for joint-demonstration opportunities.**

In preparation of the S3 Central Europe networks, it will be of the utmost importance not to follow a "one size fits all" governance/funding models because of the varied nature of thematic areas, the different type of stakeholder relations and the need for tailored financial instruments.

10.2 Possible governance of S3 Central Europe Cooperation Network

The figure below outlines the possible governance of S3 cooperation networks drawn by a typical organisational structure used by other thematic networks and initiatives. It is also important to note that such structure is used for the most advanced form of cooperation with the full commitment of financial and human resources.

Figure 7 Organisational structure of S3 Central Europe Cooperation Network (full commitment)



Source: Own based on the Cluster of Excellence MERGE, the Cluster of Excellence Integrative Production Technology for High-Wage Countries, and Metallurgy Europe.

[113] See: http://www.mkpl.eu/uploads/media/150209_mkets_assessment_report_acreo_-_formatted_-_final.pdf

[114] See: https://www.iprhelpdesk.eu/

The brief descriptions of responsibilities for each function, as shown above, is provided in the following sections.

10.2.1 High-Level Group

As the governing body of the initiative the High-Level Group (HLG), develops the strategy related to maintaining leadership and/or ensuring the coordination in the specific thematic area, provides strategic advice to the Management Board. It consists of the **Industrial Advisory Board (IAB) and the Public Authorities Board (PAB)**.

In particular, it is important to emphasise the role of the Industrial Advisory Board (IAB) members as they ensure the engagement and involvement of industrial stakeholders. Taking into account the importance of the midstream dimension of value chains (industry) it is not recommended to have in place two separate Advisory Boards (i.e. Industrial and Scientific) as they may appear in the organisational structure of the Cluster of Excellence initiatives.

The HGL allows organising the key stakeholders and empower them to "steer" the initiative to a successful conclusion. The overall role of the HLG is deliberate, advise and provide strategic oversight, however, it could also be the ultimate decision-making authority. The Public Authorities Board (PAB) can support and facilitate the securing of public co-funding for selected projects, according to national/regional priorities. Before embarking on any initiative, it will be important to clarify the role to be played by the HLG.

10.2.2 Management Board

The Chief Executive Officer (CEO) is responsible for overall operations and performance of the initiative. The person in this position will be responsible for the daily management, including the financial and human resources. The CEO should also play an active part in activities of the initiative in coordinating and liaising with its members and other relevant networks.

The Technical Director (TD) provides scientific and technical information relating to the thematic area of the initiative. This person usually possesses the highest level of skills within a specific thematic area and is recognised as an expert in the industry.

With regards to projects funded under the EUREKA (Metallurgy Europe), it is noted that the **Technical Evaluation Board** (TEB) is responsible for the overall quality, coherence and consistency of the evaluation of the project proposals, within the set-out R&D topics.

10.2.3 Implementation

The Administrative Director (AD) oversees the support operations of the initiative. Depending on the initiative, the AD may be involved in a variety of responsibilities such as finance, office and facilities management, marketing/PR, controlling, preparing contracts, etc.

The Thematic Leaders (TL) are responsible for coordinating the relevant activities and work within the thematic area.

With regards to projects funded under the EUREKA (Metallurgy Europe), ad-hoc **Working Groups** (WG) are foreseen to support the work of the IAB and the TEB.

The Network Leader (NL) is responsible for mobilisation and stakeholders engagement, events management, public affairs activities, international activities, and will work closely with the CEO and the respective TLs.

The Communication Manager (CM) is responsible for the preparation of all the publications and communication material, social media, and will liaise with IT experts in relation to the design and development of the online interface and tools.

The Communication Team (CT) will provide support for all communication activities of the initiative, whereas the IT experts will be responsible for the development and maintenance of online tools and applications.

10.3 Possible funding models of S3 Central Europe Cooperation Networks

The table below summarised the following four funding models. The choice of a specific model will largely depend on the nature of TPA, the scale of ambition and whether consensus can be reached among the major stakeholders. Co-investments for joint demonstration projects are by far the most complex and require advanced stages of development. It is much more realistic to start with the funding modes that correspond to the very early stages of the CE inter-regional cooperation i.e. with the funding and projects that can fit into the existing instruments. The experiences of Vanguard initiative are in this respect tremendously important, and DG Regio should try to ensure that all potential lead organisations benefit from these experiences[115]. Based on Vanguard experiences, two key issues for a successful project will be what is the amount of public funding available, able to match industrial investment and whether IPR and legal issues are set up. Finally, we should not overlook the experimentalist nature of this attempt and hence strong need to share learning across different cases.

Table 61 Main funding models of S3 Central Europe Cooperation Networks

Funding options	Descriptions	Degree of complexity
EU investment instruments, such as the European Structural and Investment (ESI) Funds, COSME, Horizon2020 and the European Fund for Strategic Investments (EFSI)	Bringing together ESIF and H2020 in one project (possible only for Horizon2020) Successive projects Parallel projects ESIF financing successful Horizon2020 project applications that could not be financed	High, considered not to be an easy business.
Projects could be financed by respective national authorities by the national laws, rules, regulations & procedures in effect	Example of EUREKA-funded projects	The model currently in place, thus relatively no major difficulties to be expected (at least at the national level).
15% of ERDF, CF and EMFF priority axis may be spent in EU outside programme area (Article 70(2) CPR)	Opportunity for co-investment in transnational infrastructures and actions (e.g. joint cluster initiatives, shared research infrastructures.	High, model not in place yet.
Co-investment for joint-demonstration opportunities (combination of different sources of funding)	The commitment to the Vanguard Initiative to the development of inter-regional networks, based on bottom-up entrepreneurship and regional clusters that co-invest in new, interconnected European and global value chains.	High, model not in place yet.

10.4 Governance models in individual thematic priority areas

In continuation, we outline models and areas of cooperation in selected sub-areas:

In *renewable energy area* (wind, PVC, biomass) the gap RDI and technology gap between German regions and Eastern CE is large and is compounded by different sizes and levels of investments in renewable in Germany and the rest of Central Europe. Still, there are pockets of excellence in technology applications in Central Europe either in individual firms or public research organisations. Given the leading role of Germany in this area, it would seem desirable that one of Fraunhofer institutes in this

[115] See IDEA Consult (2016) Matchmaking Event Report. Monday, 22 August 2016. Prepared for: The Vanguard Initiative

areas coordinates this cooperation which should be pitched at intermediate level i.e.,. between R&D and implementation. This collaboration could explore the applicability of new technological solutions in selected areas of renewables with the aim that in the next stage consortium attracts more private companies.

Environmental services are developed to very different degrees in Central Europe, and this unevenness represents great opportunity for knowledge exchange and dissemination of the best practice. This cooperation could focus on either macro issues like how to optimise management of complex major urban services or treatment of the most difficult forms of pollution or exploring individual technology solutions in reducing pollution or environmental sustainability. In the case of macro orientation, cooperation would involve largely public bodies and public research organisations. In the case of specific innovation projects, it should involve interested firms in the consortium led by PRO.

Medical and industrial biotechnology are two different areas but which also share common knowledge base. Industrial biotechnology is about the development, manufacture and selling of products and services that use or contain biological material as catalysts or feedstock to make industrial products while medical biotechnology is about discovering or developing new therapeutics that action in or on the body by pharmacological, immunological or metabolic means. In CE, Germany leads the way but also there are pockets of RD excellence in the rest of CE. The importance of these areas for the CE cooperation may not be justified only by the existing strengths but more by technological opportunities that it offers. Industrial biotechnology is a new promising area which may become the largest sector in comparison to agricultural and medical biotechnologies or sectors. It is comparatively less developed in Eastern Central Europe than medical biotechnology. Given the nature of this area, any cooperation would need to involve stakeholders from both public and private sector. The focus could be identified only after analyses of the competencies of involved stakeholders.

Medical devices represent quite a heterogenous area with applications of very different technological levels. The overall picture is of Bavaria as the leader, clustering of medical devices producers in Hungary and niche producers in other CE economies. Given this technological diversity and the fact that health R&D is relatively developed in eastern CE it would be worthwhile exploring how cooperation within the CE could assist internationalisation and technological cooperation of different companies. Key stakeholders in this effort should be national associations of medical devices producers and individual companies interested in further internationalisation. The aim is to facilitate the development of supply chain in the CE akin to supply chains in sectors like automotive.

The food industry is one of the current strengths of Central Europe as witnessed by the healthy competition of domestic and foreign companies on these markets. The number of clusters in the food sector in Central Europe is relatively high but equally links with the R&D organisations are not at desired level. However, given the economic importance of this sector and a variety of players in the sector as well as rising demand for healthy food there is scope for CE collaboration, which would be around building g knowledge basis in specific niches of food technologies. For example, of these niches is a functional food. There is now a growing realisation of the market potential for functional foods, based on the principle of added value linked to health benefit[116]. So, cooperation in this area would be not only desirable but in view of shift from traditional to functional food should also be seen as one of the necessities in technology upgrading of the CE food industry. As stated in the Consensus document of the EU experts in this area: 'The food industry has unique opportunities to develop products that are not only nutritional in the traditional sense, but which have additional activity that can lead to an improved state of health and well-being and/or reduction in risk of disease (functional foods)'. The aim of the cooperation would be to enhance the knowledge exchange in functional food science from which should be expected further specific projects and developments. Also, given the diversity of stakeholders in this

[116] See *British Journal of Nutrition* (1999), 81, Sl-S27, Scientific Concepts of Functional Foods in Europe

Consensus Document. Available at http://www.ufrgs.br/alimentus/disciplinas/tecnologia-de-alimentos-especiais/alimentos-funcionais/funcionais_consenso_europeu.pdf

are the cooperation should be coordinated by the public research organisation with the experiences of in the area of functional product development.

Wood (Forest) sector in Central Europe has high potential especially given the potential in Eastern CE and the fact that Germany and Austria are the largest roundwood importers after China. Also, European forest-based sector is in a period profound structural change as markets for existing import forest of the product is in decline and new forest products that did not exist in 20th century are emerging[117]. So, given this high interdependence within CE, it would seem promising to explore opportunities for technology upgrading in this sector which would be in the interest of both importers and experts. This cooperation may explore possibilities for improvements in the supply chain management, for the efficiency of forest management and improvements in the cascading use of wood. The overall aim of cooperation would be improving resource efficiency in the utilization of this valuable resource and to promote a shift from 'forest sector' to 'forest-based bioeconomy'[118].

Circular economy/bio-economy is one of the priority areas either as part of the S3 or as part of growth strategies of several CE countries. CE countries have potential regarding biomass availability and bio-economy also represents an opportunity for economic growth and job creation. At the same time, to enhance this potential, effective regional cooperation is needed, able to address various stakeholders such as researchers, economic operators, policy makers and citizens, i.e. the final beneficiaries of bio-based products. This cooperation would effectively develop regional approach along the lines of the EU Bioeconomy Strategy and action plan which focuses on three key aspects:

- developing new technologies and processes for the bioeconomy;
- developing markets and competitiveness in bioeconomy sectors; and
- pushing policymakers and stakeholders to work more closely together.

This cooperation should involve a large range of interested parties and would be in initial stages confined on dissemination of good practice and mutual learning. Given the nature of this, it should be coordinated by public organisation.

In the area of *Advanced materials and nanotechnology*, the existing networks are of great importance for cooperation across the EU. A notable example is a recently launched initiative Metallurgy Europe, the main aim of which is to contribute to the development of next-generation of alloys, compounds and composites that that can be processed into higher-performance metallic components for industrial end-users. There is still a potential for establishing new cross-border alliances with the involvement of stakeholders from CE.

As above the same conclusion can be drawn about the area of *Advanced Manufacturing systems*. By developing new partnerships, it will be possible to better explore new opportunities of cooperation between partner organisations from CE.

As far as the area of *Transport and mobility* is concerned, it will be important to focus on building upon the already existing networks at the EU level, even though there could be new regional alliances and partnerships established with a focus on multi-KETs related areas.

Within the area of *ICT & electronics*, there is a potential for establishing new regional alliances with a clearly defined thematic focus and in close cooperation with the already existing EU-level networks.

In all the above TPAs the involvement of a mix actors will be important to ensure that activities are demand-driven to support the competitiveness of European companies.

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[117] Schwarzbauer, P et al (2015) The Future of the Forest-based Sector in Central Europe – Structural Changes Towards Bioeconomy, Presented at the

[118] Lauri Hetemaki (ed) *Future of the European Forestry based sector: Structural Changes towards bio-economy* http://www.efi.int/files/attachments/publications/efi_wsctu_6_2014.pdf

11 Conclusions

The main objectives of this assignment were:

- To identify whether there will be sufficient common areas of potential cooperation in the field of R&D and innovation between the concerned Central European countries and regions on the basis of a desk research of the existing RIS3 strategies, in addition to the databases and mapping tools, such as the Eye@RIS3 database of smart specialisation priorities and Cluster Mapping tool.
- To provide indications and` recommendations for the set-up of governance models as a framework for a more efficient and enhanced cooperation platform.
- To give recommendations whether a more in-depth analysis or other specific actions for cooperation (e.g. pilot actions, workshops, common research projects, etc.) may be justified and if yes, provide some guiding principle for such follow-up activities.

