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Higher Education for Smart Specialisation in Lubelskie, Poland

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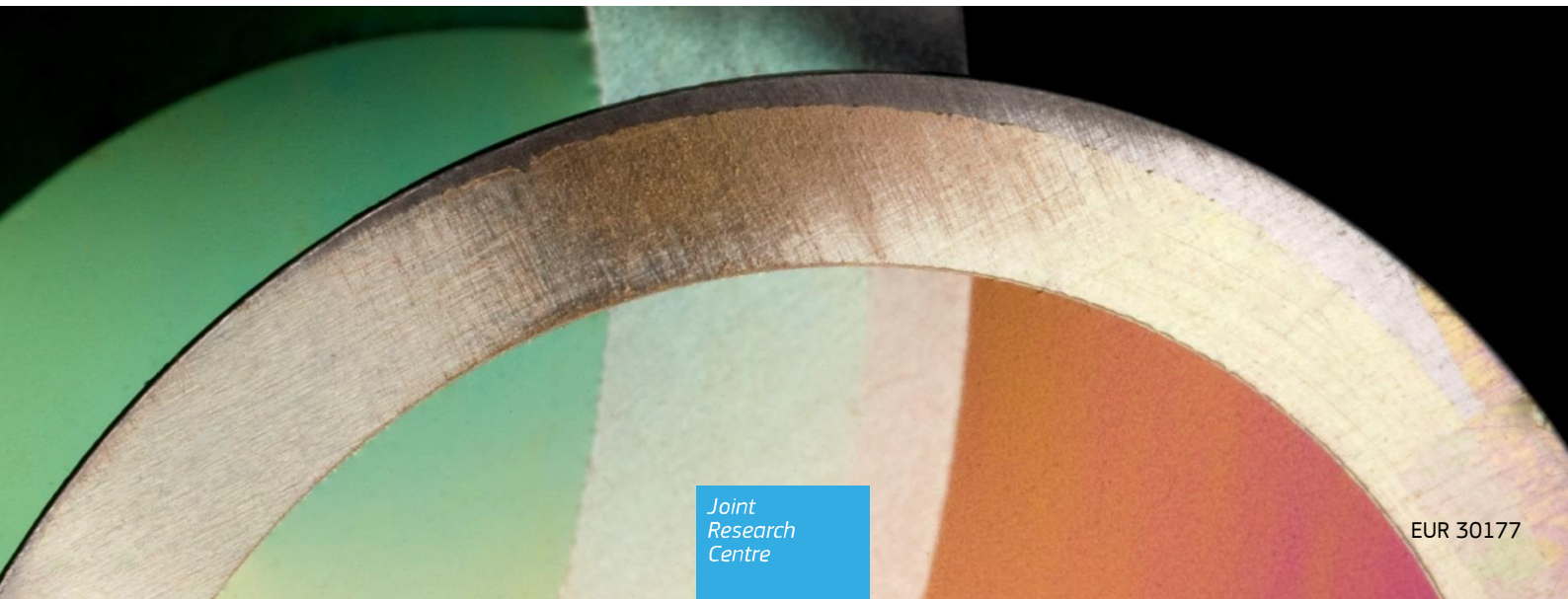

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Abstract

This technical report contains the findings of action research that was carried out in the Polish region of Lubelskie on the role of Higher Education Institutions (HEIs) in the design and implementation of its Smart Specialisation Strategy (S3). It is one of ten case studies undertaken in the project on Higher Education for Smart Specialisation (HESS), an initiative of the Joint Research Centre and DG Education, Youth, Sport and Culture.

The research shows that HEIs in Lubelskie have great potential to contribute to innovation and regional development, with strong and complementary universities as well as research institutions and higher vocational institutions. The overall issue of S3 governance is tackled and shows a good partnership between the Marshal's Office and the regional HEIs, built on a history of cooperation in developing innovation strategies, which is longer than that of other Polish regions. However, the role of HEIs in implementing S3 is hampered by a lack of targeted instruments in the EU co-financed regional operational programme. In particular, the current situation of subcontracting HEIs by companies for research and innovation projects has not led to their successful mobilisation. As for education, there are several interesting instruments in the relevant national education programme but they are not linked to S3 implementation.

In addition to the governance of S3, the action research focused on the role of HEIs in two priority domains, namely the bioeconomy and photonics. It reveals two contrasting approaches to the Entrepreneurial Discovery Process, a key element of the Smart Specialisation concept: One relies on technology push by building on the research strengths of the regional HEIs, with the other being led more by the market. Both priorities have a lot to offer the region but appropriate lessons are needed on how to increase their impact and critical mass. Based on the results of this action research specific recommendations are put forward to support the process of revising the Lubelskie S3.

Executive Summary

The overall objective of the Higher Education for Smart Specialisation (HESS) project is to analyse how Higher Education Institutions (HEIs) can be better integrated into smart specialisation policy mixes and how the European Structural and Investment Funds (ESIF) can be more effectively spent in this field. Furthermore, the project aims to explore how institutional capacity in Europe's regions can be built by strengthening the role of HEIs within the 'quadruple helix' of government, academia, business and civil society.

One of the main activities of the project is a series of case studies in selected regions and countries within the European Union that have developed and implemented Smart Specialisation Strategies (S3). Principles of action research are adopted whereby the case studies are designed and implemented in cooperation with the regional and national authorities, HEIs and other stakeholders. In Lubelskie an exploratory visit was organised in November 2018 including meetings and a workshop with the Marshal's Office and the local HEIs. This resulted in the following two research questions:

1. How can HEIs best feed into the design and implementation of the strategy – what governance mechanisms can be put in place to maximise their contribution?
2. How do HEIs work with the regional stakeholders to build critical mass in two of the S3 priority areas: Bioeconomy (an established regional specialisation) and photonics (a regional development niche)?

The exploratory visit was followed by desk research to better understand the challenges, strengths and weaknesses of the Higher Education (HE) sector in Poland, the challenges and socio-economic situation of Lubelskie and the HEIs located in that region. Next steps included interviews with key stakeholders (individual and institutional), two focus groups and two workshops.

Background: Lubelskie and its Higher Education Institutions

Lubelskie benefits from stable, long-term economic growth, rising income and living standards as well as a declining unemployment rate. However, the region is facing demographic changes such as ageing population and migration of people. Taking into account the national profile of global value added, Lubelskie is specialised in agriculture, forestry and fishing. On the other hand, the role of industry and construction are lower in comparison with other Polish regions. Lubelskie is classified as a region with low investment attractiveness and qualified as a "Modest+ innovator". Research and Innovation (R&I) is characterised by strong dependence on public funding. Among innovative enterprises the dominate approach is absorption of external knowledge and technologies (especially in machinery and technical equipment), rather than their internal (in house) development through R&I activities. Lubelskie is characterised by relatively low shares of R&I expenditures and R&I personnel in engineering and technology.

The HE sector in Poland has undergone significant restructuring over the last three decades mainly due to socio-economic changes and integration with the European Union. Nevertheless, it remains fragmented into a few big and many very small institutions. The HE sector is also facing challenges caused by demographic changes, specifically a substantial reduction in the population aged 19 to 24: between 2005/06 and 2017/18 the numbers of students decreased in all types of HEIs with the exception of medical universities. Public expenditure on higher education in Poland increased from 9 676.5 mln PLN in 2005 to 15 752.7 mln PLN in 2017, but its share related to GDP dropped from 0.99% to 0.68% over the same period. In 2017, public HEIs generated their revenues mainly from education (79.6%) and to a lesser extent from research (12.7%). HEIs were focused mainly on basic research and the shares of funding dedicated to applied research and experimental development was significantly lower. R&I activities carried out by HEIs were funded mainly by external public funds (82%) and the share of funds obtained from business enterprise sector was low (3.5%).

HEIs in Lubelskie are facing similar challenges as those in other Polish regions. Over the last 15 years they have focused mainly on educational activities and infrastructure projects. In terms of research, they are strongly dependent on public funds and focused mainly on basic research. A worrying signal for HEIs in Lubelskie is the very low number of R&I projects funded by the ESIF or the EU's Research Framework Programmes, especially Horizon 2020. However, there are a growing number of applications and funding received from the national research programmes, especially those offered by the National Science Centre (basic research).

Taking into account data related to thematic concentration of R&I expenditures, personnel and the industrial sector most active in innovative activities, direct links between public R&I and industrial sectors could be identified mainly in agricultural sciences and food products. However, the analysis of publications, international patents and commercial applications indicates that also other areas, which are related to the "bio-economy" specialisation are well-rooted in all regional HEIs. However, it is a very broad category and participants understood it in a variety of ways. In contrast, Maria Curie-Skłodowska University is recognised in the area of

"photonics" (especially in the field of applied research and experimental development), and business-science cooperation (including international and national ones), which is actively developed by a photonics cluster.

Research results

The interviews, focus groups and workshops confirmed many observations derived from the desk research. The table below summaries answers to the research questions in terms of the context and suggested actions.

Research Question	How can HEIs best feed into the design and implementation of the strategy – what governance mechanisms can be put in place to maximise their contribution?	How do HEIs work with the regional stakeholders to build critical mass in two of the S3 priority areas: bioeconomy (an established regional specialisations) and photonics (a new, emerging specialisation)?
Context	HEIs from Lubelskie are currently undergoing the process of implementation of reforms introduced by the Law 2.0 (came into force in October 2018); in particular they are developing new strategic documents and internal regulations. The reform puts emphasis on quality in research and educational activities (excellence) as well as their regional impact (relevance), especially the commercialisation of R&I projects.	The priorities of bioeconomy and photonics identified in S3 represent two different approaches to entrepreneurial discovery, a key element of the Smart Specialisation concept. In the case of bioeconomy it reflects the technology push model (the leading role is played by HEIs). In contrast the approach to photonics follows more of a demand pull model with a leading role for companies. Both areas differ in terms of description in the S3 document, policy instruments used to support projects as well as involvement in cooperation, especially at international level.
Strategic actions	Engagement of regional authorities in the development of strategic documents prepared by HEIs, especially in the area of socio-economic impact, (or more formal involvement such as permanent participation in consultative bodies of HEIs)	Redefinition of S3 priorities, especially bioeconomy
Organisational actions	Establishment of working platforms to share experience among regional HEIs (i.e. engagement in commercialisation, international programmes like Horizon 2020, dual studies, industrial PhDs, impact assessments, internal regulation of HEIs concerning the evaluation of researchers)	Improvement of cooperation between HEIs (bioeconomy – regional level; photonics – national)
Financial actions	Introduction of new instruments supporting S3 (industrial PhDs and support for universities' spin-offs i.e based on models developed by University of Warsaw or Nicolaus Copernicus University from Toruń).	Introduction of new instruments focused on business-research cooperation (consortia projects, competence centres, public-private partnerships).

Desk research raised two additional questions, which were discussed with regional stakeholders:

- How are humanities, arts, social sciences and medical sciences contributing to regional development and innovation?
- Whether the potential of engineering and technical sciences in Lubelskie is sufficient for the development of local companies (i.e. manufactures of metal products, rubber and plastic products, machinery and equipment)?

In both cases, the national and regional examples were presented and discussed, but stakeholders pointed out that both questions require more in-depth analysis and discussions.

During the meetings with regional authorities it was also pointed out that S3 should take more into account the geographical location of Lubelskie i.e. opportunities related to transport/logistic and sustainable development of the regional economy. These issues were discussed in the final phase of the project, however they could be further developed during the revision of S3.

As a result of the "action research" approach, recommendations concerning the spending of ESIF were also discussed with the Marshal's Office. They are focused mainly on the progress of implementation of S3 and the Regional Operational Programme for Lubelskie Voivodeship 2014-2020:

- In the short term identify opportunities for new/upgraded instruments or actions to accelerate progress in the existing thematic areas (i.e. bio-economy) or emerging ones (i.e. photonics),
- In the mid to longer term, enter into dialog and negotiation about the evolution of multi-level governance of the R&I system in Poland, especially the role of regional level and sources of funding for S3 after 2020.

Finally, the research identified three interesting 'good practices' concerning governance of HEIs in Lubelskie and cooperation with national, regional and municipal partners:

- The engagement of HEIs with the Innovation Incubator programme – II 2.0 (consortia of HEIs in the field of commercialisation of research) funded from the national Operational Programme for Smart Growth.
- The engagement of the team responsible for S3 in the Marshal's Office (continuous conduct of the Entrepreneurial Discovery Process, development of multi-level governance instruments and international cooperation, especially in photonics).
- The engagement of Lublin City Office in the development and promotion of the Lublin medical cluster

Structure of the report

The report consists of six parts. The next section introduces the HESS project and case study in Lubelskie. The second part presents the action research methods. The third part discusses the challenges and situation of HEIs in Poland and the fourth presents background information about R&I in Lubelskie. The fifth part is dedicated to information on HEIs in the Lubelskie. The sixth part discusses the governance of Lubelskie's regional innovation system, strategies and the progress of implementation in the Regional Operational Programme for Lubelskie Voivodeship 2014-2020, as well as involvement of HEIs in those processes. The seventh part reports on the results of interviews, focus groups and workshops. The final part presents conclusions and recommendations for further actions.

1. Introduction

Smart Specialisation Strategies (S3) aim to build competitive advantage through knowledge-based development of national and regional economies. The smart specialisation approach helps to address emerging opportunities and market developments in a coherent manner, while avoiding duplication and fragmentation of efforts.

The objective of the Higher Education for Smart Specialisation (HESS) project is to analyse how Higher Education Institutions (HEIs) can be better integrated into S3 policy mixes and how the European Structural and Investment Funds (ESIF) can be more effectively spent in this field. Furthermore, the project aims to explore how institutional capacity in Europe's regions can be built by strengthening the role of HEIs within the 'quadruple helix' of government, academia, business and civil society.

The region of Lubelskie was selected as a case study to pursue 'action research', with the dual objective of understanding how HEIs have been involved in the design and implementation of S3, and to help develop a closer partnership between the regional authority and its HEIs. The project was implemented in close collaboration with the Marshal's Office as well as the main stakeholders including: Maria Curie-Skłodowska University, The John Paul II Catholic University of Lublin, University of Life Sciences in Lublin, Lublin University of Technology, Medical University of Lublin, public higher vocational schools (i.e. in Biała Podlaska, Chełm, Zamość), Polish Air Force University (Dęblin), private higher education institutions (i.e. in Chełm, Lublin, Ryki, Zamość) and research institutes conducting doctoral studies (i.e. the Institute of Agrophysics of Polish Academy of Sciences (PAS), the National Veterinary Research Institute – State Research Institute (SRI), the Institute of Soil Science and Plant Cultivation – State Research Institute (SRI), the Institute of Agricultural Medicine).

The HESS project in Lubelskie started in November 2018 and was finished in November 2019.

2. Research Method

The HESS project in Lubelskie started with exploratory visits organised on 29-30 November 2018 in Lublin and Warsaw (first stage of the project). This included the following meetings:

- A kick-off meeting in Lublin on 29th November organised at the Marshal's Office of Lubelskie, bringing together the main universities and research organisations from the region.
- Meetings with representatives of national authorities responsible for the S3 implementation at national level in Warsaw on 30th November: the Ministry of Entrepreneurship and Technology, the Ministry of Science and Higher Education, the Foundation for Polish Science.

Taking into account the discussions with regional and national stakeholders, it was decided to include the following organisations to the group of HEIs from Lubelskie:

- The largest regional public universities and one catholic university (Maria Curie-Skłodowska University, The John Paul II Catholic University of Lublin, University of Life Sciences in Lublin, Lublin University of Technology, Medical University of Lublin)
- Public higher vocational school (i.e. in Chełm, Zamość, Biała Podlaska) and the Polish Air Force University (Dęblin)
- Private higher education institutions (i.e. in Lublin, Zamość, Ryki, Puławy)
- Research institutes conducting doctoral studies (i.e. the Institute of Agrophysics of PAS, National Veterinary Research Institute - SRI).

Based on these exploratory visits the following two research questions were identified as useful for Lubelskie to analyse the engagement of HEIs in S3 processes:

1. How can HEIs best feed into the design and implementation of the strategy – what governance mechanisms can be put in place to maximise their contribution?

2. How do HEIs work with the regional stakeholders to build critical mass in two of the S3 priority areas: bioeconomy (an established regional specialisation) and photonics (a new, emerging regional specialisation)?

The second stage of the project was desk research aimed at providing more information on the higher education sector in Poland, the socio-economic situation of Lubelskie, S3 implementation at regional level and the engagement of HEIs in that process including basic data concerning their roles, activities and regional impacts. The analysis included issues concerning funding, governance, autonomy, etc., as well as specific programmes/strategies at regional or national level to boost the engagement of HEIs in regional development. The following publicly available sources of data were used to gather information about HEIs in Lubelskie.

- Bibliometric data presenting general indicators concerning the quantity and quality of scientific outputs of HEIs from Lubelskie (publications – Scopus, patents - Polish Patent Office and European Patent Office)
- Higher education data in Poland (POLON database managed by the Ministry of Science and Higher Education), including monitoring of economic career development of students and the results of institutional evaluation for 2013-2016.
- Information and data gathered from national and regional Operational Programmes (i.e. OP Smart Growth, OP Knowledge, Education, Development, OP Eastern Poland) and programmes funded from national budgets (i.e. the Regional Excellence Initiative).
- Information obtained from the S3 platform and EC websites concerning mainly statistical data and operational programmes.
- Other publicly available data i.e. participation in 7 Framework Programme and Horizon 2020 programme and start-ups.

The third stage of the project was dedicated to fieldwork and took place on 15-16 March in Lublin:

- Meetings with representatives of HEIs (Maria Curie-Skłodowska University, The John Paul II Catholic University of Lublin, University of Life Sciences in Lublin, Lublin University of Technology, Medical University of Lublin)

- Two focus groups with representatives of the regional priority domains of bioeconomy and photonics.

The topics were sent to the participants before the meetings. The main topics discussed during the meetings and focus groups are presented in Annex 1.

The focus groups aimed to identify the challenges related to two of Lubelskie's S3 priorities: bioeconomy and photonics. Regional experts were invited to discuss the strengths/opportunities of Lubelskie in these areas, educational and research advantages, universities' strategies, collaboration patterns and policy instruments. In both cases the same basic template was used.

The fieldwork also included individual interviews with key stakeholders (10 interviews) and institutional interviews with key HEIs (five interviews – the largest public HEIs from Lubelskie). In selecting respondents, a central concern was that they should have good knowledge of smart specialisation and direct contact with activities related to the implementation of S3 at national and regional levels. Interviews were therefore conducted mainly with rectors, vice-rectors, directors and senior managers. Interviews lasted for 30-90 minutes and focused on questions concerning S3 design and implementation as well as the role of HEIs in those processes. The template of interviews is presented in Annex 2. Interviews were conducted in an informal manner, so respondents could explore some of the pre-defined topics and make their own contributions. Interviews were not recorded, but after each interview written summaries were prepared. In some cases, complementary questions were sent to interviewees to clarify issues that were discussed. The collected material was then analysed from the perspective of the specific research questions for Lubelskie and the overall objectives of the HESS project: S3 (design, implementation, involvement of stakeholders, governance mechanisms, policy instruments, critical mass) and HEIs (knowledge generation, knowledge absorption and transfer, teaching and learning, cooperation, organisation, funding and regional impact).

The preliminary results of the fieldwork were discussed with the representatives of the Marshal's Office. It allowed a comparison of the results with information about the progress of the Entrepreneurial Discovery Process and S3 implementation, clarification of some issues from the focus groups and discussion on the action plan for further activities concerning bioeconomy and photonics in Lubelskie.

