



## *National smart specialization (NSS)*

### **CHAPTER I - INTRODUCTION**

- A. *Smart specialization strategy (S3) – European context*
- B. Systemic framework for smart specialization from a national perspective
- C. Methodology of work

### **CHAPTER II - IDENTIFICATION PROCESS – NSS METHODOLOGY**

- A. STEP 1 – Cross-analysis of the project *Technology Foresight for Polish industry InSight2030* with the *National Research Programme (NRP)*.
- B. STEP 2 - Quantitative analyses
- C. STEP 3 - Qualitative analyses
- D. STEP 4 – Cross-analysis of cross-sectoral areas (results of step 1) and quantitative and qualitative analyses (step 2 and 3)
- E. STEP 5 - Selection of national smart specializations

### **CHAPTER III - NATIONAL SMART SPECIALIZATIONS**

- A. National priorities in the field of R+D+I - national smart specializations
- B. Strategic and detailed objectives of NSS
- C. NSS implementation system

### **CHAPTER IV - MONITORING AND UPDATING**

- A. Monitoring system
- B. Updating national smart specializations

### **CHAPTER V - RELATIONSHIP OF NATIONAL AND REGIONAL SMART SPECIALIZATIONS**

#### **Annexes**



## CHAPTER I. INTRODUCTION

### *A. Smart specialization strategy (S3) – European context*

In March 2010, the European Commission adopted *Europe 2020 - a strategy for smart, sustainable and inclusive growth*. The Strategy proposes three core priorities: smart growth, i.e. development based on knowledge and innovation, sustainable growth, i.e. transition towards a competitive low-carbon economy which is resource efficient, inclusive growth, i.e. fostering a high-employment economy delivering economic, social and territorial cohesion.

The above priorities will be accomplished, *inter alia*, through the **development of strategies for smart specialization by the EU Member States and their regions**, which will indicate preferences in providing support to the development of research, development and innovation (R+D+I) in the new financial perspective for 2014-2020.

**Smart specialization strategy consists in determining economic priorities in the area of R+D+I and focusing investments on areas which increase the added value of the economy and its competitiveness on foreign markets.**

**Smart specializations are to contribute to the transformation of the national economy through its modernization, structural transformation, diversification of products and services and creating innovative socio-economic solutions which also support transition to a resource-efficient economy.**

**The process of identification of smart specializations is dynamic, engaging business and research partners, as well as civil society, in order to enable the discovery of those areas in which the country has a chance to stand out in the international market. Decisions on smart specializations are not taken authoritatively, but are the result of in-depth analyses of the endogenous economic advantages and co-operation with socio-economic partners.**

**Steps taken to identify smart specializations will allow for effective financing of investments in these areas, which will bring real economic effects.**

Identifying smart specializations will primarily stimulate economic development of Poland based on innovation. Strong thematic concentration of support to specializations, which are competitive advantages of the country, will contribute to the development based on the effectiveness of actions and tangible socio-economic effects.

In addition, the emphasis on the support to national and regional specializations should lead to **greater concentration and more efficient use of EU funds**, as well as improve coordination and synergies between the initiatives taken at EU, national and regional level. According to Article 16 of Chapter III of the Commission Communication COM (2011) 615: *Member States shall concentrate support, in accordance with the Fund-specific rules, on actions bringing the greatest added value in relation to the Union strategy for smart,*



*sustainable and inclusive growth, addressing the challenges identified in the country-specific recommendations under Article 121(2) of the Treaty and the relevant Council recommendations adopted under 148(4) of the Treaty, and taking into account **national and regional needs**.*<sup>1</sup>

The need to identify smart specializations at national or regional level also arises from the need to satisfy the ex-ante condition by Poland, as referred to in relation to Thematic Objective (TO) 1: *Strengthening research, technological development and innovation*, contained in the Partnership Agreement, i.e. *the existence of a national or regional research and innovation strategy for smart specialisation in line with the National Reform Program, to leverage private research and innovation expenditure, which complies with the features of well-performing national or regional research and innovation systems*, and is a criterion for support to above areas in the operational programmes for 2014-2020.

In order to start the implementation of operational programmes, including support under TO 1, an action plan will be developed, with a schedule of activities for the full implementation of the conditions laid down by the European Commission, including a list of actions, institutions responsible and deadlines. This document will be submitted to the Commission together with the draft Operational Programme Smart Growth (OP SG).

The result of the development of the *National smart specialization* is the system that provides a bottom-up creation of the most developing areas, which are priorities for science and innovation policy until 2020. This vision of development of the Polish economy will focus financial support on specializations characterized by growth potential, which in turn will help to improve innovation and competitiveness of Polish industry and to build a knowledge-based economy.

*National smart specialization* can also be a very useful instrument to meet the global challenges such as demographic change, limited access to natural resources, energy security and climate change.

Smart specialization strategy indicates that investment in research and innovation should be concentrated on priority areas in which the region or state have advantage/capacity or have potential for development, as well as contribute to the economic transformation of the country or region. The system for identification, verification and support to smart specialization areas should:<sup>2</sup>

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<sup>1</sup> EC Communication COM (2012) 615 Proposal. Regulation Of The European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund covered by the Common Strategic Framework and laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Council Regulation (EC) No 1083/2006, p. 43.

<sup>2</sup> More at: [http://ec.europa.eu/regional\\_policy/sources/docgener/informat/2014/smart\\_specialisation\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/smart_specialisation_en.pdf), p. 2.



- involve key socio-economic and scientific partners, especially entrepreneurs (entrepreneurial discovery process),
- focus support on national and regional areas of specialization based on knowledge;
- integrate top-down and bottom-up research and development initiatives;
- be based on evidence/facts (evidence-based-policy);
- lead to concentration of investment on research and innovation (critical mass) and elimination of negative phenomena, such as fragmentation and duplication of research;
- indicate cross-sectoral areas of specialization;
- lead to an increase in the share of private funding on R+D.

Based on the experiences gained from the implementation of activities under the financial perspective 2007-2013 and in connection with recommendations of the European Commission, the **cohesion policy after 2013** should be aimed in particular at:

- increase in efficient use of EU funds,
- more effective stimulation of private expenditure on R+D,
- improving the degree of commercialization of R+D results and their implementations in enterprises,
- use of synergies between the different programmes and levels of support for R+D+I (European, national, regional),
- use of conditionality principle to a greater extent when using the support of public funds (ex-ante conditionality).

## **B. Systemic framework for smart specialization from a national perspective**

***National smart specialization is an open document, which will be subject to ongoing review and updating<sup>3</sup> on the basis of the monitoring system and ongoing socio-economic changes.***

General strategic framework for national smart specialization are in one of the nine strategies integrated under the *Strategy for Innovation and Economic Efficiency "Dynamic Poland" (SIEE)*, which in terms of assumptions is consistent with the EU development strategy Europe 2020 and the provisions of the *National Development Strategy 2020*.

The implementing document for the *Strategy for Innovation and Economic Efficiency* is the *Enterprise Development Programme 2020*, which provides a comprehensive directory of instruments to support the development of innovation and entrepreneurship in Poland.

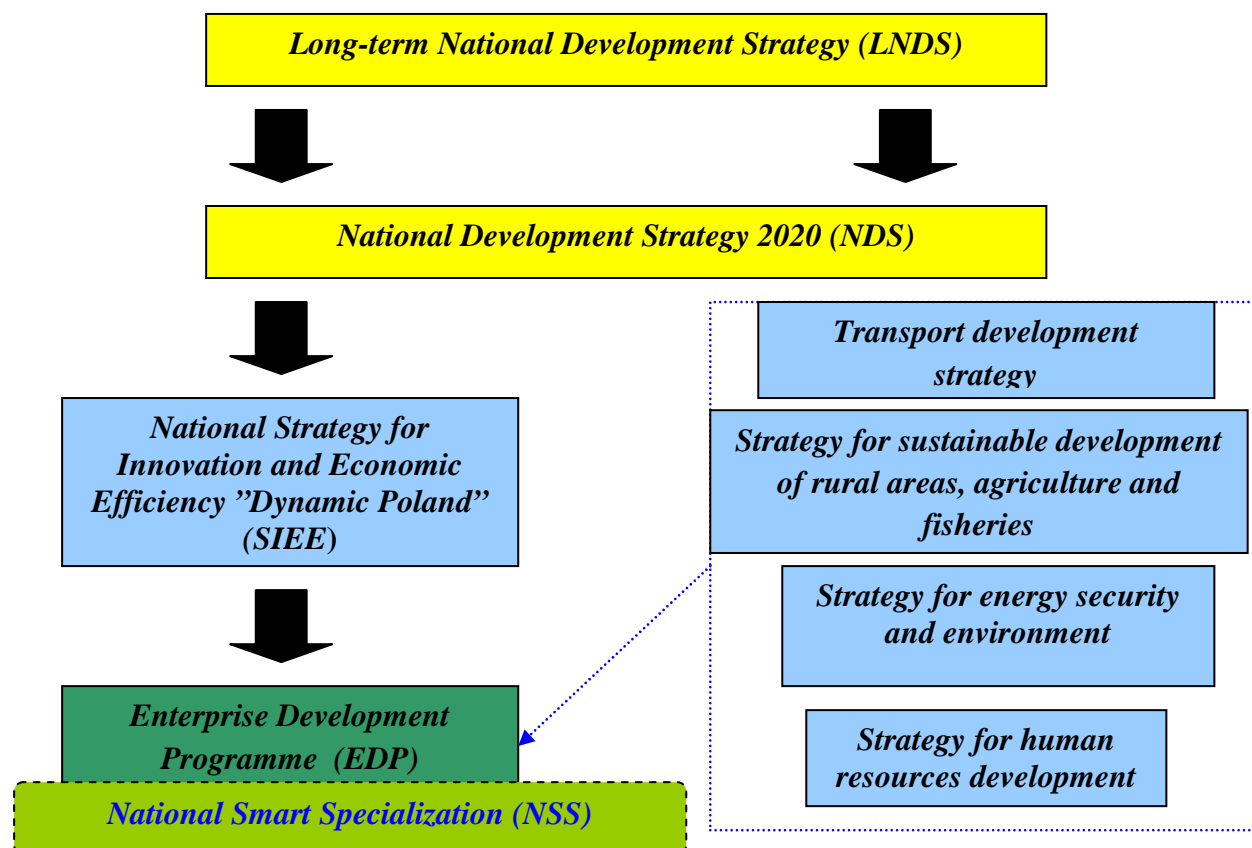
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<sup>3</sup> Current versions will be available on the website of the Ministry of Economy and a special website dedicated to smart specializations in Poland (currently in development)



*National smart specialization (NSS)* as a document indicating areas of R+D+I, under which action will be taken in order to achieve strategic objectives SIEE, is an integral part of the *Enterprise Development Programme*.

The relationships between these documents and strategies, in accordance with the provisions of the development policy, are presented in the following diagram:



The starting point for identifying national smart specializations in Poland are the two key documents in the field of scientific research and innovation, i.e.

1. *Technology Foresight for Polish industry - InSight2030*, developed by the Ministry of Economy
2. *National Research Programme*, developed by the Ministry of Science and Higher Education

### **1. Technology Foresight for Polish industry - InSight2030**

*InSight2030*<sup>4</sup> was implemented by order of the Ministry of Economy in the period September 2010 - December 2011 (revised in December 2012), and its implementation

<sup>4</sup> <http://www.mg.gov.pl/node/17503>



resulted from implementation of the objectives of the *Concept of horizontal industrial policy in Poland*<sup>5</sup> adopted by the Council of Ministers on 30 July 2007.

The aim of the project was to identify key technologies that underpin development and competitiveness of Polish industry by 2030, including technologies, where Poland could achieve commercial successes in the global market. **Identification of technologies was carried out in two phases:**

a) analysis of trends in the global technology development from the perspective of socio-economic challenges facing the world within the next 15 to 20 years, and identification of key technologies on a global scale,

b) review of research and development work in Poland and previous results and determinants of Polish industry and selection of priority technologies where Poland could achieve commercial success in international markets in the term adopted by the following analytical work:

- review of existing foresight studies in the analysed fields of technology,
- analysis of available maps of technological development,
- analysis of trends and dynamics of technology and innovation development in the world and the country,
- analysis of the development of global market and anticipated changes in its technological structure,
- examination of the needs and views of interested scientific, industrial and social groups,
- examination of systemic conditions, including legal environment for research and development and innovative, financial and organizational projects,
- analysis of potential risks, environmental and ethical threats.

This work was conducted based on the following **test methods**:

<b>desk research method</b>	review of literature in the field of foresight projects carried out in the industry.
<b>brainstorming</b>	panel discussions conducted by a trained moderator
<b>PEST analysis</b> (political, economic and socio-technological factors)	analysis conducted to identify external trends determining the choice of research areas
<b>SWOT analysis</b> (strengths and weaknesses, opportunities and threats)	method used in the selection of research areas and to identify priority technologies
<b>impact cross-analysis</b>	expert, quantitative method for determining future factors and likely events influencing the development scenario, assigning likelihood to

<sup>5</sup> [www.mg.gov.pl/NR/rdonlyres/0F1DC7FE-4A1D.../Koncepcjahpp.pdf](http://www.mg.gov.pl/NR/rdonlyres/0F1DC7FE-4A1D.../Koncepcjahpp.pdf)



	events in a particular term
<b>expert panels</b>	discussion guided by a moderator in a given thematic area
<b>Delphi method survey</b>	verification of the results obtained in the course of expert panels by a wide group of experts by double surveying
<b>road maps</b>	presenting a vision of technology development in a given term
<b>Technology atlases</b>	showing centres for development of identified technologies and industrial areas in geographical distribution
<b>scenario building</b>	formulation of a vision of technology development based on key factors such as political and economic situation

The project was a multi-dimensional **analysis of external and internal factors** affecting the possibility of development of companies in Poland in specific areas. The project included within its scope the analysis of the following factors:

<b>Global civilization challenges</b>	more efficient use of resources, demographic change and aging population, adaptation of services (mainly medical) to changing social structure
<b>Environmental factors</b>	trends related to environmental protection, including minimizing environmental impacts throughout the life cycle of products, national and EU commitments and environmental regulations, climate change, energy efficiency, pollution of water, air, soil, etc., waste and recycling
<b>Raw materials and natural resources</b>	energy security, diminishing natural resources, protection of biodiversity
<b>Geopolitical factors</b>	energy security, development trends of the European integration process
<b>International relations</b>	global trends in trade, protectionism, monetary system, the euro zone
<b>Social factors</b>	the impact of economic development on quality of life, lifestyle related trends, immigration, employment structure
<b>Technological factors</b>	analysis of emerging technologies, modern technologies, technological infrastructure, R+D trends
<b>Analysis of business environment</b>	in terms of specialization and achievements, e.g. science and technology parks, incubators, other business environment institutions taking account of their specializations, technological parks, clusters
<b>Wild cards</b>	unexpected factors, characterized by a low risk, but carrying huge implications for the economy and society in case of arising
<b>Weak signals</b>	first signs of change, of little significance at the time of onset, however, likely to have a decisive impact in the future

The work took account mainly of factors affecting the economy of the country (including the Community policy, geopolitical location of the country, social and environmental factors,



latest technological trends in the world) and identified research potential of Polish universities and research institutes. This potential was then verified with the participation of business representatives (employers' associations, chambers of industry, entrepreneurs) for real market demand, competitive advantages of companies and innovative solutions emerging in their structures, which can decide the economic potential of the country in the coming years.

*InSight2030* was the first horizontal foresight project covering the whole country and taking into account all sectors of industry and energy, mining and services related with the industry:

<b>industrial sectors</b>	classification of sectors covered by the project has been made in accordance with the document of the European Commission <i>EU industry in a changing world - sectoral overview</i> , 2009. The European Commission indicates in the document key industrial sectors for the economies of the internal market, taking into account, <i>inter alia</i> , factors such as: market structure, impact of regulation, competition with respect to third-country markets. Not all identified sectors were selected in accordance with the NACE classification (equivalent of PKD), as they are areas interfacing with different sectors (such as biotechnology), or they are industrial areas dominated by services (e.g. ICT, eco-industry) and it is not possible to classify them according to NACE. These include the following sectors: aerospace, automotive, biotechnology, cement, ceramic, chemical, plastics, rubber, construction, cosmetics, defence, eco-industries, electrical machinery, electromechanical, electronic, food, furniture, glass, ICT, tanning and leather goods, lime, machinery production (remaining), medical devices, mining of metal ores, non-ferrous metallurgy, pharmaceutical, printing, paper, rolling stock and its suppliers, shipbuilding, space, metallurgy of iron and steel, textiles and clothing, wood;
<b>sector of services associated with the industry</b>	taking into account this sector in the project resulted from the growing demand for these services by industrial users. With progressive economic change and technological development, the boundary between industry and services is often blurred, therefore analysis of industry is not possible without taking into account the service sector;
<b>mining industry</b>	in order to ensure complementarity of project results it was necessary in the analyses to take into account the mining industry, which plays a critical role in the industrial development due to access to the resource base;
<b>energy industry</b>	taking account of the energy industry in the project was necessary (like mining) so the results of the project were complete and consistent. Particularly it was important to identify technologies that provide energy security and energy generation technologies characterized by low emissions of carbon dioxide in the light of external factors, including aspects of sustainable development and political and legal trends leading to development of regulations to protect the environment.

The project required extensive analyses, as well as nearly two-year collaboration of experts from government, research institutions, chambers of industry and representatives of business organizations and companies. Cooperation and involvement of experts in work on the project resulted in the analysis of development needs of the Polish industry, which are a consensus of representatives of different backgrounds, often with different interests. Public consultations and meetings with business representatives stressed the need to strengthen cooperation in the



framework of the so-called triple helix (administration, science and business) and established a base for cooperation in the implementation of *InSight2030* results, thus giving rise to a process of active involvement of socio-economic partners in the process of identifying smart specializations for the Polish economy (entrepreneurial discovery).

*InSight2030* is a project which specified industrial technologies whose development by 2030 will become the driving force of the Polish economy and will contribute to increasing the competitiveness and innovativeness of Polish industry. Analytical work was carried out in 10 horizontal fields of research in which 127 key technologies were identified, but after public consultations and meetings with representatives of various sectors the verified list includes 99 technologies grouped in the following fields of research<sup>6</sup>:

1. Industrial biotechnologies
2. Nano-processes and nano-products
3. Advanced manufacturing systems and materials
4. Information and communication technologies
5. Microelectronics
6. Photonics
7. Technologies of cogeneration and improvement in energy efficiency
8. Natural resources
9. Healthy society
10. Green economy.