Thematic focus

The study has identified seven common technology priority areas based on the initial list of 18 areas. This selection was verified based on analysis of RD (upstream) capacities, development of clustering and patenting (midstream capacities) and evaluation of the presence of economic operators or business interests in the respective technology areas. The first list of 18 TPAs was also verified by matching TPAs to sectors which are potential users of new technology and knowledge to be developed in TPAs. This additional verification was necessary given very high degree of integration of CE in global, especially European value chains and need for CE match their upgrading though GVC with their prioritisation via S3 TPAs.

Based on the initial list of 18 priorities we have selected based on the analysis and by merging and eliminating some areas seven TPAs which seems to be the most appropriate candidates for CE cooperation. Also, through additional analysis, we have further disaggregated this seven areas into specific-subareas. The table below sumarises this result of the analysis. We would like to emphasize the limitations of the analysis which was based on the available evidence and resources. Still, we consider that it represent the robust basis for final verification based on expert insights and which should make corrections and modifications to this list based on desktop research.

Table 62 Overview of potential within the (sub-) thematic priority areas

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
Energy and Environment	• Traditional (fossil) energy technologies incl. Power engineering	• Not a priority	• Large established players. The capacity to 'kickstart' cooperation is beyond the capabilities of the CE S3 stakeholders.
	• Renewable energy (wind, PVC, biomass)	• Strong priority	• Strong and rising demand coupled with the need for diversification into new energy areas. Also, the opportunity to establish CE supply chains linked to technology upgrading.
	• Environmental services	• Moderate priority	• Solid and rising demand but very different levels of development among countries/regions represent an excellent

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
			opportunity for knowledge exchange. Working groups should explore whether it should be macro or specific innovation focused cooperation.
Public Health, Medicine and Life Science	• Biotechnology (medical and industrial)	• Very high priority	• Very promising technology area where CE needs to invest more. Developed R&D capacities in health and unrealised opportunities in medical biotech. Industrial biotechnology as new and emerging area which has not been given enough attention in national S3 strategies
	• Medical devices	• Moderate priority	• Uneven development across CE but opportunities for establishing a regional supply chain. The outcome is highly dependent on coordinating a large number of poorly coordinated players.
Agro-and Bio-Economy	• Functional food	• Strong priority	• A strong opportunity but also a necessity given the economic importance of food industry in CE. It would enhance so far poor cooperation between industry and R&D sector in CE.
	• Wood/forest sector	• Moderate priority	• The Large potential in parts of CE coupled with high trade interdependence. Cooperation should focus on improvements in the supply chain management with the aim to promote a shift from 'forest sector' to 'forest-based bioeconomy'. The biggest obstacle: a variety of national players with limited international cooperation experiences
	• Circular economy/bio-economy	• Strong priority	• Potential regarding biomass and need to develop regional approach along the lines of EU Bioeconomy strategy. A large range of stakeholders which would be possible to organise provided that

Thematic Priority Area	Sub-area	Potential of cooperation	Further information
			the cooperation is initially confined on dissemination of good practice and mutual learning.
Advanced Materials and Nanotechnology	• A wide range of specific technologies	• Strong priority	• Potential impact on industries beyond the sectors driving the development of these technologies. Creative combination of technologies into new products.
Transport and Mobility	• Automotive	• Strong priority	• A significant concentration of companies in automotive sector but a highly globalised industry with strong competition. The focus of cooperation to be determined by actual needs of relevant stakeholders.
	• Aerospace and Rail	• Moderate priority	
Advanced Manufacturing Systems	• Factory and process automation	• Strong priority	• Potential and added value for manufacturing and process manufacturing.
	• Industry 4.0 related solutions (cyber-physical systems)	• Not a priority	• Strong competition and still at early stage of development.
	• Data analytics, complex simulation, and modelling	• Moderate priority	• Availability of competencies in software systems engineering, communication.
ICT & Electronics	• Intelligent transport systems • Smart grids and energy networks • New safety and security solutions	• Strong priority	• Considered to be a priority and relevant activities undertaken in this field. • The demand for programming and modelling methods, platforms and software and available competencies in these areas.
	• Photonics sensing technologies	• Moderate priority	
	• Micro and Nanoelectronics	• Not a priority	• Activities undertaken by platforms at the national level. Area of activity important for optimisation of manufacturing and processing industry. Strong global competition in the semiconductor industry.

Governance models

Given the diversity of technology areas and their sub-areas (19), it is very difficult to come up with the developed governance models of the cooperation which would be tailored to specific areas. So, we provide heavy loaded governance model as the reference case although we are acutely aware that this may not be the way that regional cooperation in CE can be initiated given a variety of resources constraints. It is important to bear in mind that modes of governance are very unique to each of sub-areas and hence we have tried to more give rationale for the specific area and only very brief hints which could be potential stakeholders involved. Once sub-areas are selected through verification workshop it may be possible to think about modes of cooperation at more detailed level.

This study is about giving direction and opening the process of CE collaboration and we are much less in position to outline specifically desirable modes of collaboration. Specific forms of collaboration will largely depend on the willingness of stakeholders and on the size and forms of their commitments. In turn, this will determine the forms of how cooperation will be organised.

The specific mode of governance will depend on the upstream or downstream nature of the area. For example, medical biotechnology should involve much more RD players when compared to medical devices which should involve much more downstream players (companies). Also, the form of cooperation will depend on the commitment of participants and can vary from consultations, exchange of the best practices for very specific commitments in joint projects and developments. It may not be possible or even desirable in advance to specify the level of this undertaking.

Specific forms of cooperation would need to consider the existing networks at the EU level. For example, the recently established Smart Specialisation Platform for Industrial Modernisation[119] aims to accelerate the development of joint investment projects in the EU by encouraging and supporting interregional cooperation in "Thematic Networks" based on smart specialisation priorities defined by regional and national government linked to industrial modernisation. Through the Industrial Modernisation Platform, EU regions and the Member States will be able to implement more efficiently their smart specialisation strategies, and industry will benefit from the new cooperation opportunities developed with partners from other regions. It is expected that it will contribute to the development of strong Europe-wide value chains and promote investments. All this will require joint efforts and coordination. Other tools and approaches will need to be mobilised to maximise the potential success of cooperation in an area with a clearly defined thematic focus.

In almost all TPAs (i.e. Advanced materials and nanotechnology, Advanced manufacturing systems, Transport and mobility, ICT and electronics) the involvement of a mix of actors will be important to avoid the over focus on supply-side activities.

Further actions

The availability of robust evidence-based assessments leaves room for improvement. Without reliable data and more detailed information, it is already extremely difficult to identify common areas of potential cooperation with the view of strengthening the existing and/or developing new value chains. It will also be a challenging task to assess the progress achieved and put forward recommendations how to adjust the future actions and initiatives to reach the ambitions and visions set out on S3 strategies. Providing a relevant database on aspects related to specific focus areas will provide further evidence and information as a basis for policy-making.

This study has done what is possible in analytical terms based on desktop research and some limited interviewing. When assessing the outcomes, it is important to bear in mind that study could not go much beyond the evidence that is available in S3 documents and thus shares all strengths and weaknesses of S3 analytical and decision-making processes in different regions/countries. Wherever it is possible, we have tried to complement data and information from S3 analyses and EU databases with additional

[119] See: http://s3platform.jrc.ec.europa.eu/industrial-modernisation

reviews of secondary literature, which can be seen through additional references. Given these constraints, we feel quite cautious in listing and justifying sub-priority areas, which have emerged out of the analysis of S3 priorities. Moreover, some of these sub-areas areas that are proposed do not stem directly from te S3 related analyses which do not give sufficient analytical basis for such proposal but from our broader understanding of the respective areas and analysis of literature and other sources. We think that the next step should be expert verification of these results, possibly their correction and clarification. To make this step effective it would be of utmost importance to invite on the verification workshop participants from the CE countries/regions that are each familiar with at least one of seven priority areas. These experts should be familiar with RDI capacities in the area in their respective countries and generally but should also have a fair understanding of not only technical but also market and policy issues of the area. Finally, these experts should be close to policymaking bodies and be familiar with the current programs and projects in their respective area.

We suggest that the verification workshop should work in 90 minutes brainstorming sessions, which would cover each of seven proposed areas. The outcome of these sessions should be agreement on 1-2 sub-areas in which there is a consensus among participants on intra-regional CE cooperation potential, identification of the major stakeholders and proposal for the possible coordinator of the network.

To make this outcome feasible it is paramount that the workshop is well prepared. This involves not only proper moderation of brainstorming sessions but much more suitable preparations for the workshop. We propose to send a set of question to workshop participants which should be received well before the workshop so that they can be analysed and summary of the main conclusions to be sent to all participants shortly before the workshop.

We suggest the following set of questions to participants, which should be experts each in one of seven areas of the common CE S3 priorities. These questions should be sent together with the pdf copy of the study. The aim is to have written feedback on study and sound participants regarding opportunities for the CE cooperation before the workshop. It would be a mistake to use the workshop to discuss the study and its weaknesses and limitations. The study is background information based on desktop research for participants to agree on the opportunities and viable forms of intraregional CEE cooperation in S3 areas.

Below, we outline a list of questions to inform and guide the discussion of the future workshop which will take place in Zagreb (the exact date to be confirmed). Persons that should respond to these question should be experts in one or two TPAs that will be brainstormed in Zagreb.

1. **Please, specify TPA for which you are expert in your country/region (**Energy and Environment; Public health, medicine and life sciences; Agro- and bio-economy; Advanced materials and nanotechnology; Transport and mobility; Advanced manufacturing systems; ICT and electronics)

2. **Proposed common thematic priorities in S3 CE report**

    a. What is your opinion on proposed common thematic priority areas and sub-areas for the CE cooperation? Do these areas also represent a priority for your region/country? If yes, please which? If not, please, specify which areas?

    b. Could you rank the proposed technology priority sub-areas (19) in terms of interst of of your region/country? You may want to add some other sub-areas that are not proposed?

3. **Cross-border cooperation: assessment**

    a. Can you give an overview of the state of play in terms of international cooperation in your area of activities (e.g. Energy and Environment; Public health, medicine and life sciences; Agro- and bio-economy; Advanced materials and nanotechnology; Transport and mobility; Advanced manufacturing systems; ICT and electronics) and explain the results achieved so far?

    b. What are the main challenges in relation to the above-mentioned thematic priority areas?

c. Do you consider that there is a need to improve cooperation across Central Europe?

d. Are there any inter-regional programs in any of seven TPAs that are in operation or are being planned in your region/country? Please, could you specify the name of the program, give a brief description and if available web link to the program?

4. Key actors

a. Which are the key organisations (i.e. clusters, companies and RTOs) active in TPAs from your country/region?

b. Concerning companies, can you comment on the aspirations of their leadership on foreign markets and provide examples of pivotal companies?

5. Projects / investments

a. What are the programs in seven TPAs that are being funded through S3 related programs in your region/country? Please, could you specify names of the major programs, give a brief description and if available web link to the program?

b. Are any of these concern the pilot and demonstration projects? If it is the case, please provide with concrete examples.

6. Thematic focus of future cooperation efforts

a. If you consider that there is a need for cooperation in CE, what should be in your opinion the main focus of such cooperation (i.e. headline topics of future cooperation)?

b. Do you see any other TPA area or sub-area as promising for establishing CE intra-regional cooperation? If yes, please, could you justify it and outline possible mode of cooperation?

c. What do you consider as the most suitable governance model in specific TPA? Please briefly explain why?

d. Do you have any additional comments?

A letter to participants should briefly explain the purpose of the workshop and the rationale for this process as well as should contain table with seven technology priority areas and sub-areas

As further follow-up actions, we suggest that the verification workshop should result in forming several working parties to be led by lead organisations. Lead organisations should not necessarily be one from each of the regions/countries for one of each of seven or more TPAs or sub-areas but should be selected based on commitment and excellence. The lead organisations should receive assistance from DG Regio in defining to greater details the scope of the networking project, its aims and focus as well as appropriate governance model with the suggestions on potential modes of funding. Hopefully, this report offers sufficient basis for the initial stages of this work.