The final workshop (fourth stage of the project) included three parts: presentation of the action research results as well as discussion with key regional stakeholders (representatives of the management of HEIs, research institutes and the Marshal's Office), roadmapping exercises with stakeholders and a working session with the representatives of the Marshal's Office dedicated to the results of the HESS project from the perspective of new criteria for good governance of S3.

3. The challenges and situation of HEIs in Poland

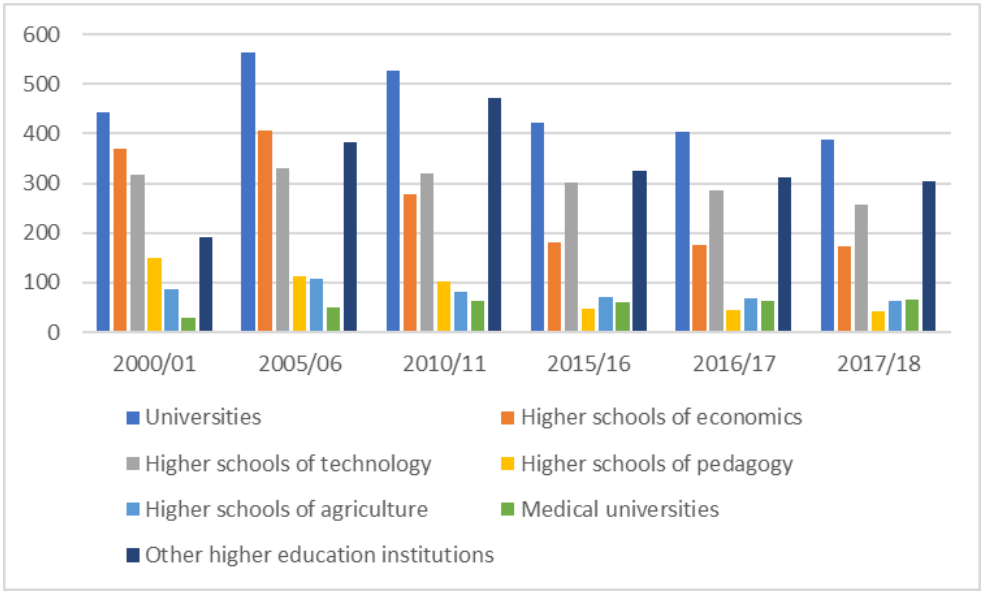
HEIs are major actors in the science and research system in Poland. In 2017 the HE sector incurred 6,764.9 mln PLN intramural R&D expenditures (second position among sectors of performance after the business sector; 32.7% of total expenditures) and employed 94 786 persons as R&D personnel (first position among sectors of performance; 50.5% of total R&D personnel) (GUS, 2018a, p. 22). The total number of HEIs in Poland is 528 (according to the register of universities included in POL-on database, data from 21.01.2019), but among them 392 organisations are currently conducting higher education activities (active HEIs), 54 are in liquidation phase, 72 were liquidated and 10 have been transformed or re-registered.[1] Among the active HEIs, 132 are public including 18 universities[2], 18 higher schools of technology, 10 medical universities and 25 vocational HEIs. The remaining 249 active HEIs are private, including 12 which are (Catholic) church run.

The higher education sector in Poland has undergone significant changes over the last three decades mainly due to socio-economic changes and the integration with the European Union. Reforms of the research and higher education systems were introduced in 1990/1991 and continued over the following years through a number of legislative initiatives (1997, 2005, 2010/2011, 2018). Thanks to European structural funds, research and innovation (R&I)[3] and educational infrastructures have been significantly modernised or expanded and many new educational programmes have been developed and implemented (EC, 2017a).

3.1 Education

The overall number of HEIs fell over the last decade, but the HE sector remains fragmented into a few big and many very small institutions (EC, 2018). The 10 largest HEIs are located in seven cities (Warszawa, Kraków, Wrocław, Poznań, Łódź, Gdańsk, Katowice) and educate 23.9% of all students in Poland (GUS, 2018b, p. 15). The HE sector is also facing demographic changes due to the decrease in the population aged 19-24. In the 2017/2018 academic year there were 1,291 mln students i.e. 4.2% fewer than a year earlier and 33.8% fewer than the 2005/2006 academic year (the academic year with the highest number of students over the last 30 years in Poland) (GUS, 2018b, p. 14). However, these changes affect different types of HEIs to varying degrees. Figure 1 presents the number of students by type of HEIs.

Figure 1. Students by type of HEIs in Poland over the last 20 years



Source: author's elaboration based on GUS (2018b, p. 16)

Between 2005/06 and 2017/18 the numbers of students have decreased in all types of HEIs except for medical universities, in which the number of students increased by 31.7%. The largest decreases in the number of students between the 2005/06 and 2017/18 academic years concerned higher schools of pedagogy (63%),

[1] https://polon.nauka.gov.pl/opi/aa/rejestry/szkolnictwo?execution=e1s1

[2] Universities do not have engineering faculties and only some of them have separate medical faculties.

[3] The term Research and Innovation (R&I) is generally used to describe research, development and innovation activities, but sometimes the term R&D is used, especially when referring to statistics that also use the term.

higher schools of economics (57%) and higher schools of agriculture (42%), universities (31%) and higher schools of technology (22%). On the other hand, in the 2017/2018 academic year the number of foreign students in Poland increased to 72 743 and was seven times higher than in the 2005/2006 academic year (GUS, 2018b, p. 22). However, the increase of foreign students was too low to offset the overall decline.

The total number of students in non-degree postgraduate programmes was relatively stable between the academic years 2005/06 and 2017/18, but the share of postgraduate students in higher schools of economics increased from 19% to 24% and the share of postgraduate students in universities decreased from 28% to 13% (GUS, 2018b, p. 24). In the 2017/18 academic year, doctoral students in HEIs and other research organisations (such as research institutes or institutes of the Polish Academy of Sciences and Medical Centre of Postgraduate Education) amounted to 41,300, which represented a 4,3% decline on the previous year, but a 26% increase compared to 2005/06 (GUS, 2018b, p. 26).

Public expenditure on higher education in Poland increased from 9,676.5 mln PLN in 2005 to 15,752.7 mln PLN in 2017, but the shares of public expenditure on higher education in GDP dropped from 0.99% in 2005 to 0.68% in 2017. Public expenditure on higher education of the budget of local government is relatively low, amounting to 37.1 mln PLN in 2017 (GUS, 2018b, p. 249). In 2017 public HEIs generated mainly revenues from educational activities (79.6%) and to a lesser extent from research activities (12.7%). Other revenue streams were less important and did not exceed 10% of total revenues. From this perspective, the most R&I oriented public HEIs were higher schools of technology (17.6% revenue from research activity) and universities (16.4% revenue from research activity). In the case of non-public HEIs, the revenues from educational and research activities amounted respectively to 89% and 2% in 2017. In public HEIs, 81.1% of teaching revenue came from government grants and 11% from tuition fees, while in the case of non-public HEIs only 1.4% came from the state budget and 94.5% from fees (GUS, 2018b, p. 257). It corresponds with the predominant type of studies: 78.7% of all students in public HEIs took advantage of full-time programmes in contrast to private HEIs in which 72.5% of students studied part-time (GUS, 2018b, p. 18).

3.2 Research

Regarding the R&I activities of HEIs, three streams of revenues can be distinguished:

- Institutional funding - grants financing statutory activities (36.5% in 2017).
- Competitive funding - funds for projects received from the National Science Centre (NSC, basic research – 22.9%), the National Centre for Research and Development (NCRD, applied research and experimental development – 13.2%), the Minister of Science and Higher Education (MSHE, 3.6%) and funds for international science cooperation (7.9%).
- Funding from commercial R&D activities – sale of other experimental R&I services (12.4%).

Revenues from R&I activities of specific types of HEIs and sources of financing are presented in Figure 2.

Figure 2 shows that two general approaches to generate R&I revenues by HEIs can be identified:

- Basic research in universities/ higher schools for economics, in which relatively high shares of total revenues come from institutional (statutory) funding, the NSC, the MSHE or international cooperation.
- Applied research in higher schools of technology/agriculture, in which revenues come to a larger extent from the NCRD, commercial sale and international cooperation.

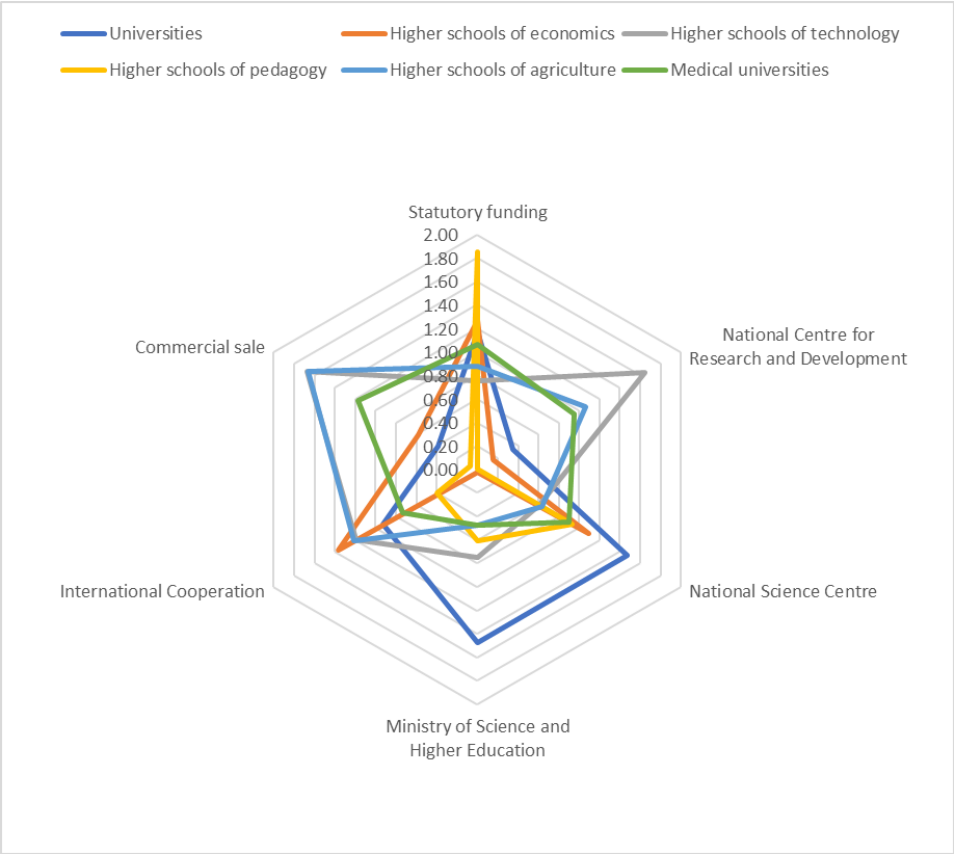
Higher schools of pedagogy and higher schools of arts are more familiar with the first approach in contrast to medical universities, which are closer to the second.

Data concerning intramural R&D expenditures show that the share of HEIs to total expenditures increased from 31.6% in 2005 to 32.8% in 2017. In the same period the share of R&D expenditure of the business enterprise sector increased from 31.8% to 64.5% and the share of government sector significantly decreased from 36.4% to 2.3%.[4] The intramural expenditures on R&D personnel (in FTE) in HEIs amounted to 103.6 tys. PLN (personnel and impersonal expenditures – 57.5 tys. PLN) and were comparable to the level of expenditures of government

[4] Data concerning the shares of business enterprise sector and government sector are not consistent in 2015 and 2016/2017 (the shares of above sectors in R&D intramural expenditures in 2015 were respectively: 46.5% and 24.4%). Nevertheless, in both cases the role of government sector decreased in analysed period.

sector - 102.3 tys. PLN (personnel and impersonal expenditures - 56.8 tys. PLN), but lower than in business enterprise sector - 181.9 tys. PLN (personnel and impersonal expenditures – 86.7 tys. PLN) (GUS, 2018a, p. 40).

Figure 2. Revenues of HEIs from research activities by source of funding in 2017



Source: author's elaboration based on GUS (2018b, p. 260)

HEIs were focused mainly on basic research and less important roles were played by applied research and experimental development (respectively: 74.8% 14.7% and 10.3% of R&D expenditures in 2017). R&D activities carried out by HEIs were funded mainly by external public funds (82%) and the share of funds obtained from the business enterprise sector was low (3.5%) (GUS, 2018a, p. 24, 25).

HEIs are also playing an important role in teaching and R&I activities in fields like humanities and social sciences. It indicates the mismatch between the thematic specialisations of HEIs and R&I profiles of other sectors, especially the business enterprise sector, which is strongly oriented towards engineering and technology (68.8% of R&D expenditures and 69.8% in R&D personnel in 2017). Table 1 presents thematic concentration of R&D and teaching activities of HEIs in Poland.

Table 1. Thematic concentration of R&D and teaching activities of HEI in Poland (2017)

Fields of R&D	R&D expenditures		R&D personnel (in FTE)		Students (all year of studies)*	Doctoral students
	PL	HEIs	PL	HEIs		
natural sciences	21.6%	30.4%	19.3%	21.2%	3.9%	15.7%
engineering and technology	52.3%	23.0%	44.9%	19.9%	24.3%	16.2%
medical and health science	11.8%	15.7%	11.9%	17.5%	18.7%	11.9%
agricultural and veterinary sciences	4.6%	7.5%	5.2%	6.9%	2.0%	4.6%
social sciences	5.9%	12.5%	10.6%	18.7%	33.5%	27.4%
humanities and arts	3.8%	10.8%	8.0%	15.9%	17.0%	23.9%
* - without individual interfield studies (0.5%)						

Source: author's elaboration based on GUS (2018b)

HEIs were very active in terms of patenting. In 2016, 33.4% of HEIs filled patent applications in the Polish Patent Office and 13.5% in foreign patent offices, which were higher than the shares of business enterprise or government sectors (GUS, 2018g, p. 121,122). Nevertheless, academic patent applications include inventions that might not be commercially viable, and they are patented due to incentives resulting from institutional funding rules (Klincewicz and Marczewska, 2017, p. 42). On the other hand, for the last 10 years many HEIs have established Technology Transfer Offices (TTOs) or Special Purpose Vehicles (SPVs) to manage the commercialisation of the results of their R&I activities. In 2016, 20 HEIs had both TTOs and SPVs in their structures (mixed model). The organisational models of knowledge transfer and commercialisation at 51 HEIs is presented in Table 2.

Table 2. The organisational models of knowledge transfer and commercialisation of HEIs

	No. of HEIs	Administrative model	TTO model	SVC model	Mixed model
Universities	18	2	6	2	8
Higher schools of technology	18	3	4	3	8
Higher schools of agriculture	6	-	4	-	2
Medical universities	9	2	1	4	2
Total	51	7	15	9	20

Source: Kardas (2016, p. 65)

Despite positive examples of commercialisation, the activities of TTOs and SPVs encounter many challenges due to legislative regulations concerning the functioning of the universities e.g. rules related to the ownership of academic inventions, the institutional funding and the evaluation of scientists. SPVs are also considered as large enterprises in terms of state aid rules. Other barriers result from the policies of universities e.g. the division of labour between research and educational activities favouring the second type of activities, the minor role of cooperation with business and external stakeholders. The activities of TTOs and SPVs were evaluated by the Supreme Audit Office in 2018, which in the final report indicates that TTOs and SPVs did not achieve the expected effects related to the commercialisation of R&D results (NIK, 2019, p. 8). However, the problems with commercialisation seems to be on the side of HEIs: The strong reliance of public funding and low funding from business enterprise sector linked with the focus on basic research and relatively low specialisation of HEIs in engineering and technology have resulted in limited number of technologies, which could be commercialised by TTOs and SPVs. The challenging task is also how to engage and take advantage of social sciences, humanities and arts in entrepreneurial activities (interesting examples could be SCUEP sp. z o.o. – SPV established by Poznań University of Economics and Business or spin-offs established by students/researchers from University of Warsaw (CRI sp. z o.o.) or the John Paul II Catholic University in 2018 (KUL Creative sp. z o.o.)).

4. The characteristics of Lubelskie

Lubelskie is located in the Eastern part of Poland with an area of 25,122 km2 (3rd position in Poland, 8% of the national territory) and a population of 2,133 mln people (8th position in Poland) in 2016. Gross Domestic Product in Lubelskie in 2016 amounted to 71,270 mln PLN/16,324 mln Euro (6th position in Poland) or 33,371 PLN per capita (68% of Poland's average, the lowest among Polish regions) (GUS, 2019c, p. 69). Lubelskie benefits from stable, long-term economic growth (1.2% in 2015 and 2.9% in 2016), rising income and living standards (gross real disposable income of households increased by 2.5% in 2015 and 8.3% in 2016) as well as reducing unemployment (14.4% in 2013 and 8.8% in 2017) (GUS, 2018c, p. 41, 53).

Taking into account the national profile of global value added, Lubelskie (62,952 mln PLN in 2016, 3.8% in national global value added) is specialised in agriculture, forestry and fishing (share of 5.3% compared to 2.6% in Poland). On the other hand, industry and construction have smaller national shares: 28.7% compared to 34.5% (GUS, 2018c, p. 139). In 2016, there were 23 economic entities with at least 500 employees in Lubelskie (1,9% of all economic entities., contributing to 47% of regional gross income and 41% of employment. The graduates of HEIs starting work for the first time in Lubelskie were employed in human health and social work (25.3%), industry (20.3%), public administration and defence, compulsory social security (15.7%), education (11.6%) and trade (10.4%) (GUS, 2018c, p. 142). Average monthly gross wages and salaries in industry amounted to 3,846 PLN, which is 6.5% below Poland's average (GUS, 2018d, p. 58, 323).

Lubelskie is facing demographic changes including a declining and ageing population (a change of -1.19 in 2017, compared to -0.02 nationally, with median age increasing from 38.7 to 40.3 between 2013-2017) and depopulation (total net migration per permanent residence per 1000 population has been -2,22 (PL: 0.04) on average since 2000; but international net migration in 2017 was positive (341 persons)) (GUS, 2018c, p. 31). Population projections show that in 2020 there will be 2.096 mln people in Lubelskie, but over the next decades the number will decrease to 1.86 mln in 2040 and 1.71 mln in 2050 (GUS, 2018e, p. 230).

Lubelskie has been classified as a region with low investment attractiveness by the Gdańsk Institute for Market Economics (IBNGR), in 14th position, and by the Polish Investment and Trade Agency (PAIH-SGH) at -F, the lowest class. According to the reports of IBNGR and PAIH-SGH, the main strengths of Lubelskie are: favourable geographical location on the international transport route (East-West), relatively low labour costs linked with access to qualified personnel in cities, potential of research and educational institutions, strong industrial traditions (especially in manufacturing of vehicles, machines, chemicals and food) and potential business process outsourcing. However, the reports point to weaknesses including low expenditures on innovation activity in industry and services, low R&D expenditures per capita or km^2, low household disposable incomes, high unemployment and low quality of life (PAIH-SGH, 2017, p. 5; IBNGR, 2016, p. 25).

The map of clusters in Poland prepared in 2015 by the Polish Agency for Enterprise and Development includes five clusters from Lubelskie: Lublin Eco-Energy Cluster, Lublin Cluster of Enterprises, Cluster of the Institutions of Business Environment, Eastern ICT Cluster and Cluster of Medical and Pro-Health Services. Three of them are thematically linked with S3 priority areas (medicine and health, ICT and automation, low-carbon emission energy production). The Eastern ICT Cluster was also awarded the title of National Key Cluster by the Ministry of Economy (since 2017 the Ministry of Entrepreneurship and Technology) (MET, 2018). On the list of Polish start-ups prepared by Startup Poland there are 33 from Lubelskie (3% of 1075 start-ups registered by Startup Poland). Most of the registered start-ups from Lubelskie offer applications and ICT platforms enabling customer management, delivering learning or data processing tools and only a few of them take advantage of more advanced R&D activities and cooperation with HEIs or research organisations. From this perspective the most active HEIs are the Medical University of Lublin or the University of Life Sciences in Lublin. The list of start-ups from Lubelskie registered by Startup Poland is presented in Annex 3.