The following graph illustrates the summary of identified technologies within each research field.

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<sup>6</sup> The current version of Research Fields and the list of technologies is in the publication: *Technology Foresight for Polish industry - InSight2030 – updated results and the national strategy for smart specialization* <http://www.mg.gov.pl/node/17503>



## Research fields

## Technologies

### PB 1 – Industrial biotechnologies

- technologies of molecular engineering of industrial catalysts
- technologies of self-cleaning photocatalytic coatings
- technologies of bioaugmentation, biosorption, bioleaching
- biotechnologies in the production of detergents
- biosensors production technologies
- technologies of bioprocesses in the synthesis and processing of polymeric materials
- nanobiotechnologies in the preparation of food ingredients carriers
- biotechnologies for utilization of by-products and agri-food industry waste
- non-phthalate plasticizers

### PB 2 – Nano-processes and Nano-products

- nanotechnologies in textile engineering for modification and functionalization of textiles
- nanocatalysis, including for environmental purification and energy production
- structural and barrier nano-materials
- polymer nano-composites
- nano-metals
- nano-biotechnologies
- nitride and carbon nano-structures (graphene, nano-tubes)
- transparent conductive oxides nano-technology
- metal, ceramic and diamond-like protective nano-layers

### PB 3– Advanced manufacturing systems and materials

- mechatronics of robots and machines
- process control technologies using image analysis
- spatial, layered, multi-functional, self-healing composite materials
- ultra-light, ultra-strong materials with radically enhanced heat resistance, allowing full recycling
- intelligent systems for diagnostics and technological process control
- interferometric measurement systems
- concurrent process control technologies

### PB 4 – Information and communication technologies

- technologies of intelligent sensor networks
- technologies of classical and quantum cryptography
- spatial navigation systems
- observation and identification systems with different ranges of electromagnetic waves than visible light and infrared radiation
- cyber security systems, combating threats by developing hardware infrastructure
- infrastructure and distributed systems technologies for e-business
- systems for logistics support and supply chain management
- smart traffic control systems
- RFID technologies (radio identification system)
- semantic web technologies
- artificial intelligence technologies for production systems



## Research fields

## Technologies

### PB 5 - Microelectronics

- technologies of specialized microsystems
- Technologies based on the use of silicon carbide
- technologies for production of specialized integrated analog and mixed signal circuits with very low power
- lithography technologies
- technologies for manufacturing radiation detectors
- battery manufacturing technologies
- technologies for manufacturing nanotube transistors
- biochips
- molecular memory
- technologies for obtaining superconducting materials at room temperature

### PB 6 - Photonics

- technologies of micro-and nano-structural special photonic fibre composite structures
- technologies of ultra sensitive photodetectors for infrared areas and terahertz frequencies
- technologies of solid and liquid crystals for photonic applications
- photonic measurement technologies
- technologies of radiation detectors
- technologies of semiconductor lasers
- passive components manufactured with plastic optical fibres
- polymer solar cells
- organic cells (an alternative to silicon cells)
- holographic and plasmonic technologies
- Multispectral and multi-dimensional imaging technologies

### PB 7 – Technologies for cogeneration and improvements in energy efficiency

- modern construction technologies - passive, zero-energy, plus energy buildings (power consumption <15 kWh/m2 per year)
- energy-efficient technologies for household appliances and lighting systems
- development of energy management systems in buildings (BMS - Building Management Systems) "smart building"
- energy-efficient heating and domestic hot water
- technologies associated with energy production based on renewable energy
- smart Grid - smart electricity distribution networks
- gas and steam systems (CCGT)
- technologies for use of waste energy, including low-temperature energy
- technologies for use of biomass for heat production in small and medium scale. utilization of organic waste for energy purposes
- technologies for generation of electricity and fuels from solar energy - artificial photosynthesis
- technologies of low-loss power transformers
- technologies of inverter systems for start-up and adjustment of electric motors
- technologies of electrothermal devices with high efficiency
- technologies of modern heat engines with high efficiency and low emissions
- technologies for rationalization of gas transmission through the use of a new type of pipelines and methods for measuring leakage
- dispensing technologies for supplying power to stationary municipal and industrial customers
- technologies of new, low-waste water turbines and a set of issues related to advanced solutions for energy efficiency and energy management
- hybrid PVT technologies (photovoltaic - thermal), more energy efficient than separate systems responsible for different types of energy
- technologies of hybrid systems, i.e. systems combining different types of generating sources



## Research fields

## Technologies

### PB 8 – Natural resources

- technologies for hydrocarbons
- technologies for production of shale gas
- technologies for mining non-ferrous metal ores
- technologies for mining coal and lignite
- technologies for obtaining basic raw materials for the chemical, cement, construction and road industry
- enrichment technology for all particle sizes of energy coals
- drilling technologies
- coal processing technologies/technologies of deep coal enrichment for production of heat and electricity
- advanced technologies for gas transmission

### PB 9 – Healthy society

- biocatalysis in processes for preparing medicinal products
- biotechnological and biosynthetic manufacture of medicinal products
- IT systems supporting diagnostics and therapies in personalized medicine
- non-invasive methods of photonic diagnostics and treatment of civilization diseases
- telemedicine and personalized medicine - software supporting pharmaceutical care
- New non-invasive technologies for post traumatic treatment, including skin and bone preparation based on stem cells
- nano-medicine technologies

### PB 10 – Green economy

- next-generation biofuels from renewable resources and waste
- head turbines for low heads - Very Low Head Hydro Power
- biodegradable plastics
- technologies for environmentally friendly means of transport
- technologies and new methods of energy production from coal in order to improve energy efficiency of coal-fired units and reduce their CO<sub>2</sub> emissions and dust and gases harming the environment, including
  - oxygen combustion technology
  - air-blown gasification technology
  - oxygen-blown gasification technology
  - indirect co-firing of biomass using gasification reactor
  - coal gasification technologies
  - coal-nuclear synergy
- coking coal
- fuel cells
- technology for injection and monitoring of CO<sub>2</sub> deposits
- research technologies related to search for CO<sub>2</sub> storage sites



## **2. National Research Programme**

The *National Research Programme (NRP)* indicates the strategic directions of research and development, defining the objectives and assumptions of the long-term science and technology policy and innovation policy of the country. The purpose of the NRP is to focus public spending on priority directions of scientific research and development from the point of view of the needs of the Polish society and the international competitiveness of the Polish economy. The NRP was prepared by the Ministry of Science and Higher Education and approved by the Council of Ministers on 16 August 2011, the NRP comprises seven strategic interdisciplinary directions of scientific research and development work. These directions are:

1. New technologies in the field of energy
2. Civilization diseases, new medicines and regenerative medicine
3. Advanced information, telecommunications and mechatronic technologies
4. Modern material technologies
5. Environment, agriculture and forestry
6. Social and economic development of Poland in conditions of globalizing markets
7. Security and defence of the state<sup>7</sup>.

Determination of the above priority directions of scientific research and development work included, among others:

- global challenges facing contemporary society,
- global development trends,
- analysis of the demand for scientific support carried out by the National Centre for Research and Development in 2009 among the leading industries in Poland,
- results of the evaluation of the *National Programme for Research and Development*, established in 2008.

Priority areas of research and development also include the results of the National Foresight Programme "Poland 2020", which was implemented in 2006-2009. The above programme included, among others, thematic panels and a Delphi survey. The main tasks of thematic panels were: evaluation of knowledge, foresight analysis of individual areas and macro-themes and preparing theses for the expert Delphi survey. Thematic panels were attended by more than 300 experts from the fields of economics, sociology, representatives of industry, innovative enterprises, institutions for the transfer of technology, media, government representatives, etc. Experts developed a list of 114 macro-themes and 680 research and development themes, a list of the key factors for the development of Poland and a list of the most important technologies. Delphi study consisted in conducting surveys twice on a selected group of anonymous experts. In order to conduct the Delphi survey we created an

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<sup>7</sup> The area of national security has the potential of innovation both in relation to the national and international level and a high level of diffusion of innovations to other sectors of the economy through the so-called technologies of dual use, so this area will also be the subject of analyses (national defense will not be included in the analyses due to lack of funding of this area from the ERDF).

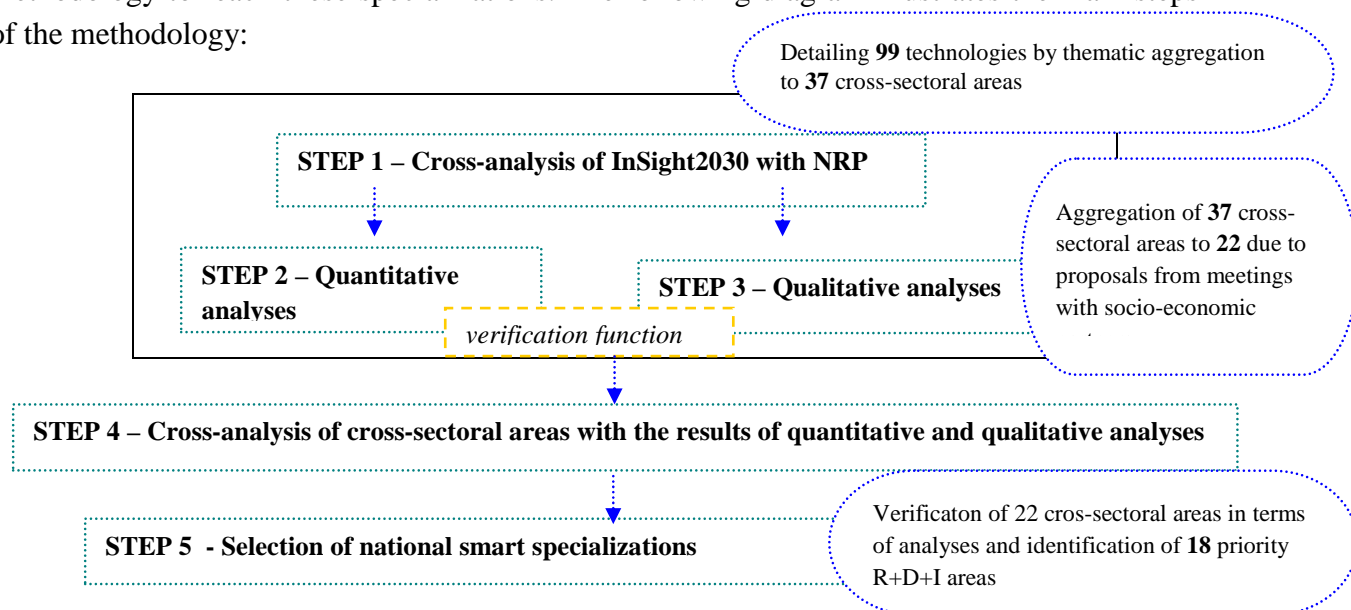


External Experts Team on NFP Poland, composed of people representing different environments (science, business, government, media, non-governmental organizations), having knowledge of the various fields of research. Both rounds of the Delphi survey covered about 2,500 experts. Expert and analytical resources for promoters of the National Foresight Programme Poland 2020 were provided by partner institutions, including:

- scientific institutions (e.g. Warsaw School of Economics, University of Warsaw, Interdisciplinary Centre for Mathematical and Computational Modelling, University of Warsaw, Centre for Advanced Technology - Adam Mickiewicz University in Poznań, Wrocław Centre for Technology Transfer);
- institutions with experience in the transfer of technology to the economy: (e.g. Polish Agency for Enterprise Development, Federation of Engineering Associations - NOT, the Institute for Market Economics);
- Polish Technology Platforms: Polish Technology Platform for Production Processes, Polish Technology Platform for Textile Industry, Polish Technology Platform for Mobile and Wireless Communications, Polish Technology Platform for Advanced Materials, Polish Technology Platform for Homeland Security, Polish Technology Platform for Aviation, Polish Technology Platform for Opto- and Nanoelectronics, Polish Platform for Sustainable Chemistry.

### C. Methodology of work

In order to define national smart specializations, the Ministry of Economy has developed a methodology to reach these specializations. The following diagram illustrates the main steps of the methodology:



Further parts of the document discuss in detail the various steps.

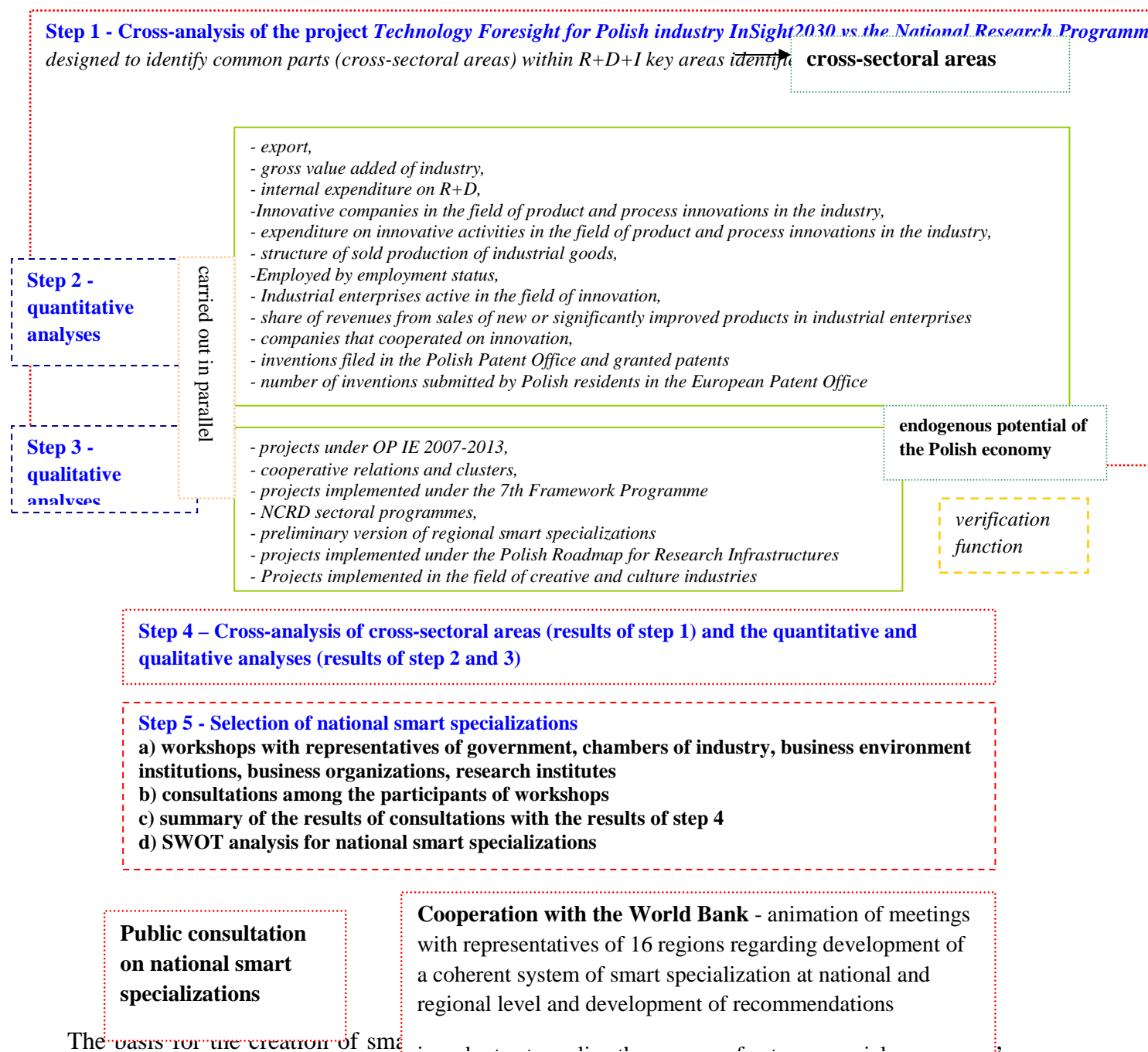
## CHAPTER II - IDENTIFICATION PROCESS – NSS METHODOLOGY

Strategic documents discussed in Chapter I provide the basis for development of a national smart specialization (NSS). However, in view of the need to take into account the actual



socio-economic potential when developing NSS, it was necessary also to conduct a series of analyses, indicating real economic effects and illustrating the activity of entrepreneurs in specific economic sectors. In order to determine economic priorities for building competitive advantages in accordance with the needs of business, the process of identification and verification of smart specializations directly involved socio-economic partners.

The diagram below shows analyses comprising the steps of a process to identify national smart specializations:



The basis for the creation of smart specializations is understood as integrating various stakeholders to identify priorities for research, development and innovation, around which public and private investments are concentrated. Entrepreneurs and representatives of business environment institutions, chambers of industry and research institutes are of key importance in determining priorities. In its actions, the Ministry of



Economy is guided by the principle that the essence of the entrepreneurial process of discovery is to support bottom-up activities and initiatives that will lead to smart growth and optimal utilization of resources, in particular those that will effectively engage the private sector in the operation and funding of research and innovation, as well as public consultation and active dialogue.

Below we discuss selected elements of the process, confirming the active involvement of entrepreneurs in the identification of priorities in the area of R+D+I.

1. The process of entrepreneurial discovery has been initiated already in 2011, with the launch of the project *Technology Foresight for Polish industry - InSight2030*, indicating the scientific and economic priorities and updating of the National Research Programme, indicating research and scientific priorities. The methodology of the *InSight2030* project in the whole process of identifying key technologies for Polish industry took into account the participation of socio-economic partners, including businesses, inter alia in brainstorming, STEEP analysis, SWOT analysis, cross-analysis of influences, expert panels, expert research with Delphi method and in the construction of scenarios.
2. to ensure full representativeness of entrepreneurs in the creation of results of *InSight2030*, the Ministry of Economy decided to hold a two-stage consultation among representatives of business, mainly in the context of the final shape of the list of technologies that will decide the development of Polish industry by 2030:
  - a. in April and May 2012, the Ministry of Economy conducted public consultations aimed at, inter alia, verifying the list of technologies and areas identified as crucial for the Polish industry and indicating importance of the technology for the development of Polish industry. Consultations were conducted among chambers of trade, industry research and scientific institutes and additionally among thematic experts from the government. Information on public consultations and the results of the project were also consulted on the website of the Ministry of Economy.
  - b. in the period June-August 2012, direct meetings were organized with the representatives of industries. During meetings they discussed in detail the stages of the project and presented its results. They also discussed the adequacy of the results of the project for strategic areas and technologies important for various industries.