Annex 1 List of projects and beneficiaries of H2020 projects in the area of energy and environment

Project's title	***Countries***	***Number of countries from Central Europe involved***
Development and advanced prefabrication of innovative, multifunctional building envelope elements for Modular Retrofitting and CONNECTions	EE;PT;NL;CH;DK;**CZ**;LV	1
Waste Heat Recovery for Power Valorisation with Organic Rankine Cycle Technology in Energy Intensive Industries	IT;**HU**;ES;RO	1
M4ShaleGas: Measuring, monitoring, mitigating managing the environmental impact of shale gas	NL;**PL;CZ**;PT;UK;NO;DE;DK;FR;ES	2
Shale gas Exploration and Exploitation induced Risks	UK;US;**PL;DE**;NL	2
Maximising the EU shale gas potential by minimising its environmental footprint	UK;**CZ;**ES;IT;FR;**DE**;EL	2
Flexible and Mobile Economic Processing Technologies	FR;UK;FI;***DE***;PT;***CZ***;SE	2
Applying European market leadership to river basin networks and spreading of innovation on water ICT models, tools and data	SK;DE;UK;ES;NL;IT;BE	2
Towards Indium-free TCOs	SK;CH;NL;BE;UK;PL;FR	2
Prospecting Secondary raw materials in the Urban mine and Mining waste	BE;FR;CZ;SE;UK;DE;NL;JP;DK;SI;CH	3
Knowledge Inventory for hydrogeology research	ES;FR;DK;HU	1
International cooperation on Raw materials	UK;ZA;PT;ES;AT;BE;DE;AU;HU;SI;US	4
FREE and open source software tools for WATer resource management	FR;MT;EL;EE;RO;ES;TR;UA;CZ;IT;DE;SI;CH;NL	3
NEW_InnoNet: The Near-zero European Waste Innovation Network	NL;SE;NO;ES;PL;BE;FI	1
Coordination and Assessment of Research and Innovation in Support of Climate Mitigation Actions	AT;BE;FR;EL;DK;CZ;DE;NL;SE	3
Consolidating the European Research Area on biodiversity and ecosystem services	LT;DE;UK;FR;AT;EE;NL;TR;CH;ES;BE;HU;NO;BG;RO;SE;PT;PL	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
Promotion of Public Procurement of Innovation for Resource Efficiency and Waste Treatment	ES;NL;SE;BE;DE;HR	2
¡Viable and Alternative Mine Operating System!	BA;ES;FR;AT;UK;PT;DE;NL;SI	2
Smart City performance measurement system	BE;AT;HR;NL;ES;FI	2
GrowSmarter	AT;SE;ES;PT;DE;BE;MT;FR;RO;HU;IE;DK	3
Regeneration Model for accelerating the smart URBAN transformation	ES;UK;TR;BE;IT;DE;HU	2
BIOmethane as Sustainable and Renewable Fuel	IT;HU;FR;DE;AT;UK;BE	2
ProCold: Empowering stakeholders to deliver highly energy efficient professional cold products	CZ;DE;FR;SE;AT;IT;PT;CH	3
PROFessional multi-disciplinary TRAining and Continuing development in skills for NZEB principles	BE;ES;DK;NL;CZ;HR;IT;SI	3
Assessing the intangibles: the socioeconomic benefits of improving energy efficiency	UK;AT;BG;PL;ES;FI	2
Game to promote energy efficiency actions	HU;FR;ES	1
Step by step commitments for energy saving	BE;PL;IT;ES;DE	2
Energy Performance Contracting Plus	CZ;AT;SI;PT;EL;IE;DE;BE;IT;BG;ES	4
A multi-stakeholder Regional Action Network as a living structural base to effectively help define and implement deep energy efficient building renovation at local, national and European level.	SI;FI;UK;IE;TR;LV;HR;IT;CZ;BG;SE;SK;RO	4
Enabling consumer action towards top energy-efficient products	CZ;ES;NO;DE;LT;PL;IT;FR;SE;UK;AT;BE;RO;LU;PT;CH	4
Building TRUST in Energy Performance Contracting for tertiary sector energy efficiency and sustainable energy projects in Southern European Countries	IT;PT;FR;ES;HR;EL	1
Fostering public capacity to plan, finance and manage integrated urban	NL;ES;HR;PL	2

Project's title	*Countries*	*Number of countries from Central Europe involved*
REGeneration for sustainable energy uptake		
GreenS – Green public procurement supporters for innovative and sustainable institutional change	ES;SE;BG;SI;LV;IT;DE;CY	2
Regional process innovations FOR Building renovation packages opening markets to zero energy renovations	NL;DK;BE;DE;SI;EE	2
STEam And Management Under Pressure	DK;IT;DE;EL;AT;NL;CZ;ES	3
Energy Efficiency Complaint Products 2014	BG;BE;UK;NL;SE;LT;AT;SI;MT;PL;DK;DE	4
Predictable Flexible Molten Salts Solar Power Plant	DE;SK;PL;IT;PT;ES;CH	3
PhD on Innovation Pathways for TES	UK;ES;NL;FR;AT;PL;LV;IT;TR;DE;IL;PT;IE;BE	3
Holistic Innovative Solutions for an Efficient Recycling and Recovery of Valuable Raw Materials from Complex Construction and Demolition Waste	FI;BE;NL;ES;CH;FR;DE;IT;PL	2
Coordinated energy-related PPIs actions for cities (CEPPI)	UK;ES;HU;PL;DE	3
New Easy to Install and Manufacture PRE-Fabricated Modules Supported by a BIM-based Integrated Design ProceSS	RO;UK;HU;IE;IT;ES;PL	2
Building energy renovation through timber prefabricated modules	DE;FR;ES;SE;DK;PL	2
FOSTERING INDUSTRIAL SYMBIOSIS FOR A SUSTAINABLE RESOURCE INTENSIVE INDUSTRY ACROSS THE EXTENDED CONSTRUCTION VALUE CHAIN	ES;IT;BE;UK;HU;SE;DE;CZ;TR	3
Transitions pathways and risk analysis for climate change mitigation and adaption strategies	UK;EL;AT;ES;CL;SE;PL;NL;CH	1
ECOLORO: Reuse of Waste Water from the Textile Industry	NL;BE;CZ	1
Train-to-NZEB: The Building Knowledge Hubs	CZ;DE;RO;IE;BG;TR;UA	2
Resource Efficient Food and dRink for the Entire Supply cHain	FR;UK;HU;NL;ES;DE;KE;BE;SE;CN;SI;AT;DK;IT	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
SMART data collection and inteGRation platform to enhance availability and accessibility of data and infOrmation in the EU territory on SecoNDary Raw Materials	IT;FI;HU;ES;UK	1
Metal Recovery from Low-Grade Ores and Wastes Plus	ES;FR;PL;BE;IT;SE;FI;CY;EL	1
Water Saving for Solar Concentrated Power	CZ;DE;ES;NL;MA;FR;IT;UK	1
Guiding European Policy toward a low-carbon economy. Modelling Energy system Development under Environmental And Socioeconomic constraints	AT;ES;CZ;EL;BE;UK;IT;BG	2
BiogasAction: Promotion of sustainable biogas production in EU	CZ;FR;SE;LV;BE;NL;HR;UK;DK;DE	3
Role of technologies in an energy efficient economy – model-based analysis of policy measures and transformation pathways to a sustainable energy system	FO;DK;DE;FI;LT;NL;HR;UK	2
Breakthrough Solutions for the Sustainable Harvesting and Processing of Deep Sea Polymetallic Nodules	NL;FR;BE;DK;DE;ES;UK;NO;HU	2
Multi-Stakeholder Platform for a Secure Supply of Refractory Metals in Europe	FR;BE;ES;PL;EL;FI;DE;SE;NL	2
A novel process for manufacturing complex shaped Fe-Al intermetallic parts resistant to extreme environments	UA;DE;NO;ES;CZ;IT;BE;UK	2
Integrated innovative metallurgical system to benefit efficiently polymetallic, complex and low-grade ores and concentrates	FR;RO;AT;PL;ZA;RS;PT;FI;ES	2
Boosting the implementation of participatory strategies on separate paper collection for efficient recycling	RO;BG;DE;BE;ES;FR;PL;AT	3
Take-off for sustainable supply of woody biomass from agrarian pruning and plantation removal	EL;FR;IT;ES;UA;HR;PT	1
Developing the sustainable market of residential Mediterranean solid biofuels.	ES;EL;HR;SI;AT;IT;PT;TR	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
Supporting PUBLic Authorities for Implementing Energy Efficiency Policies	AT;EL;ES;IT;FR;BE;PL;BG;IE;RO;HR	3
Applying energy efficient measures for metal and metalworking SMEs and industry	IT;PL;FR;ES	1
SIMPLA - Sustainable Integrated Multi-sector PLAnning	RO;HR;ES;BG;AT;IT	2
A SYSTEMATIC APPROACH FOR INSPIRING TRAINING ENERGY-SPATIAL-SOCIOECONOMIC SUSTAINABILITY TO PUBLIC AUTHORITIES	ES;EL;SI;NL;DK;LV;IT	1
Water Works 2016-2020 in Support of the Water JPI (WaterWorks2015) - Sustainable water use in agriculture, to increase water use efficiency and reduce soil and water pollution	DE;CA;IT;FI;CY;TN;ZA;TW;EG;ES;MD;NO;TR;PL;NL;RO;DK;BE;IE;SE;PT	1
EMPOWERING LOCAL PUBLIC AUTHORITIES TO BUILD INTEGRATED SUSTAINABLE ENERGY STRATEGIES	EL;HU;ES;SE;RO;HR	2
Support to the implementation of the Strategic Research Agenda (SRA) of the Joint Programming Initiative on Cultural Heritage and Global Change (JPI CH)	LT;PL;NL;CY;UK;RO;IT;ES;SE;NO;FR;BE;PT	1
Concerted Action EPBD IV	BG;FR;IE;PL;RO;HU;EL;ES;DE;MT;FI;IT;CZ;BE;UK;NO;LT;SK;NL;PT;CY;LU;EE;LV;AT;HR;SI;SE	7
Delivering Digital Energy Labelling solutions to enable consumer action on purchasing energy efficient appliances	CZ;DE;UK;US;BE;IT;ES	2

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage

Annex 2 List of projects and beneficiaries of H2020 projects in the area of public health, medicine and life sciences

Project's title	*Countries*	*Number of countries from Central Europe involved*
Conservative iron chelation as a disease-modifying strategy in Parkinson's disease: a multicentric, parallel-group, placebo-controlled, randomised clinical trial of deferiprone	FR;PT;DE;NL;ES;CZ;UK;CA;AT	3
Validating C. elegans healthspan model for better understanding factors causing health and disease, to develop evidence-based prevention, diagnostic, therapeutic and other strategies.	DE;EE;UK;BE;DK;FI;CH;HU;SE;ES;US;CN;IT	2
Screening to Improve Health In very Preterm infantS in Europe	IT;EE;BE;DK;NL;DE;PL;UK;SE;PT	2
Secondary prEvention of CardiovascUlaR Disease in the Elderly trial	PL;IT;UK;FR;CZ;HU;ES;DE	4
ULTRAsensitive PLAsmonic devices for Early Cancer Diagnosis	CZ;AT;FR;DE;NL;IT;FI	3
Fast Assay for Pathogen Identification and Characterisation	AT;NL;FR;DE;UK;BE;HR	3
Models of Child Health Appraised	IS;US;NL;CY;DK;UK;CH;IE;IT;SE;AU;NO;PL	1
Sustainable intEgrated care modeLs for multi-morbidity: Delivery, Financing and performancE	AT;UK;HR;DE;HU;ES;NO	4
I-MOVE+ Integrated Monitoring of Vaccines Effects in Europe: a platform to measure and compare effectiveness and impact of influenza and pneumococcal vaccines and vaccination strategies in the elderly	FR;UK;ES;DE;NO;IE;FI;DK;NL;PT;PL;HU;IT;HR;RO	3
A multi-center randomised, placebo-controlled trial of mirabegron, a new beta3-adrenergic receptor agonist on left ventricular mass and diastolic function in patients with structural heart disease	PL;UK;FR;EL;DE;PT;IT	2
Female cancer prediction using cervical omics to individualise screening and prevention	NO;UK;DE;CZ;AT;IT;SE;NL	2
EU-TOPIA: TOWARDS IMPROVED SCREENING FOR BREAST, CERVICAL AND COLORECTAL CANCER IN ALL OF the EUROPE	UK;IT;SI;EE;HU;FI	2