Lubelskie is classified as a "Modest + innovator" by the 2017 Regional Innovation Scoreboard with increasing innovativeness over time: the Regional Innovation Index of Lubelskie in 2017 was 0.215 (9th among 16 regions in Poland), but the increase of its value from 2011 to 2017 is the highest among Polish regions (7.6%) (EC, 2017b). According to the Scoreboard, the relative strengths of Lubelskie are: relatively high non-R&D innovation expenditures, level of tertiary education and number of design applications. The main weaknesses are related to the low engagement in marketing and organisational innovations, collaboration by innovative SMEs and low sales new-to-market/firm innovations (EC, 2017b).

Gross Domestic Expenditures on Research and Development (GERD) in Lubelskie over 2015-2017 amounted to 737.7 mln PLN, 624.9 mln PLN and 668 mln PLN. The drop of GERD in 2016 was caused by lower expenditures financed from government funds (funding from business enterprises amounted to 117 mln PLN, 153 mln PLN and 157 mln PLN). The ratio of GERD to GDP in 2016 was 0.88%, which was lower than Poland overall (0.97).

R&D expenditures in Lubelskie were mainly incurred on basic research (60.5%) and the role of experimental development is relatively low (23.7%) when compared nationally (30% of GERD for basic research and 54% for experimental development). R&D expenditures in the manufacturing sector are also focused on experimental development (84% of funds) (GUS, 2018c, p. 271, 272). It raises a question of incompatibility and mismatch between the needs of local manufacturing sector and the profile of R&I activities carried out by HEIs.

The R&I sector in Lubelskie is also characterised by a strong dependence on public funding in R&D activities. R&D expenditures in Poland are financed mainly by the business enterprise sector (52.4%) and government sector (38.3%), but in contrast four regions from Eastern Poland are characterised by very high shares of government sector as source of R&D expenditures and relatively low shares of business expenditures sector (Lubelskie – 64.3% and 23.5%, Podlaskie – 63.1% and 24.6%, Warmińsko-Mazurskie – 57.6% and 35%, Świętokrzyskie 55.7% and 39.4%) (GUS, 2018e, p. 384)

The expenditures on innovation activity in industry in Lubelskie increased from 490 mln PLN in 2010 to 604 mln PLN in 2017 (in 2016 expenditures dropped to 474 mln PLN from 555 mln PLN year before). In 2017, above expenditures accounted for 2.3% of national expenditures (GUS, 2018c, p. 275). Table 3 presents expenditures in innovation activities in industry in Poland and Lubelskie in 2017.

Table 3. The expenditures on innovation activities in industry in Poland and Lubelskie in 2017 (in mln PLN)

	Poland		Lubelskie region	
Expenditures on innovation activity in industry	26,464.3	of total	604.1	of total
on research and development	5,976	0,0%	101,8	16.9%
on the aquisition of knowledge from external sources	151.8	0.6%	8	1.3%
on the aquisition of the software	461.1	1.7%	6,1	1.0%
on buildings, constructions and land	6,118	23.1%	100,9	16.7%
on machinery and technical equipment	12,595	47.6%	377	62.4%
of which import	4,641.3	17.5%	67,9	11.2%
on personnel training connected with innovation activity	69.3	0.3%	0,8	0.1%
on the marketing for new or significantly improved products	477.5	1.8%	7,2	1.2%

Source: author's elaboration based on GUS (2018e, p. 388)

Table 4: The main characteristics of expenditures and revenues of innovative enterprises in industry in Lubelskie in 2017 (entities employing more than 49 persons)

	Industry	Manufac-turing	of which manufacture			
			food products	rubber and plastic product	metal products	machinery and equipment
Expenditures on innovation activity (in mln PLN)	604.1	396.9	74.1	12.4	44.7	34.2
on research and development	101.8	100.6	#	#	12.1	27.3
on the aquisition of knowledge from external sources	8	#			#	#
on the aquisition of the software	6.1	2.4	1	#	0.3	#
on buildings, constructions and land, machinery and equipment	477.9	#	52.9	#	30.4	#
on personnel training connected with innovation activity	0.8	#	#		0.06	#
on the marketing for new or significantly improved products	7.2	#	#		#	#
Source of funds (in mln PLN)						
own	520.4	#	41.2	2.6	19.8	30
received from abroad	39.2	39.2	#	#	#	3.2
bank credits	40.7	40.7	21.4	#	#	#
others	3.6	#	#	#	#	#
Enterprises with new product and process innovation of total enterprises during 2015-2017 (in%)	39.0%	38.8%	28.6%	33.3%	46.2%	75.0%
new or significantly improved products	23.9%	27.9%	23.4%	33.3%	20.5%	58.3%
new or significantly improved processes	34.5%	33.3%	24.7%	33.3%	38.5%	66.7%
Shares of net revenues from sales of new or significantly improved products in net revenues from sales (in%)	4.0%	5.6%	3.0%	2.9%	5.2%	14.1%
new or significantly improved products	2.0%	2.8%	1.0%	0.5%	2.7%	10.3%
new or significantly improved processes	1.6%	2.2%	0.1%	2.2%	1.9%	6.5%

Source: author's elaboration based on GUS (2018c, p. 273-276)

Compared with the national level, companies from Lubelskie were characterised by a larger share of expenditures on the acquisition of knowledge from external sources and on the machinery and technical equipment and lower shares of expenditures on research and development, personnel training and the marketing for new or significantly improved products. It suggests that among innovative enterprises the dominant approach is the absorption of external knowledge and technologies (especially in machinery and technical equipment), rather than their internal (inhouse) development through own R&I activities.

According to the regional statistical data, four industrial sectors incurred expenditures of 165.4 mln PLN on innovation activities in 2017 (27.4% of expenditures of industry): food products, metal products, machinery and equipment, rubber and plastic products. Table 4 presents the main characteristics of expenditures and revenues of innovative enterprises in industry (data concern economic entities employing more than 49 persons).

The expenditures on R&I activities focused mainly on buildings, constructions, land, machinery and equipment (manufacturing of food and metal products – respectively 71% and 79% of total expenditures) and only manufacturing of machinery and equipment incurred most expenditures on R&I (almost 80% of total expenditures). In the case of manufacturing of food and metal products, machinery and equipment, the main source of funds was self-financing (GUS, 2018c, p. 273-276).

Other challenges facing the regional research and innovation system are (based on GUS, 2018f, p. 20-89; GUS, 2018g, p. 90, 103):

- Enterprises are innovative and innovation active, especially industrial enterprises, but it's not reflected in their revenues - the share of innovation active enterprises and innovative enterprises were higher compared with the national level in the case of industrial enterprises (23.2% and 20.1% vs. 20.2% and 18.5%) and lower in the case of service enterprises (9.4% and 8% vs. 11.9% and 10.4%), but the revenues from sales of new or significantly improved products or services as the share of total revenues from sales are lower compared with Poland's average and other regions (3.8% vs. 7.1% and 1.3% vs. 3%).
- Enterprises do not take full advantage of marketing and organisational innovations – service enterprises from Lubelskie compared with enterprises from other regions introduced less frequently organisational innovations (5% vs. 7%) and marketing innovations (3.6% vs. 6.9%), the same observation concerns organisational innovations in in industrial enterprises (5.8% vs. 8.4%).
- Innovative enterprises cooperates actively in clusters – the shares of industrial and service enterprises participating in innovation activities and engaged in cooperation are lower compared with other regions, but industrial and service enterprises engaged in such cooperation are active in clusters (35.9% vs. 20% and 40% vs. 22.8%).
- Innovative enterprises rarely take advantage of public support - the shares of industrial and service enterprises which received public support for innovation activities are the lowest among Polish regions (14% vs. 22.1% and 2.8% vs. 17.9%).
- Low share of high and medium-high technology enterprises - the share of high-technology and medium high-technology enterprises to total manufacturing enterprises is lower than national average (13.3% vs. 16.7% and 14th position among Polish regions), but net revenues from sales of products of high-technology or medium-high technology to total net revenues from sale of products of manufacturing enterprises is slightly below national average (33.4 vs. 34.8 and 8th position among Polish regions).
- Low number of foreign licence agreements used by industrial enterprises – 95 foreign licence agreements were used, which was 3.3% of total agreements used in Poland in 2016.

The role of regional actors in R&D activities has changed over the last decade. The expenditures incurred by manufacturing increased from 35 mln PLN in 2010 to 118.6 mln PLN in 2017 (from 9.6% to 17.6% of total R&D expenditures), but still the largest part of expenditures was incurred by HEIs (390.3 mln PLN and 58.4% in 2017; 56.3% in 2010). On the other hand, the share of research institutes in expenditures incurred on R&D activities decreased from 27% in 2010 to 14% in 2017 (GUS, 2018c, p. 270).

In terms of thematic concentration, the highest share of R&D expenditures was incurred in engineering and technology field, but it is two times lower in Lubelskie in comparison with the national level (Revealed Comparative Advantage, RCA: 0.46). From this point of view, Lubelskie is highly specialised in agricultural and veterinary sciences (RCA: 4.2) as well as in humanities and arts (RCA: 2.8), social sciences (RCA: 1.9) and medical sciences (RCA: 1.4). These specialisation fields are also confirmed by data concerning R&D personnel (RCA in

agricultural and veterinary sciences: 2.96, medical sciences: 2.02, humanities and arts: 1.25 engineering and technology: 0.47). Data about thematic concentration of R&D expenditures and personnel in Poland and Lubelskie in 2017 is presented in Table 5.

Table 5: Thematic concentration of R&D expenditures and personnel in Poland and Lubelskie in 2017

Fields of R&D	R&D expenditures		R&D personnel (in FTE)	
	PL	Lubelskie	PL	Lubelskie
natural sciences	21.6%	18.1%	19.3%	15.2%
engineering and technology	52.3%	24.0%	44.9%	20.2%
medical and health science	11.8%	16.7%	11.9%	26.0%
agricultural and veterinary sciences	4.6%	19.4%	5.2%	14.4%
social sciences	5.9%	11.3%	10.6%	12.7%
humanities and arts	3.8%	10.6%	8.0%	11.4%

Source: author's elaboration based on GUS (2018e, p. 385)

Thematic concentration of R&D expenditures in Lubelskie is similar to the distribution of R&D expenditures of the HE sector in Poland (Table 1), which confirms the dominant role of HEIs in the regional innovation system. Additionally, Lubelskie is characterised by relatively high shares of R&D personnel in social sciences and humanities. It indicates the significant difference between the thematic concentration of R&D expenditures and personnel between Poland and Lubelskie.

5. The role, functions and activities of HEIs in Lubelskie

The register of universities (included in the POL-on database) includes 21 HEIs from Lubelskie, 17 of which are active: nine public[5], seven private and one run by the Catholic Church (all institutions are presented in Annex 4). In December 2017 three HEIs (Maria Curie-Skłodowska University, Lublin University of Technology and University of Life Sciences in Lublin) established an association called "Union of Lublin Universities" (there are only three such associations in Poland). Additionally, educational activities related to the awarding of doctoral degrees are conducted by research institutes and institutes of the Polish Academy of Sciences i.e. Institute of Agrophysics of PAS, Institute of Agricultural Medicine, Institute of Soil Science and Plant Cultivation – SRI, and National Veterinary Research Institute – SRI. This chapter analyses data on the educational and research activities of HEIs in Lubelskie, followed by their engagement in ESIF funded projects.

5.1 Educational activities

The region of Lubelskie is characterised by a high percentage of students among the total population. The share of students among 19-24 year olds in the academic year 2017/18 was 50.4% (Poland – 51.4%). The numbers of students and graduates per 10 thous. population (307.9 and 92.9) were slightly lower than the national averages (317.1 and 97.5) (GUS, 2018c, p. 62-63). In Lubelskie there were 72454 students and 21205 graduates in the academic year 2017-18 (respectively: 5.6% and 5.4% of students and graduates in Poland). Among the student population 8.3% received scholarships. Teaching activities were conducted by 6152 members of academic staff (6.4% of academic teachers in Poland) (GUS, 2018c, p. 323). Table 6 presents data concerning students and HEIS in Lubelskie.

Table 6. Students of HEIs from Lubelskie as of 30.11.2017

	Grand total	of which females	Of grand total number							
			in				first-year students			
			full-time		part-time programms				of total number of	
			total	of which females	Total	of which females	total	of which females	in full-time programmes	of which females
Lubelskie	**69 737**	**41 787**	**54 337**	**33 253**	**15 400**	**8 534**	**17 874**	**10 226**	**14 578**	**8 484**
Public higher education institutions	**50 060**	**29 641**	**42 344**	**25 835**	**7 716**	**3 806**	**12 934**	**7 292**	**11 403**	**6 573**
Maria Curie-Sklodowska University	21 274	14 406	18 807	12 700	2 467	1 706	5 820	3 691	5 324	3 389
Lublin University of Technology	8 805	2 666	7 014	2 358	1 791	308	2 081	555	1 711	486
University of Life Sciences	7 960	5 127	6 413	4 254	1 547	873	1 950	1 180	1 532	959
Medical University of Lublin	7 012	4 835	5 101	3 916	1 911	919	1 379	1 001	1 132	874
Public higher vocational schools	5 009	2 607	5 009	2 607			1 704	865	1 704	865
Non-public higher education institutions	**19 677**	**12 146**	**11 993**	**7 418**	**7 684**	**4 728**	**4 940**	**2 934**	**3 175**	**1 911**
of which The John Paul II Catholic University of Lubli	9 616	6 247	9 076	5 838	540	409	2 321	1 453	2 246	1 398

Source: authors' elaboration based on GUS (2018b)

In terms of the number of students the largest HEI in Lubelskie is Maria Curie-Skłodowska University (12th position among Polish HEIs). More detailed information about the educational profiles of HEIs from Lubelskie is presented below in Table 7.

Table 7. Foreign students of HEIs from Lubelskie, 2017

	students			**graduates**		**Nr in PL**
	total	**females in the forst year of study**	**in the first year of study**	**total**	**of which females**	
Maria Curie-Sklodowska University	1 624	1 037	494	352	239	3 (18)
Lublin University of Technology	707	190	140	131	43	4(18)
University of Life Sciences	152	95	45	31	23	3(6)
Medical University of Lublin	1 407	635	148	187	80	1(9)

Source: authors' elaboration based on GUS (2018b)

HEIs in Lubelskie are characterised by a relatively high share of participants of long-cycle programmes (about 10% of all students in Poland). The second important characteristic is the largest percentage of foreign students

[5] The John Paul II University is classified in POL-on as both public and church HEI.

among all regions in Poland: in 2017 there were 6922 foreign students in Lubelskie, representing 9.7% of the student population and 9.5% of foreign students in Poland as a whole. More detailed information is presented in Table 7. The Medical University of Lublin is the leading medical university in Poland in terms of the number of foreign students. Maria Curie-Skłodowska University is positioned at 3rd place among universities and Lublin University of Technology at 4th position among higher schools of technology.

HEIs in Lubelskie conduct many postgraduate and doctoral programmes (41 entities[6] are allowed to award PhD title). The most popular field of postgraduate programmes among students in the 2017/2018 academic year were: education (pedagogy) – 2812 (41.2%) students, business and administration – 954 (13.9%), medical and health sciences – 583 (8.5%) and social sciences – 552 (8.1%), agriculture 117 (1.7%), ICTs - 86 (1.2%) s manufacturing and processing 53 (0.8%) (GUS, 2018c, p. 224-225). Table 8 presents the professional careers of graduates from Lubelskie's HEIs (the latest available data are from 2016).

Table 8. Professional careers of graduates of HEIs from Lubelskie in 2016

	Avergae gross earnings (in PLN)	Percentage to average gross earning in poviats	Percentage of time spent on:		
			work	furher studies	unemployment
The John Paul II Catholic University in Lublin	1905	51	57.9	11.5	14.1
Maria Curie-Skłodowska University in Lublin	1959	52	60.8	7.1	15.1
Medical University in Lublin	2338	62	72.3	5.4	10
Lublin University of Technology	2693	72	71.5	5.5	10.5
University of Life Science in Lublin	1722	46	55.4	6.5	18.6
The State School of Higher Education in Chełm	no data avaiable				
The State School of Higher Education in Zamość	no data avaiable				
The State School of Higher Education in Biała Podlaska	no data avaiable				
Polish Air Force University	no data avaiable				
Lubelskie Higher School in Ryki	no data avaiable				
Higher School of Economics and Innovation	3024	81	80.8	14.4	7.7
Humanistic-Economic Higher School in Zamość	no data avaiable				
Higher School of Social Sciences in Lublin	no data avaiable				
Higher School of Entrepreneurship and Administration in Lublin	3096	79	65	5	14.6
Vincent Pol University	2378	61	68.7	8.9	7.7
Higher Scool of International Relations and Social Communication in Chełm	3069	86	79.5	16.3	7.7
University of Management and Administration in Zamość	1939	54	71.5	0	11

Source: authors' elaboration based on http://ela.nauka.gov.pl/ (24.1.2019)

HEIs from Lubelskie are engaged in implementation of many educational projects funded by the ESIF. Detailed information is presented in part 4.3, but here we note that HEIs from Lubelskie are engaged in 120 educational projects, funded mainly from the Operational Programme Knowledge Education Development (POWER or POWR, Thematic Objective - 10) including the following measures:

- Measure 3.1 – competences in HE: increasing the competences of persons participating in higher education to match the needs of the economy, labour market and the society
- Measure 3.2 – doctoral studies: improving education quality and efficiency at PhD studies
- Measure 3.3 – internationalisation of Polish HE: improving accessibility of international education programmes for Poles and foreigners participating in higher education
- Measure 3.4 – management of HEIs: support for organisational changes and increasing the competences of higher education system staff
- Measure 3.5 - complex programmes of HEIs: support for organisational changes and increasing the competences of higher education system staff

[6] In the case of HEIs their organisational units treated as scientific units.

- Measure 5.3 - high quality of medical education: improving the quality of higher education in medical studies
- Measure 5.4 – competences and qualifications of medical personnel: development of professional competences and qualifications of medical personnel as a response to epidemiological and demographic needs of the country
- Measure 5.5 – development of nursing services: improving the quality of higher education in medical studies

Table 9. The engagement of HEIs from Lubelskie in educational projects funded from the Operational Programme Knowledge Education Development in 2014-2020

HEIs / institutes	MEASURES - Operational Programme Knowledge Education Development							
	3.1	3.2	3.3	3.4	3.5	5.3	5.4	5.5
Total	73	7	9	4	11	6	3	2
The John Paul II Catholic University in Lublin	14	1	1		1			
Maria Curie-Skłodowska University in Lublin	16	1		1	1			
Medical University in Lublin	2	1		1	1	1	2	
Lublin University of Technology	10	3			1			
University of Life Sciences in Lublin	2			1	1			
The State School of Higher Education in Chełm	4				1	1		1
The State School of Higher Education in Zamość					1			1
The State School of Higher Education in Biała Podlaska	7		2	1	1	2		
Polish Air Force University	1							
Lubelskie Higher School in Ryki								
Higher School of Economics and Innovation	12		4		1	2	1	
Humanistic-Economic Higher School in Zamość								
Higher School of Social Sciences in Lublin								
Higher School of Entrepreneurship and Administration in Lublin	4		1		1			
Vincent Pol University	1		1		1			
Higher Scool of International Relations and Social Communication in Chełm								
University of Management and Administration in Zamość								
Institute of Agricultural Medicine		1						
Institute of Soil Science and Plant Cultivation - PIB								
National Veterinary Research Institute - PIB								
Institute of Agrophysics of PAS								

Source: authors' elaboration based on MID (2019a)

The list of HEIs from Lubelskie engaged in ESIF projects is presented in Table 9, above. It is notable that the largest number of projects has been implemented by the Higher School on Economics and Innovation in Lublin, which is a private HEI. Measure 3.1 is the most popular because it has the largest budget dedicated to HEIs (about 570 mln Euro) and a wide range of eligible projects including the implementation of programmes with a general academic or practical profile, as well as those improving the competence of persons participating in higher education, the provision of high quality services by HEIs or the development of the third mission.