Meetings with representatives of the industries covered 87 entities and took place on the following dates:

- 18 June 2012 – industry of production of metals and metal products, Warsaw
- 24 June 2012 - electronic and electrotechnical industry, Warsaw
- 2 July 2012 – chemical industry, Warsaw (continued in: Gdańsk, Puławy)
- 6 July 2012 - pharmaceutical industry, Warsaw
- 17 July 2012 – shipbuilding industry, Gdańsk
- 19 July 2012 – aerospace industry, Rzeszów/Mielec (continued in Świdnik)
- 30 July 2012 - defence industry, Warsaw



- 31 July 2012 – automotive industry, Warsaw (continued in: Poznań, Polkowice, Wałbrzych, Wrocław, Niepołomice)
- 1 August 2012 - yacht industry, Straszyn n/Gdańsk (continued in: Olecko)
- 3 August 2012 - building materials industry, Warsaw
- 6 August 2012 - light industry, Warsaw (continued in: Sopot)
- 7 August 2012, wood-based industry, Warsaw (continued in: Katowice)
- 8 August 2012 - rail industry, Poznań (continued in: Bydgoszcz)
- 4 September 2012 - furniture industry. Rogoźno (continued in: Orla)

As a result of comments and proposals presented during the two-stage public consultation and sectoral meetings, the Ministry of Economy verified the list of technologies in terms of bottom-up indicated growth potential of the industry

3. The Ministry of Economy, in order to maintain close contact and dialogue with socio-economic partners, organizes various meetings (workshops, bilateral and industry meetings, seminars, conferences) to promote innovation and develop a common approach to industrial policy and innovation (e.g. conference *Lead Market Initiative and European Innovation Partnerships* on 26-27 October 2011 to strengthen the ties of demand and supply approach to innovation, conference *Innovation Procurement for the benefit of industries, SMEs & stronger public services* held on 14-15 November 2013 to promote innovative and pre-commercial procurement). In addition, the Ministry of Economy is actively involved in the institutions of social dialogue, *inter alia*, in the meetings of industry tripartite teams, the Working Group on SMEs under the aegis of the NSRF CC and the Joint Commission of Government and Local Government.
4. The involvement of entrepreneurs in the process of entrepreneurial discovery is also done through sectoral programmes implemented by the NCRD, which comprise a sequence of activities allowing companies to identify research topics (e.g. in clusters or technology platforms) for the implementation of research projects designated by them.
5. NCRD launched in 2013 a programme of support for pre-commercial procurement. Its aim is to identify solutions that can help to resolve an important social problem, according to changing needs. In the first stage of the programme, NCRD invited all interested parties to submit proposals of potential social needs, whose solution can be achieved by carrying out pre-commercial procurement process. The entity submitting the proposal is to identify the need, which could become a solution to a specific problem which is in the public interest, for which there is currently no "market ready or nearly ready" solution, and which requires a considerable amount of investment in research and development.
6. A particular form of involvement of companies in the process of entrepreneurial discovery is the activity of clusters, bringing together entrepreneurs and representatives of business environment institutions. The Ministry of Economy is actively involved in initiatives designed to stimulate the development of clusters in Poland, including through the establishment of the Working Group on cluster policy and involvement in the Hungarian CENTRAMO project, implemented under the second round of the *Competitiveness and Innovation Framework Programme - CIP*. Actions for promotion



of cluster development are horizontal in nature and are a component of several areas of economic policy, including: innovation, science and technology, regional or industry. The activity of cluster concentrations has been the subject of analyses in the process of creating R+D+I priorities, while the process of monitoring and updating national smart specializations will make use of the results of recommended competitions for key clusters (PO SG).

7. As part of the streamlining of the process of entrepreneurial discovery, the Ministry of Economy, through the Ministry of Infrastructure and Development, cooperated with the World Bank. This cooperation includes a pilot project under which the study will be conducted among more than 1,000 companies in selected areas of smart specialization, indicating the endogenous potential and the demand of companies for public intervention. Good practice will be used, presented by international experts who will prepare Polish experts for their use in the process of entrepreneurial discovery in Poland.

#### **A. STEP 1 – Cross-analysis of the project *Technology Foresight for Polish industry InSight2030* with the *National Research Programme (NRP)*.**

**Purpose of analysis:** the purpose of this step is to develop a list of cross-sectoral areas, indicating the greatest innovation and competitive potential for national economy, representing a starting point for identifying national smart specializations. It should be emphasized that the force of gravity in identifying key areas for improving competitiveness and innovativeness of the economy lies with the business, and the sphere of science and R+D should mainly respond to market demand and social needs.

**Methodology:** this step involved the following activities:

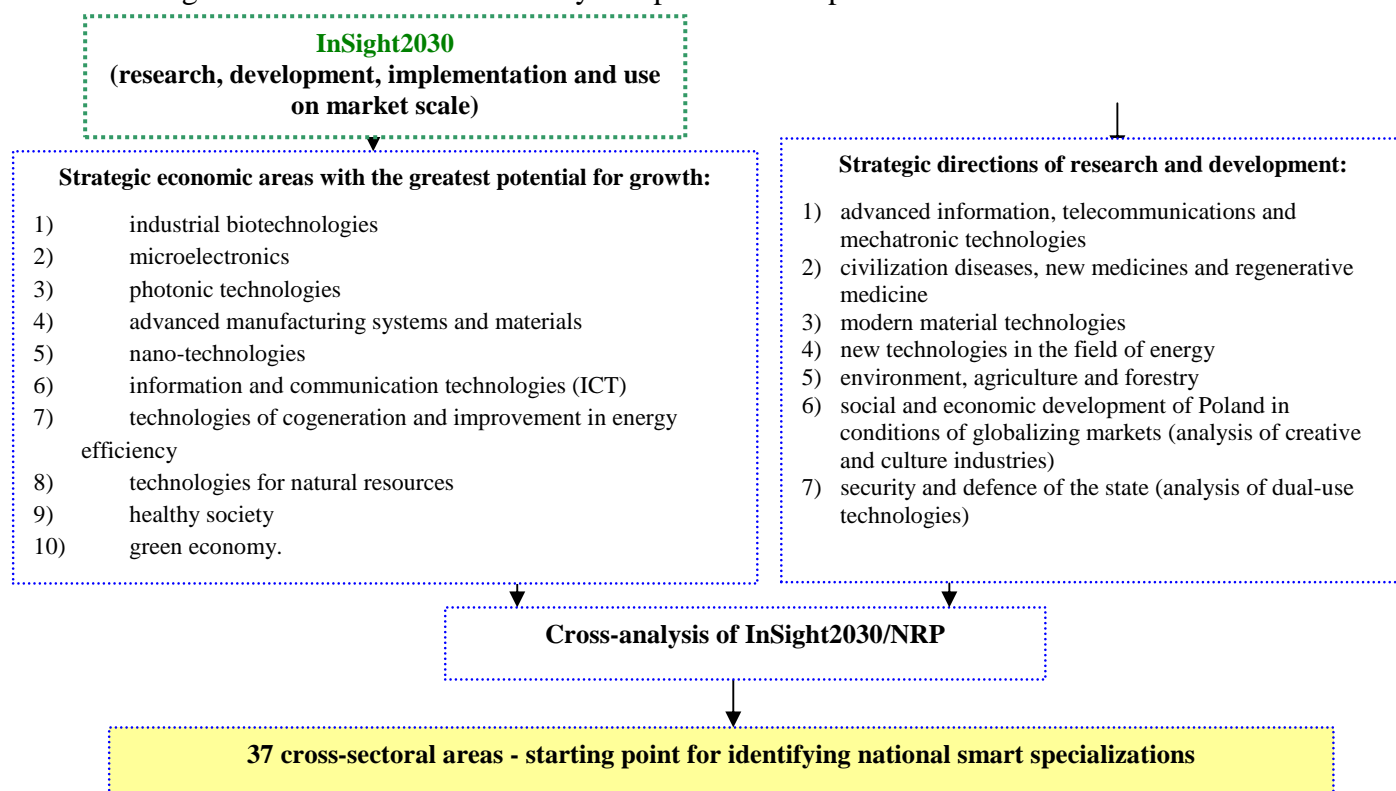
- specification of scientific and economic fields included in the national strategic documents in the area of R+D+I: *InSight2030* and *NRP*
- grouping 99 technologies identified in the project *InSight2030* in technology groups, and then making cross-analysis of these *InSight2030* technology groups with the areas



of *NRP* - cross-sectoral areas resulting from the cross-analysis were assigned to 10 research fields

**Effect of the analysis:** the result of the cross-analysis is identification of 37 cross-sectoral areas, which make scientific and economic fields contained in the *InSight 2030* and the *NRP* more precise. Identification of the 37 cross-sectoral areas consisted of thematic grouping of 99 technologies identified in *InSight2030* in groups with a greater level of generality (cross-sectoral areas) and making cross-analysis with *NRP* areas. Indicated cross-sectoral areas are crucial to the process of identifying smart specializations, because further analytical work based on them will be carried out to identify smart specializations.

The diagram below illustrates the analytical process of step 1:

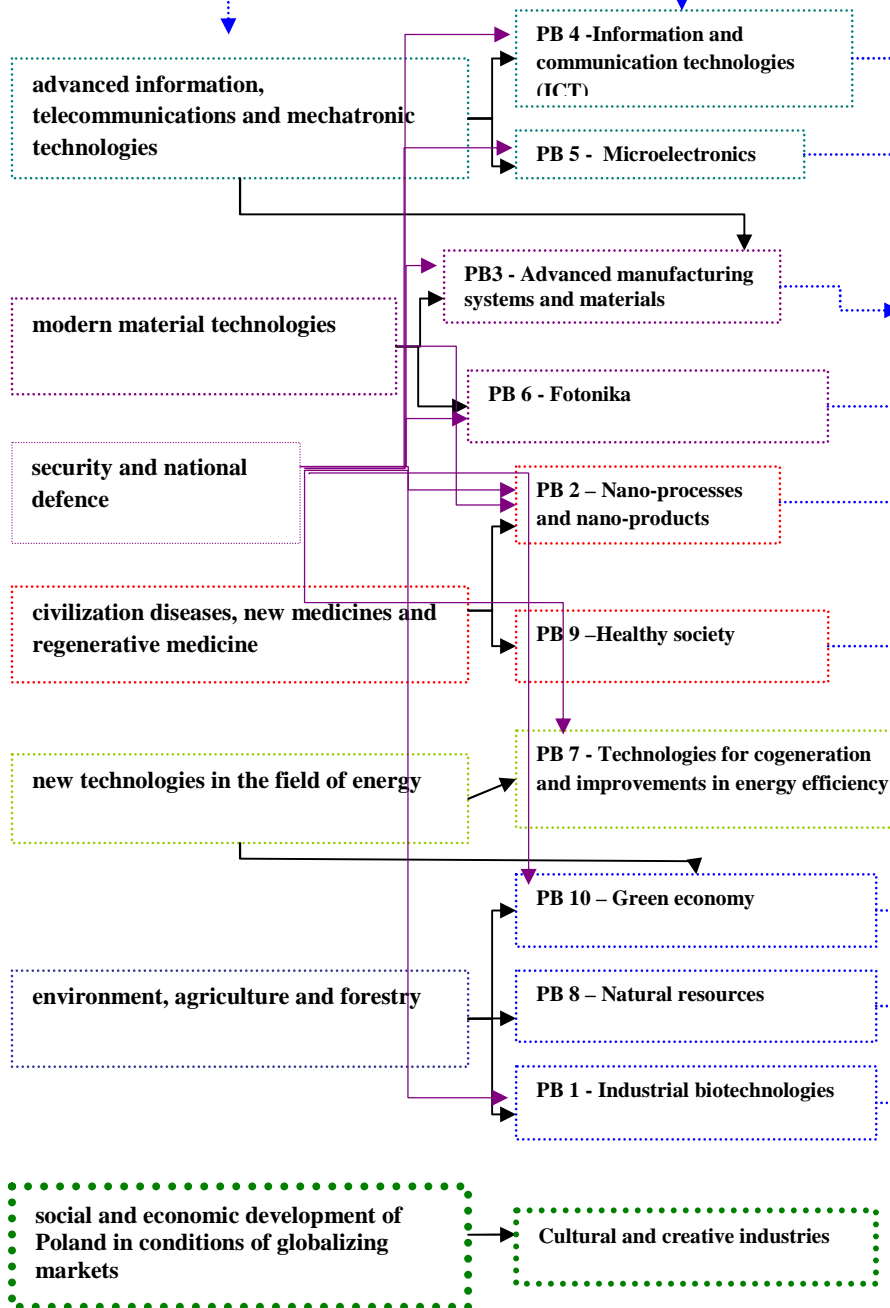




## Areas of R+D+I in Poland

NRP

InSight 2030



## 37 cross-sectoral areas for smart specialization - starting point to determine smart specializations

O1 identification, observation and spatial navigation  
O2 radio support systems  
O3 cyber threat security systems  
O4 smart sensor and semantic networks

O5 specialized microsystems  
O6 production of microelectronic components  
O7 biochips and molecular memory  
O8 manufacture of radiation detectors

O9 mechatronics of robots and machines  
O10 automation of measurement, control and diagnostic systems  
O11 spatial multifunctional composite self-healing materials  
O12 ultra-light, ultra-strong materials with radically enhanced heat resistance, allowing full recycling  
O13 non-phthalate plasticizers

O14 photonic systems and components  
O15 multidimensional images and their recording

O16 development and application of nano-materials  
O17 nano-catalytic processes in environmental protection and energy production  
O18 nano-technology in biological, textile and electronic engineering

A19 bio-manufacture of medicinal products  
O20 diagnosis and treatment in personalized medicine  
O21 non-invasive methods of diagnostics and treatment of civilization diseases and post-traumatic treatment

O23 Smart and energy efficient construction  
O24 highly efficient RES technologies  
O25 high-performance manufacture, transmission and distribution systems for electricity and heat  
O26 motors and drives with high efficiency and low emissions  
O27 high-efficiency electric energy storage technologies

O28 environmentally-friendly transport  
O29 energy-efficient and low-emission application of coal technologies  
O30 recycling

O31 technologies for natural resources  
O32 32 technologies for mining mineral deposits  
O33 production of substitutes for fossil fuels and their enrichment

O34 biotechnologies in the agri-food industry  
O35 biotechnological processes and products of household chemistry  
O36 engineering of bioprocesses and catalytic systems for environmental protection  
O37 production and use of biosensors



As a result of discussions held during the meeting with the representatives of the Marshal Offices (5 September 2013) and scientific institutions, chambers of industry, business environment institutions, clusters and business organizations (6 September 2013), as well as referring to the recommendations of the European Commission, it has been decided to reduce the number of cross-sectoral areas. Comments and suggestions were provided by the socio-economic partners during meetings and in writing were critical for reducing the number of areas (combining thematic areas or elimination thereof). As a result of these works 37 **cross-sectoral areas** were aggregated to 22:

1. innovative technologies, processes and products of the agri-food industry
2. biotechnological processes and products of household chemistry and environmental engineering
3. biosensors and smart sensor networks
4. nanomaterials, nanotechnologies and nano-catalyst processes
5. Mechatronics of robots and machines
6. automation of measurement, control and diagnostic systems
7. multifunctional materials with advanced properties
8. Remote identification, observation and navigation (remote detection)
9. cyberspace threat security systems
10. semantic web technologies
11. specialized microsystems and molecular memory
12. microelectronic components
13. optoelectronic systems and materials
14. smart and energy efficient construction
15. highly efficient RES technologies
16. high-performance manufacture, storage, transmission and energy distribution systems
17. modern technology of exploration and exploitation of natural resources and for production of substitutes thereof
18. manufacturing technologies and production of medicinal products
19. diagnosis, prevention and therapy of civilization diseases
20. environmentally-friendly transport
21. clean coal technologies
22. recovery, recycling and disposal of waste.



## **B. STEP 2 - Quantitative analyses (verification function for step 1)**

In order to determine national smart specializations whose development is to contribute to the economic growth of the country and raising the degree of innovation of manufactured products and services, it is necessary to combine available knowledge in the field of R+D+I with the existing economic potential of the country. This approach will allow achieving competitive advantages in existing innovative areas of business, which, due to the scientific and technological progress or market and social demand for concrete solutions can contribute to significant changes in the economic structure.

Therefore, smart specializations should relate to:

- existing potential in the area of R+D+I,
- current economic potential of the economy,
- existing cooperative relations within the areas of specialization,
- development trends and market niches that will select new specializations.

Taking the above into consideration, it is necessary to verify the areas identified in step 1 with respect to quantitative analyses indicating economic sectors that have the best economic effects. Quantitative analyses thus serve to detail the areas identified in the cross-analysis in step 1 by demonstrating the economic effects of enterprises. Indication of specialization through analysis of R+D potential and economic potential of the economy will strengthen cooperation between science and business and translate the results of scientific studies to commercial solutions.

**Purpose of analysis:** the purpose of quantitative analysis is to identify sectors of the economy characterized by the best economic effects in the domestic economy which will be taken into account when detailing cross-sectoral areas

**Methodology:** in this step, analyses were carried out of the economic sectors according to the products included in the *Insigos* database and by PKD 2007 in CSO publications: *Industry Statistical Yearbook 2012 CSO, Expenditures and results of the industry in 2012, CSO Science and Technology in 2011, Innovation activities of enterprises in 2009-2011, Workers in the national economy in 2011*

Analyses were conducted based on the following 12 statistical indicators<sup>8</sup>:

- export (data from CSO studies by PKD and Insigos database by product)
- gross value added of industry,
- internal expenditure on R+D,

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<sup>8</sup> Detailed analyses for each indicator are provided in *Annex I*. Statistical indicators used for quantitative analysis were selected in terms of the greatest degree of innovation of enterprises and their specific contribution in creating social and economic added value.



- innovative companies in the field of product and process innovations in the industry [% of companies],
- expenditure on innovative activities in the field of product and process innovations in the industry,
- structure of sold production of industrial goods [% of companies],
- employed by employment status [total],
- industrial companies active in innovation [% of companies],
- share of revenues from sales of new or significantly improved products in industrial enterprises in total sales revenue,
- companies that cooperated in the field of innovative activity in % of industrial processing companies active in innovation,
- inventions filed in the Polish Patent Office and granted patents by areas of expertise of the International Patent Classification,
- number of inventions reported by Polish residents in the European Patent Office by ranges of the International Patent Classification

These indicators were used for the following 7 sections of PKD classification:

- Section A - Agriculture, forestry, hunting and fishing,
- Section B - Mining and quarrying,
- Section C – Industrial processing,
- Section E - Water supply; sewerage and waste management and reclamation activities,
- Section F - Construction,
- Section H - Transportation and storage,
- Section Q - Health care and social assistance.