Project's title	*Countries*	*Number of countries from Central Europe involved*
PREvention of Complications to Improve Outcome in elderly patients with acute Stroke	HU;UK;NO;PL;DE;IT;NL;EL;FR;EE;BE	2
Screening for Chronic Kidney Disease (CKD) among Older People across Europe (SCOPE)	DE;SE;ES;IL;NL;AT;PL	3
Comparing the effectiveness and safety of additional low-dose glucocorticoid in treatment strategies for elderly patients with rheumatoid arthritis	HU;PT;RO;NL;SK;IT;DE	3
Added Value for Oral Care	IE;DE;NL;HU;UK;DK	2
Ageing Trajectories of Health: Longitudinal Opportunities and Synergies	AT;IT;DE;FI;UK;PL;SE;ES;BE;CH;EL	3
Improving and professionalising the Health NCP service across Europe.	DE;AT;FR;BE;PL;UK;HR;CH;EL;IL;IT;PT	4
Shaping EUROpean policies to promote HEALTH equitY	ES;EL;BE;CZ;UK;DE;NL;PT;SK;FR;SE;IT	3
Medical Intelligence for Assistive Management Interface – Mild Dementia	ES;SE;IL;UK;BE;LU;CZ	1
ERA-NET for establishing synergies between the Joint Programming on Neurodegenerative Diseases Research and Horizon 2020	DE;IT;BE;ES;SE;RO;UK;SK;NL;FI;LU;NO;IL;CA; AT;PL;TR;FR;DK;PT	4
Robotic Assistant for MCI patients at home	IT;UK;DE;EL;ES;PL	2
Independent Living support Functions for the Elderly	SE;ES;EL;IE;SI;AT;NL;UK	2
Collaborative Management Platform for detection and Analyses of (Re-)emerging and foodborne outbreaks in Europe	DE;FR;UK;BE;EL;IT;DK;ES;NL;HU;AU	2
Stem Cell therapy in IschEmic Non-treatable Cardiac diseasE (SCIENCE)	AT;SI;DE;DK;NL;BE;PL	4
eHealth in Rheumatology	UK;CZ;DK;NL	1
Cost effective self-management of urinary incontinence addressed to women across Europe	FI;CZ;ES;RO;CH;NL	1
Mobile Therapeutic Attention for Patients with Treatment-Resistant Schizophrenia	IT;ES;HU;FI;BE;IL;EL	1

Project's title	*Countries*	*Number of countries from Central Europe involved*
Eliciting Mucosal Immunity to Tuberculosis	DE;MZ;ES;UK;SE;CZ;IT	2
ehcoBUTLER. A global ecosystem for the independent and healthy living of elder people with mild cognitive impairments.	SI;ES;EL;NL;IL;RS;FR;IT	1
FoResight and Modelling for European Health Policy and Regulation	AT;EE;FR;PL;IT;FI;BE;ES	2
ERA-NET rare disease research implementing IRDiRC objectives	DE;AT;CA;IT;CH;BE;ES;NL;HU;IL;PL;TR;RO;EL;LV;PT	4
Natural sense of vision through acoustics and haptics	PL;RO;IS;HU;IT	2
ERA-NET: Aligning national/regional translational cancer research programmes and activities	DE;FR;AT;NO;EE;ES;IT;BE;NL;TW;SK;IL;PL;TR;HU;SI;EL;LV;PT	6
Enabling Robot and assisted living environment for Independent Care and Health Monitoring of the Elderly	UK;FR;EL;IT;PL;NL	1
Developing and implementing a community-based intervention to create a more supportive social and physical environment for lifestyle changes to prevent diabetes in vulnerable families across Europe	HU;BE;ES;EL;FI;BG;DE	2
Evaluating mHealth technology in HIV to improve Empowerment and healthcare utilisation: Research and innovation to Generate Evidence for personalised care	BE;ES;UK;PT;HR;DE	2
European Consortium for Communicating Stem Cell Research	IT;PL;UK;ES;NL;CZ;AT;BE;DK;DE;IE;CH;HU;SE;FR	4
Ubiquitous iNteroperable Care for Ageing People	UK;IT;SI;ES;RO;DE;EL;SE;MK	2
Coordination Action in support of the sustainability and globalisation of the Joint Programming Initiative on Neurodegenerative Diseases	DK;NL;RO;FR;IT;UK;SK;SE;HR;DE;ES;PT	3
Tobacco cessation within TB programmes: A 'real world' solution for countries with dual burden of disease	PK;UK;DE;NP;BD;CZ	2
An Integrated European 'Flagship' Program Driving Mechanism-based Toxicity Testing and Risk Assessment for the 21st Century	FR;DE;UK;IT;BE;HU;NL;CH;DK;ES;US;AT;SE	2

Project's title	*Countries*	*Number of countries from Central Europe involved*
Autologous Stem Cell-Seeded Tissue Engineered Trachea	AT;UK;DE;IT;PL	3
Regenerative Stem cell therapy for Stroke in Europe	FI;ES;FR;UK;CZ	1
ERA-NET for establishing synergies between the Joint Programming Initiative on Antimicrobial Resistance Research and Horizon 2020	IL;BE;SE;TR;IT;UK;ES;DE;DK;LV;NO;PT;NL;FR;PL	2
Antibodies against Nogo-A to enhance plasticity, regeneration and functional recovery after acute spinal cord injury, a multicenter European clinical proof of concept trial	IT;DE;ES;FR;CZ	2
BIOengineered grafts for Cartilage Healing In Patients (BIO-CHIP)	HR;DE;IT;CH;FR	2
European AIDS Vaccine Initiative 2020	IT;CA;FR;UK;AU;ES;DE;AT;HU;NL;SE	3
Resetting the THYRoid axis for prevention of AGE-related diseases and co-morbidities	NL;UK;IT;FR;HU	1
VISION-DMD - Phase 2 Clinical Trials of VBP15: An Innovative Steroid-like Intervention on Duchenne Muscular Dystrophy	UK;NL;US;FR;CZ	1
Novel therapeutic approaches for the treatment of cystic fibrosis based on small molecule transmembrane anion transporters	ES;HU;DK;IT;DE	2
INter-sectoral Health Environment Research for InnovaTions	UK;PT;ES;BE;DE;CZ;EL;MK;NL;NO;SE;LV	2
New therapies for uveal melanoma	NL;UK;FR;PT;DE;SE;PL	2
Targeting epigenetic REPROGRamming of innate immune cells in Atherosclerosis Management and other chronic inflammatory diseases	US;DK;NL;IT;RO;CH;DE;FR;PL	2
Improving Diagnosis by Fast Field-Cycling MRI	FI;FR;IT;DE;PL	2
Personalised Risk assessment in febrile illness to Optimise Real-life Management across the European Union	SI;UK;FR;LV;EL;NL;DE;CH;ES;AT	3
Ubiquitous Pharmacogenomics (U-PGx): Making actionable pharmacogenomic data and effective treatment optimisation accessible to every European citizen	AT;NL;FR;SE;DE;UK;SI;IT;EL;ES	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
Children's Liver Tumour European Research Network	IT;DE;IE;FR;NO;UK;BE;CH;ES;CZ;PL;SE	3
Personalised Decision Support for Heart Valve Disease	NL;PL;FR;DE;UK	2
ICT services for Life Improvement For the Elderly	EL;BE;NL;HU;FR;ES	1
Empowering Patients for a BeTTer Information and improvement of the Communication Systems	ES;SI;UK;DK;FR;IE	1
Integrated inter-sector framework to increase the thermal resilience of European workers in the context of global warming	NL;CH;SI;UK;CY;EL;IT;PT;SE;ES	1
mhealth platform for Parkinson's disease management	IT;SI;EL;DE;UK;ES	2
Personal Decision Support System For Heart Failure Management	FI;SI;BE;IT;ES	1

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage.

Annex 3 List of SMEs service providers in the area of industrial biotechnology

Organisations	***Countries***
Centre for Advanced Manufacturing Technologies (CAMT)	Poland
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)	Germany
Fraunhofer Institute for Chemical Technology ICT	Germany
German Institute of Food Technologies - Deutsches Institut fur Lebensmitteltechnik e.V. (DIL)	Germany
Institute of Ceramics and Building Materials - ICIMB	Poland
Institute of Textile Technology and Process Engineering (ITV) Denkendorf	Germany
JOANNEUM RESEARCH Forschungsgesellschaft mbH	Austria
Josef Stefan Institute	Slovenia

Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 4 List of projects and beneficiaries of H2020 projects in the area of agro and bioeconomy

Project's title	*Countries*	*Number of countries from Central Europe involved*
EuroMix	FR;ES;IS;UK;EL;BE;CZ;NO;CY;IT;DE;CH;DK;SE;SI;NL	2
Strengthening Animal Production and Health through the Immune Response	FR;IT;CH;BE;IE;UK;PL;SE;NL;ES;CN;NO	1
Distributed, integrated and harmonised forest information for bioeconomy outlooks	AT;BE;PT;SI;DK;CH;RO;DE;RS;IE;NO;LV;SE;HU;ES;FR;IT;CZ;UA;SK;UK;EE;LT;EL	6
Ecosystem Approach to making Space for Aquaculture	IT;CA;ES;IE;NO;UK;EL;HU;FR;AU;PT;DE;CN	2
Adapting the feed, the animal and the feeding techniques to improve the efficiency and sustainability of monogastric livestock production systems	DK;ES;HU;CN;FR;UK;NL;IT;CH	1
Embedding crop diversity and networking for local high-quality food systems	FI;HU;FR;ES;NO;IT;CH;NL;AT;UK;PT;CY	2
DiscardLess – Strategies for the gradual elimination of discards in European fisheries	IS;BE;UK;IT;CA;ES;PL;DK;FR;NO;IE;EL;PT	1
Metrics, Models and Foresight for European Sustainable Food and Nutrition Security	AT;FR;FI;UK;NL;BE;CZ;DE;SE;DK;IT;TW	3
Public Ecosystem Goods And Services from land management - Unlocking the Synergies	AT;NL;PT;EE;DE;SI;FR;IT;UK;CZ;BE	4
Farming Tools for external Nutrient Inputs and water Management	ES;EL;TR;NL;LV;CZ;AT;BG;PT;DE;IT;FR	3
Effective Management of Pests and Harmful Alien Species - Integrated Solutions	ES;IT;UK;CZ;BE;NL;LV;FR;HU;CA	2
Advanced Tools and Research Strategies for Parasite Control in European farmed fish	CZ;IE;UK;IT;HU;NL;FR;EL;NO;HR;DK;ES;DE	4
Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector	IS;FI;FR;ES;IT;EL;UK;DE;PL;TR;NL	2
LAND Management: Assessment, Research, Knowledge base	SI;FR;BE;RO;NL;DK;AT;IE;SE;HU;CH;IT;ES;CN;BR;DE;UK	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
Camelina & crambe Oil crops as Sources for Medium-chain Oils for Specialty oleochemicals	EL;UK;PL;FR;DE;NL;IT;ES;LT	2
Sustainable finance for sustainable agriculture and fisheries	RS;FR;IT;PT;DK;EL;PL;UK;LV;BE;DE	2
Development of high-quality food protein through sustainable production and processing	PE;RO;BE;IE;UG;FR;DE;SE;NL;IT;ES;PL	2
Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience	NL;CN;FR;ES;IT;EE;PT;CH;RO;SI;PL;EL;UK;HU;BE	3
Network for the exchange and transfer of innovative knowledge between European wine-growing regions to increase the productivity and sustainability of the sector	PT;DE;ES;IT;HU;FR;HR	3
Platform of bioeconomy ERA-NET Actions	IT;DE;DK;NL;AT;SI	3
Practice-led innovation supported by science and market-driven actors in the laying hen and other livestock sectors	UK;SE;CZ;ES;NL	1
Organic Knowledge Network Arable	EE;IT;HU;LV;FR;DK;BG;AT;DE;CH;BE;UK	3
Towards a long-term Africa-EU partnership to raise sustainable food and nutrition security in Africa	FI;UK;FR;DK;BE;BF;IE;SE;AT;DE;BW;ZA;HU;NO;UG;GH;ES;PT;CZ;SN	4
PROVIding smart Delivery of public goods by EU agriculture and forestry	DE;FR;AT;FI;NL;CZ;RO;IT;PL;BG;ES;EE;UK	4
Flagship demonstration of an integrated biorefinery for dry crops sustainable exploitation towards biobased materials production	UK;NL;SK;IT	1
The second coordination and support action for the JPI Healthy Diet for a Healthy Life	DE;IT;NZ;ES;CZ;FR;BE	2
EU Fruit Network	RO;CH;FR;DE;UK;ES;IT;HU;BE;LT;NL	2
ERA-NET for Monitoring and Mitigation of Greenhouse Gases from Agri- and Silvi-Culture	DE;UK;FI;NL;TR;NZ;US;NO;PL;RO;FR;LV;DK;IE;SE	2