There are no specific measures dedicated to support higher education activities at either national or regional level, which raises the question of how to support educational activities related to S3 priorities. Generally, all projects implemented under measures 5.3-5.5 (by vocational HEIs) are in line with the regional priority "medicine and health". The Operational Programme Knowledge Education Development does indicate that "appropriate mechanisms, taking into account specific needs of regional labour markets and regional smart specialisations, will be applied under implementation processes" (MID, 2014, p. 233), but in practice only measure 3.1 refers to regional S3 in the context of the implementation of the third mission of HEIs. As a result, there are no specific instruments/measures dedicated to support educational activities of HEIs that are prioritised by S3.

5.2 Research and innovation

The most popular indicator related to R&I activities in Poland is the result of the institutional evaluation, which has been organised systematically for four year periods by the Ministry of Science and Higher Education since the 1990s. The last institutional evaluation was carried out in 2017 and took into account the results of R&I activities from 2013-2016. In the case of HEIs the institutional evaluation was focused on their organisational/scientific units such as departments. The assessment was based on four criteria: scientific and creative achievements (C1), scientific potential (C2), practical effects of scientific and artistic activity (C3) and other effects of scientific and artistic activity (C4). These results were limited only to active scientific personnel (so called "number N"). The final assessment scores classifies departments in one of the following categories: A+, A, B and C (MSHE, 2017). Results from Lubelskie are mixed. The highest scores were achieved by research

institutes[7], which received categories A+ or A. In the case of HEIs, 44 scientific units were evaluated and among them only one scientific unit received the category A+ while ten units received the A category. The 23 other scientific units received category B and 9 category C. Full details of the results can be found in annex 5.

In 2018, the Ministry of Science and Higher Education published the call entitled "Regional Excellence Initiative" aiming to support for the development of outstanding regional HEIs and the implementation of their R&I strategies. The competition was addressed to regional HEIs active in R&I activities. HEIs were allowed to apply for the competition only if the organisational unit in a discipline covered by the call had at least the scientific category "B" and it had permission to award doctoral degrees in that discipline. HEIs could receive a maximum of 3 mln PLN over four years. The MSHE selected up to three disciplines in one region or group of regions. The selection criteria includes the planned results and their impact on regional innovation strategies and international scientific cooperation, the scientific level of HEI resulting from the most important scientific achievements since 2015. In total, 30 HEIs received funds for strategic initiatives worth 326.1 mln PL for four years, including three proposals from Lubelskie presented in Table 10.

Table 10. Grantees of the call for Regional Excellence Initiative organised by the MSHE in 2018

HEI	Group of sciences	Group of scientific disciplines	The title of the project	Finansowanie
The John Paul II Catholic University in Lublin	humanities, arts and social sciences	philosophy and theology	Philosophy and theology in the context of contemporary changes in science	11.7 mln PLN
University of Life Sciences in Lublin	life sciences	food and food processing	Food production and packaging systems ensuring the preservation of bioactive components important in the prevention of civilization diseases	11.9 mln PLN
Lublin University of Technology	engineering and technology	mechanics and machinery	Lublin University of Technology - Regional Excellence Initiative	12 mln PLN

Source: author's elaboration based on MSHE (2018)

Taking into account the structure of GERD in Lubelskie, a large part of funding is dedicated to conduct basic research. In 2016, HEIs and institutes from Lubelskie received 22.3 mln PLN for 52 projects from the National Science Centre (9th position among Polish regions). In 2017, beneficiaries from Lubelskie took 8th place with 125 applications and funding amounting to 32 mln PLN (66 applications with 22.3 mln PLN in life sciences – so called "NZ panel" and 32 applications with 6.3 mln PLN in technical sciences – so called "ST panel"). However, HEIs and institutes from Lubelskie were not represented among the 10 most active HEIs or institutes in competitions organised by the National Science Centre in 2017. One grant from the prestigious 'Maestro' competition was awarded to a researcher from Maria Curie-Skłodowska University (biophysics, 1.97 mln PLN) as well as 27 grants from the 'Miniatura' competition (0.98 mln PLN) for researchers who had not previously participated in calls organised by the National Science Centre (NSC, 2018, p. 35).

HEIs and research institutes in Lubelskie have obtained funds for research projects from the European Framework Programmes since the mid-1990s, as shown in Table 11. Participation of HEIs increased over time, although research institutions have been more active. Participation in Horizon 2020 seems to be low in comparison with previous Framework Programmes, especially 7FP.

Table 11. The engagement of HEIs and institutes from Lubelskie in the Framework Programmes and Horizon 2020 Programme

Framework Programme	Projects	Engaged in projects as:		Types of organisations:		
		Coordicantors	Partners	HEIs	Institutes	Others
Fourth (1994-1998)	11	0	11	1	8	2
Fifth (1998-2002)	20	4	16	7	8	5
Sixth (2003-2006)	47	3	44	11	17	19
Seventh (2017-2013)	57	10	47	21	22	14
Horizon 2020 (2014-2020)	31	8	23	7	14	10

Source: author's elaboration based on CORDIS database

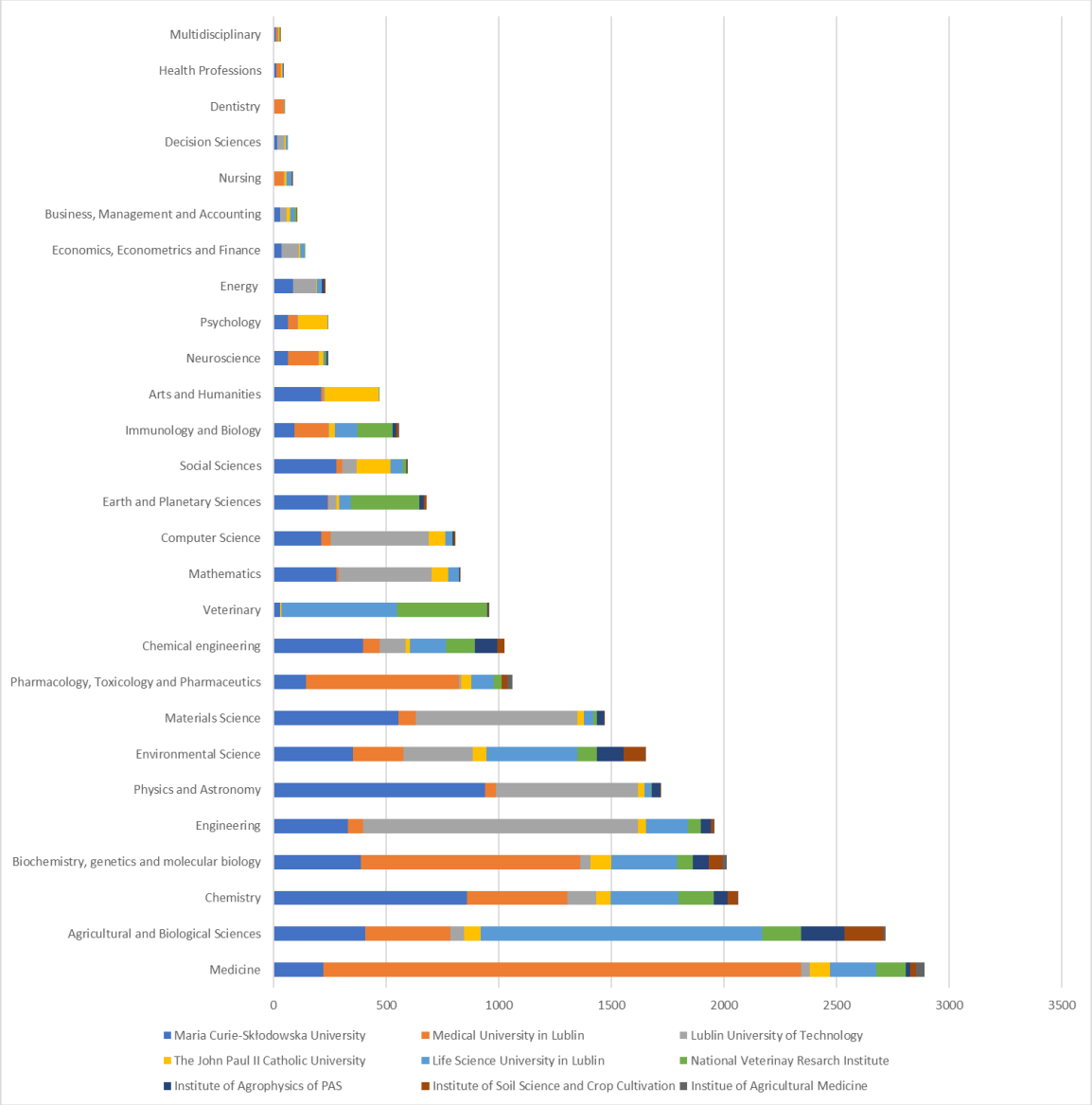
The most active HEIs from Lubelskie in terms of the number of scientific publications published in 2013-2017 were the Medical University of Lublin (3446 publications) and Maria Curie-Skłodowska University (3273 publications). Both universities are also leaders in the numbers of subject areas of publications and titles. From the perspective of the average citation impact of each of entity's publications (citation per publication) the leading organisations were the Institute of Agricultural Medicine and the Institute of Agrophysics of PAS.

[7] Research institutes are not discussed in previous sections because they do not have teaching rights and responsibilities.

Nevertheless, only one HEI (Medical University of Lublin) achieved a higher number of citations per publication than the national average. The same observation concerns another indicator related to the quality of publications - Field-Weighted Citation Impact (FWCI). It is important to note that HEIs or institutes from Lubelskie did not achieve a FWCI above 1, which means that the citations received by publications were cited less frequently than the world average for the same field, publication type and publication year. In the case of all HEIs (except the Medical University of Lublin) the ratios of publications having reached the threshold 10% of the most cited publications to all publications were lower than the national average. The same observation concerns the shares of publications published in the top 10 journal percentile (except Maria Curie-Skłodowska University) and published in collaboration with foreign authors (except Lublin University of Technology). The most active HEI from the perspective of academia-business collaboration was the Medical University of Lublin.

The main disciplines of publications of HEIs from Lubelskie are presented in Figure 3. We can see that the most popular disciplines of publications of HEIs and institutes were Medicine, Agricultural and biological sciences, Chemistry, Biochemistry, genetics and molecular biology and Engineering.

Figure 3. Thematic scope of publications and the contribution of HEIs and institutes



Source: author's elaboration based on Scopus/Scival

HEIs and institutes from the Lubelskie, like all organisations in Poland, are not very active in filing patent applications to the European Patent Office (EPO). 58 documents in Patstat database from Lubelskie since 2013 were identified (more detailed information in Annex 6). The numbers of patent applications filed to the National Patent Office by HEIs and institutes are significantly higher than to the EPO and in 2013-2017 included 1056

applications. In terms of patenting activity, the most active HEI was Lublin University of Technology, which filed 356 patent applications between 2013-2018.

The results of R&I activities also include the commercial or societal applications of inventions or new solutions. HEIs and research institutes can register such applications in the POL-on database. Notification is voluntary; nevertheless, it is an interesting source of information on regional research activities. There are 190 applications reported by HEIs and institutes from Lubelskie, including 65 by the John Paul II Catholic University (radio and tv programs, social projects) and 64 by Lublin University of Technology (mainly technological solutions or laboratory research). Most of these applications were implemented in Lubelskie (63%).

The links between R&I activities carried out by HEIs and institutes from Lubelskie and priorities identified in regional smart specialisation are presented in Table 12.

Table 12. Links between R&I activities of HEIs/institutes and S3 priorities

S3 priority	Links with R&I activities of HEIs and research institutes from Lubelskie
Bioeconomy (agricultural and industrial biotechnology, nanotechnology, biophysics)	• Research potential of leading institutes: Institute of Agrophysics of PAS and National Veterinary Institute – SRI, classified as A+ • All HEIs are engaged in R&I and educational activities in this area, and includes the Regional Excellence Initiative of University of Life Sciences in Lublin • Large number of publications, patents (Authors and Inventors) and most of the ESIF and FP funded R&I projects
Medicine and health (biotechnology and medical nanotechnology, personalised pharmacoteraphy, advanced materials)	• Research potential of the Medical University of Lublin (A+ in pharmacy), State Higher Vocational Schools and private HEIs • Large number of publications and authors dealing with these topics at regional level, regional cluster
Information technology and automation (mechatronics, smart buildings, control systems, industrial automation, mobile applications)	• Relatively good position of Lublin University of Technology in institutional evaluation and its Regional Excellence Initiative • Large number of commercial applications, popular in start-up activities (i.e. KUL Creative sp. z o.o.) • National Key Cluster
Low-carbon emission energy production (bioenergy, photonics, clean fossil technologies, prosumer energy, smart energy systems, renewable energy sources)	• Relatively good position of Faculty of Chemistry in Maria Curie-Skłodowska University in institutional evaluation and some faculties of Lublin University of Technology • Engagement in international networks (photonics) and international projects (7FP and Horizon 2020) • Many publications and Authors, regional cluster • Joint Undertaking of Marshal's Office and the NCRD

Source: author's elaboration

5.3 European Structural and Investment Funds for R&I and education

HEIs and institutes from Lubelskie benefited significantly from the European Structural and Investment Funds (ESIF) since Poland joined the EU. The total value of projects implemented under the financial perspective 2007-2013 was 2,118 mln PLN, of which 1,652 mln PLN was EU funding. The most popular were educational projects but many HEIs also implemented infrastructure projects. In terms of financial volume, the largest projects were for infrastructure (1,690 mln PLN, of which 1,300 was EU funds). However, the number of R&I projects were relatively low (only 10). Table 13 below presents the data according to each HEI in the region.

Table 13. The engagement of HEIs and institutes from Lubelskie in projects funded from ESIF between 2007-2013

HEIs / institutes	Number of projects	Value of projects (in PLN)	Eligible expenditures (in PLN)	EU funding (in PLN)	Operational Programmes	R&D projects	Educational projects	Infrastructural projects
Total	306	2 118 006 892.80	2 068 043 878.65	1 652 464 218.78		6	235	49
The John Paul II Catholic University in Lublin	33	219 439 066.16	209 412 034.84	160 531 262.93	25 POKL, 1 POIiŚ, 2 PORPW, 5 RPLU		25	7
Maria Curie-Skłodowska University in Lublin	40	519 536 293.98	513 011 921.58	414 617 676.45	25 POKL, 6 RPLU, 4 POIG, 4 PORPW, 1 POIiŚ	1	25	7
Medical University in Lublin	18	268 339 924.35	260 324 284.26	198 414 081.80	11 POKL, 6 PORPW, 1 RPLU		11	7
Lublin University of Technology	35	264 800 954.14	264 277 775.11	212 797 400.03	24 POKL, 6 POIG, 4 PORPW, 1 RPLU	2	24	5
University of Life Sciences in Lublin	14	235 269 480.04	231 750 180.36	187 033 430.05	5 POKL, 4 RPLU, 3 PORPW, 2 POIG	2	5	4
The State School of Higher Education in Chełm	19	136 182 831.00	123 604 511.55	101 343 427.52	16 POKL, 3 PORPW		16	3
The State School of Higher Education in Zamość	10	38 257 575.54	38 256 985.14	31 925 720.53	7 POKL, 2PORPW, 1 RPLU		7	3
The State School of Higher Education in Biała Podlaska	37	74 218 088.00	73 519 898.60	60 197 137.06	32 POKL, 2 RPLU, 2 PORPW, 1 POIG		32	3
Polish Air Force University	2	28 942 973.14	22 110 054.15	16 559 462.80	2 RPLU			2
Lubelskie Higher School in Ryki	2	2 276 988.40	2 276 988.40	1 838 642.14	7 POKL, 2PORPW, 1 RPLU		7	
Higher School of Economics and Innovation	48	147 447 228.89	147 400 217.55	118 707 271.09	45 POKL, 2 PORPW, 1 RPLU		44	3
Humanistic-Economic Higher School in Zamość	3	975 846.00	975 846.00	829 469.10	3 POKL		3	
Higher School of Social Sciences in Lublin								
Higher School of Entrepreneurship and Administration in Lublin	19	21 730 992.61	21 730 992.61	18 313 890.82	19 POKL		19	
Puławy Higher School	4	2 751 209.90	2 751 209.90	2 312 390.92	4 POKL		4	
Vincent Pol University	1	491 764.40	491 764.40	417 999.74	1 POKL		1	
Higher Scool of International Relations and Social Communication in Chełm	3	1 813 331.00	1 813 331.00	1 541 331.35	3 POKL		3	
University of Management and Administration in Zamość	10	18 289 243.27	18 280 997.31	15 047 624.42	9 POKL, 1 RPLU		9	1
Institute of Agricultural Medicine								
Institute of Soil Science and Plant Cultivation - PIB	4	52 795 216.42	51 610 986.68	39 146 961.23	2 PORPW, 2 RPLU			1
National Veterinary Research Institute - PIB								
Institute of Agrophysics of PAS	4	84 447 885.56	84 443 899.21	70 889 038.81	3 PORPW, 1 POIG	1		3

Source: author's elaboration based on MID (2019b)

In the current programming period, the value of projects funded from ESIF is significantly lower compared to 2007-2013, mainly due to limited support for infrastructure projects. This is broken down by HEI in Table 14.