The research method consisted of:

- indicating the top 10 items for 29 PKD sections for each of the 12 indicators,
- making a cross-analysis of 12 statistical indicators with the indicated 29 sections of PKD for the emergence of the given PKD section in the first 10 items of the statistical indicator,
- indicating for each PKD section total appearances in the first 10 items for 12 statistical indicators.
- developing a hierarchical compilation of the most cost-effective PKD sections.

Due to the varying level of detail of the available data for exports and its dynamics (CSO data at the level of PKD sections and Insigos data at product level) the indicator was given more than 10 top items (the highest items, according to Insigos data differed from the highest CSO items), and the products included in the Insigos database were assigned by theme in available sections of PKD. Insigos data used the following symbols: *EX* - exports, *EX d* – exports dynamics. In the case of overlapping CSO and Insigos data we use simple symbols – *x*.

Due to the availability of data on patent applications by ranges of the International Patent Classification (IPC), which differs from PKD, ranges of the IPC has been thematically assigned to



available PKD for analytical purposes. In case of applications to the PPO we use PPO symbols, and in the case of applications to the European Patent Office – we use EPO symbols.

**Effect of the analysis:** the analyses indicated PKD sections of the Polish economy, characterized by the best economic effects, in hierarchical terms. Then, by developing a system of weights for the identified sectors, cross-sectoral areas will be modified and expounded on the basis of the results of this analysis.

A diagram showing the results of cross-analysis is presented below.



## QUANTITATIVE ANALYSES

Indicators  PKD 2007 section (part in brackets)	Export	Gross value added of industry	Internal expenditure on R+D	Innovative companies in the field of product and process innovations in the industry	Expenditure on innovative activities in the field of product and process innovations in the industry	Structure of sold production of industrial products (high technology)	Employed by employment status	Industrial enterprises active in the field of innovation	Share of revenues from sales of new or significantly improved products in industrial enterprises in total sales revenue	Companies that cooperated in the field of innovative activity in % of industrial processing companies active in innovation	Inventions filed in the Polish Patent Office and granted patents by areas of expertise of the International Patent Classification	Number of inventions reported by Polish residents in the European Patent Office by categories of the International Patent Classification	TOTAL
<i>Manufacture of machinery and equipment (C)</i>	x	x	x	x	x			x	x	x	Polish PO	EPO	10
<i>Production of chemicals and chemical products (C)</i>	x	x	x	x	x			x	x	x	Polish PO	EPO	10
<i>Manufacture of computers, electronic and optical products (C)</i>	x		x	x		x		x		x	Polish PO	EPO	8
<i>Manufacture of motor vehicles, trailers and semi-trailers (C)</i>	x	x	x		x			x	x	x			7
<i>Manufacture of electrical equipment (C)</i>	x	x		x	x			x	x	x			7
<i>Manufacture of pharmaceutical products (C)</i>	EX d		x	x		x		x		x			6
<i>Manufacture of metal products (C)</i>	x	x	x		x		x						5
<i>Manufacture of tobacco products (C)</i>	EX d			x				x	x	x			5
<i>Manufacture of coke and refined petroleum products (B)</i>	EX			x				x	x	x			5
<i>Mining of coal and lignite (B)</i>		x		x				x			Polish PO	EPO	5
<i>Metal production (C)</i>				x	x			x		x			4
<i>Manufacture of food products (C)</i>	x	x	x				x						4
<i>Manufacture of rubber and plastic products (C)</i>	x	x	x		x								4



<i>Manufacture of furniture (C)</i>	x						x		x				<b>3</b>
<i>Manufacture of other non-metallic mineral products (C)</i>	EX	x			x								<b>3</b>
<i>Repair, maintenance and installation of machinery and equipment (C)</i>		x							x	x			<b>3</b>
<i>Manufacture of other transport equipment (C)</i>	x		x						x				<b>3</b>
<i>Land and pipeline transport (H)</i>							x				Polish PO	EPO	<b>3</b>
<i>Specialized construction works (F)</i>							x				Polish PO	EPO	<b>3</b>
<i>Construction of buildings (F)</i>							x				Polish PO	EPO	<b>3</b>
<i>Manufacture of paper and paper products (C)</i>					x				x		Polish PO		<b>3</b>
<i>Construction of buildings and civil engineering structures (F)</i>							x				Polish PO		<b>2</b>
<i>Manufacture of other products (C)</i>	EX d		x										<b>2</b>
<i>Collection, treatment and supply of water (E)</i>	EX d				x								<b>2</b>
<i>Manufacture of textiles (C)</i>											Polish PO	EPO	<b>2</b>
<i>Agriculture, animal husbandry, hunting (A)</i>	EX d						x						<b>2</b>
<i>Health care (Q)</i>							x						<b>1</b>
<i>Production of beverages (C)</i>				x									<b>1</b>
<i>Manufacture of aircraft and spacecraft (C)</i>						x							<b>1</b>

**additional data, not classified according to PKD\***  
EX - exports acc. to Insigos (products)  
EX d - growth of exports acc. to Insigos (products)  
  
Polish PO - inventions and patents acc. to CSO (IPC)  
EPO - inventions acc. to CSO (IPC)  
  
\* Overlapping **Ex**, **Ex d** and **x** data in the Export table are marked with **x**



### C. STEP 3 - Qualitative analyses (verification function for step 1)

In order to take account of cooperative relations created by companies and their activities in development projects in the process of selecting smart specializations, it is necessary to perform qualitative analyses, which, like the results of quantitative analyses, will verify areas identified in step 1

**Purpose of analysis:** the purpose of qualitative analysis is to identify industries showing the highest commitment of companies and research institutes in projects in the field of R+D+I, and most active in the creation of cooperative relations between firms (clusters);

**Methodology:** this step involved the following activities<sup>9</sup>:

a. analysis of enterprise contribution to projects:

- *Operational Programme Innovative Economy 2007-2013,*
- *7. Framework Programme,*
- *Polish Roadmap for Research Infrastructures,*
- *Food and nutrition in the twenty-first century - a vision of the development of Polish food sector,*
- implemented under the sectoral programmes of the National Research and Development Centre
- implemented in the field of creative industries and culture<sup>10</sup>,
- relating to dual-use technologies (safety area),

b. analysis of activity in the creation of cooperative relations,

c. analysis of identified smart specializations at the regional level

**Effect of the analysis:** As a result of qualitative analyses that took into account the activity of enterprises in development projects, corporate relations and pre-defined smart specializations at the regional level, we developed a hierarchical list of industrial sectors with the highest activity of enterprises.

Detailed records of the analysis can be found in the diagram below.

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<sup>9</sup> Detailed analyses are provided in *Annex 2*.

<sup>10</sup> Given the characteristics of creative and culture industries and the fact that these areas were not subject to InSight2030 analysis, the methodology to identify areas of R+D+I for creative industries will be developed with the MCNH and socio-economic partners, indicating bottom-up initiatives and projects in this area.



## QUALITATIVE ANALYSES

Industry/area	OP IE 2007-2013	Clusters	7 RP	NCRD programmes	RIS 3 (regions)	Polish roadmap for research infrastructure	Food and nutrition	Dual-use technologies	Creative industries and culture	TOTAL
<i>Medical industry/health</i>		x	x	x	x (lfs)	x				5
<i>chemical sector</i>	x	x			x	X				4
<i>pharmaceutical sector</i>	x	x			x (lfs)	X				4
<i>manufacture of metals and fabricated metal products</i>	x	x			x	x				4
<i>food industry (food, agriculture, fisheries)</i>	x	x	x		x					4
<i>ICT</i>		x	x		x	x				4
<i>biotechnologies</i>		x	x		x (lfs)	x				4
<i>environment</i>			x	x	x (lfs)	x				4
<i>renewable energy</i>		x			x	x				3
<i>energy industry</i>		x			x	x				3
<i>advanced materials</i>			x	x (gf)		x				3
<i>transport</i>			x		x	x				3
<i>production of machinery and equipment</i>	x	x			x					3
<i>aviation sector</i>		x		x		x				3
<i>ceramics</i>	x					x				2
<i>electrical equipment</i>	x					x				2
<i>mineral resources</i>				x (gf)		x				2
<i>construction</i>	x	x								2
<i>manufacture of vehicles</i>	x				x					2
<i>wood products, paper industry</i>	x	x								2
<i>manufacture of computers, electronic and optical products</i>	x					x				2
<i>clothing, textiles</i>	x									1
<i>furniture sector</i>		x								1
<i>tourism</i>		x								1
<i>business services</i>		x								1
<i>human resources</i>			x							1
<i>nano-technologies</i>			x							1
<i>research for SMEs</i>			x							1
<i>research infrastructures</i>				x						1



<i>security</i>			x							<b>1</b>
<i>automation</i>					x					<b>1</b>

**Legend:**

*gf* – graphene      *gt* – shale gas      *lfs* - lifescience



#### **D. STEP 4 – Cross-analysis of cross-sectoral areas (results of step 1) and quantitative and qualitative analyses (step 2 and 3)**

As a result of quantitative and qualitative analyses we selected industries which are the most active in innovation, cooperation of enterprises and have the best economic effects.

**Purpose of analysis:** the purpose of the analysis is to make a cross-analysis allowing for further modification and refinement of cross-sectoral areas.

**Methodology:** Taking into account the results of analyses showing the greatest potential of selected industrial sectors, as well as to modify and detail previously identified 22 cross-sectoral areas, we developed a weighting system whereby each cross-sectoral area was awarded points calculated taking into account their weights. This step involved the following activities<sup>11</sup>:

- developing a system of weights, according to which the industries that received the most points in quantitative and qualitative analyses have been assigned accordingly to weights W1, W2, W3 and W4, which is illustrated by the specification below,
- making a cross-analysis of 22 cross-sectoral areas with sectors assigned to each of the weights (4 cross-analyses)
- specification for each of the 22 cross-sectoral areas of a weighted sum of points obtained in cross-analyses conducted for each of the weights in order to modify and establish a hierarchy of 22 cross-sectoral areas for the national economy.

**Effect of the analysis:** the analysis indicated cross-sectoral areas, which are the starting point for identifying national smart specializations. The above-mentioned areas in the next stage were subjected to a SWOT analysis, performed in collaboration with socio-economic partners.

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<sup>11</sup> Detailed analyses are provided in *Annex 3*.



TOTAL	ANALYSIS	INDUSTRIAL SECTOR	WEIGHT
10 10 8	I	manufacture of machinery and equipment manufacture of chemicals and chemical products manufacture of computers, electronic and optical products	W4 - 4
5 4 4 4 4 4 4	J	medical industry/health food industry (food, agriculture, fisheries) environment manufacture of metals and fabricated metal products biotechnologies ICT pharmaceutical sector chemical sector	
7 7 6 5 5 5 5	I	manufacture of electrical equipment manufacture of motor vehicles, trailers and semi-trailers manufacture of pharmaceutical products manufacture of metal products mining of coal and lignite manufacture of tobacco products manufacture of coke and refined petroleum products	
3 3 3 3 3 3	J	manufacture of machinery and equipment aviation sector advanced materials transport energy industry renewable energy	
4 4 4 3 3 3 3 3 3 3 3	I	metal production manufacture of rubber and plastic products manufacture of food products land and pipeline transport specialized construction works construction of buildings manufacture of paper and paper products manufacture of other non-metallic mineral products repair, maintenance and installation of machinery and equipment manufacture of other transport equipment manufacture of furniture	
2 2 2 2 2 2 2 2	J	wood products, paper industry manufacture of vehicles wood products, paper industry construction manufacture of computers, electronic and optical products ceramics electrical equipment mineral resources	
2 2 2 2 2 1 1 1	I	manufacture of textiles manufacture of other products collection, treatment and supply of water construction of buildings and civil engineering structures agriculture, animal husbandry, hunting production of beverages manufacture of aircraft and spacecraft health care	W1 - 1
1 1 1 1 1 1 1 1 1 1 1	J	furniture sector clothing, textiles tourism business services human resources nanotechnologies research for SMEs research infrastructures security automation	

*I - quantitative analyses*

*J - qualitative analyses*



Each of the 22 industries indicated in the above table is grouped according to weight and compared with cross-sectoral areas. The cross-analysis was to point to the relationships between industrial sectors, which are the result of quantitative and qualitative analyses, and cross-sectoral areas. For each cross-analysis, the total score has been calculated, indicating the cross-sectoral areas in which lies the real scientific and economic potential. The total score of each analysis for weights 4, 3, 2 and 1 was assigned to each cross-sectoral area. This process is shown in the table below.

<b>22 cross-sectoral areas</b>	<b>WEIGHT T 4</b>	<b>WEIGHT 3</b>	<b>WEIGHT T 2</b>	<b>WEIGHT T 1</b>	<b>WEIGHT ED AVERAG E</b>
nanomaterials, nanotechnologies and nano-catalyst processes	8	8	15	12	9.8
effective waste management and recovery of secondary raw materials	8	10	12	7	9.3
multifunctional materials with advanced properties	5	10	16	9	9.1
automation of measurement, control and diagnostic systems	5	9	14	12	8.7
biosensors and smart sensor networks	7	7	11	10	8.1
highly efficient RES technologies	7	7	6	6	6.7
smart and energy efficient construction	6	7	6	8	6.5
mechatronics of robots and machines	4	6	9	9	6.1
high-performance manufacture, storage, transmission and electricity and heat distribution systems	4	8	8	4	6.0
modern technology of exploration and exploitation of natural resources and for production of substitutes thereof	7	5	4	3	5.4
innovative technologies, processes and products of the agri-food industry	7	3	4	5	5.0
optoelectronic systems and materials	3	6	7	6	5.0
specialized microsystems and molecular memory	3	6	5	10	5.0
semantic web technologies	3	4	5	5	4.4
production of microelectronic components	3	4	7	6	4.4
remote identification, observation and navigation (remote detection)	3	4	7	4	4.2
environmentally-friendly transport	5	7	7	3	4.0
biotechnological processes and products of household chemistry and environmental engineering	6	1	2	4	3.5
diagnosis, prevention and therapy of civilization diseases	5	1	2	3	3.0
clean coal technologies	3	3	2	2	2.7
manufacturing technologies and production of medicinal products	4	2	1	2	2.6
cyberspace threat security systems	2	0	1	1	1.1



## **E. STEP 5 - Selection of national smart specializations**

**Purpose:** Selection of national smart specializations by comparing the results of the SWOT analysis with weighted averages resulting from step 4 and the observations and proposals of socio-economic partners and representatives of public administration.

**Methodology:** Selection of national smart specializations took place in four stages:

- a) workshop held by the Ministry of Economy entitled *SWOT analysis of national smart specializations* involving socio-economic partners (06.09.2013),
- b) consultation conducted among workshop participants
- c) comparison of the results of consultations with the weighted averages resulting from step 4 and proposals made by partners of the process and identifying national smart specializations,

Weighted averages, as a result of quantitative and qualitative analyses, illustrate the current potential of industries and represent an additional element in defining national smart specializations. Smart specializations should relate not only to existing economic potential, but also to emerging potential that will allow achieving a competitive advantage in the future.

- d) meeting with representatives of companies (19.09.2013), socio-economic consultations (second half of October 2013) and inter-ministerial consultations and individual meetings with the various partners of the process,
- e) implementation of a SWOT analysis for national smart specializations

**Effect:** These efforts have achieved the following results:

- a) as a result of the workshop attended by 106 representatives of chambers of industry, research institutes, business organizations and business and government environment institutions, the decision was made about the need for aggregation of cross-sectoral areas from 37 to 22,
- b) as a consequence of comparing the results of workshop and consultations with the weighted averages of step 4, the number of cross-sectoral areas was reduced and in effect they constitute national smart specializations; cross-sectoral areas, which received more than 5 points for the weighted average (on a scale of 0-10) are given priority when combined with cross-sectoral areas verified in consultation with the participants of the workshop,
- c) consultation with the participants of the workshop, which aimed to present proposals for detailing the cross-sectoral areas and make a SWOT analysis for them, yielded 31 proposals to modify areas and records in the SWOT analysis, which in turn contributed to the aggregation of 22 cross-sectoral areas to 16 national smart specializations
- d) the most important step in the clarification of the provisions on smart specialization was the meeting with the partners of the process, i.e. the representatives of chambers of industry, business



organizations, entrepreneurs, research institutes, universities, and representatives of public administration - meetings and consultations initiated the process of active participation of stakeholders in the process of creating NSS and identifying partners who will participate in the monitoring and updating of national smart specializations; as a result of meetings and consultations, which reflect the demand of socio-economic partners, R+D+I areas were added two areas - *innovative technologies for processing and recovery of water and reducing its consumption*<sup>12</sup>, and *opto-electronic systems and materials*<sup>13</sup>, thus giving 18 national smart specializations.

e) conducting a SWOT analysis for the identified 18 national smart specializations.

**Then 18 national smart specializations (national priorities in the field of R+D+I) were grouped into five thematic areas:**

### **HEALTHY SOCIETY**

- 1. Medical engineering technologies, including medical biotechnologies*
- 2. Diagnosis and treatment of civilization diseases and personalized medicine*
- 3. Production of medicinal products*

### **AGRI-FOOD, FORESTRY-TIMBER AND ENVIRONMENTAL BIOECONOMY**

- 4. Innovative technologies, processes and products of the agri-food and forestry-timber industry*
- 5. Healthy food (high quality and organic production)*
- 6. Biotechnological processes and products of household chemistry and environmental engineering*

### **SUSTAINABLE ENERGY**

- 7. High efficiency, low-emission and integrated energy production, storage, transmission and distribution systems*
- 8. Smart and energy efficient construction*
- 9. Environmentally friendly transport solutions*

### **NATURAL RESOURCES AND WASTE MANAGEMENT**

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<sup>12</sup> Note of the Minister of the Environment on the basis of cooperation with socio-economic partners

<sup>13</sup> Note of the Optocluster, Institute of Applied Optics, the Polish Defence Holding (PCO SA), Warsaw University of Technology, Białystok University of Technology, Military University of Technology, Institute of Electronic Materials Technology, Polish Photonics Society on the basis of the arguments presented in terms of the potential of the above entities in conducting R+D and implementation in the field of optoelectronics and the competitive potential on foreign markets



10. *Modern technologies for sourcing, processing and use of natural resources and production of substitutes thereof*
11. *Minimising waste, including waste unfit for processing and use of waste for material and energy purposes (recycling and other recovery methods)*
12. *Innovative technologies for processing and recovery of water and reducing its consumption*

#### **INNOVATIVE TECHNOLOGIES AND INDUSTRIAL PROCESSES (IN HORIZONTAL APPROACH)**

13. *Multifunctional materials and composites with advanced properties, including nano-processes and nano-products*
14. *Sensors (including biosensors) and smart sensor networks*
15. *Smart grids and geo-information technologies*
16. *Electronic based on conducting polymers*
17. *Automation and robotics of technological processes*
18. *Optoelectronic systems and materials*

SWOT analysis has been performed on the stage of developing the project *Technology Foresight for Polish industry - InSight2030* in order to identify strengths and weaknesses and opportunities and threats for identified 10 research areas, where priority technologies were selected for the Polish industry.