Project's title	*Countries*	*Number of countries from Central Europe involved*
Innovative Management of Genetic Resources	PT;CH;DE;FR;IT;SE;UK;PL;NL;AT;AR;MA;ES;CO;HU;EG	3
Tools for Assessment and Planning of Aquaculture Sustainability	NL;UK;HU;MT;EL;IE;DK;ES;NO;FR	1
Improving the stability of high-quality traits of berry in different environments and cultivation systems for the benefit of European farmers and consumers	IT;DE;BE;CL;ES;PL;UK;NO;FR;CN	2
A Europe-wide thematic network supporting a sustainable future for EU dairy farmers	FR;FI;PL;NL;BE;DE;ES;IE;UK;SI;PT;IT;SE;DK	3
AUTHENT-NET – Food Authenticity Research Network	IS;UK;IT;NL;FR;CZ;ES;NO;BE;US;IE	1
High Nature Value Farming: Learning, Innovation and Knowledge.	FI;FR;RO;BG;PT;UK;SE;EL;IE;HR;ES	1
Small farms, small food businesses and sustainable food security	TN;NO;IT;UK;PL;RO;CV;KE;EL;ES;LV;GH	1
ERA-NET Biomarkers for Nutrition and Health implementing the JPI HDHL objectives	DE;IT;ES;RO;NL;BE;CA;AT;PL;TR;UK;DK;IE	3
Alternative models and robust decision-making for future forest management	AT;SE;DE;PT;NL;IT;LT;IE;SK;TR;BE	3
Social Innovation in Marginalised Rural Areas	SK;CH;IT;ES;AT;LB;NO;UK;FR;EL;FI;EG;NL;CZ	3
Co-creating a decision support framework to ensure sustainable fish production in Europe under climate change	CZ;UK;DK;IS;IT;DE;CA;ES;NO;EL;HU;VN;FR;FO;CL;SE	3
Linking genetic resources, genomes and phenotypes of Solanaceous crops	IL;DE;TR;IT;TW;BG;UK;PE;ES;PL;FR;NL	2
Soil Care for profitable and sustainable crop production in Europe	ES;UK;FR;DE;CZ;NL;DK;IT;IE;SE;RO;CH;PL;NO;PT;EL;BE;HU	3
Strengthening European Food Chain Sustainability by Quality and Procurement Policy	RS;IT;UK;HU;VN;PL;BE;DE;EL;NL;TH;NO;HR;ES;FR	3

Project's title	*Countries*	*Number of countries from Central Europe involved*
DIVERSITY OF LOCAL PIG BREEDS AND PRODUCTION SYSTEMS FOR HIGH-QUALITY TRADITIONAL PRODUCTS AND SUSTAINABLE PORK CHAINS	PT;SI;LT;HR;RS;ES;IT;DE;FR	4
Cooperation between NCPs for Horizon 2020 Societal Challenge 2 on "Food Security, Sustainable Agriculture, Marine and Maritime Research and the Bioeconomy" and the Key Enabling Technology	IS;DE;CZ;BE;EL;FR;MD;HR;CH;NL;TR;IL;IT;PT	3

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional cov

Annex 5 List of projects and beneficiaries of H2020 projects in the area of advanced materials and nanotechnology

Projects' title	***Countries***	***Number of countries from Central Europe involved***
Nanomaterial FAte and Speciation in the Environment	**CZ**;IT;FR;CH;UK;SE;NL;**DE**;PT;ES;**PL;AT;SI**;BG	5
"Nanocomposite for building constructions and civil infrastructures: European network pilot production line to promote industrial application cases."	FR;SE;IT;**SI**;ES;**PL;DE**;UK;CH	3
Development and implementation of Grouping and Safe-by-Design approach within regulatory frameworks	EL;NL;ES;RO;FR;IT;**DE**;CH;SE;NO;BG;DK;UK;BE;**CZ;PL**	3
Microbial Desalination for Low Energy Drinking Water	**AT;HU**;TN;NL;CL;PT;ES;**DE**	3
High-level Integrated Sensor for NanoToxicity Screening	**SK;AT**;IE;**DE**;ES;NO;IL;UK	3
Improving the services of the NMP NCP Network through Transnational Activities	EL;**DE**;IL;UK;IT;FR;PT;**PL**	2
Processing and control of novel nanomaterials in packaging, automotive and solar panel processing lines	BE;ES;HU;**DE**;IT;**SI**;UK	2
Scaling-up biodegradable nanomedicines for multimodal for multimodal precision cancer immunotherapy	UK;NL;**DE;CZ**;BE;PL;IT	2
Smart Tools for Gauging Nano Hazards	IE;FR;UK;**SI**;**DE**;FI;DK;SE	2
Diabetes Reversing Implants with enhanced Viability and long-term Efficacy	IT;UK;IE;NL;**DE;CZ**;ES	2
NANOmaterials for the REStoration of works of ART	**DE**;FR;IT;ES;UK;US;NL;BR;**SI**;SE;IE;DK	2
Trash-2-Cash: Designed high-value products from zero-value waste textiles and fibres via design driven technologies	SE;FI;ES;**SI**;UK;IT;NL;DK;**DE**;TR	2
High energy lithium sulphur cells and batteries	**SI**;FR;**DE**;FI;ES;IL;SE	2
Open access pilot plants for sustainable industrial scale nanocomposites manufacturing based on bucky papers, doped veils and prepregs	ES;IT;EL;UK;BE;**PL**	1
The Development of Medium- and Large-Scale Sustainable Manufacturing Process Platforms for Clinically Compliant Solid Core Nanopharmaceuticals	UK;CH;IE;ES;**PL**;IT	1

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Development of novel, high-Performance hybrid TWV/GPF Automotive afteR treatment systems by raTIonAL design: substitution of PGMs and Rare earth materials	US;BE;DK;**CZ**;UK;ES;EL;IT;NL;FR	1
Carbon fibre microelectrodes for human brain research and clinical applications	HU	1
Quality and Production Control with Integrated Machine Vision	HU	1
Digitally controlled Braille jet printing	HU	1
The Complete Solution for Fast and Cost-efficient Yeast Separation Process in Production of High-Quality Sparkling Wine	SI	1
Re-Industrialisation of the European Union 2016	SK	1

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage.

Annex 6 List of SMEs service providers in the area of advanced materials and nanotechnology

Organisations	***Countries***
IMS Nanofabrication AG	Austria
JOANNEUM RESEARCH Forschungsgesellschaft mbH	Austria
Polymer Competence Center Leoben GmbH (PCCL)	Austria
CEITEC - Central European Institute of Technology	Czech Republic
The Institute for Nanomaterials, Advanced Technology and Innovation	Czech Republic
AMO GmbH	Germany
Application Center for Innovative Polymer Technologies	Germany
Center for Microtechnologies	Germany
Fraunhofer Institute for Applied Optics and Precision Engineering IOF	Germany
Fraunhofer Institute for Applied Solid State Physics IAF	Germany
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)	Germany
Fraunhofer Institute for Chemical Technology ICT	Germany
Fraunhofer Institute for Electronic Nano Systems ENAS	Germany
Fraunhofer Institute for Integrated Systems and Device Technology IISB	Germany
Fraunhofer Institute for Machine Tools and Forming Technology - IWU	Germany
Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM	Germany
Fraunhofer Institute for Mechanics of Materials IWM	Germany
Fraunhofer Institute for Microelectronic Circuits and Systems IMS	Germany
Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP	Germany
Fraunhofer Institute for Process Engineering and Packaging IVV	Germany
Fraunhofer Institute for Silicon Technology ISIT	Germany
Fraunhofer Institute for Surface Engineering and Thin Films IST	Germany
Fraunhofer pilot plant centre (PAZ) for polymer synthesis and polymer processing	Germany
Fraunhofer-Institut für Silicatforschung ISC	Germany
Fraunhofer-Institut für Solare Energiesysteme ISE	Germany
German Institute of Food Technologies - Deutsches Institut fur Lebensmitteltechnik e.V. (DIL)	Germany
Hahn-Schickard	Germany

Organisations	***Countries***
IAB Weimar Institute of Applied Construction Research	Germany
IHP GmbH - Innovations for High-Performance Microelectronics	Germany
Innovent Technology Development Jena	Germany
Institute of Textile Technology and Process Engineering (ITV) Denkendorf	Germany
Karlsruhe Nano Micro Facility (KNMF)	Germany
MERGE Technologies for Multifunctional Lightweight Structures	Germany
Textile Research Institute Thuringia-Vogtland - TITV	Germany
The Institut für Mikroelektronik Stuttgart (IMS CHIPS)	Germany
TITK Thuringian Institute of Textile and Plastics Research	Germany
Bay Zoltan Institute for Materials Science and Technology	Hungary
Centre for Advanced Manufacturing Technologies (CAMT)	Poland
Foundry Research Institute in Cracow	Poland
Institute of Ceramics and Building Materials - ICIMB	Poland
Institute of Electronic Materials Technology (ITME)	Poland
ITB, Instytut Techniki Budowlanej (Building Research Institute)	Poland
Josef Stefan Institute	Slovenia

Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 7: List of projects and beneficiaries of H2020 projects in the area of transport and mobility

Projects' title	***Countries***	***Number of countries from Central Europe involved***
Innovative Intelligent Rail	UK;**DE**;FR;**CZ**;PT;ES;SE;IT;**AT**;BE;LU;**PL**;EL;NL	4
NEW DEPENDABLE ROLLING STOCK FOR A MORE SUSTAINABLE, INTELLIGENT AND COMFORTABLE RAIL TRANSPORT IN EUROPE	BE;IT;**DE**;FR;SE;**SK**;ES;UK;**AT;CZ**	4
Smart Supply Chain Oriented Rail Freight Services – Smart-Rail	**CZ;DE**;NL;IT;FR;NO;BG;ES;**AT**;BE;**HU**	4
Open social transport network for urban approach to carpooling	IT;UK;EL;**HR**;CH;LU;NL;**HU;SI**;ES;BE;MK;**PL**	4
Gas-Only internal combustion engines	**DE;PL;AT**;UK;FR;**CZ**;LU;CH;IT;ES	4
Range of Electric Solutions for L-category Vehicles	**DE;AT**;IT;**CZ;PL**;UK;ES	4
Safety CaUsation, Benefits and Efficiency	UK;**DE**;ES;BE;NO;EL;SE;FR;**SI;AT**;NL;IT	3
PROactive Safety for Pedestrians and CyclisTs	ES;**AT;DE**;SE;NL;BE;**HU**;UK;FR	3
Rethinking Container Management Systems	IT;IL;**DE**;ES;**SI;PL**	3
Multi-source Big Data Fusion Driven Proactivity for Intelligent Mobility	BE;EL;LU;**AT**;PT;**SI**;UK;RS;**HU**	3
Enhanced real-time services for an optimised multimodal mobility relying on cooperative networks and open data	BE;**HU;SI**;IT;**DE**;UK;NL;ES	3
Decision Support Tool for Rail Infrastructure Managers	NO;DE;**SI**;NL;**AT**;CH;**HR**;IE;UK	3
EfficienSea 2 - Efficient, Safe and Sustainable Traffic at Sea	DK;UK;FI;**AT**;SE;FR;LV;MT;**DE**;EE;NO;**PL**	3
a LOW environmental impact BRAke SYStem	IT;**DE**;SE;**HU;CZ**;BE	3
Users, Safety, Security and Energy In Transport Infrastructure	BE;**DE;AT;PL**;PT;FR;UK	3
Strengthening European Transport Research and Innovation Strategies	**DE**;ES;BE;**AT**;NL;**PL**;FR;UK	3
Flutter Free Flight Envelope eXpansion for ecOnomical Performance improvement	**HU;DE**;EL;UK;NL;**AT**	3
InDeV: In-Depth understanding of accident causation for Vulnerable road users	SE;CA;ES;DK;NL;**DE;PL**;BE	2

Projects' title	*Countries*	*Number of countries from Central Europe involved*
BUSINESS MODELS FOR ENHANCING FUNDING AND ENABLING FINANCING OF INFRASTRUCTURE IN TRANSPORT	EL;IT;BE;PT;**PL**;NL;UK;RS;FR;**DE**;FI;ES	2
INFORMATION TECHNOLOGIES FOR SHIFT TO RAIL	IT;FR;**DE**;EE;UK;ES;BE;**CZ**;NL	2
Needs Tailored Interoperable Railway	UK;RO;SE;**SI**;UK;TR;**DE**;NL;FR	2
New cooperative business models and guidance for sustainable city logistics	**AT**;IT;ES;EL;BE;UK;SE;FR;DK;NL;**PL**	2
Promoting excellence and recognition seal of European aerospace Universities	FR;BE;IT;**CZ**;RO;NL;ES;**DE**	2
Future Sky Safety	**DE**;PT;UK;CH;FR;IE;ES;IT;**CZ**;RO;RU;BE;SE;NL	2
Forever Open infrastructure across (X) all transport modes	BE;**DE**;NL;FR;**SI**	2
Low energy passenger comfort systems based on the Joule and peltier effects.	PT;ES;IT;LU;**DE**;UK;FR;**HR**;DK	2
Ultralight and ultrasafe adaptable 3-wheeler	ES;IT;ES;TR;**PL**	2
Efficient and cost-effective intermodal road-rail container freight system	DK;**CZ**	2
European Transport Network Alliance 2020	IT;CY;BE;IE;EL;BA;**PL**;LV;UK;**SK**;NL;ES;FR;RO;IL;PT	2
Super-IcePhobic Surfaces to Prevent Ice Formation on Aircraft	**PL**;ES;**DE**	2
Validation of Integrated Safety-enhanced Intelligent flight cONtrol	FR;UK;ES;**HU**	1
Ground-breaking and convenient electronic bicycle fleet management system available for the mass adoption.	**SI**;IT	1
COMPetition for AIR traffic management	BE;IL;ES;**HU**	1
Navigation of Airborne Vehicle with Integrated Space and Atomic Signals	PT;CH;FR;**SK**	1
Tunnel fire stopper or TFS shortly	SI	1
Establishing new eco-driving methods to score drivers and to enhance good driving habits based on advanced analytical B2B software platform for Connected Cars.	PL	1