Table 14. The engagement of HEIs and institutes from Lubelskie in projects funded from ESIF for 2014-2020

HEIs / institutes	Number of projects	Value of projects (in PLN)	Eligible expenditures (in PLN)	EU funding (in PLN)	Operational Programmes	R&D projects	Educational projects
Total	141	285 225 812.59	280 179 979.82	237 315 195.29		4	120
The John Paul II Catholic University in Lublin	21	38 104 389.95	38 104 389.95	32 131 882.70	19 POWR, 1 PLBU		18
Maria Curie-Skłodowska University in Lublin	24	40 731 621.04	40 655 226.97	35 147 127.73	20 POWR, 2 POIR, 1 POIS, 1 RPLU	2	19
Medical University in Lublin	10	48 001 550.59	45 392 045.59	38 414 094.50	8 POWR, 1 POIR, 1 RPLU	1	8
Lublin University of Technology	16	36 418 956.00	36 149 746.50	30 575 304.76	14 POWR, 1 RPLU, 1 POIR	1	14
University of Life Sciences in Lublin	6	11 362 130.93	10 622 551.39	8 970 633.98	4 POWR, 1 POIS, 1 RPLU		4
The State School of Higher Education in Chełm	8	12 756 554.21	12 756 554.21	10 752 705.49	7 POWR, 1 RPLU		8
The State School of Higher Education in Zamość	2	4 179 599.88	4 179 599.88	3 522 566.77	2 POWR		2
The State School of Higher Education in Biała Podlaska	13	12 991 966.84	12 991 966.84	10 949 629.64	13 POWR		13
Polish Air Force University	1	2 805 747.00	2 805 747.00	2 364 683.57	1 POWR		1
Lubelskie Higher School in Ryki							
Higher School of Economics and Innovation	22	44 953 323.67	44 953 323.67	37 920 806.04	20 POWR, 2 RPLU		21
Humanistic-Economic Higher School in Zamość							
Higher School of Social Sciences in Lublin							
Higher School of Entrepreneurship and Administration in Lublin	6	9 005 611.09	9 005 611.09	7 589 929.03	6 POWR		6
Vincent Pol University	3	3 439 648.30	3 439 648.30	2 898 935.59	3 POWR		3
Higher Scool of International Relations and Social Communication in Chełm							
University of Management and Administration in Zamość							
Institute of Agricultural Medicine	5	11 831 454.59	11 821 454.59	9 996 950.98	1 POIS, 1 RPLU, 3 POWR		3
Institute of Soil Science and Plant Cultivation - PIB	1	992 544.00	922 273.25	783 932.25	POIS		
National Veterinary Research Institute - PIB							
Institute of Agrophysics of PAS							

Source: author's elaboration based on MID (2019b)

All public HEIs have been engaged in the implementation of ESIF funded projects since 2014, while two research institutes and five private HEIs have not. HEIs from Lubelskie are active in the implementation of educational projects, but an alarming signal is that only four R&I projects have been implemented:

- *electric vehicle charging system integrated with lighting infrastructure* (Lublin University of Technology, measure 4.1 Operational Programme Smart Growth),
- *xanthophylls in the retina of the eye* (Maria Curie-Skłodowska University, measure 4.4 Operational Programme Smart Growth),
- translation regulation in spore-forming bacterium – specialized ribosomes in Bacillus subtilis (Maria Curie-Skłodowska University, measure 4.4 Operational Programme Smart Growth),
- the use of spectroscopic methods to evaluate bone formation on biomaterials of ceramic type in vitro (Medical University of Lublin, measure 4.4 Operational Programme Smart Growth).

To summarise, the financial perspective 2007-2013 enabled HEIs and institutes from Lubelskie to implement ambitious infrastructure projects. However, these investments have so far not contributed significantly to the number and value of R&I projects funded by the ESIF or Horizon 2020, which seems to be one of the most pressing issues for policy makers.

6. The involvement of HEIs in the Lubelskie S3

Many challenges discussed in previous sections seem to be recognised by the regional authorities and addressed in strategic documents. The first regional innovation strategy in Lubelskie (tittle: "*Regional Innovative Strategy of Lubelskie Voivodeship. Innovative Lubelskie – transformation ideas to actions"*, the RIS LV) was prepared in close cooperation with Lublin University of Technology and accepted by regional authorities in 2004. As most regional innovation strategies prepared at that time by Polish regions, the RIS LV lacked a separate budget to implement the proposed policy instruments. In 2012, the Lubelskie Council for Innovation was established. The members of the Council are representatives of the Marshal's Office, enterprises and local business associations as well as regional public HEIs and institutes. The Council was an active discussion forum of stakeholders during the process of revising the RIS LV, which began in 2012.

The RIS LV was updated in 2014 (*"Regional Innovative Strategy of Lubelskie Voivodeship 2020"*) and fulfilled the criteria of the smart specialisation ex-ante conditionality in the financial perspective 2014-2020. The S3 proposes a new vision, goals, four thematic priorities (bio- economy, medicine and health, automation and ICT, low-carbon economy) and three horizontal priorities:

- Priority 1 - Increase in the ability of business entities to create and absorb knowledge and to implement innovations in the areas of S3 (428.1 mln PLN),
    - 1.1: stimulating the development of entrepreneurship, especially technology entrepreneurship
    - 1.2: increasing the level of innovation of already operating companies
    - 1.3: knowledge and skill developing of industrial personnel (employees and managers)
    - 1.4: stimulating and developing a network of cooperation between business entities
    - 1.5: developing financial engineering for innovation used to adapt, to a greater extent than before, the type of financial support to the nature of innovation
- Priority 2 - Increase in the ability of R&D entities to create and commercialise knowledge in the areas of S3 (33.2 mln PLN):
    - 2.1: increasing the ability of R&D personnel to create and transfer knowledge for the development of smart specialisation of the region
    - 2.2: increasing the effectiveness of the use of R&D infrastructure to conduct and commercialise research in the fields connected with smart specialisation of the region
    - 2.3: raising importance of Lublin science sector in the areas of smart specialisation at the national and international level
- Priority 3 - Strengthening business environment institutions and public administration bodies open to innovation (327.4 mln PLN):
    - 3.1: transforming business environment institutions into regional growth centres
    - 3.2: developing efficient and open to innovation public administration bodies
    - 3.3: promoting entrepreneurship and innovation

The S3 also proposes "pilot projects", which take form of umbrella initiatives aimed at testing new instruments, evaluating their effectiveness and preparing procedures for popularizing the most effective solutions. The first "pilot projects" include:

- Regional research programmes in smart specialisation areas
- Technology entrepreneurship
- Partnership, networks, clusters
- Regional growth centres
- Financial engineering for innovation
- Innovative public procurement

The implementation of the S3 is divided into three bodies:

- Board of the Voivodeship (supervising and coordinating the implementation of the Strategy)
- Council for Innovation (consultative body stimulating discussions on challenges, problems and recommendations of the regional innovation system)
- Managing Authority (operational body for coordination, implementation, monitoring and evaluation)

According to the S3, the tasks of Managing Authority are performed by one of the departments of the Marshal's Office appointed by the Board of the Voivodeship.

The main source of financing for the S3 is the Regional Operational Programme (ROP) for Lubelskie Voivodeship 2014-2020 with a budget of 2,624 mln Euro, including 2,230 mln Euro from the European Union. The Programme proposes various measures to support R&I activities, which are presented in Table 15. The Delegated Implementing Authority for most of them is Lublin Agency for Enterprise Development (an agency established and supervised by the Marshal's Office).

Table 15. Measures dedicated to support research and innovation (Priority Axes 1 and 3) in the Regional Operational Programme for Lubelskie Voivodeship 2014-2020

1. Research and Innovation		3. Competitiveness of enterprises	
Objectives: • Increase market orientation of R&D activities • Increase research and development activity of enterprises		Objectives: • Better conditions for SMEs development~ • Increase level of export of SMEs • Increase diffusion of innovations in SMEs	
Activity	Allocation (mln Euro)	Activity	Allocation (mln Euro)
1.1. Regional R&D infrastructure	10.4	3.1. Inverstment areas	18.9
1.2. Goal-oriented research	39.7	3.2. Financial instruments	11.5
1.3. R&D infrastructure in entreprises	37.7	3.3. Spin-offs and spin-outs	5
1.4. Knowledge transfer and commercialisation	6.9	3.4. Business environment institutions	13.5
1.5. Innovation voucher	6	3.5. Advice voucher	6
		3.6. Marketing of the region	10.6
		3.7. Increased competitiveness of SMEs	202.6
		3.8. Investments areas in functional territories	0
		3.9. Trades and missions	4.4
		3.10. Increased competitiveness in subregional cities	4.6

Source: author's elaboration based on Detailed Description of the Regional Operational Programme for Lubelskie Voivodeship 2014-2020 (December 2018).

The share of funds dedicated to Thematic Objective 1 in the ROP for Lubelskie 2014-2020 is 4.5% of the total budget (this compares with an average of 10.2% in the EU and 9.4% in Poland) and Thematic Objective 3 which

is 12.4% of total budget (14.8% in the EU and 13.6% in Poland). TO1 has the eighth largest allocation in the ROP and the fifth largest among Polish regions, whereas TO3 has the third largest in the ROP and the second largest in Poland (EC, 2019), illustrating a strong enterprise focus in ESIF programming in Lubelskie.

The implementation of the ROP for Lubelskie Voivodeship 2014-2020 is at a similar level of completion as all ESIF in Poland: 65% had been allocated and 16% spent in 2018 (in Poland respectively 65% and 21%) However, total EU payments in Lubelskie (21%) were lower than the EU average (27%) in 2018 (11% and 16% in 2017) (EC, 2019).

Generally, the implementation of activities from Priority Axis 3 is more advanced than Priority Axis 1 in terms of the value of signed contracts (Priority Axis 3 – 62% and Priority Axis 1 – 55%, total ROP – 66%) and payments made by the European Commission (Priority Axis 3 – 23% and Priority Axis 1 – 16%, total ROP – 18%). The detailed information about the progress of implementing the Regional OP for Lubelskie Voivodeship 2014-2020 is presented in Annex 9 (data on 31.12.2018).

An interesting example of "pilot projects" proposed in the S3 is regional research programmes in the emerging priority of photonics. The programme is implemented as a Joint Undertaking of the Marshal's Office and the National Centre for Research and Development (the NCRD) and was established in 2017. The financial contribution of each partner to the Joint Undertaking is 35 mln PLN. Its main objective is to increase the ability of the regional economy and science to develop new knowledge in the field of photonic technologies and commercialise the results of R&D works by 2026. The partners organise calls for projects concerning industrial research (the NCRD) and experimental development (the Marshal's Office) (NCRD, 2017). The programme was the first activity implemented by the NCRD with the regional authority and was used as good practice to establish programmes with other regions. It is also an example of an instrument linking national and regional policy makers.

HEIs were very active in designing phases of regional strategic documents (RIS from 2004 and S3). Their representatives are members of the Council of Innovation and active on other regional consultative meetings, conferences and workshops. However, from the perspective of S3 implementation, most instruments supporting R&I activities presented above (mainly the Lubselskie ROP for 2014-2020) are dedicated to entrepreneurs, so the role of HEIs in implementing the S3 (and especially the ROP) is rather low and limited to the role of subcontractor. One exemption is activity 1.1, but in that case the regulations concerning the commercial use of public infrastructure constitute difficult conditions for participation of HEIs (i.e. so-called own contributions to the projects). On the other hand, there are no specific instruments at regional and national level to support educational activities related to S3.

7. HEIs and S3 implementation in Lubelskie – qualitative assessment

Like in most countries, the legal frameworks for the functioning of HEIs in Poland are established at the national level. From the point of view of the HEIs a key regulation concerning their activities entered into force on 1st October 2018 (popularly called as Law 2.0 or the Constitution for Science and Higher Education). Law 2.0 has changed significantly the rules of the functioning of HEIs, in particular with regard to institutional autonomy and the financing of higher education and science. Currently, Law 2.0 is implemented by HEIs through the development of new or redefining existing missions, strategic goals and organisational models. The most important tasks of HEIs are to develop and adopt new strategies, statutes and other internal regulations reflecting increasing autonomy, transparency and accountability. At the time of fieldwork, HEIs in Lubelskie were completing these tasks. From the perspective of researchers, the implementation of Law 2.0 is associated primarily with the hopes of increasing public funding and simplifying procedures related to the functioning of HEIs. However, it was pointed out that many issues are understood and interpreted differently, which may make it difficult to reach a consensus and agreement between different academic environments at the universities. Rectors and chancellors mentioned that the new processes require a lot of work and engagement, are not easy to conduct and are time absorbing (many meetings and workshops), but academic communities treat them as a chance for more significant changes in the higher education landscape and are generally supportive.

Law 2.0 has also introduced a new funding system for HEIs. Before 2019 HEIs had obtained funding mainly from the national level (the Ministry of Science and Higher Education, the MSHE) as block grants (statutory funding), which included two parts: one dedicated to science and a second dedicated to higher education (usually the second part was higher than the first). Since 2019, HEIs have received one single subsidy for both types of activities and HEIs have autonomy related to its internal distribution. Most of the respondents positively assessed this change. Much attention was devoted by the respondents to discuss the new rules of so-called "parametric evaluation" (the assessment of R&I activities carried out by HEIs and research organisations for last four years). Until 2019, parametric evaluation was based on the assessment of scientific units (i.e. faculties), where under the new law it will be carried out at the level of scientific disciplines (defined in line with OECD guidelines) in which HEIs are active (decision about being evaluated in specific scientific discipline depends on the board of the HEI). It means that the results of researchers' work from various faculties of the HEI for the years 2017-2020 may contribute to the same scientific discipline. Additionally, the reform puts more emphasis on the assessment criteria reflecting the quality of publications and the impact of R&I activities carried out by HEIs. The management of HEIs in Lubelskie is fully aware of these changes and are taking measures to improve the results of their R&I activities in the light of new rules and assessment criteria. According to one interviewee representing the board of an HEI:

"Our results in educational activities are very good, but on the other hand we should improve the results of research and development, because in the absence of a positive effect of parametric evaluation in 2021, it is most likely that some of the faculties [university's organizational units] will be closed down".

The respondents representing HEIs indicted that apart from the subsidies received from the MSHE, HEIs could get funding in a competitive way from the national agencies funding research and development as well as international cooperation such as the National Centre for Science, the National Centre for Research and Development, the Foundation for Science and the Polish National Agency for Academic Exchange. Programmes offered by these institutions are funded from national budget or the ESIF. The main source of funding for HEIs from the ESIF is the POWER programme supporting educational activities i.e. instrument 3.5 POWER – integrated programmes of HEIs, which is implemented by the majority of HEIs from Lubelskie. From the regional perspective, under the ROP for 2014-2020, there are no dedicated instruments for HEIs, which results in lower interest of HEIs (also the Operational Programme Eastern Poland in which there are no instruments directly dedicated to HEIs). One interviewee representing an HEI pointed out that:

"We are currently not interested in participation in the calls organised under the ROP, because there is nothing interesting for us there. That's why we are interested mainly in the implementation of national programmes, especially educational ones".

HEIs from Lubelskie have benefited from the Horizon 2020 programme, but to a relatively low extent. This issue was raised by the representatives of all HEIs being interviewed and indicated as one of the main weaknesses of HEIs in the region. In all cases, the representatives of HEIs informed us that they are taking measures to improve the situation i.e. offering financial incentives for researchers obtaining funding from international programmes. It is worth noting that several projects carried out by HEIs from Lubelskie are dedicated to support SMEs and only indirectly linked with R&I activities (i.e. Maria Curie-Skłodowska University, the Lublin University of Technology and Medical University of Lublin). The low level of internationalization measured by the

participation in international projects was explained by the existence of mental barriers, strong focus of researchers on educational activities or national programmes for research funding, as well as the specific profile of HEIs from Lubelskie i.e. relatively important role of humanities, pedagogical and social sciences, which are generally characterized by lower level of internationalization. In the context of the preparation of research projects and applying for their funding, it was pointed out that it is easier to prepare projects submitted to national programmes than international ones due to the fact that national programmes allow for applications by individual researchers (not consortia) and are easier to implement from the perspective of project management. One researcher indicated that:

"… to succeed in international programmes it's necessary to participate actively in international networks and research consortia, which has not been our strong point so far".

On the other hand, the strength of HEIs from Lublelskie region is the high level of internationalization of educational activities: each HEI runs and develops English-language studies (all three stages of studies, including doctoral studies). The representatives of HEIs stressed that these courses are very important for their organisations and will be developed further in the coming future.

The respondents have a good understanding about the possibilities of obtaining funding for research, development and education from various national and international sources and they said there was an active information policy from HE managers and regional authorities on this matter. The HEIs usually offer scientists support for the preparation of applications, especially budget construction, project management, risks evaluation as well as in monitoring and evaluation procedures. However, the respondents pointed to a lack of more detailed information and specialised training. One researcher pointed out that:

"There are many trainings, conference and meeting discussing the general rules of participation in European programmes, but it's not difficult to get that information from Internet. The most valuable are direct meetings with successful applicants, who share with you their experience how to identify research problems and methods attractive from the perspective of reviewers."

The interviewees representing HEIs indicated that the main challenge related to the use of ESIF is the obligation to deliver their "own contribution" to the projects, which is in line with state aid rules. Companies are not willing to offer it on behalf of HEIs or within common projects carried out with HEIs (companies prefer to employ individual researchers as subcontractors, which is more cost effective and less bureaucratic for them than cooperation with HEIs). In the case of the Lubelskie, an important problem is that the regional economy is dominated by SMEs, for which providing own contribution into their own projects is often a challenging task. The respondents were also sceptical about the role of private investors (i.e. Venture Capital funds) who do not take risks and are not willing to invest in HEIs' projects and spin-offs. One representative of the board of an HEI stressed that:

"Venture Capital funds are not interested in our research and innovation activities, because they think that we are engaged only in basic research. They often expect that we could offer them products, which are ready to market, but it's not our role."

The representatives of HEIs stressed the need to change the approach to financing projects from ESIF in the next financial perspective (2021-2027) through more partnership treatment of HEIs, especially in the fields of research, development and innovation (TO1 and TO3). Currently, the role of the HEIs is reduced to being subcontractors of companies, although often universities initiate the projects and are the main source of knowledge needed to overcome the identified research problems. The need for financial support dedicated to research consortia was pointed out by many interviewees (as examples the respondents indicated projects based on research consortia carried out by the Medical University of Lublin from STRATEGMED programme or the University of Life Sciences from the BIOSTRATEG programme – both funded from national budget by the National Centre for Research and Development). Interviewees also underlined the challenges related to numerous legal regulations such as public procurement, taxes and state aid regulations, especially for large infrastructure projects.

Law 2.0 has not introduced any significant changes in the area of commercialisation of R&I yet the interviewees stressed its increasing importance for the new parametric evaluation. Organisational structures responsible for the commercialisation of research and development are very diversified and some HEIs from Lubelskie are considering the reorganisation of their structures responsible for commercialisation (i.e. costs and benefits of the establishment of the Special Purpose Vehicles to create and manage the portfolio of spin-offs). Most of the HEIs from Lubelskie took part in the Innovation Incubator programme organised by the Ministry of Science and Higher Education (funded from ESIF). HEIs from Lubelskie have established two regional consortia to submit proposals to the call, whose leaders are Maria Curie-Skłodowska University (with the John Paul II University and

Medical University of Lublin) and the Lublin University of Technology (with two State Higher Education Schools from Zamość and Biała Podlaska). Among HEIs from Lubelskie only Life Science University is not participating in the programme.

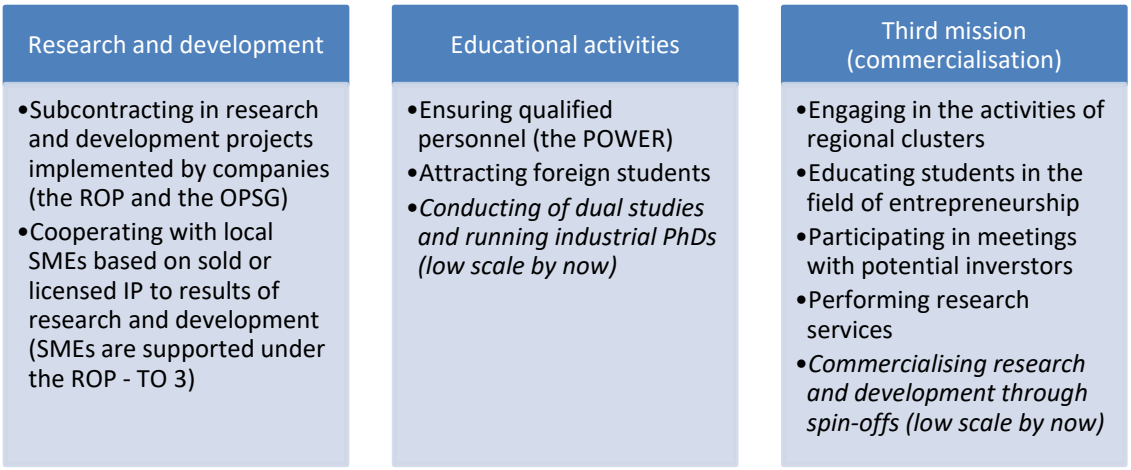
Some HEIs, such as the Lublin University of Technology and the University of Life Sciences in Lublin, position themselves as regional universities whose main task is to support the region's economic development. Others including Maria Curie-Skłodowska University, the John Paul II Catholic University and Medical University of Lublin, while emphasising their links to the local environment, also identify themselves as leading institutions in south-eastern Poland (according to the respondents the scale of their activities is wider than just Lubelskie).