SWOT analysis was performed as part of the document *National smart specialization* to determine the vision of development of specific specializations and adapting instruments to support them. Furthermore, the results of the SWOT analysis will be an important element in the process of monitoring and updating NSS, as well as in a continuous process of entrepreneurial discovery.



## SWOT analysis of identified 18 national smart specializations within five thematic areas

<b>HEALTHY SOCIETY</b> <i>Medical engineering technologies, including medical biotechnologies</i> <i>Diagnosis and treatment of civilization diseases and personalized medicine</i> <i>Manufacture of medicinal products</i>	
<b>Strengths</b> <ul style="list-style-type: none"> <li>-high quality of research results</li> <li>- high qualifications and experience of a significant part of scientific and technical staff</li> <li>-developed technical base for research at the stage of R+D</li> <li>- scientific capacity of the industry</li> <li>- high share of exports in production sold</li> <li>- high quality of products</li> <li>- investment in research infrastructure, which, especially in recent years, greatly strengthened the research and manufacturing capacity in this field</li> <li>- numerous scientific personnel</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- small number of hi-tech enterprises</li> <li>- lack of resources to finance investment</li> <li>- lack of integration processes among manufacturers</li> <li>- lack of mechanisms for knowledge transfer to industry, resulting in a small number of scientific studies with a commercial success</li> <li>- low level of expenditure on R+D sector</li> </ul>
<b>Opportunities</b> <ul style="list-style-type: none"> <li>- increase in spending on R+D sector</li> <li>-favourable national and EU policy on the industry</li> <li>-possibility of using the support of EU funds</li> <li>-increase in demand for solutions in the scope of medical services and products</li> <li>-expansion of the zone of prosperity and increasing awareness of own health in the world</li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>- permanent emigration of scientific personnel</li> <li>- great foreign competition in the field of technology</li> </ul>

<b>AGRI-FOOD, FORESTRY-TIMBER AND ENVIRONMENTAL BIOECONOMY</b> <i>Innovative technologies, processes and products of the agri-food and forestry-timber industry</i> <i>Healthy food (high quality and organic production)</i> <i>Biotechnological processes and products of household chemistry and environmental engineering</i>	
<b>Strengths</b> <ul style="list-style-type: none"> <li>- investment in research infrastructure, which, especially in recent years, greatly strengthened the research and manufacturing capacity in this field</li> <li>- highly organic production, healthy food produced with the principles of the so-called integrated production<sup>14</sup></li> <li>- a large reservoir of labour force in the countryside, which could be allocated to labour-intensive organic farming</li> <li>- significant production potential of agri-food sector, which is a key element of the system of food</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- low level of expenditure on R+D sector</li> <li>- lack of resources to finance investment</li> <li>- obsolete technical equipment of many farms</li> <li>- shortage of qualified managers to support commercialization of biotechnology products</li> <li>- high investment costs for green technologies and infrastructure and long waiting period for return on investment</li> </ul>

<sup>14</sup> it uses technical and biological progress in cultivation, plant protection and fertilization, and pays particular attention to the protection of the environment and human health.



<ul style="list-style-type: none"> <li>supply for the EU</li> <li>- well-developed advisory network</li> <li>- high level of expertise of engineers in growing organic food and biotechnology and their relatively great numbers</li> <li>- qualified staff of agri-food sector - a few dozen research units operating in the food supply system (of the agri-food sector) and a high level of R+D resources in agriculture and bioengineering</li> <li>- increase in the level of training in new technologies</li> <li>- strong ties to world science in some areas</li> <li>- numerous association ties of manufacturers and research units</li> <li>- high potential of institutes, universities and agricultural organizations</li> <li>- favourable, compared to the EU-27, age structure of farm owners</li> <li>- rich resource base (in agriculture and forestry)</li> </ul>	<ul style="list-style-type: none"> <li>- lower agricultural productivity for eco-technologies</li> <li>- economy based on small businesses do not have the accumulated capital, while banks and funds with capital are reluctant to invest in long-term studies</li> <li>- small private sector investments in research innovation regarding methods of crop and livestock production and new technologies and production equipment</li> <li>- lack of leading R+D centres in the field of biotechnology and lack of mechanisms of information flow between units involved in biotechnology</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>- possibility of using the support of EU funds</li> <li>- high susceptibility to innovation</li> <li>- large resources and values of the current environmental diversity in Poland and great importance applied to the conservation of biodiversity by the EU</li> <li>- low degree of degradation of the agricultural environment in comparison with the rest of the EU</li> <li>- expanding niche in the rich countries for agricultural products produced in organic farms (not using chemicals, etc.)</li> <li>- high position among the EU's priorities in the framework of programmes in support of research and entrepreneurship (7.RP/Horizon 2020, CIP/COSME) agri-food sector (food supply system) is supported by the European Commission also in the form of subsidies to producers (farmers)</li> <li>- very important for socio-economic development of non-urbanized Polish regions</li> <li>- promoting associations of entrepreneurs (farmers), producer groups, in many federations and associations</li> <li>- increasing environmental sensitivity of the public</li> <li>- orientation of plant and animal production on consumer safety</li> <li>- intensive investments in the modernization of farms and agricultural technologies</li> <li>- increase in demand for agricultural products in the main sectors of agriculture from the agri-food processing</li> <li>- continued growth in exports of agri-food products</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>- permanent emigration of scientific personnel</li> <li>- great foreign competition in the field of technology</li> <li>- research units do not fully exploit their potential to create value-added in the sector, often pursuing research without proper market analysis</li> <li>- strong competition (lobbying) from producers of traditional technologies</li> </ul>



## ***SUSTAINABLE ENERGY***

***High efficiency, low-emission and integrated energy production, storage, transmission and distribution systems***

***Smart and energy efficient construction***  
***Environmentally friendly transport solutions***

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>- investment in research infrastructure, which, especially in recent years, greatly strengthened the research and manufacturing capacity in this field</li> <li>- fuel base (availability of primary fuels and renewable energy sources, including relatively large biomass resources in the country)</li> <li>- scientific and project-related potential</li> <li>- proven financial and legal instruments that increased energy efficiency of energy production</li> <li>- consolidation trends in the fuel and energy industry to increase investment potential and stable development strategy of the national fuel and energy sector</li> <li>- good economic condition of gas and oil sector enterprises</li> <li>- high potential to improve energy efficiency of the production and use of energy, including development of energy-efficient construction</li> <li>- high level of technology in the construction corresponding to the European standards</li> <li>- qualified management and engineering staff</li> <li>- price competitiveness compared to other EU countries (common market)</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>- low level of expenditure on R+D sector</li> <li>- lack of resources to finance investment</li> <li>- the need for rapid adaptation of the Polish energy sector to environmental conditions and other relevant constraints associated with the current state of the energy sector, which encourages purchasing of ready-made solutions and avoiding the risks associated with the development of own technology</li> <li>- high investment costs and long payback period</li> <li>- lack of stability of economic and legal instruments that increase attractiveness of investing in renewable energy sources (no new law on RES expected by the market)</li> <li>- low efficiency of commercial power companies</li> <li>- high energy transmission losses resulting from aging infrastructure</li> <li>- limited possibilities of connecting new producers of electricity to the grid</li> <li>- lack of collaboration with the R+D sphere in the case of construction industry</li> <li>- development of whole regions based on traditional sources of energy production and use (e.g. Silesia)</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>- possibility of using the support of EU funds</li> <li>- high susceptibility to innovation</li> <li>- growing interest in alternative propulsion</li> <li>- high technical level of products and product technology</li> <li>- significant percentage of buildings requiring modernisation</li> <li>- large potential regional market and export opportunities</li> <li>- common energy policy within the European Union, which will increase the security of supply, facilitate investment in delivery infrastructure</li> <li>- development of clean coal technologies and energy storage technologies</li> <li>- the need for low-carbon transformation due to limited resources</li> <li>- improving competitiveness of the economy by lowering energy costs and the costs of investment activities</li> <li>- increasing environmental awareness and educational level of the public</li> <li>- strong ties and cooperation between science, design companies and the fuel and energy industry</li> <li>- inflow of external capital</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>- permanent emigration of scientific personnel</li> <li>- great foreign competition in the field of technology</li> <li>- risk for innovative projects due to high competition in the global market</li> <li>- increase in energy prices caused by investments in modern technologies for reducing GHG emissions</li> <li>- more strict criteria of accessibility to housing loans</li> </ul>



<ul style="list-style-type: none"> <li>- potential for development of means of transport</li> <li>- trend towards smart and green buildings (gradual reduction of costs associated with the use of highly effective materials and solutions)</li> <li>- growing demand for energy (use of biomass)</li> <li>- resource base (biomass) in rural areas</li> <li>- large investment needs in the energy sector - ability to direct funds to sustainable energy instead of directing them only to reconstruct the lost generation capacity</li> </ul>	
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### ***NATURAL RESOURCES AND WASTE MANAGEMENT***

*Modern technologies for sourcing, processing and use of natural resources and production of substitutes thereof*  
*Minimising waste, including waste unfit for processing and use of waste for material and energy purposes (recycling and other recovery methods)*  
*Innovative technologies for processing and recovery of water and reducing its consumption*

<b>Strengths</b> <ul style="list-style-type: none"> <li>- investment in research infrastructure, which, especially in recent years, greatly strengthened the research and manufacturing capacity in this field</li> <li>- large reserves of coal and lignite and some other minerals, such as copper</li> <li>- high state of identification of raw materials of the country, e.g. large number of proven reserves, development of detailed geological maps of Poland</li> <li>- potential in building modern facilities for waste management</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- low level of expenditure on R+D sector</li> <li>- lack of resources to finance investment</li> <li>- difficult procedure for obtaining a license for identification, exploration of resources, as well as the extraction of minerals</li> <li>- negative impact of technology for sourcing minerals on the environment</li> <li>- poor infrastructure facilities for the management of municipal waste</li> <li>- low resource efficiency of Polish industry</li> <li>- lowest water resources per capita in Europe</li> <li>- inadequate supervision and control over the flow of waste</li> </ul>
<b>Opportunities</b> <ul style="list-style-type: none"> <li>- possibility of using the support of EU funds</li> <li>- high susceptibility to innovation</li> <li>- developments of technologies for thermal recovery of waste, which should help solve the problem of waste disposal in Poland</li> <li>- development of the technology for efficient recovery of scarce elements from waste, as well as efficient recovery of energy</li> <li>- development of technologies related to shale gas</li> <li>- high level of development of techniques for sourcing, treatment and recovery of raw materials</li> <li>- new areas and ways to use coal</li> <li>- development of and compliance with the legal provisions obliging the use of resources from waste before natural resources</li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>- permanent emigration of scientific personnel</li> <li>- great foreign competition in the field of technology</li> </ul>

### ***INNOVATIVE TECHNOLOGIES AND INDUSTRIAL PROCESSES***

*Multifunctional materials and composites with advanced properties, including nano-processes and nano-products*



<p style="text-align: center;"> <i>Sensors (including biosensors) and smart sensor networks</i>  <i>Smart grids and geo-information technologies</i>  <i>Electronic based on conducting polymers</i>  <i>Automation and robotics of technological processes</i>  <i>Optoelectronic systems and materials</i> </p>	
<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>- investment in research infrastructure, which, especially in recent years, greatly strengthened the research and manufacturing capacity in this field</li> <li>- better performance of modern materials which reduce their consumption and reduce energy consumption in the economy</li> <li>- scientific capacity of the industry</li> <li>- high qualifications and experience of a significant part of scientific and research staff</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>- low level of expenditure on R+D sector</li> <li>- lack of resources to finance investment</li> <li>- lack of mechanisms for knowledge transfer to industry, resulting in a small number of scientific studies with a commercial success</li> <li>- lack of integration processes among entrepreneurs</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>- possibility of using the support of EU funds</li> <li>- high susceptibility to innovation</li> <li>- ability to use technology in virtually all fields of science, economy and in actions promoting safety, health and environment</li> <li>- strong and growing industrial demand resulting from the need to increase productivity and improve product quality</li> <li>- direct and strong impact of mechatronic technology on the development of economy</li> <li>- intense scientific cooperation with foreign centres</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>- permanent emigration of scientific personnel</li> <li>- great foreign competition in the field of technology</li> </ul>



## CHAPTER III - NATIONAL SMART SPECIALIZATIONS

### A. Description of national smart specializations

The first quarter of 2014 will see organisation of meetings with experts of 18 Working Groups for NSS, where each area of R+D+I will be detailed. The aim is to ensure the uniqueness of interpretation of the substantive scope of individual specializations and allow for indication of relationships between national and regional specializations. The process of describing smart specializations, actively engaging entrepreneurs and other stakeholders, has been initiated at meetings with entrepreneurs, representatives of research institutes and business environment institutions and government representatives, organized by the Ministry of Economy in September 2013. This part will be updated with examples of best practices and success stories within each specialization.

### B. Strategic and detailed objectives of NSS

*National smart specialization* has been developed in order to concentrate support on areas where development will contribute to the growth of innovation and improvement in the competitiveness of Polish economy.

Actions taken under the NSS are part of the EU's growth strategy *Europe 2020*, which implements the objectives in terms of employment, innovation, education, social inclusion, climate change and energy policy to be achieved by 2020. In these areas, Poland determined the following objectives to be achieved, which are included in the *National Reform Programme (NRP)*:

- **target for employment** (employment rate - 71%)
- **target for expenditure on R+D** (investments in R+D - 1.7% of GDP)
- **energy targets** (14% - target for reducing CO2 emissions<sup>15</sup>, 15% target share of energy from renewable sources in gross final energy consumption<sup>16</sup>, 13.6 Mtoe - projected primary energy savings cumulatively in 2010-2020<sup>17</sup>)
- **education targets** (dropping out - 4.5%, higher education - 45%)
- **anti-poverty targets** (reducing the number of population at risk of poverty or social exclusion – 1,500,000)

In addition, NSS is part of strategic objectives set out in the *National Strategy for Innovation and Economic Efficiency (SIEE)* for which the Enterprise Development Programme is an executive document, i.e.

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<sup>15</sup> National targets for emission cuts set out in Decision 2009/406/EC (also called "the decision on the common reduction effort"), relate to emissions not covered by the emissions trading system.

<sup>16</sup> Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

<sup>17</sup> National Reform Programme for the implementation of the strategy "Europe 2020". Update of 2012/2013, adopted by the Council of Ministers on 25 April 2012



- **adjustment of the regulatory and financial environment to the needs of innovative activity**
- **ensuring adequate resources of knowledge and work for the economy**
- **increase in efficiency of use of natural resources and raw materials**
- **increase in the internationalization of the Polish economy.**

Monitoring work will be carried out for the implementation of the above-identified targets through development and implementation of national smart specializations, using the indicators set out in the above strategies.

Furthermore, specific objectives and activities to be implemented within specific areas of R+D+I will be formulated as a result of the description of national smart specializations and the activities of individual Working Groups for NSS, also with regard to the SWOT analysis.

### **C. NSS implementation system**

The manner of including areas of smart specialization in support instruments for R+D+I implemented by 2020 is shown below.

Implementation of *National smart specialization* will take place both through the implementation of national programmes (e.g. NCRD, PAED projects) and with the use of EU funds under the operational programmes, mainly OP SG.

One should also take into account the adaptation of research infrastructure to the development of R+D+I areas identified in the NSS, including adaptation of projects under the *Polish Roadmap for Research Infrastructure*.<sup>18</sup>

Supporting the development of smart specialization will be done through preferential treatment of R+D+I areas, defined as national smart specializations, in competitions conducted under national programmes and the OP SG, giving them extra points when assessing applications. In addition, it is planned to launch additional programmes for entrepreneurs, dedicated to the development of smart specializations.

## **Chapter IV - MONITORING AND UPDATING**

### **A. Monitoring system**

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<sup>18</sup> Detailed rules for the financing of research infrastructure are specified in Annex 4



Development of a system for monitoring the *National smart specialization* aims to assess the accuracy of the definition of national smart specializations and the progress of activities conducted for the benefit of their development. The results of monitoring will also provide a basis for updating them. Monitoring shall also include observation of economic change, the degree of achievement of indicators and performance targets and identification of new emerging competitive advantages of the country.

Monitoring the implementation of activities and the degree of achieved results will take place on an ongoing basis.

Monitoring of the implementation of activities and updating of national smart specialization will take into account, *inter alia*

- results of competitions for key clusters, which are territorial clusters of economic activity of particular importance for the country,
- changes in the structure of export and investment of companies,
- implementation of research results, their dissemination and commercialization,
- increase in research capacity in enterprises,
- emerging niche markets,
- results of scientific studies and research,
- effects of projects under the OP IE and OP SG,
- results of the economic observatory (selected business representatives)
- change in the structure of employment in the areas of specialization.

Developed monitoring indicators will be based on the indicators included in *Europe 2020* and *SIEE*, and will take into account existing national and regional monitoring systems in the area of smart specialization and innovation policy.