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Torque Vectoring Platform for Next Generation of Electric Driven Vehicles	SI	1
Instant Foam for Fighting Forest Fires	HU	1
COMPA - Market Study of Composite Patch Repair for Marine PipesA cost-efficient and durable pipe repair in urgency	HR	1
Integrated PERmanent Magnet Motor-Clutch Drive for Parallel Hybrid Power MARINE Propulsion Systems	HR	1
In-wheel electric drive for E-commercial vehicles	SI	1
Augmented reality aerial navigation for a safer and more effective aviation	HU	1
The Development of a »New« Planocentric Gearbox with a Closed Cage and S-gear Tooth Flank	SI	1
Development of Polymer Halter for Oil Filters	SI	1
Smart protective coatings on classic materials for a new generation of ecologically sustainable 'green' railway vehicles	PL	1
Piloting and industrial validation of autonomous and sustainable animal deterring system for the rail transport	**PL**;NO	1
Smart Road Modular Sensor (SmaRMS) Prototype Testing and Commercialization Viability	SI	1
WATTsUP Electric flight to future	SI	1
Navigational Decision Support System for Improved COLREGs Safety Management	PL	1
Electric axle for hybrid / electric commercial vehicles	HU	1
Situation-Aware Mobile Platform for Airport Collaborative Decision-Making	**HU**;UK;SE	1

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage.

Annex 8 List of projects and beneficiaries of H2020 projects in the area of advanced manufacturing systems

Projects' title	***Countries***	***Number of countries from Central Europe involved***
Compact Retrofit Advanced Thermal Energy Storage	**DE**;IT;NL;**PL;CZ**;FR;BE;UK;**AT**	4
Symbiotic Human-Robot Collaborative Assembly: Technologies, Innovations and Competitiveness	SE;**DE**;ES;**HU;AT**;EL;FI	3
Development of insulating concrete systems based on novel low CO2 binders for a new family of eco-innovative, durable and standardised energy efficient envelope components	EL;ES;DK;IT;**HU**;RO;UK;**CZ**;FR;**DE**	3
Multi-ObjecTive design Optimisation of fluid eneRgy machines	**AT**;NL;**CZ;DE**;SE;BE	3
Modelling Optimisation of Energy Efficiency in Buildings for Urban Sustainability	EL;**PL;DE**;PT;IE;RS;ES;UK;**CZ**;NL	3
Mobilisation of innovative design tools for refurbishing of buildings at district level	FI;**SI**;NL;LV;**DE;AT**	3
Computer Aided Technologies for Additive Manufacturing	FR;ES;**DE**;NO;IT;**AT;SI**	3
Smart integrated Robotics system for SMEs controlled by Internet of Things based on dynamic manufacturing processes	FR;**PL;DE**;NL;ES;**SI**;EL	3
A Reconfigurable robot workCell for fast set-up of automated assembly processes in SMEs	**DE**;DK;**AT**;LT;**SI**;FI	3
COMbination of non-contact, high-speed monitoring and non-destructive techniques applicable to LASER Based Manufacturing through a self-learning system	**DE**;FI;ES;**AT**;FR;**SI**;UK	3
Advanced Material And Nanotechnology Cluster	EL;ES;SE;**DE**;**PL**;UK;IT	2
Integrated Process Control based on Distributed In-Situ Sensors into Raw Material and Energy Feedstock	IT;SE;ES;**PL;DE**;IL	2
Adaptable Reactors for Resource- and Energy-Efficient Methane Valorisation	NL;FR;BE;**DE;SI**;DK;UK;ES	2
ICT Powered Machining Software Suite	IT;**DE**;ES;NO;FR;UK;**HU**	2
Factories of the Future Resources, Technology, Infrastructure and Services for Simulation and Modelling 2	IT;**DE**;SE;FR;ES;UK;**SI**;NL;NO;BE	2

Demonstration of an integrated Renovation approach for Energy Efficiency At the Multi building scale	ES;UK;SE;**DE;PL**;IT;BE	2
An Integrated Collaborative Platform for Managing the Product-Service Engineering Lifecycle	LU;**PL**;ES;**DE**;FR;EL;IT;NL	2
PREdictiVe system to recommend Injection mould sEtup in Wireless sensor networks	ES;IE;NL;**DE;**UK;**HU**;IT	2
Synthesis of methanol from captured carbon dioxide using surplus electricity	ES;BE;**DE**;IT;IS;**SI**;UK	2
Multimodal spectrAl control of laSer processing with cognitivE abilities	IT;**DE**;ES;SE;FR;**SI**;EL	2
Energy Efficient Ventilated Facades for Optimal Adaptability and Heat Exchange enabling novel NZEB architectural concepts for the refurbishment of existing buildings	FR;EL;ES;IT;**CZ;PL**;BE;UK	2
Improving the services of the NMP NCP Network through Transnational Activities	EL;**DE**;IL;UK;IT;FR;PT;**PL**	2
TCBL – Textile and Clothing Business Labs Transformative Business Models for the Textile Clothing Sector	IT;**DE**;EL;UK;PT;NL;BE;**SI**	2
Enhanced energy and resource Efficiency and Performance in process industry Operations via onsite and cross-sectorial Symbiosis	FR;**PL;SI**;CH;BE;UK	2
Process Intensification through Adaptable Catalytic Reactors made by 3D Printing	**DE**;NO;UK;PT;FR;**CZ**;ES	2
New integrated methodology and Tools for Retrofit design towards the next generation of Energy efficient and sustainable buildings and Districts	FI;UK;IE;**DE**;ES;IT;**HU**	2
Thermal Energy Storage Systems for Energy Efficient Buildings. An integrated solution for residential building energy storage by solar and geothermal resources	PT;EL**;AT**;CY;ES;**DE**;PL;UK	2
Highly Innovative building control Tools Tackling the energy performance GAP	IE;**DE**;FR;CY;UK;IT;ES;**PL**;TR;EL	2
Assembly of miniaturised PCBs by using low-cost hyper-fine solder powders	DK;SE;EL;BE;CY;PT;**PL**;UK;NL;IT	1
Cloud Collaborative Manufacturing Networks (C2NET)	**SK**;ES;FR;PT;FI;BE	1
Re-Industrialisation of the European Union 2016	**SK**	1
RESEARCH ON EFFICIENT INTEGRATED SYSTEMS FOR THE MANUFACTURING OF COMPLEX	ES;**PL**;FR;DE;IT	1

PARTS BASED ON UNIDIRECTIONAL TAPES FOR THE AUTOMOTIVE AND AERONAUTICAL		
Sustainability Toolkit for easY Life-cycle Evaluation	**SK**;FR;SE;NL;BE;UK	1
Breakthrough solutions for adaptable envelopes for building refurbishment	ES;**HU**;FR;NL;TR;IL;BE;EL;IT	1
Energy and resource management systems for improved efficiency in the process industries.	**DE**;IT;PT;PL;UK	1
Flexibility Activated Zero Energy Districts	BE;NL;FI;**DE**;ES;PL	1

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage.

Annex 9 List of SMEs service providers in the area of advanced manufacturing systems

Organisations	***Countries***
IMS Nanofabrication AG	Austria
JOANNEUM RESEARCH Forschungsgesellschaft mbH	Austria
Polymer Competence Center Leoben GmbH (PCCL)	Austria
The Institute for Nanomaterials, Advanced Technology and Innovation	Czech Republic
AMO GmbH	Germany
Application Center for Innovative Polymer Technologies	Germany
Fraunhofer Institute for Applied Optics and Precision Engineering IOF	Germany
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)	Germany
Fraunhofer Institute for Chemical Technology ICT	Germany
Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS	Germany
Fraunhofer Institute for Machine Tools and Forming Technology - IWU	Germany
Fraunhofer Institute for Manufacturing Engineering and Automation IPA	Germany
Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM	Germany
Fraunhofer Institute for Mechanics of Materials IWM	Germany
Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP	Germany
Fraunhofer Institute for Process Engineering and Packaging IVV	Germany
Fraunhofer Institute for Production Technology IPT	Germany
Fraunhofer pilot plant centre (PAZ) for polymer synthesis and polymer processing	Germany
German Institute of Food Technologies - Deutsches Institut fur Lebensmitteltechnik e.V. (DIL)	Germany
Hahn-Schickard	Germany
IAB Weimar Institute of Applied Construction Research	Germany
IHP GmbH - Innovations for High-Performance Microelectronics	Germany
Institute of Textile Technology and Process Engineering (ITV) Denkendorf	Germany
Karlsruhe Nano Micro Facility (KNMF)	Germany
Textile Research Institute Thuringia-Vogtland - TITV	Germany
TITK Thuringian Institute of Textile and Plastics Research	Germany
Bay Zoltan Institute for Materials Science and Technology	Hungary
Centre for Advanced Manufacturing Technologies (CAMT)	Poland
Foundry Research Institute in Cracow	Poland
Institute of Ceramics and Building Materials - ICIMB	Poland
Institute of Electronic Materials Technology (ITME)	Poland
Josef Stefan Institute	Slovenia

Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 10 List of projects and beneficiaries of H2020 projects in the area of ICT and electronics

Projects' title	***Countries***	***Number of countries from Central Europe involved***
Transnational Cooperation among ICT NCPs	IL;UK;BE;MX;LV;**AT**;MD;EE;IS;AM;**HU**;CY;**CZ**;GE;GT;**PL**;NO;BY;**HR**;BG;CH;**SK**;ES;EL;RO;LU;FR;IT;AR;PT	6
Seven Nanometer Technology	**DE**;NL;BE;IL;FR;**AT;CZ;HU**	4
Cyber-Physical System based Proactive Collaborative Maintenance	FI;**AT**;PT;DK;**SI;**ES;IT;NL;BE;**DE;HU**;UK	4
Seven Nanometer Technology	**DE**;NL;BE;IL;FR;**AT;CZ;HU**	4
Symbiosis of smart objects across IoT environments	EL;**AT**;IT;ES;**DE;PL;HR**;PT	4
Cyber-Physical System based Proactive Collaborative Maintenance	FI;**AT**;PT;DK;**SI**;ES;IT;NL;BE;**DE;HU**;UK	3
Aligned, Quality-centric Software and Data Engineering	IE;UK;**AT;PL;DE**	3
European Network of competencies and platforms for Enabling SME from any sector building Innovative CPS products to sustain demand for European manufacturing	UK;FR;**AT;DE**;IT;**HU**;SE;IE;NL	3
Synergies in Nanotechnologies, Materials and Production in the European Research Area	**AT**;ES;FR;BE;**DE**;RO;NL;**SI**;PT	3
MidInfraRed Photonics devices fABrication for chemical sensing and spectroscopic applications	CH;NO;**DE**;UK;FR;BE;NL;**PL;AT**	3
Next generation sepsis diagnosis	**DE**;SE;**CZ**;DK;**AT**	3
elastic Wireless Networking Experimentation	BE;FR;IE;**SI**;FI;**PL;DE**;CH	3
Understanding Collective Awareness Platforms with the Maker Movement	NL;**DE**;EE;DK;**AT**;ES;**HR**	3
Spinal Exoskeletal Robot for Low Back Pain Prevention and Vocational Reintegration	**DE**;NL;BE;**AT;SI**	3
Modular Microserver DataCentre	**PL;DE**;UK;FR;**SI**;CH;IT	3
European Data Science Academy	SE;**SI**;UK;**DE**;FR;NL	2
Transregional Web Innovative Services for Thriving Digital and Mobile Entrepreneurship	**DE**;SE;**PL**;IT;FR;ES	2
Supporting and promoting responsible research and innovation in ICT	FR;UK;IT;BE;**SI;AT**	2