The respondents were aware of the main challenges and bottlenecks of regional innovation systems. The interviewees pointed out that the low values of indicators related to the innovativeness of Lubelskie result primarily from historical problems, the specific profile of the region (mainly agricultural and dominated by low and medium technology industries), as well as the conditions related to globalization processes (i.e. headquarters of companies are usually located in other regions or countries and R&D expenditures are recorded there). Demographic challenges as well as migrations of employees and graduates were also pointed out as important challenges for the regional economy. According to the opinions of respondents, they resulted mainly from the lower attractiveness of the labour market in Lubelskie compared to neighbouring regions, especially the capital Mazowieckie region (the labour market in the Lubelskie is dominated by SMEs and the public sector). On the other hand, relatively low labour costs in relation to high employees' qualifications are perceived as a strength side of the regional economy and an argument for attracting foreign investors (i.e. the trend related to the migration of companies to Lubelskie from Mazowieckie is recently evident and could be documented by many examples).

An important trend emphasized by HEIs from Lubelskie is the growing role of interdisciplinary research, as more and more research must be conducted at the interface between different fields of science. In some cases, such as the John Paul II Catholic University, this was an impulse for larger reforms, including the launch of a new area of activity related to biotechnology or the introduction of socio-cultural aspects to the traditional process of technology development i.e. involvement of social sciences in issues related to the development of autonomous cars or brain signal testing in devices for rehabilitation, research on self-motivation and healthy lifestyles. From the perspective of HEIs, interdisciplinarity means opportunities to strengthen their cooperation, but according to the opinions of respondents, there is a need to ensure larger public funding for interdisciplinary projects.

The following figure presents the activities carried out by HEIs from Lubelskie, which are directly or indirectly involved in the implementation of S3.

Figure 4. The engagement of HEIs from Lubelskie in the implementation of S3



Source: author's elaboration

The representatives of HEIs pointed out that it is not easy to satisfy the expectations of local companies regarding the competences of graduates. At the same time, it was emphasized that companies expect to hire

people ready to take up work immediately, but in any case, the graduate must prepare himself for the specific requirements of a particular employer and his expectations. One respondent representing HEIs pointed out that:

"Employers are looking for "competences needed for now", while universities are looking at this problem more broadly and in the context of continuous development and self-retraining i.e. after five years. From our perspective, the aim of the university is to educate people who will be able to change their competences every five years and still be attractive on the labour market, while companies usually have short-term needs and it is difficult for them to understand that they need to invest in every graduate."

Some of the HEIs from Lubelskie have initiated discussions about the establishment of dual studies or industrial PhDs. The most advanced in this field is Life Science University from Lublin, offering both types of activities since the 2018/19 academic year.

According to the interviewees, the association of HEIs from Lubelskie established by three HEIs is a very good starting point to identify areas for future cooperation, but the translation of identified options for cooperation into real actions requires additional, external funding. There is currently no dedicated financial support from national and regional authorities. However, the Medical University of Lublin is cooperating with Maria Curie-Skłodowska University and the John Paul II Catholic University in the Innovation Incubator programme (commercialisation of R&D). The representatives of Medical University of Lublin indicated that the situation of their university from a regional perspective is very specific due to the fact that its didactic activities are centrally regulated by the Ministry of Health and research projects are attractive mainly for international or national companies. The representative of Medical University stressed that:

"Our situation is unique. We have a large number of foreign students from western countries, which strongly motivates us to improve the quality of our educational activities and our infrastructure. So, we have to invest a lot, but those activities are also important part of our revenues. And benefits for our region, because our students are living here."

Respondents from the national level indicated that there are no problems with the implementation of projects funded by the Lubelskie ROP compared to other regions or the national level. One entrepreneur indicated that:

"The research teams are usually constructed at the stage of preparation of the application, so it's necessary to engage as soon as possible experienced researchers supporting research teams working in the companies. In Lubelskie it is relatively easy to recruit highly qualified researchers to projects carried out by companies. However, companies usually prefer to cooperate with individual researchers rather than with HEIs."

From the point of view of the project implementation a key success factor is the engagement of the decision-makers from the beginning of the project - the owner, manager or other person who makes the decision, assumes the risk and consequences of the project. One entrepreneur indicated that:

"It's not easy to involve such persons in discussions, workshops and meetings. On the other hand, the most innovative projects are initiated by small and medium-sized companies, because large companies are more conservative and prefer to buy ready-made solutions on the market. I think that it could be especially problematic in Lubelskie, where the largest companies are affiliates of foreign companies and it's probably difficult to convince decision makers from their headquarters to carried out research projects in Lubelskie."

Many interviewees stressed that from the perspective of applying for funding from the ROP the most important issue is still the quality of applications (compliance with S3 is not the main challenge due to the fact that specialisations are usually broadly defined). They indicated that increasing the level of quality of submitted applications requires intensive work for potential beneficiaries and funding bodies. From this point of view, cooperation with the Marshal's Office in S3 processes could be used as a continuous educational platform enabling better understanding of the needs, priorities and limitations faced by key stakeholders: entrepreneurs, HEIs and regional authorities.

Many respondents stressed the growing role of regional authorities and pointed out on their expectations related to the regional authorities. The representative of the management of HEI stressed that:

"There is a need of a clear and strong voice from the region's authorities about the role of HEIs in Lubelskie. The Marshal's Office should communicate its expectations towards universities, as well as quickly launch new support schemes in response to the identified challenges and opportunities i.e. to support local clusters and important local initiatives or projects."

Similar opinions were presented by representatives of other HEIs. It raises questions about the various roles which should be played be the Marshal's Office from the perspective of HEIs: leader communicating vision and

goals, facilitator of dialog between HEIs and business, orchestrator of activities/projects carried out by HEIs and funder of research projects prepared and implemented by HEIs.

According to the respondents representing national authorities, strengthening cooperation between HEIs in Lubelskie would be very beneficial because it could help to:

1. [Attract money to the region] Competition for R&I funding has a national and international dimension (not regional ones) i.e. universities from Lubelskie have not managed to get a grant from the competition called International Research Agenda managed by the Polish Foundation for Science (very prestigious competition in Poland), but the chances would have been higher if the universities from Lubelskie had applied jointly to this competition.
2. [Attract talents to the region] Competition for students is determined not only by the offer of HEIs from one city, but increasingly by economic conditions and the labour market in regions and their largest cities – in fact, competition for talent and employees is taking place among employers (not directly universities) and they could strengthen their position only through active cooperation with local HEIs.
3. [Attract leaders to the region] Competition for research contracts with companies is to a large extent determined by the skills and networks of experienced researchers and managers employed usually in TTOs or SPVs – the number of these mid-level managers in Lubelskie is still relatively low compared to other regions (additionally, during the workshops and interviews only a few people actively dealing with commercialisation or engaged in international cooperation have been identified).

On the basis of interviews and workshops, three governance mechanisms were identified that could help to better integrate the activities of HEIs from Lubelskie:

1. [FORMAL AGREEMENTS] The association of HEIs is a formal agreement in which HEIs define the potential areas for future cooperation, but without external, additional funding the effectiveness and impact of such mechanisms has been limited (HEIs do not have incentives to strengthen cooperation and regional authorities have very limited possibility to ensure additional funding in 2014-2020).
2. [METROPOLITAN TTOs] Integrating the activities of HEIs through joint projects can bring more tangible benefits, as exemplified by Innovation Incubator programmes (II+ and II2.0) organised by the MSHE. The participation in these programmes demonstrates that universities are able to cooperate, but that an important role is played by additional, external funding (the programme II2.0 will end in 2020, but there is debate about the continuation of the programme after 2020).
3. [COMMUNICATION PLATFORMS] Activities carried out by universities, which are good practices at the regional level and could be implemented by other universities in the region such as: implementation of dual studies and industrial PhDs (University of Life Sciences in Lublin), engagement in international projects (Maria Curie-Skłodowska University), integration of scientific and educational quality (Medical University of Lublin), contract research and cooperation with business (Lublin University of Technology), interdisciplinarity in conducting research and commercialization activities (the John Paul II University). In all cases the Marshal's Office could ensure regular meetings and workshops for HEIs from Lubelskie to discuss these issues and share experiences.

Many respondents formulated very positive comments about the engagement of Lublin City Office in the development of the city's medical cluster. They indicated that without the financial support from the City Office it would not have been possible to develop the cluster as far as it is now. The interviewees indicated that it would be desirable to strengthen the cooperation between the Marshal's Office, Lublin City Office and HEIs from Lublin in other areas, especially biotechnology.

As a part of the project and "action research" special attention was devoted to two regional priorities: bioeconomy and photnics. They represent two different logics of the engagement of HEIs in the process of entrepreneurial discovery. In comparing the two priorities, the focus was put on the role of stakeholders, the way of defining the area in the strategic documents, the nature of cooperation and their institutionalisation, as well as the mechanisms dedicated to funding the projects.

Table 16. The comparison of two areas of activity: bioeconomy and photonics

	Bioeconomy	Photonics
Key stakeholders	HEIs and research institutes in Lublin and Puławy (lack of one leading research organisation and the research potential is dispersed among many research organisations, lack of leading industrial partners from the region).	Companies, mainly SMEs; HEIs are their partners in research and development activities (by now mainly Maria Curie-Skłodowska University and Lublin University of Technology).
Description in S3 documents	Explicitly indicated in S3 document. HEIs lobbied for the creation of dedicated research and innovation programmes in this filed, but they have not been established.	Indirectly indicated in S3 document, mentioned in other areas of specialisation – regional development niche being the result of the EDP (photonics is understood in that case by regional authorities as Key Enabling Technology).
Characteristics of cooperation	The cooperation in this field is not strongly institutionalised (i.e. cluster) and is dominated by research organisations. Universities are mainly focused on regional perspective, research institutes on national and international perspective (Institute of Agrophysics of the PAS, Institute of Soil Science and Plant Cultivation - SRI).	Active cluster with many international links and well-rooted in international networks (i.e. reflected in projects funded from Horizon 2020). The area characterised by relatively low number of companies, but cooperating with leading research organisation in this field – Maria Curie-Skłodowska University.
Links to quadruple helix	The idea of establishment of active cluster promoted by Maria Curie-Skłodowska University, but by now without dedicated support from the Marshal's Office or national/local authorities.	Cluster established by private companies and characterised by very good cooperation with regional and national authorities as well as universities from Lubelskie (mainly Maria Curie-Skłodowska University).
Funding mechanisms	Individual research projects or projects carried-out by consortia and funded from national programmes, relatively low links of HEIs with the ROP (projects implemented by SMEs).	International projects funded from Horizon 2020, dedicated multi-level instrument established by the Marshal's Office and the NCRD (first such instrument in Poland linking the OPSG and the ROP).
Recommendations	Bioeconomy is a priority integrating all HEIs from Lubelskie – they could contribute to the development of this area. On the other hand, there is a lack of regional leader, which could integrate the dispersed activities (probably at the beginning phase, this role should be played by the Marshal's Office). Bioeconomy is also very popular area of specialisation in other regions, which raise the question of the uniqueness of Lubelskie in that field.	The Marshal's Office cooperates with cluster/SMEs and promotes the regional potential in this field. The main challenge is to strengthen the cooperation with other regions, HEIs and companies dealing with photonics (Łukasiewicz Research Network , Warsaw University of Technology, VIGO S.A.). Its' worth to intensify dialog between regional HEIs, which could be better engaged in the development of this specialisation and build critical mass among local HEIs.

Source: authors' elaboration based on interviews and workshops

Bioeconomy and photonics represent two different approaches to conduct the EDP and to define priorities for smart specialisation: the first is close to a technology push model (with leading role of HEIs) and the second to a demand pull model (with leading role of business). Bioeconomy is a very broad domain including a lot of detailed sub-domains, research topics and innovation challenges. The broad interpretation allows all HEIs from

Lubelskie to contribute (each HEI from Lubelskie is engaged to some extent in R&I activities related to the bioeconomy). However, respondents stressed that the scope of the bioeconomy priority should be clarified and narrowed down, especially in terms of the economic potential of the region and the related activities of regional HEIs. Photonics seems to be a narrower domain, but contrary to bioeconomy, the main challenge of photonics presented in S3 is related to widening the scope of potential partners, including HEIs, which could be engaged in the development of this priority (i.e. HEIs other than Maria Curie-Skłodowska University). Here the question is how to generate "the snowball effect" and to "escape from the small club of partners". In both cases, but especially for bioeconomy, HEIs should be more engaged in the commercialisation of the results of their R&I activities i.e. by transferring knowledge through spin-offs and possibly running under the ROP a dedicated scheme to support those activities (the models of commercialisation used by Nicolaus Copernicus University from Toruń or Warsaw University could be applied). In the case of bioeconomy, this model would allow bottom-up identification of more specific areas / topics (narrowing the area of specialisation), while in the case of photonics it would give a chance to establish new companies (spin-offs) using fiber and optic technologies that are used in the local photonics community (strengthening the critical mass).

The interviewees indicated that the agreement signed between the Marshal's Office and the NCRD dedicated to support photonics is an interesting idea, but it is too overregulated and complicated for potential applicants who have to apply twice (once to the NCRD and then at regional level to the LAWP). At the level of implementation in the ROP, it is difficult to assess the effectiveness of this instrument, because only two contracts with selected companies have been approved so far. The respondents recommended to significantly simplify this support scheme.

As part of focus groups, much attention was devoted to the discussion on how to define priorities in the regional S3 and to ensure effective mechanisms for their implementation. In the case of both priorities i.e. bioeconomy and photonics, the importance of general capabilities related to running a business and an innovative activity was underlined, especially through support provided by public institutions in the phase of the creation of companies based on new business models or offering innovative products and services.

The regional policy mix concerning S3 results to a large extent from the negotiation and agreement between the European Commission, the Ministry of Infrastructure and Development and regional authorities, which set the scope of public intervention at the national and regional levels. Due to this, the competition between national and regional programmes is limited, but on the other hand, the respondents indicated that above consensus has also limited the room for manoeuvre when proposing and designing new instruments at the regional level. Another important limitation is related to the regulations regarding state aid and public procurement. The respondents also mentioned the bureaucracy related to data protection regulations.

The instruments implemented at regional level in Lubelskie are funded from the ROP 2014-2020 and mainly support enterprises in the field of research, development and innovation (TO1 and TO3) as well as in a limited scope for the investment in research infrastructure. In the case of HEIs, the most problematic issue concerns "own contributions" to projects funded from the ROP. In practice, HEIs have played an indirect role as they are suppliers of the results of R&I activities implemented by companies (active in this field is the Lublin University of Technology) or develop various expert opinions and offer research services for companies. Nevertheless, instruments supporting innovation activities (implementation of the results of R&I under TO3) are more popular among entrepreneurs than instruments dedicated to support R&I projects (TO1). From this point of view, it would be valuable to consider the introduction of a new mechanism in the financial perspective after 2021 based on research consortia between HEIs and companies.

The representatives of the Marshal's Office and subordinated agency informed us that the popularity of policy instruments (i.e. number of applications submitted and selected, value of funded projects) is monitored regularly and many modifications of instruments have been introduced to increase their popularity among potential beneficiaries (like innovation vouchers, which has been very popular). On the other hand, there were also instruments like patent vouchers which was withdrawn due to low interest of potential beneficiaries.

During the focus groups, the possibilities of launching new instruments enabling the region to benefit more from the potential of the region's HEIs were discussed. Among them were instruments such as: industrial PhDs, pre-commercial procurement and the SBIR (PCP) programme, public-private partnerships (i.e. EIT and competence centers mechanisms). The comparison of these instruments from the perspective of bioeconomy and photonics is presented below in Table 17. Among the instruments presented, the most simple to implement and at the same time to deliver tangible results are the industrial PhDs, especially that currently one HEI (the Life Science University from Lublin) is implementing two such programmes. It is also possible to propose similar instruments at regional level, which could be funded from the ROP and based on examples from Spain (industrial PhDs could be treated as research projects, in which the ownership to IP of the research results are taken over

by the enterprise). Two other instruments (i.e. PCP and CC/PPP) seem to be more difficult to implement at regional level and their implementation requires more in-depth analyses, however they might be interesting for the next financial perspective (especially the model of Competence Centres implemented in the Czech Republic and funded from ESIF[8]).

Table 17. New policy instruments from the perspective of challenges concerning bioeconomy and photonics

	Bioeconomy	Photonics
Industrial PhD	Two industrial PhDs are currently conducted by the Life Science University in Lublin. It's worth to promote above examples among HEIs from Lubelskie.	The participants were very interested about the engagement in industrial PhDs – it's worth to continue discussion with them about the use of this instrument.
Pre-commercial procurements (PCP)	The participants pointed out that the instrument is interesting and proposed some topics, which could be developed under this scheme.	The participants were interested in SBIR programme and declared to study it. However, they pointed out that the procedure could be difficult to implement.
Public-private partnerships (CC and PPP)	PPP could create critical mass in specific topics related to bioeconomy, but the most problematic issue is the participation of private companies in these activities (i.e. ensuring own contributions).	PPP could help to create "the snowball effect" and popularise the region as a place to locate businesses based on photonics. However, by now, it probably could be better used PPP in photonics at national, than regional level.

Source: author's elaboration

Due to the large interest of start-up and spin-off activities shown by the participants of focus groups and workshops, it would also be worth considering the introduction of new mechanisms dedicated to support R&I activities of spin-offs in the ROP. Good examples of such activities could be offered by two universities: Nicolaus Copernicus University from Toruń (more than 30 spin-offs established over the last five years) and Warsaw University (about 20 spin-offs established over the same period). The instrument offered in the ROP for Kujawsko-Pomorskie region for 2014-2020 (activity 1.3.1) is an example of a policy instrument related to support spin-offs that could be used. However, the introduction of such instruments require consultation with HEIs and researchers interested about in commercialisation of the results of their R&I activities.[9]

[8] Nevertheless, the respondents representing national institutions were rather sceptical about the use of this instrument in Poland (they indicated that the instrument should be highly selective and provide support for relatively small number of centres, which could be difficult to implement in relatively large country like Poland).

[9] Representatives of HEIs from Lubelskie during the workshop organised on 28th of May stressed many concerns about the use of this instrument.

8. Conclusions and recommendations

The desk research and fieldwork allowed for in-depth discussions with HE stakeholders about the potential actions to address specific challenges of Lubelskie's regional innovation system, boost the participation of HEIs in S3 and strengthen critical mass in the domains of bioeconomy and photonics. Key issues related to the participation of HEIs in S3 were also discussed with national and regional stakeholders representing business and administration. The results of the desk research and fieldwork allow us to answer (partially) the research questions formulated through action research in Lubelskie:

1. [short-term perspective] How can HEIs best feed into the design and implementation of the strategy – what governance mechanisms can be put in place to maximise their contribution?

HEIs from Lubelskie were engaged in the design of S3, which took place between 2013-2016. Since 2016 the Marshal's Office has facilitated the discussions about S3, taking advantage of many meetings, workshops and conferences. The Marshal's Office is also planning to coordinate the revision of S3 2020. At the same time, HEIs in Poland are currently implementing changes resulting from the reform of higher education and science, which came into force in 2018, in particular the development and adoption of new missions, strategies, statutes and organizational regulations (one of the priorities is to put more emphasis on the third mission of HEIs and the impact of their R&D and educational activities). Both processes, the EDP facilitated by the Marshal's Office and the preparation of new strategic documents by HEIs should be linked to allow the Marshal's Office and HEIs to better understand their needs and expectations as well as to define the common vision of regional development actively supported by HEIs.