This system will consist of the following elements:

a) **IT platform, which will be basis for the monitoring system**

system to monitor the results of implementation of national smart specializations and conduct quantitative analysis of socio-economic data (based on the updated results of Technology Foresight for Polish industry, projects in clusters and OP IE 2007-2013, OP ID 2014-2020, statistical data of CSO from portals STRATEG, INSIGOS, PIK and others) **[implementation: ME in collaboration with PAED]**

b) **Steering Committee (SC)**



management entity whose task is to strategically manage and control the process of NSS implementation in order to achieve the projected outcomes and strategic and detailed objectives, its role will be also to select experts to WG on NSS **[implementation: ME]**

c) **Consultative Group (CG)**

advisory entity, composed of representatives of government, involved in the implementation of smart specializations, responsible for making recommendations on the implementation and monitoring of smart specializations and recommending changes to SC as regards the shape of national smart specializations **[implementation: ME]**

d) **Economic Observatory (EO)**

entity established for qualitative analysis of available and developing R+D+I potential in Poland, among others, identification of barriers, risks and opportunities and market niches, development trends, observation of positively completed implementations of results of R+D, preparation of periodic reports on the implementation of NSS, current level of innovation and change in the structure of the economy; the observatory will include representatives of companies, business environment institutions and business organizations (in order to ensure adequate voice of entrepreneurs)

**[implementation: ME in collaboration with PAED]**

e) **Working Groups for domestic smart specializations (WG)**

bodies established in the areas of national smart specializations to monitor performance and status of implementation of different strategic and detailed objectives through the development of given specialization; WG will be responsible for reporting to the SC about development of specialization and recommending changes to the implementation system or specializations **[implementation: ME]**

f) **Regional Forum for Smart Specialization (RFSS)**

platform for dialogue at EU, national and regional level, whose aim is to exchange experience and information in the area of smart specialization; the forum is comprised of representatives of 16 Marshal Offices, the Ministry of Economy, the Ministry of Infrastructure and Development, the Ministry of Science and Higher Education, involved in the process of selecting specializations and implementation of programmes in the field of smart specialization, as well as representatives of the European Commission and the World Bank, indicating recommendations for the improvement of smart specialization process in Poland

## **B. Updating national smart specializations**

National smart specializations are a process subject to continuous monitoring and responding to changing external factors. With this in mind, where the monitoring process shows the need to



redefine already defined specializations or the emergence of potential new ones, the work will be done to supplement and update identified specializations.

It is planned to carry out the annual update of national smart specializations. Moreover, based on the recommendations of the Consultative Group, in case there is a need to modify smart specializations, the system provides for its conduct on an ad hoc basis.

The process of developing smart specializations, their implementation and the emergence of new areas of R+D+I is a dynamic process, so the system of updating is adapted to respond quickly to changing factors and socio-economic environmental, including to verify, correct and update records.

Any changes in the implementation of the *National smart specialization* and specific priorities in the area of R+D+I will be subject to approval of the Steering Committee in the manner specified in the rules of the Committee's work. In addition, information about updating the document will be provided to stakeholders of the process through the website of the Ministry of Economy and the NSS website.

## **CHAPTER V - RELATIONSHIP OF NATIONAL AND REGIONAL SMART SPECIALIZATIONS**

Poland adopted the principle that smart specializations will be determined both at the national and regional levels, but it should be emphasized that the work on identifying them were conducted



independently, i.e. it was not accepted that national smart specialization prevail over specializations defined at the regional level.

The progress of work on defining regional smart specializations varies, however, it is worth noting that it notes the convergence of specialization selected at national and regional level, which suggests that both approaches indicated real specializations aimed at developing the economy of the whole country.

To ensure the proper development of the various regions and the entire national economy, it is necessary to exchange experiences on national and regional level, as well as to conduct a joint process of monitoring and updating. This is the purpose of **meetings initiated by the Ministry of Infrastructure and Development with representatives of the Ministry of Economy, Ministry of Science and Higher Education, the World Bank, the European Commission, as well as 16 Marshal Offices**. Works in cooperation include, among others, developing principles for the implementation, monitoring and updating of the *National smart specialization*. It should be emphasized that the processes of monitoring and updating on national and regional level will be closely related, and financial supports from EU funds at national and regional level will complement each other.

Moreover, the Marshal of Kujawsko-Pomorskie Voivodeship created the **Regional Forum for Smart Specialisation**, in which experiences will be exchanged with regard to the implementation of national and regional smart specializations, which will allow for effective coordination and consistency of interventions.

After final development of 16 regional strategies for smart specialization we will draw a map indicating **geographical location of national and regional smart specializations in Poland** and identify entities directly associated with the development of the area of R+D+I and its place in the value chain.



## Annex 1 - Quantitative analyses

<b>Analysis of export potential in industry (2011-2012) – goods characterized by export - according to the highest value of exports on an annual basis for 2011 and 2012 (<i>Insigos data</i>)</b>			
<b>Name</b>	<b>PKD<sup>19</sup></b>	<b>2012 [PLN]</b>	<b>2011 [PLN]</b>
Mechanical and electrical equipment for recording and reception of sound	Section 28 - Production of machinery and equipment	1,41479	1,31642
Nuclear reactors, boilers, machinery and mechanical appliances and parts thereof	Section 28 - Production of machinery and equipment	75 208 038 697	68 638 488 313
Electrical machinery and equipment, sound and image recorders and reproducers, and parts thereof	Section 26 - Manufacture of computers, electronic and optical products	66 270 961 294	63 003 470 873
Non-rail vehicles and parts and accessories thereof	Section 29 - Manufacture of motor vehicles, trailers and semi-trailers, with the exception of motorcycles	67 333 661 728	7 0434 985 667
Furniture, bedding, mattresses, etc., lamps, neon signs, etc.;	Section 31 Manufacture of furniture	30 919 491 784	29 775 723 964
Mineral fuels, mineral oils and products of their distillation; bituminous substances, mineral waxes	Section 19 Manufacture and processing of coke and refined petroleum products	29 411 813 405	27 087 629 039
Plastics and articles thereof	Section 22 Manufacture of plastic products	26 359 652 146	24 349 962 792
Articles of iron and steel	Section 24 Manufacture of metals	20 860 132 389	19 364 452 246
Textiles and textile articles	Section 13 Manufacture of textiles	18 595 562 728	17 867 960 481
Rubber and rubber products	Section 20 Production of chemicals and chemical products	15 549 689 876	15 040 393 986
<b>Exports by sections and part of PKD (current prices) <i>Statistical Yearbook of Industry</i></b>			
<b>Name</b>		<b>2010 [PLN]</b>	<b>2011 [PLN]</b>
Manufacture of motor vehicles, trailers and semi-trailers		73 423,2	85 749,9
Manufacture of food products		28 177,7	33 296,1
Manufacture of electrical equipment		26 960,4	27 592,2
Manufacture of rubber and plastic products		21 610,4	26 606,2

<sup>19</sup> Own assignment, ME



Manufacture of metal products	20 040,7	25 399,5
Production of chemicals and chemical products	16 730,7	20 872,9
Manufacture of computers, electronic and optical products	21 312,3	19 742,2
Manufacture of furniture	14 285,0	18014,0
Manufacture of machinery and equipment	15406,8	16190,3
Manufacture of other transport equipment	12895,3	14996,6
<b>Changes in gross and net exports in EUR in the period from 2000 to 2012 (according to CSO) – by growth of exports <i>data from Insigos system</i></b>		
Name	PKD <sup>20</sup>	Growth of exports
Cereals	Section 01 - Agriculture, animal husbandry, hunting	20 178,3
Tin and articles thereof	Section 24 Manufacture of metals	11 968,2
Tobacco and manufactured tobacco substitutes	Section 12 Manufacture of tobacco products	2 090,4
Miscellaneous manufactured articles	Section 32 Manufacture of other products	1 691,1
Other base metals, cermetes and goods made of these materials	Section 24 Manufacture of metals	1 570,6
Meat and edible meat offal	Section 10 Manufacture of food products	1 314,1
Pharmaceutical products	Section 21 Manufacture of basic pharmaceutical products and medicines and other pharmaceutical products	1 288,7
Miscellaneous chemical products	Section 20 Production of chemicals and chemical products	1 133,6
Fats, animal and vegetable oils, products of their decomposition; edible fats, animal and vegetable waxes	Section 10 Manufacture of food products	1 057,6
Residues and waste from the food industry; prepared animal fodder	Section 10 Manufacture of food products	1 002,0

<sup>20</sup> Own assignment, ME



<b>Gross value added of industry by sections and parts (current prices) - <i>Industry Statistical Yearbook 2012</i></b>				
<b>Name</b>	<b>2005</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Manufacture of food products	23 734,1	33 079,0	32 905,1	33 084,3
Manufacture of metal products	13 122,2	211 335,0	21 466,6	25 890,7
Manufacture of motor vehicles, trailers and semi-trailers	12 279,0	15 858,8	14 997,9	19 201,5
Mining of coal and lignite	14 770,4	15953,9	16 159,4	19 115,2
Manufacture of rubber and plastic products	9 838,6	14 655,6	15 222,4	16 803,7
Manufacture of other non-metallic mineral products	10 556,8	14 691,7	13 638,5	15 064,6
Production of chemicals and chemical products	8 409,0	9 315,6	10 408,4	12 897,2
Manufacture of machinery and equipment	8 260,7	14 108,6	12 293,7	11 836,9
Repair, maintenance and installation of machinery and equipment	6 763,1	6 929,6	7 583,5	10 427,7
Manufacture of electrical equipment	5 903,8	9 280,0	8917,3	9 497,8
<b>Internal expenditure on research and development (R+D) and scientific research equipment in the industry by sections and parts - <i>Industry Statistical Yearbook 2012</i></b>				
<b>Name</b>	<b>Total internal expenditures (in million PLN)</b>			
Manufacture of pharmaceutical products	187,5			
Manufacture of metal products	170,3			
Manufacture of machinery and equipment	166,7			
Manufacture of other transport equipment	138,0			
Production of chemicals and chemical products	111,1			
Manufacture of computers, electronic and optical products	112,8			



Manufacture of motor vehicles, trailers and semi-trailers	97,0
Manufacture of rubber and plastic products	94,1
Manufacture of other products	91,2
Manufacture of food products	73,8
<b>Innovative companies in the field of product and process innovations in the industry by size, sections and parts in 2009-2011 - <i>Industry Statistical Yearbook 2012</i></b>	
<b>Name</b>	<b>in % of total enterprises</b>
Manufacture of coke and refined petroleum products	90,5
Manufacture of pharmaceutical products	82,0
Mining of coal	52,9
Production of chemicals and chemical products	63,9
Manufacture of electrical equipment	57,3
Manufacture of machinery and equipment	53,0
Metal production	51,5
Production of beverages	47,9
Manufacture of computers, electronic and optical products	46,9
Manufacture of tobacco products	44,4
<b>Expenditures on innovation in terms of product and process innovations in the industry - <i>Industry Statistical Yearbook 2012</i></b>	
<b>Name</b>	<b>Expenditure in PLN million</b>
Manufacture of motor vehicles, trailers and semi-trailers	2915,5



Manufacture of food products	1168,0		
Manufacture of metal products	1037,8		
Production of chemicals and chemical products	1006,6		
Manufacture of rubber and plastic products	845,6		
Manufacture of electrical equipment	841,9		
Manufacture of machinery and equipment	826,8		
Manufacture of other non-metallic mineral products	773,6		
Metal production	666,8		
Collection, treatment and supply of water	556,3		
Structure of sold production of industrial products in industrial processing section by levels of technology Industry Statistical Yearbook 2012 (percentage share of production in a given sector in total production)			
Name	in percentage		
High technology	2009	2010	2011
Manufacture of pharmaceutical products	1,5	1,5	1,2
Manufacture of computers, electronic and optical products	4,1	5,0	3,8
Manufacture of aircraft and spacecraft	0,3	0,3	0,4
Inventions filed with the Polish Patent Office and granted patents by ranges of knowledge of the International Patent Classification in 2011 - <i>Science and Technology in 2011</i>			
	Inventions submitted	Patents submitted	PKD <sup>21</sup>

<sup>21</sup> Own assignment, ME



<b>chemistry, metallurgy</b>	<b>790</b>	<b>602</b>	<b>Section 20 Production of chemicals and chemical products</b>
<b>various industrial processes, transportation</b>	<b>737</b>	<b>385</b>	<b>Section 49 Land transport and transport via pipelines / Section 50 Water transportation / Section 51 Air transport/ Section 52 Warehousing and support activities for transportation</b>
<b>basic human needs</b>	<b>501</b>	<b>219</b>	<b>unclassified</b>
<b>physics</b>	<b>477</b>	<b>250</b>	<b>unclassified</b>
<b>unclassified</b>	<b>415</b>		<b>unclassified</b>
<b>engineering, lighting, heating, equipment, explosives</b>	<b>387</b>	<b>245</b>	<b>Section 28 Production of machinery and equipment</b>
<b>construction, mining</b>	<b>318</b>	<b>171</b>	<b>Section 05 Mining of coal and lignite Entire Section F</b>
<b>electrotechnics</b>	<b>207</b>	<b>113</b>	<b>Section 26 Manufacture of computers, electronic and optical products</b>
<b>textiles, papermaking</b>	<b>46</b>	<b>4</b>	<b>Section 13 Manufacture of textiles / Section 17 Manufacture of paper and paper products</b>



Number of inventions submitted by Polish residents in the European Patent Office by categories of the International Patent Classification		
	PKD <sup>22</sup>	Inventions submitted
basic human needs	unclassified	43,9
chemistry, metallurgy	Section 20 Production of chemicals and chemical products	42,1
physics	unclassified	37,5
various industrial processes, transportation	unclassified	34,7
engineering, lighting, heating, equipment, explosives	Section 28 Production of machinery and equipment	27,3
electrotechnics	Section 26 Manufacture of computers, electronic and optical products	25,5
construction, mining	Section 05 Mining of coal and lignite Entire Section F	17,0
textiles, papermaking	Section 13 Manufacture of textiles / Section 17 Manufacture of paper and paper products	3,8

\* according to the method of molecular calculation

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<sup>22</sup> Own assignment, ME



<b>Employed persons by employment status, sections and parts (as of 31.12.2011) - Employment in national economy in 2011</b>	
<b>Name</b>	<b>Total</b>
<b>Agriculture, animal husbandry, hunting</b>	<b>2 325 605</b>
<b>Health care</b>	<b>607 116</b>
<b>Land and pipeline transport</b>	<b>491 459</b>
<b>Manufacture of food products</b>	<b>406 960</b>
<b>Specialized construction works</b>	<b>401 197</b>
<b>Construction of buildings</b>	<b>320 171</b>
<b>Manufacture of metal products</b>	<b>290 147</b>
<b>Construction of buildings and civil engineering structures</b>	<b>187 870</b>
<b>Manufacture of rubber and plastic products</b>	<b>176 814</b>
<b>Manufacture of furniture</b>	<b>159 425</b>

<b>Industrial enterprises active in innovation field in 2009-2011 by PKD sections - Innovation activities of enterprises in 2009-2011</b>	
<b>Name</b>	<b>%</b>
<b>Manufacture of pharmaceutical products</b>	<b>56,9</b>
<b>Manufacture of coke and refined petroleum products</b>	<b>50,0</b>
<b>Mining of coal and lignite</b>	<b>50,0</b>
<b>Production of chemicals and chemical products</b>	<b>45,7</b>
<b>Manufacture of computers, electronic and optical products</b>	<b>36,3</b>



Manufacture of motor vehicles, trailers and semi-trailers	35,2
Manufacture of tobacco products	33,3
Manufacture of machinery and equipment	30,6
Manufacture of electrical equipment	29,9
Metal production	29,3

**Share of revenues from sales of new or significantly improved products in industrial enterprises in total sales revenue in total by PKD sections in 2011 - *Innovation activities of enterprises in 2009-2011***

Name	%
Manufacture of other transport equipment	21,5
Manufacture of motor vehicles, trailers and semi-trailers	19,5
Manufacture of coke and refined petroleum products	16,6
Manufacture of machinery and equipment	15,0
Manufacture of electrical equipment	14,3
manufacture of paper and paper products	11,5
Production of chemicals and chemical products	11,4
Repair, maintenance and installation of machinery and equipment	10,2
Manufacture of furniture	9,5
Manufacture of tobacco products	9,5
Manufacture of metal products	9,5
Manufacture of computers, electronic and optical products	9,5
Manufacture of other products	9,5



<b>Enterprises from the industrial processing sector, which in 2009-2011 cooperated in the field of innovative activity in% of industrial processing companies active in innovations by PKD - <i>Innovation activities of enterprises in 2009-2011</i></b>	
<b>Name</b>	<b>%</b>
Manufacture of tobacco products	75,0
Manufacture of coke and refined petroleum products	72,7
Metal production	59,7
Manufacture of electrical equipment	56,7
Manufacture of pharmaceutical devices	51,8
Manufacture of machinery and equipment	48,4
Manufacture of computers, electronic and optical products	44,7
Production of chemicals and chemical products	43,5
Manufacture of motor vehicles, trailers and semi-trailers	41,4
Repair, maintenance and installation of machinery and equipment	38,2
Manufacture of other non-metallic mineral products	32,5
Manufacture of paper and paper products	30,8
Manufacture of rubber and plastic products	30,2



## Annex 2 - Qualitative analyses

Projects under OP IE 2007-2013 (number of projects)	Cooperative relations - clusters	Projects implemented under the 7th Framework Programme	Regional smart specializations (based on MRD material)	NCRD sectoral programmes	Projects implemented under the Polish Roadmap for Research Infrastructure	Projects implemented in the field of creative and culture industries <sup>23</sup>	Projects in the area of defence (dual use technologies)	Areas identified in the project <i>Food and nutrition in the 21st century</i>
chemical and pharmaceutical industry, ceramics and processing of non- metallic materials (831)	renewable energy / energy (32)	PEOPLE (271) - development of human resources	low carbon energy / renewable energy sources (9)	INNOLOT – aviation industry	Development of science through basic research (7)			
electrical equipment, manufacture of machinery and equipment (452)	ICT/IT (29)	ICT (215)	computing/ICT (9)	INNOMED – medical industry	Development of science through interdisciplinary research (5)			
manufacture of basic metals and fabricated metal products (except machinery and equipment) (419)	tourism and construction (23)	NMP (142) - nano-sciences, nano- technologies, materials and new production technologies	medical and health services / pharmacy (7)	BlueGas – Polish shale gas	High quality of life in society (1)			
other sections (344)	food sector (18)	TPT (137) - transport	production of high quality food (7)	GRAF-TECH - use of graphene	Effective health care and increase in the effectiveness of health promotion activities (5)			

<sup>23</sup> To be completed in collaboration with the MCNH.