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Refactoring Parallel Heterogeneous Resource-Aware Applications - a Software Engineering Approach	**HU**;IT;UK;ES;IL;**AT**	2
ACE Creative: Harnessing the strengths of innovation multipliers to accelerate creative industry growth through an integrated ecosystem of supports in finance, market access and technology exploitation.	BE;DK;**DE**;NL;LU;**SK**;UK;IT;FR;ES	2
Health in my Language	UK;**CZ;DE**	2
A TEAM-BUILDING, THEMATICALLY-FOCUSED AND LEAN-TRAINING SUMMER ACADEMY SYSTEM FOR YOUNG FUTURE ICT ENTREPRENEURS	UK;ES;**DE**;BE;IT;NL;EL;**PL**	2
Security In trusted SCADA and smart-grids	IT;FR;**PL**;CH;BE;**AT**	2
intelligent Converged network consolIdating Radio and optical access aRound User equipment.	CY;UK;**DE**;ES;FR;**SI**	2
Social Semantic Emotion Analysis for Innovative Multilingual Big Data Analytics Markets	ES;IE;**CZ;DE**;IT	2
Accelerating Entrepreneurial Learning across European Regions	IE;**DE**;ES;DK;**PL**;EL	2
Scalable and Secure Infrastructures for Cloud Operations	FI;UK;**DE;PL**;IT;RO;NL;CH	2
Network of summer academies for the improvement of entrepreneurship in innovative sectors	EE;NL;UK;**SI;DE**;EL;IT	2
Learning from Failure in a collaborative Entrepreneurship Network	BE;ES;**HR**;FR;FI;EE;LT;NL;UK;PT;**DE**;NO	2
Revolutionising optical fibre transmission and networking using the Orbital Angular Momentum of Light	IT;UK;CH;CA;**PL;DE**	2
A NOVEL RECONFIGURABLE BY DESIGN HIGHLY DISTRIBUTED APPLICATIONS DEVELOPMENT PARADIGM OVER PROGRAMMABLE INFRASTRUCTURE	IE;EL;IT;NO;**DE;SI;**CY	2
Compact High-performance Quantum cascade laser Sensors	**DE**;UK;**PL**	2
Improving the services of the NMP NCP Network through Transnational Activities	EL;**DE**;IL;UK;IT;FR;PT;**PL**	2

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Coordinated control and spectrum management for 5G heterogeneous radio access networks	IL;FI;**PL**;FR;EL;IT;SE;**DE**;UK	2
Converged Heterogeneous Advanced 5G Cloud-RAN Architecture for Intelligent and Secure Media Access	FR;**DE**;EL;LU;PT;ES;IL;UK;**SI**	2
Millimetre-Wave Based Mobile Radio Access Network for Fifth Generation Integrated Communications	FR;DK;**DE**;SE;FI;ES;**PL**;UK	2
Mobile and wireless communications Enablers for Twenty-twenty (2020) Information Society-II	**DE;PL**;TW;FR;SE;UK;IT;US;CN;ES;FI;JP	2
Photonic Integrated Circuits Accessible to Everyone	UK;**PL**;FR;DK;**DE**;NL;IT;ES;EL	2
A portable MicroNanoBioSystem and Instrument for ultra-fast analysis of pathogens in food: Innovation from LOVE-FOOD lab prototype to a pre-commercial instrument	EL;**DE;CZ**;FR	2
High-Performance Real-time Architectures for Low-Power Embedded Systems	IT;**CZ;DE**;CH	2
Bringing flexible organic electronics to pilot innovation scale	**CZ**;UK;**DE**;NL;FI	2
Variety, Veracity, VaLue: Handling the Multiplicity of Urban Sensors	EL;**DE**;IE;IL;**PL**	2
Networked Labs for Training in Sciences and Technologies for Information and Communication	**SK**;UK;**CZ**;IT;ES;RO;IE	2
Breaking Educational Barriers with Contextualised, Pervasive and Gameful Learning (BEACONING)	RO;**DE**;FR;PT;UK;IT;ES;**PL**;TR	2
Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices.	ES;BE;PT;CH;**PL;DE**;FR	2
Interoperability of Heterogeneous IoT Platforms	ES;IT;FR;**SI**;NL;**PL**;UK	2
Enabling Multichannel Participation Through ICT Adaptations	**CZ**;PT;**DE**;IT;UK	2
Making Supplier Networks Transparent, Understandable and Responsive	EL;**PL**;UK;**DE**	2
STREAMLINE	SE;**DE**;FI;**HU**;FR;PT	2

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Micro Kernel virtualization for high-performance cloud and hpc systems	**DE**;IL;IE;**SI**	2
Communication Platform for Tenders of Novels Transport Networks - COMPLETE	**PL;CZ**;EL	2
Strengthening the web entrepreneurship ecosystem in Europe for young people by creating a pan-European network of actively engaged student networks and student entrepreneurship centres	**HU;DE**;IT;UK;BE;TR;IL	2
Promoting Financial Awareness and Stability	**SK**;EL;UK;**AT**;BE	2
Preparing R2 extension to 300mm for BCD Smart Power	**SK**;NL;IT;FI	1
Optimal SIC substrates for Integrated Microwave and Power Circuits	SE;**SK**;NO;FR	1
Advertisement displays manufactured by hybrid in-mould integration	FI;BG;ES;UK;**HU**	1
Software Workbench for Interactive, Time Critical and Highly self-adaptive cloud applications	NL;RO;**SI**;PT;ES;UK	1
A Novel, Comprehensible, Ultra-Fast, Security-Aware CPS Simulator	**HU**;ES;SE;IT;UK;EL	1
Behavioural Based Forwarding	IT;FR;UK;SE;**CZ**	1
Software Defined Storage for Big Data	FR;**SI**;ES;IL;IE	1
Programmable multi-wavelength Mid-IR source for gas sensing	**PL;**FI;NO	1
empowering privacy and security in non-trusted environments	CH;**SI**;IT;ES;BE	1
European Procurers Platform - health - Transforming the market for health Solutions	UK;ES;DK;**PL**	1
Consumer-oriented ICT Solutions for creative SMEs providing Art in Bespoke Fashion	IE;NL;**PL**;BE	1
High-Performance Low-Cost Virtual Studios for Creative Industries SMEs	**HU**;NO;FI;ES	1
Aquaculture Smart and Open Data Analytics as a Service	EL;**SI**;IE;PT;ES;IL	1
Developing Data-Intensive Cloud Applications with Iterative Quality Enhancements	FR;RO;ES;UK;**SI**;IT;EL	1

Projects' title	*Countries*	*Number of countries from Central Europe involved*
Smart Augmented and Virtual Reality Marketplace for Furniture Customisation	ES;**SI**;IT	1
Development of a Master Socket for optimised design of prosthetic socket for lower limb amputees	PT;**PL;**UK;IT;EL	1
Imaging analysis in all lighting and off weather conditions	BE;UK;IT;FR;IL;**PL**	1
European guide and recommendations for the combined funding of large-scale RDI initiatives	**PL**;NL;FR;PT;BE;UK;ES;FI	1
A Collaboration Ecosystem enabling EU Creative SMEs to exchange multi-media content and create multi-plot, interactive Apps for Children, curated according to Reader ability and educational value.	IT;UK;IE;**PL**;EL	1
Preparing R2 extension to 300mm for BCD Smart Power	**SK**;NL;IT;FI	1
Optimal SIC substrates for Integrated Microwave and Power Circuits	SE;**SK**;NO;FR	1
SETA: An open, sustainable, ubiquitous data and service ecosystem for efficient, effective, safe, resilient mobility in metropolitan areas	UK;IT;NL;ES;**PL**	1
An innovative solution to tackle food waste through the collaborative power of ICT networks	**HU**;UK;BE;EL	1
Collective Awareness Platforms for Environmentally-sound Land management based on data technologies and Agrobiodiversity	EL;IT;**CZ**;BE;NL;UK	1
Big Speech data analytics for contact centres	LU;ES;IT;**CZ**;BE	1
Re-Industrialisation of the European Union 2016	**SK**	1
5G Exchange	EL;ES;HU;NO**;DE**;IE;IT;UK;SE;FR	1

Source: Own based on the H2020 projects' database. Nb: Projects coordinated by Austrian and German organisations are not included as it is not possible to determine the regional coverage.

Annex 11 List of SMEs service providers in the area micro-, nanoelectronics, and photonics

Organisations	***Countries***
JOANNEUM RESEARCH Forschungsgesellschaft mbH	Austria
Polymer Competence Center Leoben GmbH (PCCL)	Austria
AMO GmbH	Germany
Application Center for Innovative Polymer Technologies	Germany
Center for Microtechnologies	Germany
Fraunhofer Institute for Applied Optics and Precision Engineering IOF	Germany
Fraunhofer Institute for Applied Solid State Physics IAF	Germany
Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)	Germany
Fraunhofer Institute for Electronic Nano Systems ENAS	Germany
Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS	Germany
Fraunhofer Institute for Integrated Systems and Device Technology IISB	Germany
Fraunhofer Institute for Mechanics of Materials IWM	Germany
Fraunhofer Institute for Microelectronic Circuits and Systems IMS	Germany
Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP	Germany
Fraunhofer Institute for Reliability and Microintegration IZM	Germany
Fraunhofer Institute for Silicon Technology ISIT	Germany
Fraunhofer-Institut für Solare Energiesysteme ISE	Germany
Hahn-Schickard	Germany
IAB Weimar Institute of Applied Construction Research	Germany
IHP GmbH - Innovations for High-Performance Microelectronics	Germany
Institute of Textile Technology and Process Engineering (ITV) Denkendorf	Germany
Karlsruhe Nano Micro Facility (KNMF)	Germany
MERGE Technologies for Multifunctional Lightweight Structures	Germany
Textile Research Institute Thuringia-Vogtland - TITV	Germany
The Institut für Mikroelektronik Stuttgart (IMS CHIPS)	Germany
TITK Thuringian Institute of Textile and Plastics Research	Germany
Centre for Advanced Manufacturing Technologies (CAMT)	Poland
Institute of Ceramics and Building Materials - ICIMB	Poland

Organisations	*Countries*
Institute of Electronic Materials Technology (ITME)	Poland
CICECO	Portugal
Josef Stefan Institute	Slovenia

Source: https://ec.europa.eu/growth/tools-databases/kets-tools/kets-ti-inventory/map

Annex 12 The initial list of S3 priorities of the Central European regions/countries

	NUTS ID	Region/Country Name	Description
		1	**ENERGY & ENVIRONMENT**
1	AT	Austria	Energy & Environment
2	AT1	Steiermark	Eco-Tech
3	PL	Poland	Smart and energy efficient construction
4	PL	Poland	High efficiency, low-emission and integrated circuits manufacturing, storage, transmission and distribution of energy
5	PL	Poland	Innovative technologies and processing water recovery and reducing its consumption
6	HR	Croatia	Energy and sustainable environment
7	CZ01	Praha	Smart energy
8	PL22	Slaskie	Energy: Advanced materials (Energy distribution)
9	PL21	Malopolskie	Sustainable energy
10	PL52	Opolskie	Energy technologies (with renewable energy) (Fuel production technologies, Engine technologies, High-voltage technologies
11	HU	Hungary	Clean and renewable energies
12	PL22	Slaskie	Cleaner environment & energy efficient networks (e.g. smart grids) (power generation/renewable sources)
13	HU	Hungary	Sustainable environment
14	CZ08	Moravskoslezsko	Treatment and utilisation of secondary raw materials and wastes in environment of Ostrava agglomeration (with utilisation of infrastructure of former mining facilities, former industrial sites - brownfields, etc.), development of wasteless production technologies
15	PL	Poland	Minimising waste, including unfit for processing and use of materials and energy waste (recycling and other recovery methods)
16	SK01	Bratislavský Kraj	R&D in biology active materials, biopolymers, biocompatible and biodegradable materials (e.g. vas implanters)
17	PL51	Dolnoslaskie	Raw materials and recyclable materials
18	DE2	Bayern	Clean tech
19	PL32	Podkarpackie	Green growth
20	PL43	Lubuskie	Environmental technologies
21	PL43	Lubuskie	Green economy: Other supporting sectors: ICT, metal industry, logistics
22	PL43	Lubuskie	Advanced environmental services
		2	**ICT & ELECTRONICS**
1	AT	Austria	ICT (embedded systems; micro-electronics; visual computing; semantic systems; quantum informatics; optoelectronics)
2	AT2	Burgenland	innovative (IT-based) services and creative industries.
3	CZ	Czech Republic	ICT, automatisation and electronics.
4	CZ01	Praha	Digital media, mobile applications, visualisation and design, production & distribution of media products
5	CZ01	Praha	Internet & IT-based services
6	HU	Hungary	ICT and information services
7	DED	Sachsen	ICT & digital communication (IT infrastructures, e-commerce, e-business, e-government, software development, IT services, mobile embedded elements for communication among daily objects and towards their environment (embedded systems & internet of things), self-learning systems for the creation and storage of knowledge and learning, time & resource-efficient computing systems for simulation & visualisation,applications for IT security with legal implications (identity management, authentification, linking information), cyber-physical systems)
8	SK	Slovakia	ICT and Services.
9	DE2	Bayern	Innovative technology-based services
10	PL21	Malopolskie	ICT
11	PL51	Dolnoslaskie	ICT