Each HEI from Lubelskie has positive experience and knowledge in some aspects of the functioning of HEIs: Maria Curie-Skłodowska University in international cooperation and knowledge transfer, Lublin University of Technology in knowledge transfer and cooperation with SMEs, Medical University of Lublin in cooperation with international companies and high level research outputs, the John Paul II University in the role of social and humanities in commercialisation, Lublin University of Life Science in cooperation with business (dual studies and industrial PhDs). It would be highly beneficial to share this experience among HEIs in Lubelskie through regional knowledge working groups (informal cooperation supported by the Marshal's Office).

The engagement of HEIs from Lubelskie in the implementation of S3 is rather low due to the fact that policy instruments at national and regional levels proposed in the Operational Programmes are mainly dedicated to entrepreneurs (it concerns the OPs from all regions in Poland in the perspective 2014-2020[10]). HEIs are engaged indirectly in the implementation of the R&I projects funded from the ROP as subcontractors. On the other hand, HEIs have implemented many educational projects funded from the national Operational Programme Knowledge Education Development over the last four years and many could be linked to S3 (projects indicate links with S3, despite the fact that there is no formal obligation to do so). Taking into account the opinions presented during the workshops and the interviews, HEIs could be more engaged in the implementation of S3, but it requires the introduction of new instruments, especially those that involve consortia of HEIs and companies. However, it is still possible to implement new activities in the current ROP that were discussed during the workshops or take advantage of activities implemented at national level (by now with relatively low interest of HEIs from Lubelskie). New activities should be based on short-term and simple mechanisms with a relatively small financial scale, based on GBER and ESIF regulations like industrial PhDs or support scheme for universities' spin-offs (i.e. using examples of Nicolaus Copernicus University from Toruń or Warsaw University – two national examples that show it is possible to build successful strategies for commercialisation of research and innovation by universities in Poland).

Based on these observations, the following actions can be recommended:

- [strategic] the engagement of regional authorities in the development of strategic documents prepared by HEIs, especially in the area of socio-economic impact, (or more formal involvement such as permanent participation in consultative bodies of HEIs).
- [organisational] the establishment of thematic taskforces which aim to discuss concrete ideas/ projects in the specific areas. These working groups should be linked to/ supervised by an Innovation Board (i.e. engagement in R&D commercialisation, international programmes like Horizon 2020, dual studies, industrial PhDs, impact assessments, internal regulation of HEIs concerning the evaluation of researchers).

[10] This argument is also mentioned by HEIs and research organisations from other Polish regions and probably should be taken into account in the design of new OPs for 2021-2027.

- [financial] the introduction of new instruments supporting S3 (industrial PhDs and support for universities' spin-offs i.e. based on models developed by University of Warsaw or Nicolaus Copernicus University from Toruń; instruments supporting mobility and application projects).

2. [mid-term perspective] How do HEIs work with the regional stakeholders to build critical mass in two of the S3 priority areas: bioeconomy (one of the main regional specialisations) and photonics (a new regional development niche)?

Bioeconomy and photonics identified in Lubelskie's S3 represent two different approaches to the EDP. In the case of bioeconomy the approach proposed in S3 could be described as a technology push model with leading a role for HEIs. On the other hand, the priority of photonics represents a demand pull model with a leading role for companies. Both approaches have advantages as well as disadvantages and both are valuable from the perspective of policy learning. The priority of bioeconomy should be refined, taking into account the interest of regional companies i.e. through in-depth desk research based on data derived from other OPs and the Horizon 2020 programme , followed by workshops with key entrepreneurs identified earlier to clarify their needs and expectations. It should include a focus on selected sub-areas of bioeconomy, which have potential from the business perspective (building critical mass through concentration and better cooperation with local/regional companies). The priority of photonics should be explicitly defined in the S3 and better linked with complementary activities (based on photonics) carried out by HEIs and research performing organisations from Lubelskie and other European regions (building critical mass through international/national networking and mobilisation of new regional partners like universities' spin-offs). These issues, especially in the field of bioeconomy, could be further developed under the project gov LAB funded by PARP and implemented by the Marshal's Office in 2019/2020.[11] By now, the regional potential, especially from the perspective of business part, seems to be not sufficient to establish instruments such as competence centres or public-private partnerships, but it could be strengthened by joint projects carried out by consortia of HEIs and regional enterprises.

The results of the action research suggest that the following actions could be implemented:

- [strategic] the redefinition of S3 priorities, especially bioeconomy
- [organisational] the improvement of cooperation between HEIs, research organisations and companies (bioeconomy – regional level; photonics – national)
- [financial] the introduction of new instruments focused on business-research cooperation (research consortia, competence centres, public-private partnerships).

Desk research analysis raised two additional questions, which were discussed with regional stakeholders:

- how humanities, arts, social sciences and medical sciences are contributing to regional development and innovation?
- whether the potential of engineering and technical sciences in Lubelskie is sufficient for the development of local companies (i.e. manufactures of metal products, rubber and plastic products, machinery and equipment)?

In both cases, national and regional examples were presented and discussed, but regional stakeholders pointed out that both questions require more in-depth analysis and discussions.

During the meetings with regional authorities it was also pointed out that S3 should take more into account the geographical location of Lubelskie i.e. opportunities related to transport/logistic and sustainable development of the regional economy. These issues were discussed in the final phase of the project; however they could be further developed under the revision of S3.

These proposed activities could support the implementation of S3 and the current Lubelskie ROP. Furthermore, regional authorities should actively participate in dialog and negotiation concerning the functioning of multi-level governance of the research and innovation system in Poland, especially the role of the regional level and sources of financing S3 after 2020.

[11] https://www.parp.gov.pl/index.php/component/grants/grants/gov-lab-program-edukacyjny-dla-jednostek-samorzadu-terytorialnego

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Annexes

Annex 1. Topics discussed during the focus groups

Focus group – bioeconomy (15.03.2019; 8.30-11.30)

- Presentation and introduction of participants
- Description of experience: all the participants
    - Pros and Cons
    - Quality of relationship between Institutions/Universities/Firms
    - What are the unique strengths/opportunities of Lubelskie region in bioeconomy (compared with other regions)
    - Educational advanatges
    - Innovative educational schemes related to bioeconomy
    - Level of involvement of firms in the definition of learning pathways
    - Mobility of students (including brain drain and brain gain)
- Comments on implementations (what works, what is critical)
    - R&D advantages
    - National and regional programmes/instruments (what are the most popular instruments used by regional stakeholders, should be added new instruments to policy mix?)
    - Level of satisfaction of available instruments
    - Are publications/patents/spin-offs good measures of success? How Lubelskie region is classified among other regions in terms of above measures?
- Universities' strategies for the inter-sectorial collaboration
    - Is there a strategy for partnering with private and public sector at University level?
    - Which role and relevance bioeconomy have within this strategy?
    - Do you know cases of collaboration between universities, firms and public administration (at both local and international level) that you feel important and replicable at regional level?
    - Awareness of European Funds, Programmes and Tools
- Use of Structural Funds, Horizon, Cosme, etc…
    - EU Funds > Examples of best practices, pros and cons
    - Intra-regional collaboration and S3
    - What is the level of Universities participation within the S3 (i.e. bioeconomy)?
    - Which role do you feel bioeconomy can have within the S3?
    - What mechanisms can be used to more effectively support photonics in Lubelskie region (i.e. PCP, Innovative procurements, Industrial PhDs)?
- Discussion on next steps:
    - Which outputs do you expect from HESS project?
    - Availability to be interviewed and to give contact of key informants:
    - Scholars and teachers
    - Involved firms, start-ups
    - Firms that hired PhD
    - Current PhD students and graduates

- Availability to take part to the final event and suggestions of key informants.

Focus group – photonics (15.03.2019; 13.00-16.00)

- Presentation and introduction of participants
- Description of experience related to PSS (Photonics Support Scheme): all the participants
  - Pros and Cons
  - Quality of relationship between Institutions/Universities/Firms
  - How the novelty of PSS has been perceived by Universities/Firms
  - Research and innovation approach
  - Level of involvement of firms and universities/research organisations in the definition of projects
  - Main elements of novelty in relation to traditional R&D support schemes
- Comments on implementations (what works, what is critical)
  - PSS are useful to obtain a positioning at international level?
  - PSS
  - Application process (two phases)
  - Expectations of business and HEIs/RO
  - Level of satisfaction
  - Development perspectives
- Universities' strategies for the university-business collaboration
  - Is there a strategy for partnering with private and public sector at University level?
  - Which role PSS have within this strategy?
  - Do you know cases of collaboration between universities, firms and public administration bodies (at both local and international level and other than PSS) that you feel important and replicable at regional level?
- Awareness of European Funds, Programmes and Tools
  - Use of Structural Funds, Horizon, Cosme, etc…
  - EU Funds > Examples of best practices, pros and cons
  - Cross-sectoral collaboration and S3
  - What is the level of Universities participation within the S3 (i.e. photonics)?
  - Which role do you feel photonics can have within the S3?
  - What mechanisms can be used to more effectively support photonics in Lubelskie region (i.e. PCP, Innovative procurements, Industrial PhDs)?
- Discussion on next steps:
  - Which outputs do you expect from HESS project?
  - Availability to be interviewed and to give contact of key informants:
  - Leading researchers
  - Involved firms
  - Technology brokers/intermediaries
  - Availability to take part to the final event and suggestions of key informants.

Final meeting with stakeholders - agenda (19.05.2019):

Part I (High-policy level representatives and rectors)

9.00-9.30: The challenges of HEIs in Poland

9.30-10.00: HESS project – goals, actions and results

10.00-11.00: Presentation of the results of HESS project in Lubelskie region

11.00-11.30: Coffee break

Part II (external stakeholders)

11.30-13.30: Interactive roadmapping for HEIs in Lubelskie region: why do we need to act? what should we do? how can we do it?

14.00-15.00: Lunch break

Part III (the Marshal's Office)

15.00-17.00: The results of the HESS project from the perspective of new RIS3 criteria

Annex 2. Template of interviews with stakeholders

INSTITUTIONAL INTERVIEWS

The goal of the interviews was to discuss with universities the main issues concerning their engagement in RIS3 process and make self-assessment exercise with each of them. The university will receive before the meetings a questionnaire with the main questions, which were discussed during 5 separate session. Each session consisted of a brief introduction of the project and participants (max. 5 minutes) and then presentation of answers (max. 40 minutes), experts' comments (max 10 minutes) and discussions about identified challenges.

7.30-8.30 – Marshal's Office of Lubelskie region

8.30-10.00 – Maria Curie Skłodowska University

10.15-11.45 – Medical University of Lublin

12.00-13.30 – the John Paul II University

14.00-15.30 – Lublin University of Technology

11.30-13.00 - Life Science University in Lublin

Questionnaire for universities (which will be delivered to universities before the workshop)

Objectives:

The HESS self-assessment exercise with your university is aimed at better understanding how universities are integrated into the RISS3 policy mix and contributed to RIS3 implementation (both ant national and regional levels). This also should allow to initiate a process of self-reflection that will bring about changes to policy approaches.

The objective is for the JRC and external experts to better understand the regional context, maturity of the research and innovation system, the role played by the Higher Education Institutions (the HEIs) in R&D, innovation and education activities, as well as the opportunities, challenges and barriers to the territorial engagement of the HEIs and their role in RIS3 implementation.

Guidelines:

The questionnaire includes open ended questions on the perspectives, concerns and visions of HEIs related to RIS3 processes.

Questionnaire (concerning your university):

Background

- In your opinion, what has been the level of engagement of university in the regional development strategies so far?
- What are the factors enabling or hampering the engagement of university in regional development? Give some examples.

1. Knowledge generation

- To what extent is the knowledge produced by university relevant to addressing regional (or national) priorities?
- How would you describe the role of university in the Entrepreneurial Discovery Process and Smart Specialisation Strategy definition?

2. Knowledge absorption and transfer

- Are there examples of the generation of new companies from university (spin-offs) or knowledge transferred to companies from Lubelskie region?
- Are there examples of knowledge transferred by university outside the region (export of knowledge)?

3. Teaching and Learning

- To what extent do the curricula of degree programmes in university match regional priorities?

- Do you think that the region has access to the appropriate quantity and quality of graduates?
- Which specific tools have been promoted to enhance the development of human capital and skills in response to regional development needs? Which further tools would be needed to enhance it?
- Do university promote an entrepreneurial spirit among the academic community and the students? Which further tools would be needed to enhance it?

4. Cooperation

- Which have been the specific tools develop to increase the cooperation of university with other research and innovation stakeholders?
- How would you describe the connections of university to other stakeholders of the territory (research and technology centres, regional authorities, companies, clusters, etc.)?
- Which specific barriers/challenges have been encountered to improve the cooperation of university with other stakeholders of the territory?
- How do university contribute to the overall vision and marketing of the region?

5. Organisation

- Are there any complementarities with other regional universities and other vocational training or education institutions of the territory?
- How is the role of university in the regional development strategy influenced by national rules and policies? What is the degree of autonomy of university to adapt their activities to regional development needs?
- How is the performance of university measured? How these influences on the way they engage in regional development?

6. Funding

- What is the level of engagement of university with international research networks (H2020, etc.)?
- What is the level of engagement of university in international teaching/learning networks (Erasmus+, knowledge alliances, etc.)?
- Are the examples of using international / national funding programmes in synergy with regional funds (including the ESIF?) How could this be improved?

Concluding questions

- Overall, which of the three missions of university (education, research, outreach) has been better integrated in the RIS3? Why?
- Which could be the potential specific mechanisms that would be needed to optimize involvement of university in the implementation of RIS3 and make it sustainable over time?
- Which are the key future challenges to improve the role of university in the RIS3 of the region?

INDIVIDUAL INTEVIEWS

GENERAL ISSUES/QUESTIONS

I. In general, the university can play an important role in its community, as well as within a larger, regional ecosystem. One of its key functions is that to support and coordinate the regional, social and community development.

- In your opinion, to what extent is your university involved in the regional and/ or local development so far?
- Is your university involved in the regional policies development?
- What kind of in-put do you offer?

- Is your expertise being used one way or another? Please give examples.

II. Collaboration, engagement and information sharing with local and/ or regional stakeholders, with different industries, with the public sector is important for a university that aims to become a driving force for the region in which it acts.

- Does your university have any departments/ organizations acting as knowledge transfer actors or which are required by businesses to provide different services? Please give examples.
- What would be helpful to boost the transfer knowledge, from the legal framework perspective or otherwise?

III. The mobility of human resources, especially researchers, between the private and research sector is a critical element of knowledge transfer.

- How much does your university promote/ take part into exchanges of personnel?
- What tools/ information/ policy support would you need to enhance this type of knowledge transfer?

IV. One of the conclusions of the self-evaluation exercise, implemented in an earlier stage of the research, states that the main channel through which universities contribute to regional development is through graduate production.

- Which are the main drivers and barriers for realistically defining the demand and supply needs at local and/ or regional level, considering the programmes of studies from your university?
- Do you use specific tools to enhance the development of human capital and skills in response to regional development needs? Which further tools would be needed to enhance it?
- Are the local and/or regional partners involved in the process of designing and implementing study programmes (any cycle – B, M, PhD)?
- Do you find solutions for integrating the experiences and the expertise of the local and/ or regional partners in designing and delivering didactic activities, extracurricular activities or support services?
- Are there recruited at the university level relevant persons, with significant expertise form the local/ regional area?
- Are there developed post-university programmes of study (especially) based on requirements expressed by local/ regional organizations?
- In order to develop the professional competences of students which is the perspective for the professional practice? Strengths and weaknesses, opportunities and threads.
- How does your university respond to the development of cross-curricular of competences including the entrepreneurial ones?
- Are there projects or programmes or any other initiatives within your university focused on this issue?
- Does your university offer opportunities, formal or non-formal contexts for the development of an entrepreneurial thinking and other related skills?
- Are there available programmes of mentoring or of personal/ professional development delivered by persons with expertise either in academic field or in the related professional area?

V. The partnership between the university and the community can be strengthen by reciprocal involvement at management/ administrative level, by coordination specific activities, by developing and implementing strategies focused on regional and/ or local development.

- Does your university support different collaborative partnerships with the local communities and organizations, the central and local administration, chambers of commerce and industry and alumni of the institution? Please give examples.
- Do you think that there might be useful for your university to involve the local/ regional partners in some kind of consultative body that might contribute to the development of strategies and practices focused on the regional/ local development? Which might be the pros and cons.
- What about involving your university in the local governance together with other stakeholders within the regional/ local ecosystem?

- What kind of input can your university offer?
- Which might be the instruments that you could use in this context?

VI. Projects represent a tool for creating partnerships and by which the universities can contribute to reaching some goals related to the regional and/ or local development

- In your opinion, to what extent the projects in which your university is involved have a direct impact on the regional and/ or local development?
- What kind of funding do you access for these projects?
- What incentives might there be put in place in order to boost the interest for this kind of projects?
- How does the process of building up partnerships with local and/ or regional stakeholders work?
- Which are the barriers and which are the motivator factors?
- Did you use or intend to develop a strategy or tools to increase the cooperation of your university with other research and innovation stakeholders in the region (business incubators, technological parks and other external initiatives)?