<b>wood products (excluding furniture), papermaking and printing (223)</b>	<b>metal and mechanical sector (17)</b>	<b>SME (129) - Research for SMEs</b>	<b>automotive, transport equipment (6)</b>	<b>GEKON - environmentally friendly technologies</b>	<b>Raising increase in the effectiveness of production, storage and transmission of energy (4)</b>			
<b>manufacture of computers, electronic and optical products (199)</b>	<b>medical sector, biotechnology, pharmaceuticals (13)</b>	<b>INFRA (127) - research infrastructures</b>	<b>automation (6)</b>		<b>Development of advanced materials and technologies (3)</b>			
<b>clothing, textiles, leather products (149)</b>	<b>business services (11 clusters),</b>	<b>KBBE (93) - food, agriculture, fisheries and biotechnology</b>	<b>life science/bioeconomy (4)</b>		<b>Development of smart systems and infrastructure (2)</b>			
<b>food industry (145)</b>	<b>timber, furniture sector (9)</b>	<b>HEALTH (92) - health</b>	<b>machine/metal sector (4)</b>		<b>Ensuring sustainable development of natural environment and human environment (6)</b>			
<b>manufacture of vehicles (142)</b>	<b>aviation sector (8)</b>	<b>ENV (91) - environment</b>	<b>energy industry (4)</b>					
<b>Specialized construction works (100)</b>	<b>chemical sector (7)</b>	<b>SEC (62) – security</b>	<b>chemical sector (4)</b>					
			<b>advanced construction materials (4)</b>					



## Projects under OP IE 2007-2013

Analysed measures of the Operational Programme Innovative Economy 2007-2013:

- 1.4. Support for goal-oriented projects,
- 4.1. Support for implementation of results of R+D works,
- 4.2. Stimulation of R&D activity of enterprises and support in the scope of industrial design,
- 4.4. New investments of high innovative potential,
- 6.1. Passport to export,
- 3.1 Initiating of innovative activity
- 5.1. Support for development of supra-regional cooperative relations
- 5.2. Supporting business environment institutions providing proinnovative services and their networks of supra-regional importance,
- 5.3. Support for innovation centres.

### Methodology:

The analysis covered 6,251 projects under the above measures of the OP IE, i.e. 5,738 projects under measures 1.4-4.1, 4.2, 4.4, 6.1, 82 projects under measure 3.1, 32 projects under Measure 5.1, 33 projects – under measure 5.2 (and 5.2 - systemic) and 13 projects under measure 5.3.

Each project was analyzed in terms of project's industry, as defined by PKD code, according to the classification of 2007 (in the case of PKD code of 2004, changes were made to correct the code by using CSO link keys).

Areas in particular voivodeships were distinguished on the basis of the largest number of projects within defined sections and groups<sup>24</sup> in various voivodeships.

## Dolnośląskie

1. Industrial processing (192 projects) including:

<sup>24</sup> Section A - Agriculture, forestry, hunting and fishing

Section B - Mining and quarrying

Section C – Industrial processing

- Food industry (sections 10-12),
- Clothing, textiles, leather products (sections 13÷15)
- Wood products (excluding furniture), papermaking and printing (sections 16÷18)
- Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23)
- Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25)
- Manufacture of computers, electronic and optical products (section 26)
- Electrical equipment, manufacture of machinery and equipment (sections 27÷28)
- Manufacture of vehicles (sections 29÷30)
- Other sections 31-33

Section D and E (Section D - production and supply of electricity, gas, steam, hot water and air for air conditioning and Section E - water supply; sewerage and waste management and reclamation activities),

Section F - Construction

Section G - Wholesale and retail trade; repair of motor vehicles and motorcycles

Section H - Transportation and storage

Section I - Activities related to accommodation and food service

Section J – information and communication, including ICT 61-62

Section K - Financial and insurance activities

Section L - Activities associated with real estate services

Section M - Professional, scientific and technical activities

Section N - Activity in administration services and support activities

Section P - Education

Section Q - Health care and social work

Section R - Activities related to culture, entertainment and recreation

Section S - Other service activities



- Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) - 59 projects, in particular the **chemical industry** (27), **production of plastic products** (14)
  - Electrical equipment, manufacture of machinery and equipment (sections 27 ÷ 28) - 34 projects, in particular the **manufacture of special purpose machinery** (13),
  - **Manufacture of computers, electronic and optical products** (15)
  - **Food industry** (9),
2. **Information and communication** - 71 projects including 40 **ICT** projects,
  3. Wholesale and retail trade; repair of motor vehicles and motorcycles - 61 projects,
  4. **Professional, scientific and technical activities** - 41 projects,
  5. **Activities related to accommodation and food service** - 7 projects.

## Kujawsko-Pomorskie

1. Industrial processing (156 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) - 46 projects, in particular **production of plastic products** (32)
  - **Manufacture of basic metals and fabricated metal products** (except machinery and equipment) (sections 24÷25) – 31 projects,
  - Electrical equipment, manufacture of machinery and equipment (sections 27 ÷ 28) – 22 projects, in particular the manufacture of general purpose and agricultural machinery – 16 projects,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 42 projects.

## Lubelskie

1. Industrial processing (82 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) – 23 projects, in particular the **production of chemicals and chemical products** (11)
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 11 projects, in particular **manufacture of machines** (11),
2. Professional, scientific and technical activities - 19 projects,

## Lubuskie

1. Industrial processing (72 projects) including:
  - Electrical equipment, manufacture of machinery and equipment (sections 27 ÷ 28) – 15 projects, in particular the manufacture of general purpose and agricultural machinery,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 25 projects.

## Łódzkie

1. Industrial processing (**180 projects**) including:
  - Clothes, textiles, leather goods (sections 13 ÷ 15) - 32 projects, specializing in the preparation and spinning of textile, production of garment,
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) - 55 projects, specializing in the **production of chemicals** (including paints, varnishes, soap, fertilizers), **plastic products, manufacture of pharmaceuticals**,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 50 projects.
3. **ICT** sector – 19 projects.

## Małopolskie

1. Industrial processing (306 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) – 93 projects, specializing in the **production of chemicals** (including paints, varnishes, soap, fertilizers) and **plastic products**,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 49 projects,
  - Electrical equipment, manufacture of machinery and equipment (sections 27 ÷ 28) – 40 projects, in particular the **manufacture of specialized and general purpose machinery**,
  - Wooden products (excluding furniture), papermaking and printing (sections 16 ÷ 18) - 23 projects, specializing in **the production of wood, pulp, paper, paperboard**,
  - Manufacture of computers, electronic and optical products (section 26) – 24 projects



- Manufacture of parts and accessories for motor vehicles - 14 projects,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 106 projects,
  3. Information and communication - 156 projects, in particular **ICT** and **publishing**,
  4. Professional, scientific and technical activities - 125 projects, specializing in the field of **architecture and engineering and related consultancy, research and analysis and R+D in the field of natural sciences and engineering**,
  5. Other education - 9 projects (distinguished by the number of projects in comparison to other voivodeships, second place after Mazowieckie Voivodeship - 13 projects)
  6. Health care - 21 projects (distinguished by the number of projects in comparison to other voivodeships, second place after Mazowieckie Voivodeship - 22 projects)
  7. Activities related to accommodation and food service - 7 projects (distinguished by the number of projects in comparison to other voivodeships).

## Mazowieckie

1. Industrial processing (463 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 146 projects, specialization: **chemicals** (soap, detergents, varnishes, paints), **manufacture of plastic products**,
  - Food industry (sections 10-12) - 32 projects,
  - Wooden products (excluding furniture), papermaking and printing (sections 16 ÷ 18) – 38 projects, specialization: **production of wood, pulp, paper, paperboard, printing activity**,
  - Clothing, textiles, leather products (sections 13÷15) – 21 projects,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 58 projects,
  - Manufacture of computers, electronic and optical products (section 26) – 42 projects,
  - Electrical equipment, manufacture of machinery and equipment (sections 27÷28) – 51 projects,
  - Other (sections 31-33) - in particular Manufacture of medical equipment, instruments and products, including dental products - 29 projects,
2. Professional, scientific and technical activities - 250 projects, specializing in the field of architecture and engineering and related consultancy, research and analysis and R+D in the field of natural sciences and engineering, consulting in management, advertising, market research and public opinion,
3. Wholesale and retail trade; repair of motor vehicles and motorcycles - 223 projects,
4. Information and communication - 227 projects, in particular ICT and publishing,
5. Construction - 51 projects,
6. Activity in administration services and support activities - 43 projects,

## Opolskie

1. Industrial processing (81) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) – 29 projects, in particular **production of plastic products**,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 20 projects,

## Podkarpackie

1. Industrial processing (226 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 85 projects, specialization: **manufacture of articles from plastic, glass, ceramic materials, concrete, plaster**,
  - Electrical equipment, manufacture of machinery and equipment (sections 27÷28) – 35 projects,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 33 projects,
  - Manufacture of parts and accessories for motor vehicles - 9 projects
2. Information and communication - 39 projects, in particular ICT,
3. Wholesale and retail trade; repair of motor vehicles and motorcycles - 36 projects,
4. Professional, scientific and technical activities - 26 projects,
5. Construction - 17 projects.

## Podlaskie

1. Industrial processing (63 projects) including:
  - Manufacture of computers, electronic and optical products (section 26) – 11 projects, specialization: **manufacture of instruments and appliances for measuring, control and navigation; manufacture of watches and clocks**,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 16 projects.

## Pomorskie



1. Industrial processing (223 projects) including:
  - Electrical equipment, manufacture of machinery and equipment (sections 27 ÷ 28) - 53 projects, specializing in **manufacture of lighting equipment and machinery**,
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 48 projects, in particular: **manufacture of plastic products**,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 30 projects,
  - Other sections 31-33 - 33 projects, specialization: **manufacture of furniture** - 15 projects
  - manufacture of ships and boats,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 82 projects,
3. Information and communication - 58 projects, in particular ICT,
4. Professional, scientific and technical activities - 39 projects,

## Śląskie

1. Industrial processing (283 projects) including:
  - Electrical equipment, manufacture of machinery and equipment (sections 27÷28) – 65 projects,
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19 ÷ 23) – 64 projects, specialization **manufacture of plastic products**,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 52 projects, specialization **manufacture of metal constructions elements and processing of metals**,
  - Manufacture of motor vehicles (sections 29-30) - 23 projects - specialization: **manufacture of parts for motor vehicles, manufacture of aircraft, spacecraft, manufacture of railway locomotives**,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 107 projects,
3. Information and communication - 72 projects, in particular ICT,
4. Professional, scientific and technical activity - 70 projects, specializing in R+D in the field of natural sciences and engineering,
5. Construction - 23 projects,

## Świętokrzyskie

1. Industrial processing (73 projects) including:
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 18 projects,
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 16 projects,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 16 projects.

## Warmińsko-Mazurskie

1. Industrial processing (63 projects) including:
  - Electrical equipment, manufacture of machinery and equipment (sections 27÷28) – 16 projects,
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 15 projects,

## Wielkopolskie

1. Industrial processing (372 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 104 projects, specialization: **production of chemicals, manufacture of plastic products**,
  - wood products (excluding furniture), papermaking and printing (sections 16÷18) – 40 projects,
  - Manufacture of basic metals and fabricated metal products (except machinery and equipment) (sections 24÷25) – 45 projects,
  - Electrical equipment, manufacture of machinery and equipment (sections 27÷28) – 49 projects, specialization manufacture of machines,
  - Manufacture of furniture - 22 projects
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 139 projects,
3. Information and communication - 95 projects, in particular ICT,
4. Professional, scientific and technical activity - 83 projects, specializing in R+D in the field of natural and technical sciences and management consultancy.

## Zachodniopomorskie



1. Industrial processing (70 projects) including:
  - Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (sections 19÷23) – 22 projects,
2. Wholesale and retail trade; repair of motor vehicles and motorcycles - 26 projects.
3. Information and communication - 23 projects, in particular ICT,
4. Professional, scientific and technical activities - 23 projects,

Overall results of the analysis of all these activities are summarized in the following table.



Specialized construction works	9	3	1	6	2	10	29	2	10	1	8	5	3		9	2	100
Construction of buildings	3	7	2			6	16		3	2	8	8	1		4	4	64
Construction of civil engineering structures	3	3	4	2	1	3	6		4	1	3	10	2	rskie	6	2	50
Section G Wholesale and retail trade; repair of motor vehicles and motorcycles	61	42	12	23	50	104	223	12	39	17	82	107	16	6	139	26	959
Section H - Transportation and storage,	Dolnośląskie	Kujawsko-Pomorskie	Lubelskie	Lubuskie	Łódzkie	Małopolskie	Mazowieckie	Opolskie	Podkarpackie	Podlaskie	Pomorskie	Śląskie	Świętokrzyskie	Warmińsko-Mazurskie	Wielkopolskie	Zachodniopomorskie	Total
	3	3		2	1	3	14		1	2	3	4	2		2	3	43
Section A - Agriculture, forestry, hunting and fishing	7	1		3	1	7	8				1				4		34
Section I Activities related to accommodation and food services	71	18	15	6	26	156	263	8	39	10	58	72	8	10	95	23	878
Section_J_Information and communication	40	13	12	6	19	120	163	4	24	2	40	61	2	8	75	17	606
ICT sector (61-62)	31	5	3		7	36	100	4	15	8	18	11	6	2	20	6	272
Clothing, textiles, leather products (15-19) other	26	17	10	4	25	32	60	2	17	12	33	29	8	10	55	4	344
Other sections (31-33)	3		1		1		13	1							2	1	22
Section K Financial and insurance activities	15	14	6	4	4	24	42	1	6	12	23	16	4	2	20	6	199
Manufacture of computers, electronic and optical products (26)	1	2			1	4	9		1		2	3			5		28
Section L Activities associated with real estate services	41	20	19	3	29	125	250	5	26	5	43	70	5	9	83	23	756
Manufacture of basic metals and fabricated metal products (except machinery)	9	10	6	2	1	3	12	4	17	3	5	23	3	6	16	1	107
Section M Professional, scientific and technical activities	6	2	3			10	17		1		4	4			5	2	54
Manufacture of vehicles (20-30)	59	46	23	19	55	93	146	29	85	7	48	64	16	15	104	22	831
Section N Activities in administration services and support activities	3	7			1	21	22	1		2	4	11			13	2	87
Chemical and pharmaceutical industry, ceramics and processing of non-metallic materials (19-23)	9	8	6	6	13	11	32	4	12	2	4	14	1	1	17	5	145
Section O Education	1					1			2								4
Food industry (10-13)	34	24	12	15	17	40	51	8	35	8	53	65	14	16	50	10	452
Section P Education	1		2	1	2	2	6	2			4	2		3	7	2	34
Electrical equipment, manufacture of machinery and equipment (27-28)	13	8	7	5	9	23	38	12	14	6	20	14	2	3	42	7	223
Section Q Health care	1	1				4	1	1	2		2	2		1			15
Section R Activities related to culture, entertainment and recreation											1						1
Wood products (excluding furniture), papermaking and printing (16-18)	421	275	153	120	308	783	1406	118	361	109	460	593	112	97	771	164	6251
(empty)																	
other																	
Section_D_production and supply of electricity, gas, steam, hot water and air for air conditioning		1	2		2		6				3	2	2	4			22
Section E - Water supply; sewerage and waste management and reclamation activities	4	1	8	1	4	8	13	2	3	3	5	9		1	6	2	70
Section_F_Construction	15	13	7	8	3	19	51	2	17	4	19	23	6		19	8	214



## Cooperative relations - clusters

voivodeship	wood / furniture	tourism	food	construction (ceramics, glass)	renewable energy industry	IT /ICT	education and creation of knowled ge services for business	design / creativ e	chem ical	aviat ion	automot ive	hairdre ssing	yach ts	printin g	metal / mechani cal / metalwo rking	lingerie	medical / biotechnolo gy / pharmaceuti cals	resou rces	agricu lture	protecti on of the environ ment / waste manage ment	optoelectro nics, photonics	transp ortati on logisti cs	water and sewerage	maritim e econom y
Warmińsko - Mazurskie	*X	*XXX	*XXX	WW*XX	X	*XXX	*	X							X		X							
Podlaskie	X	W*X	XXX	W	X		WW*						X		*X	W	XP							
Lubelskie	X	X	**X		W**X	X	X			X	X	X	X	X										
Podkarpackie		*PX	X		*	*XXX			*X	**X P					*W									
Świętokrzyskie		*XX	X	*WX	*WXX		*	X							W*XX									
Dolnośląskie				*	**BPP	*									*PP			*						
Kujawsko- Pomorskie	M	***M				M			*										*					
Lubuskie		**	*			*									*							M		
Łódzkie			*B	*BP	*P	B									*	*				*				
Małopolskie				BP	BM	B		**	*					B			**						M	
Mazowieckie			*	MM	B*MPPP	B*MM	*M	*		BM	*			B	P		*MMPPP			M	*	*		
Opolskie	*	**		*		*			P													*		
Pomorskie				*p	**	*p											*							
Śląskie	*			*	BMP	**	*			*										MMM			*	
Wielkopolskie	M		*B	B	B	**BP	*M		*		B			*	*		B							
Zachodniopomo rskie	M	*		*		*p			*						*									**
<b>TOTAL</b>	<b>9</b>	<b>23</b>	<b>18</b>	<b>23</b>	<b>32</b>	<b>29</b>	<b>11</b>	<b>5</b>	<b>7</b>	<b>8</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>17</b>	<b>2</b>	<b>13</b>	<b>1</b>	<b>1</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>2</b>	<b>2</b>

### LEGEND

\*W,X,P,B,M,P – each mark.letter represents one cluster \* - clusters located in the regional directories (OP HC, measure 2.1.3), **W** - clusters, which have received support under the OP DEP (measure 1.4), **X** - clusters listed in regional directories in the description of the region (no entry in the directory), **P** - received support in 5.1, **B** - clusters involved in benchmarking 2010 and 2012, **M** - clusters of the Cluster Map



If the cluster appears e.g. in the directory and at the same time e.g. participated in the benchmarking, it was included only once.