12	PL32	Podkarpackie	ICT
13	SK01	Bratislavský Kraj	ICT
14	PL43	Lubuskie	ICT (smart media, infotainment, Internet of things, smart manufacturing technologies, data protection)
15	DED	Sachsen	Microelectronics including organic and polymer electronics (semiconductors)
16	PL22	Slaskie	Micro/ Nano-electronics (Computer programming, consultancy & related activities)
17	SK	Slovakia	Consumer electronics and electrical equipment.
18	SK01	Bratislavský kraj	Control & automation
19	CZ08	Moravskoslezsko	Supercomputing methods for solutions of engineering tasks, applications in natural and technical sciences, modelling and simulations of occurrences and situations with impact on human activity
		3	**PUBLIC HEALTH & MEDICINE**
1	CZ	Czech Republic	Healthcare and medical technology and devices.
2	PL	Poland	Medical diagnosis and treatment of lifestyle diseases and personalised medicine
3	PL	Poland	Medical engineering technologies, including biotechnologies
4	PL	Poland	Production of medicinal products
5	HR	Croatia	Health and quality of life
	HU	Hungary	Healthy society and wellbeing
6	PL22	Slaskie	Public health & well-being (Human health activities (medical services)
7	PL22	Slaskie	Public health & well-being (Services - other professional, scientific & technical activities)
8	SI	Slovenia	Health/Medicine - relates to two sets, medical and quality of life. They include new substances and technologies in biomedicine combined with smart healthcare, high-quality food and clean environment.
9	AT1	Steiermark	Health Tech
10	CZ08	Moravskoslezsko	Regenerative medicine, genomics and new approaches to data analysis
11	PL22	Slaskie	Ageing societies (Residential care activities)
12	PL22	Slaskie	Public health & well-being (Basic pharmaceutical products & pharmaceutical preparations)
13	PL22	Slaskie	Public health & well-being (Human health activities (medical services))
14	PL22	Slaskie	Public health & security (Services - Scientific research & development)
15	PL43	Lubuskie	Medical technologies
16	PL22	Slaskie	Public health & well-being (Biotechnology)
16	CZ01	Praha	Pharmaceutical & clinical research, bio-materials & molecular biology
17	SK01	Bratislavský Kraj	R&D in diagnostics of oncology diseases & monogenetic diseases
		4	**AGRO-BIO-ECONOMY**
1	HR	Croatia	Bio-economy
2	PL43	Lubuskie	Green economy: Bioeconomy
3	SI	Slovenia	Networks for the transition to the circular economy: sustainable biomass transformation and new bio-based materials, technologies for the use of secondary and raw-materials and reuse of waste; and production of energy based on alternative sources.
4	AT2	Burgenland	Life Science (Health and Wellness, pharmaceutical, Medizintechnik, beverages and food services in accommodation)
5	HR	Croatia	Agro-food
6	PL32	Podkarpackie	Agro-food
7	HU	Hungary	Healthy local food
8	PL51	Dolnoslaskie	High - quality food
9	PL43	Lubuskie	Health & quality of life: Healthy & safe food (including regional products)
10	PL52	Opolskie	Food and agriculture technologies (Plant production technologies, Technologies food production and processing, in particular, processing of the milk)
11	SI	Slovenia	Sustainable food production: sustainable production of high-quality food in relation to a business model that will integrate knowledge institutions with manufacturers and economic entities along the entire value chain, including the development of new marketing models; establish an innovative and short supply chains for locally and organically produced foods with a guaranteed and recognised traceability

			from the field to the table; ensure long-term sustainable conditions for the development of the varieties and farming practices adapted to Slovenian territory and to climate change.
12	HU	Hungary	Agricultural innovation
		5	**TRANSPORT & MOBILITY**
1	PL	Poland	Environmentally friendly transport solutions
2	HR	Croatia	Transport and mobility
3	PL51	Dolnoslaskie	Spatial mobility
4	SI	Slovenia	Mobility - developing demanding and complex energy-efficient products with higher value added, consistent with the new EU standards in the field of transport emission reductions (EURO 6c, EURO 7) and in the field of security (EURO NCAP) - incl. niche components and systems for internal combustion engines, E-mobility and energy storage systems, systems and components for security and comfort (interior and exterior), and materials for the automotive industry.
5	AT	Austria	Mobility
6	AT1	Steiermark	Mobility
7	SK01	Bratislavský kraj	Navigation systems
8	SK	Slovakia	Automotive & Mechanical engineering industries
9	HU	Hungary	Advanced technologies in the vehicle and other machine industries
10	PL43	Lubuskie	Automotive industry (spare parts, energy efficiency, alternative engines, traffic security and smart transport systems)
11	PL32	Podkarpackie	Aviation
12	CZ01	Praha	Aerospace
		6	**ELECTROTECHNICAL AND MECHANICAL INDUSTRIES**
1	CZ	Czech Republic	Engineering industries and electrotechnics.
2	PL51	Dolnoslaskie	Manufacture of machinery and equipment, materials processing
3	SK	Slovakia	Production and processing of iron and steel.
4	PL43	Lubuskie	Mining & quarrying (innovative quarrying processes, energy efficiency & limitation of greenhouse gas emission, new application of fossil fuels)
5	PL21	Malopolskie	Electro technical and mechanical industries
6	PL21	Malopolskie	Production of metal, metal products and mineral products
7	PL52	Opolskie	Metal and machine industry technologies (Technologies of power transmission system, Technologies of design and manufacture of machinery and devices, Metal Technologies)
8	PL43	Lubuskie	Metal industry (manufacture of machinery and equipment, manufacture of fabricated metal products, except machinery and equipment, metal constructions and welded items)
9	CZ07	Střední Morava	Mechanical engineering
10	CZ07	Střední Morava	Electrotechnics, scientific instruments
11	PL	Poland	Optoelectronic systems and materials
12	AT2	Burgenland	(Opto) electronics, mechatronics,
		7	**ADVANCED MANUFACTURING SYSTEMS**
1	DED	Sachsen	Advanced production technologies
2	PL	Poland	Automation and Robotics processes
3	SI	Slovenia	SI_industry 4.0 - Smart Factories/ integrated solutions enabling companies to build competent value-chains incl. production optimisation: (distributed) production management and control, quality assurance, regulation and data processing, intra-logistics, automation; 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.
4	AT2	Burgenland	Industry 4.0: automation and IT networking production and logistics, digital production and 3D printing, product and process safety, control and regulating technique
5	PL22	Slaskie	Advanced manufacturing systems (Information service activities)
6	PL22	Slaskie	Advanced manufacturing systems (Power generation/ renewable sources)
7	PL22	Slaskie	Advanced manufacturing systems (Energy distribution)
8	CZ08	Moravskoslezsko	Special machines, facilities and technological procedures of industrial automation for production and testing

9	CZ08	Moravskoslezsko	Mechatronic systems and facilities (incl. connected modelling and simulations)
10	DE2	Bayern	Efficient production technologies, mechatronics, automatisation & robotics
		8	**NEW MATERIALS**
1	AT	Austria	Materials & production
2	PL	Poland	Electronic conducting polymers
3	PL	Poland	Multifunctional materials and composites with advanced properties, including nano-processes and nano-products
4	PL	Poland	Modern technology sourcing, processing and use of natural resources and the production of substitutes
5	AT2	Burgenland	Materials (plastic, wood, metal) and their intelligent application
6	AT2	Burgenland	Materials (plastic, wood, metal) and their intelligent application
7	CZ08	Moravskoslezsko	Advanced materials and materials with low energy demand, their development, production and technologies of their processing (incl. utilisation of nanotechnologies)and mutual connecting (alloys, high-grade steels, composites, aluminium, plastics, natural materials)
8	DED	Sachsen	New materials
9	PL32	Podkarpackie	Advanced materials
10	DE2	Bayern	New and intelligent materials, nano- and micro-technology
11	SK01	Bratislavský kraj	New materials
12	SK01	Bratislavský Kraj	New materials in electrotechnical, photovoltaic, sensors
13	SK01	Bratislavský Kraj	Intelligent surfaces
		9	**LIFE SCIENCES**
1	AT	Austria	Life Sciences
2	AT2	Burgenland	Life Science: Pharmaceutical and Medizintechnik
3	CZ07	Střední Morava	Life Sciences
4	DE2	Bayern	Life sciences (esp. biotechnology and systems biology)
5	PL21	Malopolskie	Life Sciences
6	PL52	Opolskie	Life and environmental science (Health products, Spatially integrated regional tourist product, The process of organising the intermodal system environmentally in a friendly way)
		10	**SECURITY**
8	DE2	Bayern	ICT (cyber-security; big data; cloud computing; industry 4.0; e-commerce; craftsmanship 4.0; robotics for automation in production, logistics & healthcare; connected mobility; e-health, digital care, precision medicine & tele-medicine; smart energy; digital media e.g. in film and gaming; e-tourism; e-finance; smart construction; digital agriculture for resource efficiency & transparency; e-environment & environmental protection)
2	HR	Croatia	Security
3	CZ07	Střední Morava	e-Security
4	CZ08	Moravskoslezsko	Integrated safety systems (development of complex safety systems for public and private sector)including elements of environmental prevention and protection (pollutants, epidemiological occurrences)
5	SK01	Bratislavský Kraj	Security
		11	**TOURISM**
1	AT	Austria	Service innovation (tourism etc.)
2	PL21	Malopolskie	Creative and leisure industries
3	SI	Slovenia	Sustainable Tourism and Creative Cultural and Heritage based Services - social innovations based on rich cultural heritage and local creativity in services promoting activities and services centred around the sustainable use of natural resources and innovative well-being programmes.
4	PL43	Lubuskie	Health tourism
5	PL43	Lubuskie	Health & quality of life: Other supporting sectors: ICT, metal industry, logistics
		12	**BIOTECHNOLOGY**
1	DED	Sachsen	Biotechnology
2	PL32	Podkarpackie	Biotechnology

3	PL22	Slaskie	Advanced manufacturing systems (Biotechnology)
4	PL22	Slaskie	Industrial Biotechnology (Biotechnology)
		13	**SMART CITIES AND COMMUNITIES**
1	SI	Slovenia	Smart Cities and Communities - manufacture of electric and electronic components and equipment, ICT systems, components and systems for district heating and the HVAC systems. Develop ICT-based projects in the areas of energy, urban mobility, safety and smart health systems.
2	PL	Poland	Smart networks and geo-information technologies
3	PL	Poland	Smart creative technologies
4	PL	Poland	Sensors (including biosensors) and smart sensor networks
5	CZ08	Moravskoslezsko	Smart grids and smart cities with utilisation of specificities of the Moravian-Silesian Region during a process of changes of its technological profile - geothermal energy, methane, co-generation and accumulation, underground infrastructure
6	SI	Slovenia	Smart buildings and homes - energy refurbishment of buildings, interfaces between a smart building and a smart grid, integrated management systems for buildings, homes and the working environment of the future, and smart appliances for energy efficiency and self-sufficiency of buildings; re-use of construction waste and renewable and health-friendly materials; integration of the wood chain in the design of homes and working environments of the future by including research and innovation deriving from traditional knowledge and skills in using the wood and wood-compatible natural materials.
7	SI	Slovenia	Smart use of resources - materials, products, applications and services supporting the circular economy, re-use and efficient use of resources, acquisition of alternative fuels.
8	AT2	Burgenland	Renewable energy, smart grids, new building materials, energy efficiency in buildings and transport)
		14	**CONSULTANCY**
1	CZ01	Praha	Research consultancy, technology services, qualified human resources & creative services
2	CZ01	Praha	Business consultancy
3	SK01	Bratislavský kraj	Data recognition & data mining
4	SK01	Bratislavský kraj	Financial services
		15	**NANOTECHNOLOGY**
1	DED	Sachsen	Nanotechnology
2	PL32	Podkarpackie	Nanotechnology
3	SK01	Bratislavský kraj	Nano technology
		16	**WOOD TECHNOLOGIES**
1	PL43	Lubuskie	Wood, furniture & paper industry (technological innovation, ergonomic and aesthetic, development of techniques of raw materials, materials and energy efficiency)
2	PL52	Opolskie	Construction and wood technologies (Low-energy construction technologies, Cement and concrete technologies, Wood technologies)
		17	**CHEMICAL TECHNOLOGIES**
1	PL21	Malopolskie	Chemistry
2	PL51	Dolnoslaskie	Chemical and pharmaceutical industry
3	PL52	Opolskie	Chemical technologies (Polymers, plastics and rubber technologies, Organic chemistry technologies, Cleaning materials technologies)
		18	**PHOTONICS**
1	DED	Sachsen	Photonics
2	PL32	Podkarpackie	Photonics
			OTHER
1	PL32	Podkarpackie	Social innovation
2	HU	Hungary	Inclusive and sustainable society

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