Annex 3. List of start-ups from Lubelskie registered by Startup Poland

Name (Hyperlink to website where available)	Activity	Area
ACTIVE PROPULSION LABORATORY	ACTIVE Propulsion Laboratory is based on a commercial basis, self-organizing laboratory of the structure is not hierarchical, established to implement the automotive industry and the energy of the active drive technology APS or AA (from active status Antriebstechnik).	Energy
ANTARA	Programming services mainly in the field of web application development and content management systems.	ICT
BATTERLINE	An upgraded, free of violence and pornography vision of the internet.	ICT
BOXLO	Boxlo is an online platform for launching and managing their own store subscription.	ICT
BRESHKE DESIGN	design, 3D, 3D design, automotive, furniture, electronics, cars, 3D modeling, rendering, 3D modeling	Industrial design
CLEANERGY	The company produces microbiological products for the disposal of organic industrial waste.	Environment
CO LUDZIE POWIEDZĄ	School English language and British culture.	Learning
CODENGER	Online recruitment software to test the programming skills of your candidates.	ICT, HR
ENTIS	Easy to use sales system in which you can collect information about their customers, analyze sales opportunities, set goals and measure sales.	ICT, CMS
FB-NINJA	We have spent countless hours designing a set of unique tools which will help you manage your teams more effectively, much quicker and with better results.	ICT, DATA
FRENDI	Testing products.	ICT, CMS
FROEBEL-PL	"Festivity gift" program is designed for teachers, parents and students of preschool education and early primary school.	Learning
GREENIT	We design innovatory IT systems for the Internet of Things solutions.	ICT, IoT
INFINUM3D	Accesories to 3D printers.	Electronic industry
IWISHER	Helping to find new or cheaper products.	ICT, CRM
JUMBSTER	Jumbster allows gas stations to show their fuel and gastronomy offer to drivers.	ICT, CRM

KCALMAR	Kcalmar is a nutrition-coaching platform connecting patients with real professionals thanks to top-notch software solutions.	ICT, food
MYBOX.PL	mybox.pl Ltd provides an intelligent web data analytics platform for website administrators which monitors websites, detects problems	ICT
NEXBIO	Nexbio company provides services in the development of a wide range of molecular tests based on the analysis of nucleic acids, for both applications in various industrial sectors, as well as in research and development and research projects.	Biotechnology
PHYSIOSTAT	Physiostat is a system for professionals in the field of sport, who focus on the preparation of professional athletes, in order to achieve an increase in their value over time.	Health
PLANTALUX	We manufacture LED COB lamps for horticulture production.	Agriculture
POOL-INTELIGENCE	Innovative installations for swimming pool.	Industry
PREDICTAIL	Predictail.com is a system of remote diagnostics and prediction of failure of industrial machinery.	Industry
PYRAMID GAMES	We are game development studio located in Lublin, Poland, City of Inspiration.	ICT
SKAKANKA	Set of electronic games and methods helping children at age from 3 to 14 to overcome sensory processing problems, which result with lack of cognitive control, problems with focus/attention and over-reaction.	Learning
STARTSTOP	StartStop.pl is a system that facilitates efficient use and management of time.	ICT, management
SUBDAY-STUDIO	Online condolences.	ICT
SUNDOSE	Personalized mix of vitamins, minerals and probiotics designed, based on a lifestyle survey.	Food
SWIATPRACY	You will find us jobs in Poland and abroad, and add your resume so employers can find you alone, as an ideal candidate for a job.	ICT, management
TECHNALAB	TinyCP is web based software for managing linux like systems.	ICT
TRISAMYA-COSMETICS	TRISAMYA would primarily focus on creating innovative high-end cosmetic products and technologies to be used at beauty and health spas for rejuvenation therapies.	Health
WOODINSPECTOR	IT systems manufacturer for lumber industry.	ICT, wood industry
ZAREKLAMY		ICT

Annex 4. List of HEIs in Lubelskie region (POL-on database)

Name including hyperlink to website	Name (EN)	Type of HEI
Katolicki Uniwersytet Lubelski Jana Pawła II (KUL)	The John Paul II Catholic University in Lublin	Public university
Uniwersytet Marii Curie-Skłodowskiej w Lublinie	Maria Curie-Skłodowska University in Lublin	Public university
Uniwersytet Medyczny w Lublinie	Medical University in Lublin	Public medical university
Politechnika Lubelska	Lublin University of Technology	Public higher school of technology
Uniwersytet Przyrodniczy w Lublinie	University of Life Sciences in Lublin	Public higher school of agriculture
Państwowa Wyższa Szkoła Zawodowa w Chełmie	The State School of Higher Education in Chełm	Public vocational higher school
Państwowa Wyższa Szkoła Zawodowa im. Szymona Szymonowica w Zamościu	The State School of Higher Education in Zamość	Public vocational higher school
Państwowa Szkoła Wyższa im. Papieża Jana Pawła II w Białej Podlaskiej	The State School of Higher Education in Biała Podlaska	Public vocational higher school
Lotnicza Akademia Wojskowa w Dęblinie	Polish Air Force University	Public military higher school
Lubelska Szkoła Wyższa w Rykach	Lubelskie Higher School in Ryki	Private higher school
Wyższa Szkoła Ekonomii i Innowacji w Lublinie	Higher School of Economics and Innovation	Private higher school
Wyższa Szkoła Humanistyczno-Ekonomiczna im. J. Zamoyskiego w Zamościu	Humanistic-Economic Higher School in Zamość	Private higher school
Wyższa Szkoła Nauk Społecznych z siedzibą w Lublinie	Higher School of Social Sciences in Lublin	Private higher school
Wyższa Szkoła Przedsiebiorczości i Administracji w Lublinie	Higher School of Entrepreneurship and Administration in Lublin	Private higher school
Wyższa Szkoła Społeczno-Przyrodnicza im. Wincentego Pola w Lublinie	Vincent Pol University	Private higher school
Wyższa Szkoła Stosunków Międzynarodowych w Komunikacji Społecznej w Chełmie	Higher Scool of International Relations and Social Communication in Chełm	Private higher school
Wyższa Szkoła Zarządzania i Administracji w Zamościu	University of Management and Administration in Zamość	Private higher school

Annex 5. Results of institutional evaluation of HEIs and institutes from Lubelskie (2013-2016)

HEIs / institutes	Faculty	GWO	N of unit	C1	C2	C3	C4	Final category
The John Paul II Catholic University in Lublin	Biotechnology and Environmental Sciences	NZ1B	63.59	65.96	104.96	0.93	46	C
	Phiosophy	HS1FT	77.5	45.86	480.15	0.15	81	A
	Mathematics, Informatics and Landscape Architecture	NJNUCZ	57.25	43.87	13.18	0.03	26.27	C
	Humanities	HS1FB	242.91	39.09	1172.76	0.2	76	B
	Social Sciences	HS1SP	202.97	47.9	924.59	0.55	63	A
	Law, Canon Law and Administration	HS1PR	133	38.18	757.41	0.11	45	B
	Theology	HS1FT	142.63	45.05	967.03	0.19	38	A
	Law and Social Sciences in Stalowa Wola	NJNUCZ	82.88	32.79	45.25	0.28	0	C
Maria Curie-Skłodowska University in Lublin	Arts	TA1PK	101.19	39.99	175.33	0.77	35	B
	Biology and Biotechnology	NZ1B	125	90.42	722.82	0.97	43	B
	Chemistry	SI1CT	158.13	109.29	662.11	3.42	80	A
	Economics	HS1EK	103	40.19	194.99	0.58	50	B
	Philosophy and Sociology	NJNUCZ	78.75	40.81	261.8	0.14	41.03	B
	Humanities	HS1FB	338.75	40.02	1390.77	0.56	77	B
	Mathematics, Physics and Computer Science	SI1FA	149.25	81.8	639.38	0.5	50	B

	Earth Sciences and Spatial Management	NZ1Z	93.75	59.49	342.14	0.89	77	B
	Education and Psychology	HS1SP	119.88	36.25	513.14	0.13	36	B
	Political Science	HS1SP	92.75	40.62	563.36	0.86	63	B
	Law and Administration	HS1PR	124.56	37.89	513.82	0.06	40	B
Medical University in Lublin	Medicine with Dentistry Division	NZ1M	376.56	54.36	1184.93	0.49	75	B
	Medicine with English Language Division	NZ1M	434.95	60.32	1289.41	0.37	84	A
	Pharmacy with Medical Analytics Division	NZ1F	169.14	96.1	539.66	0.99	69	A+
	Nursking and Health Sciences	NZ1M	136	50.49	476.43	0.04	52	C
Lublin University of Technology	Civil Engineering and Architecture	SI1BA	80.75	70.99	185.04	8.05	80	A
	Electrical Engineering and Computer Science	SI1EA	95.25	75.75	302.5	2.48	65	A
	Environmental Engineering	SI1BA	35	98.25	314.39	5.11	80	A
	Mechanical Engineering	SI1MH	132.13	118.37	808	9.15	91	A
	Fundamentals of Technology	NJNUCZ	26.75	48.11	49.74	2.09	49.7	B
	Management	HS1EK	58.25	45.83	96.71	0.62	28	B
University of Life Science in Lublin	Agrobioengineering	NZ1R	124.19	62.18	364.95	0.73	78	B
	Biology, Animal Science and Bioeconomy	NZ1R	134.94	71.81	406.32	1.19	67	B
	Production Engineering	NZ1R	136.25	66.66	420.57	1.69	58	B
	Veterinary Medicine	NZ1R	119.75	75.24	336.55	0.24	75	B

	Foodscience and Biotechnology	NZ1R	82.94	88.33	505.71	3.23	45	A
	Horticulture and Landscape Architecture	NZ1R	105.25	63.06	336.28	1.87	59	B
The State School of Higher Education in Biała Podlaska	Economics and Technical Sciences	HS1EK	22.5	56.47	190.68	3.87	7	A
	Health and Social Sciences	NZ1M	22.25	56.18	268.63	1.98	40	B
Polish Air Force University	National security and logistics	HS1SP	24.75	50.59	49.48	0	24	B
	Aviation	SI1MH	39.94	38.81	90.99	0.05	35	C
Higher School of Economics and Innovation	Administration and Economics	HS1EK	26	32.43	15.54	0	17	C
	Education and Psychology	HS1SP	30	26.23	37.51	1.5	17	C
	Transport and Informatics	SI1MH	12	30.08	125.12	24	44	C
University of Management and Administration in Zamość	Physioterapy and Education	NZ1M	14	22.43	4.69	0	5	C
	Management and Administration	HS1EK	9	42.44	9	0	0	B
Institute of Agrophysics of PAS		NZ2R	57.19	112.48	579.37	7.62	75	A+
Institute of Agricultaral Medicine		NZ3M	55.3	93.85	282.13	3.98	50	A
National Veterinary Institute - PIB		NZ3R	141.38	81.91	450.36	5.43	91	A+
Institute of Soil Science and Plant Cultivation - PIB		NZ3R	125.88	63.84	835.45	10.62	88	A
New Chemical Synthesis Institute		SI3TM	149.19	33.75	214.47	36.44	90	A

Source: MSHE (version - October 2017)

Annex 6. Patent applications in EPO of HEIs from Lubelskie (for period 2013-2018)

Publication	Title	Abstract	Applicant	IPC
EP 2918657 A1 20150916	AGENT FOR IMPROVEMENT OF LIGHT SOIL PROPERTIES AND THE USE OF THE AGENT FOR IMPROVING THE LIGHT SOIL PROPERTIES	An agent for improving the properties of light soils and its use is disclosed wherein said agent contains drill cuttings obtained when drilling for and extracting shale gas, sewage sludge and spent mineral wool.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	C09K 17/40
EP 3037500 A1 20160629	MIXTURE OF WASTE FOR IMPROVEMENT OF LIGHT SOIL PROPERTIES AND IMPROVEMENT OF ITS PRODUCTIVE PROPERTIES	A mixture of waste intended for the improvement of light soil properties and the properties of its production, comprising waste obtained through hydro-segregation of quartz sand and municipal sewage sludge, stabilized through sludge fermentation in municipal wastewater treatment plant.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	C09K 17/40
EP 3199497 A1 20170802	METHOD OF PRODUCING DRILLING FLUIDS FROM WASTEWATER OBTAINED DURING SHALE GAS EXTRACTION	A method of producing hydraulic fracturing fluid from wastewater obtained during the shale gas extraction is disclosed wherein H2O2 is added to the flowback water which is then mixed until the redox potential of 700-720 mV is achieved; then the 5% Ca(OH)2 suspension in 10% solution of NaCO3 is added and intensively mixed to obtain pH of 11.15 ± 0.15, the precipitate is then separated by a known method, most preferably by means of a centrifuge.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	C02F 103/10

EP 2977118 A1 20160127	METHOD OF SOIL SUBSTITUTE PRODUCTION FOR USE IN RECLAIMING EXCAVATIONS WITH IMPLEMENTATION OF WASTE DRILLING FLUID		Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	B09B 3/00 (2006.01); C05D 9/00 (2006.01); C05G 3/04 (2006.01); C05F 7/00 (2006.01); B09B 1/00 (2006.01); B09C 1/00 (2006.01); C02F 11/12 (2006.01)
EP 2979768 A1 20160203	METHOD OF RECLAIMING MINE EXCAVATIONS	The method of reclaiming excavations after the mineral resources exploitation is characterized by filling an excavation with a mixture of coal bed rocks, drill cuttings and ash to the level of 1-2 m below ground. Afterwards, a 1-2 m layer of artificial soil is created from cuttings separated from drill liquid, biological wastewater treatment plant sludge and top soil accumulated during the preparation for exploitation. In the artificial soil drill cuttings are present in the amount of 10-30%, preferably 20%, sludge is present in the amount of 20-40%, preferably 30%, and top soil is present in the amount of 30-60%, preferably 40%.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	B09B 1/00 (2006.01); B09B 3/00 (2006.01); B09C 1/00 (2006.01); E21C 41/32 (2006.01)
EP 3037184 A1 20160629	METHOD OF RECLAIMING EXCAVATIONS FOLLOWING THE EXPLOITATION OF RESOURCES FOR ROAD ENGINEERING	Method for reclaiming excavations following the exploitation of resources for road engineering characterized by dewatering the fermented sewage sludge from municipal wastewater treatment plants to at least 20% of dry mass and mixing it with ash from biomass combustion and coalassociated shales obtained from bituminous coal mining in the weight ratio of 3 : 2 : 10. The resulting mixture is used for filling the top layer of excavation, with the thickness of 0.5-2.5m, depending on the vegetation.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	B09C 1/00 (2006.01); B09C 1/08 (2006.01); E21C 41/32 (2006.01); C05F 7/00 (2006.01); B09B 3/00 (2006.01); C05D 3/04 (2006.01)
EP 3037499 A1 20160629	MIXTURE OF TAILINGS FOR APPLICATION IN LIGHT SOIL	A mixture of mining tailings for application in light soil, comprising coal-associated shales, municipal sewage sludge and post-consumption mineral wool, characterized with the following composition: coal-associated shales with pH of 6.8 in 1-mole KCl solution, sorption capacity of 12.6 cmol(+) kg-1, total base cations of	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy	C09K 17/40 (2006.01); C05D 9/00 (2006.01)

		12.3 cmol(+) kg-1, saturation of sorption complex with base cations equal to 98%, carbon content of 62.4 g/kg-1, nitrogen content of 2.23g/kg-1, in the amount of 200-500 Mg ha-1; municipal sewage sludge with pH of 6.2 in 1-mole KCl solution, sorption capacity of 33.9 cmol(+) kg-1, total base cations of 29.6 cmol(+) kg-1, and saturation of sorption complex with base cations equal to 87%, carbon content of 199.8 kg-1, with the Ctot : Ntot ratio of 7.2 in the amount 10 Mg ha1 as well as post-consumed Grodan mineral wool from gardening, with high base cation content amounting to 52.04 cmol(+) kg-1 and high water capacity of 1450% in the amount of 400-500m3 ha-1.	Akademicka 13 20-950 Lublin PL	
EP 2918571 A1 20150916	A METHOD FOR PRODUCING AN ARTIFICIAL SOIL	Disclosed is the method for producing an artificial soil from drill cuttings obtained when drilling for and extracting shale gas, which method is characterised in that drill cuttings (40-50 wt%) from drilling wells are mixed with digested sludge (20-30 wt%) from municipal sewage treatment works and ground gangue (10-20 wt%).	Politechnika Lubelska Nadbystrzycka 40A 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	C05G 3/04 (2006.01); C05D 9/00 (2006.01); B09B 1/00 (2006.01); B09C 1/00 (2006.01)
EP 3199498 A1 20170802	METHOD OF PRODUCING HYDRAULIC FRACTURING FLUID FROM WASTEWATER OBTAINED DURING SHALE GAS EXTRACTION	A method of producing hydraulic fracturing fluid from wastewater obtained during the shale gas extraction is disclosed wherein fresh water is added to flowback or produced water until desired salinity is achieved which is then followed by adding H2O2 in the amount related to BOD. CaO is used to adjust pH and then sediments are precipitated by intensively mixing them with solution of Na2CO3 or K2CO3, the precipitates are then separated in a centrifuge and solution of H2SO4 is added to the clarified water in order to obtain clarified solution.	Politechnika Lubelska Nadbystrzycka 40B 20-618 Lublin PL Uniwersytet Przyrodniczy Akademicka 13 20-950 Lublin PL	C02F 9/00 (2006.01); C02F 1/38 (2006.01); C02F 1/52 (2006.01); C02F 1/66 (2006.01); C02F 1/72 (2006.01); C02F 1/68 (2006.01)

Annex 7. Progress of implementation of Lubelskie ESIF co-funded Regional Operational Programme

Axis - code	RPLU.01.00.00	RPLU.02.00.00	RPLU.03.00.00	RPLU.04.00.00	RPLU.05.00.00	RPLU.06.00.00	RPLU.07.00.00	RPLU.08.00.00	RPLU.09.00.00	RPLU.10.00.00	RPLU.11.00.00	RPLU.12.00.00	RPLU.13.00.00	RPLU.14.00.00	Total
Axis - name	Research and innovation	Digital Lubelskie	Competitiveness of enterprises	Energy friendly to environment	Energy effectiveness and low-emission economy	Environmental protection	Culture	Regional mobility and transport	Labour market	Adaptability of enterprises and employees	Social inclusion	Education, competences	Social infrastructure	Technical assistance	
Calls - numbers	11	6	12	2	17	7	14	6	17	12	29	18	17	5	173
Applications - numbers	297	56	442	505	516	120	110	11	694	239	627	747	312	44	4720
Applications - value (PLN)	714,273,835.80	431,520,197.80	1,654,380,268.66	1,352,949,368.74	1,490,230,702.40	632,851,579.60	431,608,467.29	1,185,486,867.80	1,305,380,969.66	812,482,692.00	919,024,141.53	705,945,493.80	1,365,835,424.38	225,653,377.56	13,227,623,387.02
Applications - contribution EU (PLN)	404,193,329.53	362,862,679.30	971,656,212.19	888,627,465.32	842,857,644.89	381,047,621.56	310,780,089.56	897,705,403.62	1,107,555,489.92	690,432,072.08	780,931,047.66	597,849,932.22	876,816,029.96	191,805,370.68	9,305,120,388.49
Contracts - numbers	174	51	249	403	425	102	83	11	279	94	341	360	211	44	2827

Contracts - value (PLN)	419,422,352.86	402,103,428.83	1,173,220,847.86	1,006,968,470.08	1,244,512,525.48	544,706,648.87	341,852,668.08	1,158,257,594.64	562,263,530.57	191,126,156.60	526,560,754.90	362,717,358.93	877,421,721.45	216,261,811.89	9,027,395,871.04
Contracts - contribution EU (PLN)	234,355,144.10	337,691,037.77	737,187,941.99	680,704,336.52	717,387,163.10	325,297,375.03	236,517,248.86	873,488,824.76	477,924,000.42	162,114,215.81	447,572,328.46	308,232,544.08	606,367,640.91	183,822,539.98	6,328,662,341.79
Payments - number	605	78	929	1311	549	376	325	56	1400	323	917	1533	481	258	9141
Payments - value (PLN)	120,692,368.31	14,673,046.94	457,173,898.23	289,745,066.82	103,126,551.82	165,737,193.62	66,051,142.02	273,375,163.04	382,696,300.45	51,815,550.30	86,801,746.72	148,063,777.96	154,158,279.97	133,562,270.09	2,447,672,356.29
Payments - contribution EU (PLN)	68,930,183.33	12,309,098.75	267,640,265.39	215,826,555.12	59,049,417.45	95,900,283.00	47,284,464.79	216,377,687.60	322,233,899.15	41,553,545.07	72,814,245.65	124,560,010.88	87,997,347.80	113,488,865.01	1,745,965,868.99

Source: https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/raporty/raporty-sprawozdania/stan-wdrazania-funduszy-europejskich-w-polsce-w-latach-2014-2020-nabory-wnioski-o-dofinansowanie-umowy-wnioski-o-platnosc/

ROPLV - allocation, contribution EU (EUR)	100,416,755.00	81,970,176.00	277,298,996.00	180,698,971.00	275,896,270.00	110,139,605.00	73,020,103.00	271,031,040.00	225,794,843.00	48,093,025.00	150,510,722.00	123,735,094.00	232,928,490.00	79,424,084.00	2,230,958,174.00
ROPLV - allocation, contribution EU (PLN)	429,783,711.40	350,832,353.28	1,186,839,702.88	773,391,595.88	1,180,836,035.60	471,397,509.40	312,526,040.84	1,160,012,851.20	966,401,928.04	205,838,147.00	644,185,890.16	529,586,202.32	996,933,937.20	339,935,079.52	9,548,500,984.72
Allocation vs applications	94%	103%	82%	115%	71%	81%	99%	77%	115%	335%	121%	113%	88%	56%	97%

Allocation vs contracts	55%	96%	62%	88%	61%	69%	76%	75%	49%	79%	69%	58%	61%	54%	66%
Allocation vs payments	16%	4%	23%	28%	5%	20%	15%	19%	33%	20%	11%	24%	9%	33%	18%

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