### Annex 3 – Cross-analysis of 22 cross-sectoral areas with results of quantitative and qualitative analyses

<b>WEIGHT A cross-sectoral areas</b>	<i>manufacture of machinery and equipment</i>	<i>production of chemicals / chemical sector</i>	<i>manufacture of computers, electronic and optical products</i>	<i>medical industry /health</i>	<i>food industry (food, agriculture, fisheries)</i>	<i>environmen t</i>	<i>manufacture of basic metals and fabricated metal products</i>	<i>biotech nologie s</i>	<i>ICT</i>	<i>pharmaceutical industry</i>	<i>TOTA L</i>
innovative technologies, processes and products of the agri-food industry		x	x	x	x	x		x		x	7
biotechnological processes and products of household chemistry and environmental engineering		x	x		x	x		x	x		6
biosensors and smart sensor networks			x	x	x	x		x	x	x	7
nanomaterials, nanotechnologies and nano-catalyst processes		x	x	x	x	x	x	x		x	8
mechatronics of robots and machines	x		x				x		x		4
automation of measurement, control and diagnostic systems	x		x			x	x		x		5
multifunctional materials with advanced properties	x	x				x	x			x	5
remote identification, observation and navigation (remote detection)			x			x			x		3
cyberspace threat security systems			x						x		2
semantic web technologies	x		x						x		3
specialized microsystems and molecular memory	x		x						x		3



production of microelectronic components	x		x				x				3
optoelectronic systems and materials			x	x			x				3
smart and energy efficient construction	x	x	x			x	x		x		6
highly efficient RES technologies	x	x	x		x	x	x		x		7
high-performance manufacture, storage, transmission and electricity and heat distribution systems			x			x	x		x		4
modern technology of exploration and exploitation of natural resources and for production of substitutes thereof	x	x	x			x	x	x	x		7
manufacturing technologies and production of medicinal products		x		x				x		x	4
diagnosis, prevention and therapy of civilization diseases		x	x	x					x	x	5
environmentally-friendly transport	x		x			x	x		x		5
clean coal technologies		x	x			x					3
effective waste management and recovery of secondary raw materials	x	x	x		x	x	x	x	x		8



<b>WEIGHT B cross-sectoral areas</b>	<i>Manufactur e of pharmaceut ical products</i>	<i>Manufacture of electrical equipment</i>	<i>Manufacture of motor vehicles, trailers and semi-trailers</i>	<i>Manufacture of metal products / manufacture of basic metals and fabricated metal products</i>	<i>Mining of coal and lignite</i>	<i>Manuf acture of tobacco product s</i>	<i>Manufact ure of machiner y and equipmen t</i>	<i>Aviation sector</i>	<i>Advanced materials</i>	<i>Transport</i>	<i>Energy industr y</i>	<i>Renew able energy</i>	<i>TOTA L</i>
innovative technologies, processes and products of the agri-food industry	x					x			x				3
biotechnological processes and products of household chemistry and environmental engineering									x				1
biosensors and smart sensor networks	x	x	x					x	x	x	x	x	7
nanomaterials, nanotechnologies and nano-catalyst processes	x	x	x	x				x	x	x	x	x	8
mechatronics of robots and machines		x	x	x			x		x	x			6
automation of measurement, control and diagnostic systems		x	x	x			x	x	x	x	x	x	9
multifunctional materials with advanced properties	x	x	x	x			x	x	x	x	x		10
remote identification, observation and navigation (remote detection)			x					x	x	x			4
cyberspace threat security systems													0
semantic web technologies							x	x	x		x		4
specialized microsystems and molecular memory			x				x	x	x	x	x		6
production of microelectronic components			x	x			x		x				4



optoelectronic systems and materials			x	x				x	x	x	x	x	<b>6</b>
smart and energy efficient construction		x		x	x		x		x		x	x	<b>7</b>
highly efficient RES technologies		x		x	x		x		x	x		x	<b>7</b>
high-performance manufacture, storage, transmission and electricity and heat distribution systems		x		x	x			x	x	x	x	x	<b>8</b>
modern technology of exploration and exploitation of natural resources and for production of substitutes thereof				x	x		x		x		x		<b>5</b>
manufacturing technologies and production of medicinal products	x								x				<b>2</b>
diagnosis, prevention and therapy of civilization diseases	x												<b>1</b>
environmentally-friendly transport			x	x			x	x	x	x		x	<b>7</b>
clean coal technologies					x				x		x		<b>3</b>
effective waste management and recovery of secondary raw materials		x	x	x	x		x	x	x	x	x	x	<b>10</b>



<b>WEIGHT C cross-sectoral areas</b>	<i>Metal producti on</i>	<i>Man ufact ure of food produ cts</i>	<i>Land and pipeline transpor t</i>	<i>Speciali zed construc tion works</i>	<i>Constru ction of building s / construc tion</i>	<i>Manufactu re of paper and paper products / wood products, papermaki ng</i>	<i>Manufa cture of rubber and plastic products</i>	<i>Manufactu re of other non- metallic mineral products</i>	<i>Repair, maintenan ce and installation of machinery and equipment</i>	<i>Manufactu re of other transport equipment</i>	<i>Manufa cture of furnitur e</i>	<i>Manufa cture of vehicles</i>	<i>Manufactu re of computers, electronic and optical products</i>	<i>cera mics</i>	<i>Electric al equipme nt</i>	<i>Mineral resource s</i>	<b>TOTAL</b>
innovative technologies, processes and products of the agri-food industry		x				x					x					x	<b>4</b>
biotechnological processes and products of household chemistry and environmental engineering			x													x	<b>2</b>
biosensors and smart sensor networks		x	x	x	x		x		x	x	x	x	x		x	x	<b>11</b>
nanomaterials, nanotechnologies and nano-catalyst processes	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	<b>15</b>
mechatronics of robots and machines	x		x	x	x				x	x		x	x		x		<b>9</b>
automation of measurement, control and diagnostic systems	x	x	x	x	x	x	x	x	x	x	x	x	x		x		<b>14</b>
multifunctional materials with advanced properties	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	<b>16</b>
remote identification, observation and navigation (remote detection)	x		x						x	x		x	x		x		<b>7</b>
cyberspace threat security systems													x				<b>1</b>
semantic web technologies									x	x		x	x		x		<b>5</b>
specialized microsystems and molecular memory									x	x		x	x		x		<b>5</b>
production of microelectronic components	x		x		x					x		x	x		x		<b>7</b>



optoelectronic systems and materials	x		x		x					x		x	x		x		<b>7</b>
smart and energy efficient construction	x			x	x				x					x	x		<b>6</b>
highly efficient RES technologies	x		x		x					x		x				x	<b>6</b>
high-performance manufacture, storage, transmission and electricity and heat distribution systems	x		x		x				x	x		x		x		x	<b>8</b>
modern technology of exploration and exploitation of natural resources and for production of substitutes thereof	x		x					x				x				x	<b>4</b>
manufacturing technologies and production of medicinal products	x																<b>1</b>
diagnosis, prevention and therapy of civilization diseases		x											x				<b>2</b>
environmentally-friendly transport	x		x						x	x		x			x	x	<b>7</b>
clean coal technologies	x															x	<b>2</b>
effective waste management and recovery of secondary raw materials	x	x	x		x	x		x		x	x	x	x	x		x	<b>12</b>

<b>WEIGHT D cross-sectoral areas</b>	<i>Manufacture of textiles / clothing textiles</i>	<i>Collection, treatment and supply of water</i>	<i>Construction of buildings and civil engineering structures</i>	<i>Agriculture, animal husbandry, hunting</i>	<i>Production of beverages</i>	<i>Manufacture of aircraft and spacecraft</i>	<i>Health care</i>	<i>Furniture sector</i>	<i>tourism</i>	<i>Business services</i>	<i>Human resources</i>	<i>nano-technologies</i>	<i>Research for SMEs</i>	<i>Research infrastructures</i>	<i>Security</i>	<i>automation</i>	<i>TOTAL</i>
------------------------------------------	----------------------------------------------------	--------------------------------------------------	-------------------------------------------------------------------	-----------------------------------------------	--------------------------------	-----------------------------------------------	--------------------	-------------------------	----------------	--------------------------	------------------------	--------------------------	--------------------------	---------------------------------	-----------------	-------------------	--------------



innovative technologies, processes and products of the agri-food industry		x	x	x	x							x					<b>5</b>
biotechnological processes and products of household chemistry and environmental engineering		x	x	x								x					<b>4</b>
biosensors and smart sensor networks		x	x	x	x	x	x					x		x	x	x	<b>10</b>
nanomaterials, nanotechnologies and nano-catalyst processes	x	x	x	x	x	x	x	x				x		x	x	x	<b>12</b>
mechatronics of robots and machines	x	x	x	x	x	x		x				x		x		x	<b>9</b>
automation of measurement, control and diagnostic systems	x	x	x	x	x	x	x	x				x		x	x	x	<b>12</b>
multifunctional materials with advanced properties	x		x	x	x	x	x	x				x				x	<b>9</b>
remote identification, observation and navigation (remote detection)						x			x						x	x	<b>4</b>
cyberspace threat security systems															x		<b>1</b>
semantic web technologies						x	x			x					x	x	<b>5</b>
specialized microsystems and molecular memory		x	x			x	x		x	x		x		x	x	x	<b>10</b>
production of microelectronic components			x			x						x		x	x	x	<b>6</b>
optoelectronic systems and materials			x				x					x		x	x	x	<b>6</b>
smart and energy efficient construction		x	x				x		x			x		x	x	x	<b>8</b>
highly efficient RES technologies		x	x	x								x			x	x	<b>6</b>



high-performance manufacture, storage, transmission and electricity and heat distribution systems			x									x			x	x	<b>4</b>
modern technology of exploration and exploitation of natural resources and for production of substitutes thereof												x			x	x	<b>3</b>
manufacturing technologies and production of medicinal products							x					x					<b>2</b>
diagnosis, prevention and therapy of civilization diseases							x					x			x		<b>3</b>
environmentally-friendly transport									x			X				x	<b>3</b>
clean coal technologies												X				X	<b>2</b>
effective waste management and recovery of secondary raw materials		x	x	x	x			x				X				x	<b>7</b>



#### **Annex 4 Financing of research infrastructure located on the *Polish Roadmap for Research Infrastructures***

1. Polish Roadmap for Research Infrastructures (PRRI) has been approved by the Minister of Science and Higher Education on 23 February 2011. PRRI defines projects comprising strategic research infrastructure in Poland, and reference to PRRI is *inter alia*, in the "Strategy for Innovation and Economic Efficiency for 2012 - 2020", making PRRI an important strategic element of the funding for research and innovation in Poland.
2. Polish Roadmap for Research Infrastructures is an expression of ambition and expectations of Polish scientific community. Following an open call for proposals and the competition selection with participation of independent foreign experts, PRRI was set up with 33 project proposals, of which:
  - 12 applies to the development of science: basic sciences (astronomy, astrophysics, physics) - 7, and interdisciplinary sciences - 5,
  - 21 refer to long-term societal challenges such as: improving the quality of life - 1, health care - 5, production, storage and transport of energy - 4, development of advanced materials and technology - 3, construction of smart systems and infrastructure - 2 and environmental sustainability – 6.

Institutions involved in the proposed projects are usually leading units in these areas, which include: 20 academic schools, 11 PAS institutes and 10 R+D institutes.

Estimated cost of construction and maintenance of all projects placed on PRRI over the next 10 years is about PLN 6 billion.

3. In 2013, the update process for PRRI was launched. In the competition announced on 15 January 2013, applicants submitted 100 proposals for projects involving several disciplines of science (total investment cost at PLN 14 billion). These proposals were evaluated by national reviewers and members of the PRRI Team Advisory Committee (15 members, interdisciplinary nature) appointed by order of the Minister of Science and Higher Education of 28 May 2013. Its effect was to qualify 36 project proposals for the second stage of the PRRI update process, including 25 in an unconditional manner and 11 in conditional manner. The second stage provided for assessment of both domestic and foreign reviewers. Completion of PRRI update is planned for the first quarter of 2014.

Estimated cost of new investments related to projects covered by PRRI update is about PLN 3 billion.

4. Placing project proposals in PRRI is not an expression of commitment for their financing by public institutions, however, it may be a prerequisite for applying for support from public funds. The following main sources of funding are provided from public funds for the above projects:
  - Funds at the disposal of the Ministry of Science and Higher Education - in recent years, an annual average of about PLN 300 million for large research infrastructure and investment in appliance and construction projects, awarded by the Minister of Science and Higher Education on the basis of proposals submitted annually and evaluated in competition,



- Funds under the Operational Programme Smart Growth - subject to the conditions set out in the Partnership Agreement, in particular fitting with the national or regional smart specialization,
- Funds under Regional Operational Programmes - subject to the conditions set out in the Partnership Agreement, in particular fitting with the national or regional smart specialization, as well as following settlement in the Territorial Contract,

In the framework of projects in the field of research infrastructure not covered by PRRI, but resulting from the implementation of international commitments, Polish participation in CERN is financed from the national budget (annual fee of about PLN 100 million + PLN 30 million of research grants). Negotiations are currently underway for the Polish accession to the ESO (start from 2015, each year about PLN 25 million fee + research grants).

5. Detailed information on the projects covered by PRRI is presented in the following Table. This table, after PRRI update and supplementing information for projects included within the update will be made available in an interactive format on the website of the MSHE.



Table. List of projects covered by the Polish Roadmap for Research Infrastructures (version of 23 February 2011)

<b>No.</b>	<b>Project title</b>	<b>Coordinator</b>	<b>Nature of the project</b>	<b>Estimated investment costs [PLN million]</b>	<b>Potential sources of funding</b>
1	PolarPOL – Polish Multidisciplinary Polar Research Laboratory	Institute of Geophysics Polish Academy of Sciences, Warsaw	National research centre which is part of the international SIOS project of the ESFRI roadmap (environmental sciences)	40	OP SG* Budget part 28 Science
2	NEBI - National Centre for Imagining Examination in biological and biomedical sciences	M. Nencki Institute of Experimental Biology PAS, Warsaw	National research centre which is part of the international Euro-BioImaging project of the ESFRI roadmap (biology)	150	OP SG* Budget part 28 Science
3	ELIXIR - Information System for Complex Biological Systems	Institute of Biochemistry and Biophysics PAS, Warsaw	National research centre which is part of the international ELIXIR project of the ESFRI roadmap (biology)	0	-
4	EURO-ARGO - Global Oceans Observing System	Institute of Oceanology PAS, Sopot	Polish contribution to the international project of the ESFRI roadmap (Earth science)	2,5 (request letter was signed on the appointment of EURO-ARGO ERIC)	Budget part 28 Science
5	Pol-Openscreen - Polish Platform of Screening Infrastructure for Biological Chemistry	Institute of Medical Biology, PAS, Łódź	National research centre which is part of the international EU-Openscreen project of the ESFRI roadmap (biology)	13	OP SG* Budget part 28 Science
6	CLARIN - Common language resources and technology infrastructure	Wrocław University of Technology	Polish contribution to the international project of the ESFRI roadmap (humanities)	Project is financed	Project is financed



7	CTA - TeV gamma astronomy observatory	Jagiellonian University in Kraków	Polish contribution to the international project of the ESFRI roadmap (astrophysics)	100	OP SG* Budget part 28 Science
8	ICOS-PL - Integrated Carbon Observation System	University of Life Sciences in Poznań	Polish contribution to the international project of the ESFRI roadmap (Earth science)	43	OP SG* Budget part 28 Science
9	POLFAR - low-frequency radio interferometer	Jagiellonian University in Kraków	National research centre which is part of the International LOFAR project (astronomy)	Project is financed	Project is financed
10	90 m radio telescope National Centre for Radio Astronomy	N. Copernicus University, Toruń	National research centre (astronomy)	260	OP SG* Budget part 28 Science
11	ESS – European Spallation Source	H. Niezawodniczański Institute of Nuclear Physics PAS, Kraków	Polish contribution to the international project of the ESFRI roadmap (interdisciplinary sciences)	72	OP SG* Budget part 28 Science
12	ESRF <i>Upgrade</i>	Institute of Physics PAS, Warsaw	Polish contribution to the international project of the ESFRI roadmap (interdisciplinary sciences)	20	Budget part 28 Science
13	SUNLAB - Underground Laboratory in Sieroszowice	H. Niezawodniczański Institute of Nuclear Physics PAS, Kraków	National research centre (physics)	10	OP SG* Budget part 28 Science
14	C4@A4 – Complexity, Correlations, Coherence, Cognition along the A4	Jagiellonian University in Kraków	National research centre (computer science)	46	Budget part 28 Science
15	NLPQT - National Laboratory for Photonics	University of Warsaw	National research centre (physics)	80	OP SG*



	and Quantum Technologies				
16	EIEC - European Institute for Environmental Cancer	J. Nofer Institute of Occupational Medicine, Łódź	National research centre (medicine)	60	OP SG*
17	NCTE - National Centre for Energy Technology	S. Staszic University of Mining and Metallurgy in Kraków	National research centre (energy)	520	OP SG*
18	NCBB - National Baltic Research Centre	University of Gdańsk	National research centre (Earth sciences)	162	OP SG*
19	EPOS - European Plate Observation System	Institute of Geophysics Polish Academy of Sciences, Warsaw	Polish contribution to the international project of the ESFRI roadmap (Earth science)	40	OP SG* Budget part 28 Science
20	SPIRAL2	H. Niezawodniczański Institute of Nuclear Physics PAS, Kraków	Polish contribution to the international project of the ESFRI roadmap (physics)	6	Budget part 28 Science
21	COPAL – Long-range Tropospheric Aircraft	University of Warsaw	Polish contribution to the international project of the ESFRI roadmap (Earth and environmental sciences)	In preparation	In preparation
22	PolFEL	National Centre for Nuclear Research, Świerk	Polish contribution to the international project of the ESFRI roadmap (interdisciplinary sciences)	400	OP SG*



23	NCBiA - National Centre for Research and Application of New Materials and Technologies for Electrical Power	S. Staszic University of Mining and Metallurgy in Kraków	National research centre (energy)	800	OP SG*
24	NLEJ - National Laboratory of Nuclear Energy	National Centre for Nuclear Research, Świerk	National research centre (energy)	400	OP SG*
25	Consortium for Foundry and Metallurgy FOUNDRYMET	S. Staszic University of Mining and Metallurgy in Kraków	National research centre (technologies)	220	OP SG*
26	National Synchrotron Radiation Centre SOLARIS	Jagiellonian University in Kraków	National research centre (interdisciplinary sciences)	170	OP SG*
27	FAIR - Centre for Research with Antiprotons and Ions in Europe	Jagiellonian University in Kraków	Polish contribution to the international project of the ESFRI roadmap (physics)	Project is financed	Project is financed
28	European XFEL - European X-ray Free-Electron Laser	National Centre for Nuclear Research, Świerk	Polish contribution to the international project of the ESFRI roadmap (interdisciplinary sciences)	Project is financed	Project is financed
29	PRACE - Cooperation in the field of advanced calculations in Europe	Institute of Bioorganic Chemistry of the Polish Academy of Sciences - Poznań Supercomputing and Networking Centre	Polish contribution to the international project of the ESFRI roadmap (computer science)	Project is financed	Project is financed



30	CePT - Centre for Preclinical Research	Medical University of Warsaw	National research centre (medicine)	Project is financed	Project is financed
31	CCTW - Centre for Clean Coal Technologies	Central Mining Institute, Katowice	National research centre (energy)	Project is financed	Project is financed
32	CEZAMAT - Centre for Advanced Materials and Technologies	Warsaw University of Technology	National research centre (technologies)	Project is financed	Project is financed
33	WCZT - Wielkopolska Centre for Advanced Technology	A. Mickiewicz University in Poznań	National research centre (technologies)	Project is financed	Project is financed

\* - funding under OP SG subject to the above support in light of the conditions laid down in the OP SG